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Environmental impacts of the Jamuna multipurpose bridge during its construction, Bangladesh

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ABSTRACT: A 4.8 km long multipurpose bridge is under construction in Bangladesh over the river Jamuna, one of the largest and mightiest rivers in Asia. It is being built at a total estimated expense of US $ 900 million. The presence of the Jamuna river acts as a formidable barrier to the socio-economic development of the north-western part of Bangladesh. The morphometric and the hydrogeologic data for the past 30 years show a number of changes in the course of the Jamuna river. This necessitates river training work. In addition to providing vehicle transfer across the river, provisions for transfer of gas and electricity and construction of a single meter-gauge railway track is also included in the project. While some of the environmental impacts related to the construction of the bridge may occur in any country undertaking such a project, others are unique and may only occur in a developing country like Bangladesh. This paper is an attempt to identify the major impacts involved with each activity related to the construction of the Jamuna Multipurpose Bridge.

1 INTRODUCTION

Economic development and social unity between the eastern and north-western parts of Bangladesh is adversely affected due to the presence of the Jamuna river which acts as a formidable barrier. The morphometric as well as the hydrogeologic data for the past 30 years show a number of changes in the course of the Jamuna river. Transfer of energy, such as power and gas, is not possible due to the enormous width of the river. Thus, in August 1994, construction of the 4.8 km long Jamuna Multipurpose Bridge (JMB) has commenced with a total estimated expense of US $ 900 million.

After conducting the geomorphological and hydrodynamic study in 1986, in order to identify the suitable location for the bridge, *Bhuapur*, located about 8 km downstream of the existing ferry port was selected as the bridge site (see Figure 1). Construction of the main bridge, bridge end facilities, approach roads and river training works involve massive activities which is expected to have both positive and negative impacts on the environment. These impacts will be temporary as well as permanent in nature. Primary data on demographic and socio-economic situation in the impact area were used for environmental impact assessment of the Jamuna Multipurpose Bridge Project (JMBP) (RPT-NEDECO-BCL, 1989). A comprehensive Environmental Management Action Plan (EMAP) was developed by Ahmed, et al (1994) for the JMBP. General Environmental Guidelines (Ahmed, et al, 1994b) prepared for the JMBP suggests plans for mitigation of impacts, caused by the construction activities.

2 COMPONENTS OF THE BRIDGE

The major components of the construction of the JMB are (a) River training works, (b) Construction of approach roads and railway track, (c) Construction of the bridge ends, (d) Construction of the bridge and viaducts at the banks of the river, and (e) Support services. The salient features of the project are shown in Table 1. The longitudinal profile of the proposed bridge is shown in Figure 2. Some of the construction activities in progress are also shown in Figures 3-8.

2.1 *River training works (RTW)*

To prevent outflanking channels of the Jamuna river from breaching the bridge approaches and to divert flow under the bridge RTW and a hard point at *Bhuapur* are essential. The total estimated cost of construction is US $ 296 million. The RTW involves (i) Dredging, (ii) Disposal of dredge spoil using hydraulic fill method, (iii) Dredge spoil stockpiling, (iv) River training works, (v) Construction of hard point, and (vi) Construction of guide bunds.

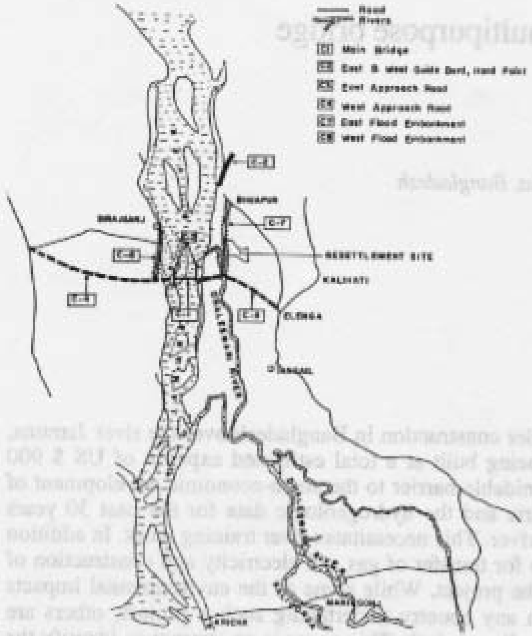

Figure 1 Location of the JMBP

Table 1. Salient features of the Bridge.

Component	Specification
Length of bridge	4.8 km
Length of viaducts (each side)	128 m
Width of bridge	18.5 m
Number of span	47 + 2
Length of each span	99.38 m / 64.69 m
Number of road lane	4
Length of east guide bund	2.2 km
Length of west guide bund	2.2 km
Length of east approach road	15.3 km
Length of west approach road	14.4 km
Number of total pile	121
3 pile pier (2500 mm OD)	21 Nos
2 pile pier (3150 mm OD)	29 Nos
Number of total pier	50 Nos
Tubular steel pile thickness	40 mm - 60 mm
Average length of pile (below bed level)	83 m (72 m)
Pier stem height	2.72 m -12.04 m
Absolute rake of pile	1 : 6
Each box girder segment	4.0 m

2.2 *Construction of approach roads and rail- track*

The approach roads will be connected to the existing road network. A flood embankment, maintaining natural cross drainage, will also be constructed on either side of the river. The total estimated cost of construction of the approach roads, the bridge ends, the culverts, and the flood embankments is about US $69 million. The major activities involved are (i) Closure of the northern intake of the Dhaleswari river, (ii) Earth movement, (iii) Borrow pit excavation and refilling, (iv) Construction of road pavement, and (v) Construction of railway approach road.

2.3 *Construction of bridge ends*

These bridge ends will be used to accommodate facilities for proper operation and maintenance of the bridge after completion of the construction works. The major activities involved are (i) Dredging and disposal of spoils, (ii) Stockpiling of dredge spoils.

2.4 *Construction of the bridge and viaducts*

The approved structural design of the main bridge includes a multi-span box-girder structure with total length of 4.8 km (with provision for additional 500m depending on the location of the guide bunds). Driving of long tubular steel piles have been completed. Air lifting of enclosed soil is in progress. About half of the pile caps have been completed. About 10% of the box-girders are ready for erection. The estimated total cost of construction of the bridge and viaducts is US $ 265 million. Some of the main activities involved in the bridge construction include (i) Piling works, (ii) Fabrication of bridge elements, (iii) Installation of bridge elements, and (iv) Dredging and disposal of spoils.

2.5 *Support services*

Extensive support services and supporting (logistical) infrastructure will be required for the implementation of the project. Those support activities affecting the environment are (i) Dredging of access channel and disposal of dredged materials, (ii) Riverine transport of equipment and construction material, (iii) Road transport, (iv) Storage of materials and equipment, (v) Construction of temporary access roads, (vi) Construction of infrastructure related to labour camp and offices, and (vii) Solid waste management.

3 POTENTIAL ENVIRONMENTAL IMPACTS

The five main components of the JMBP will be realised through a number of construction activities. Different activities may cause impacts or risks of similar nature simultaneously. The impacts related to the construction activities may primarily be negative,

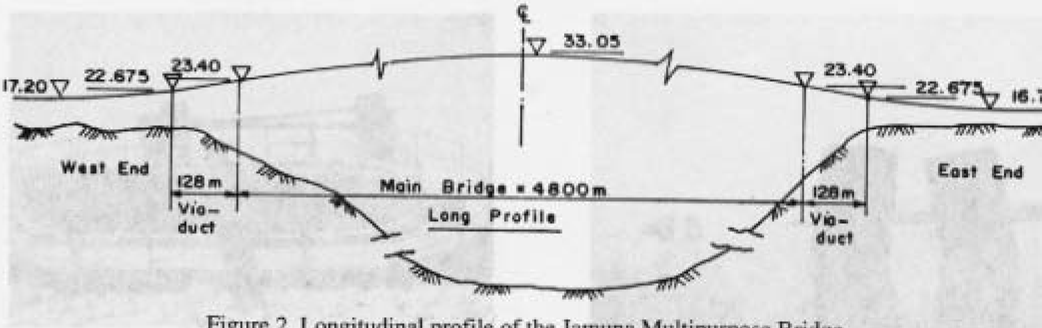

Figure 2 Longitudinal profile of the Jamuna Multipurpose Bridge

however, some may be positive. For example, prior to construction about 13,000 people were made to vacate their house in the working area and werev replaced by some 2,000 staff and labourers. Even without proper sanitary facilities the impact on ground water pollution due to excreta disposal will only diminish.

In this paper attempt has been made to structure the potential impacts by grouping these into (i) direct impacts on receiving media, (ii) social impacts, (iii) indirect impacts, and (iv) economic impacts.

3.1 *Direct impacts on receiving media*

3.1.1 *Surface water quality*

Following the land based disposal of dredged materials by hydraulic fill method, the transport water is guided back to the river. In case of presence of heavy metals or toxic substances in the dredged spoils they could be carried back to the river. However, initial testing of two samples of bed materials indicated little presence of heavy metals.

The discharge of effluent from the reclamation areas and the dredging process itself is expected to increase the suspended solids load of the river, posing a potential threat to downstream aquatic biota. However, this load is only a fraction of the total sediment load carried by the Jamuna river. The activities affecting the surface water quality are dredging operations, discharge of effluents from hydraulic fill and stockpiling, offices housing, and labour camp, and spills, accidental or wanton waste disposal from ships and dredging vessels.

3.1.2 *Groundwater quality*

Accidental spillage of toxic chemicals such as fuel, lubricants, thinner and solvents may contaminate the groundwater system through infiltration. If soak pits are used in the sanitation system then the groundwater quality is likely to be affected. Also, leachate generated at the solid waste disposal site may contaminate the ground water system.

3.1.3 *Surface and ground water quantity*

Temporary works, such as cofferdams, access roads, dredge spoil stockpiles, etc. may be built during the construction process affecting the hydrology and cross drainage. Construction of the approach road embankment may locally impede the surface drainage, causing longer flooding periods than at present. Closure of the northern intake channel of the Dhaleswari River has reduced flow in the downstream section of the Dhaleswari river which is likely to reduce flood risks. Similarly, one of the side channels of the Jamuna River on the West bank will also be closed which may have similar impacts. A summary of potential impacts include obstruction of surface water drainage by the construction of the bridge end and approach road embankment, reduction of flow, thus flood risk, in the upstream part of the Dhaleswari, and an increased extent of open water due to excavation of borrow pits for construction of road embankment.

3.1.4 *Soil quality*

Prolonged storage of toxic and hazardous chemicals at certain locations along with accidental spillage of such chemicals may deteriorate soil quality at the construction site. Potentially this could be compounded by the use of contaminated dredge spoils in construction of the bridge components. Solid waste may be another source of soil contamination at the disposal site.

3.1.5 *Air quality*

Pollution of air occurs through the use of vehicle and machinery, as well as through cleaning of iron grit

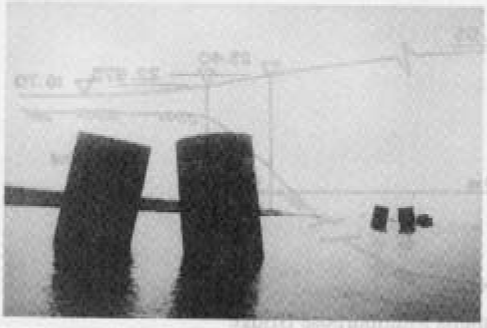

Figure 3 Pile Driving

Figure 4 Precast pile cap reinforcement fabrication

and coating of construction materials around the construction site. A concrete asphalt plant, needed for construction of the road pavement, may also contribute to air pollution through dust emission. Indiscriminate burning of solid wastes may add to air pollution.

3.2 *Social impacts*

3.2.1 *Noise pollution*

The activities that may have impact on noise level are dredging, pile driving, use of vehicles, generators and machinery, and construction of bridge elements.

3.2.2 *Occupational health hazards*

Apart from being exposed to the risk of accidents, the construction workers may also be at risk of occupational health hazards due to the materials handled and the working conditions. Sources posing occupational health hazards for the project labourers and nearby population are all construction related works, especially, use of machinery and chemicals, and increased traffic.

Figure 5 Precast pile cap ready for concreting

3.2.3 *Other health hazards*

At the contractors' work site a labour camp has been constructed with temporary accommodation for about 2000 persons during the peak of the construction works. Good sanitary facilities, such as an excreta disposal system, and a reliable supply of safe drinking water are essential to reduce the risk of diseases vectors. Lack of adequate drainage facilities in the camp area and on the work site may cause accumulation of sullage water, providing breeding ground for mosquito and water-borne or water related diseases. Improper sanitary facilities may contaminate the environment in general and even the water supply system. Garbage, rubbish, construction wastes may pose an additional health threat and nuisance. Breeding of flies and some mosquito species may occur due to lack of proper collection and disposal system. Uncontrolled vending of food on the work site may also pose a risk with respect to the transmission of contagious diseases. Furthermore, immoral practices and prostitution may cause the spread of venereal diseases.

3.2.4 *Social disruption*

About 13,000 people have been relocated prior to the commencement of the works. This, in itself, is an enormous disruption of the social life of the local population. Resettlement of these people may further disrupt the social fabric of the population in the regions where they are settled. The influx of non-local labourers, may also result in social disruption. These outsiders, with better economic conditions may disrupt the local economy and social order.

3.3 *Indirect impacts*

3.3.1 *Disruption of agricultural practice*

Around the construction site agricultural practice is

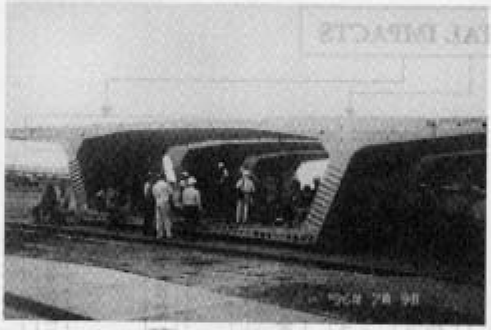

Figure 6 Precast box girder section

Figure 7 Launching gantry for erection of box girder

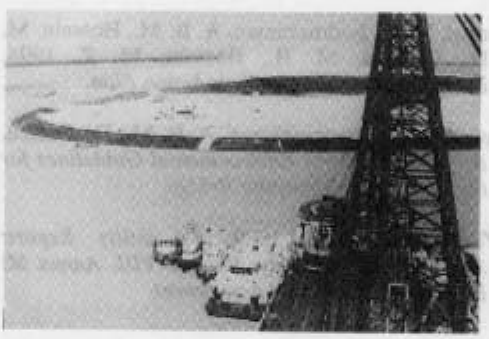

Figure 8 South of west guide bund

being disrupted as a result of temporary but unavoidable disruption of the surface water hydrology. It may further be hampered by earth works, outside the planned work area. Agricultural land required for stockpiling of fill, for access roads and borrow pits outside the designated areas have caused loss of production during the construction period. Even after dismantling the temporary earth works agricultural production will be reduced for some time as a result of damage to the soil structure.

Dust originating from the work site may also influence agricultural production through reduced photosynthetic oxygen generation. Prolonged period of flooding due to impeded drainage may also disrupt the agricultural practice.

3.3.2 *Additional health risks*

The excavation of borrow pits for the construction of the approach road embankment will result in a larger extent of open stagnant water. This may lead to more breeding ground for mosquito and other water-borne and water related disease vectors.

3.3.3 *Impacts on flora and fauna*

Plants and vegetation on the land required for the construction of the bridge ends and approach roads have been cleared. Excavation of borrow pits may add to the destruction of flora. Dust produced by vehicle movement and construction related activity (e.g., asphalt plant) usually settle on plants and crops which contribute to their demise. Noise by vehicles and machinery may affect the behaviour of fauna. Increased turbidity in the river due to dredging and the discharge of dredge spoil effluent may affect aquatic life in the river. The inflow of pollutants that may enter the river water (potentially from dredging operations, from accidental spills, and from the discharge of effluents) may affect the river ecology.

3.4 *Economic impacts*

3.4.1 *Hindrance to navigation*

Considerable quantities of construction material and equipment are being brought in by river, using barges. Increased riverine traffic may disrupt or hinder the usual river traffic. Piling works have interfered with the local river traffic. Closure of the northern intake of the Dhaleswari River have blocked the usual transport along this river arm, and thereby changed the economic condition of the localities and people using this transport way.

3.4.2 *Hindrance to road traffic*

Although most of the construction material and equipment are being transported by river there has been a tremendous increase in road traffic to the construction site during the construction period. Due to this insified road traffic, the normal traffic flow, especially in the stretch between *Tangail* and

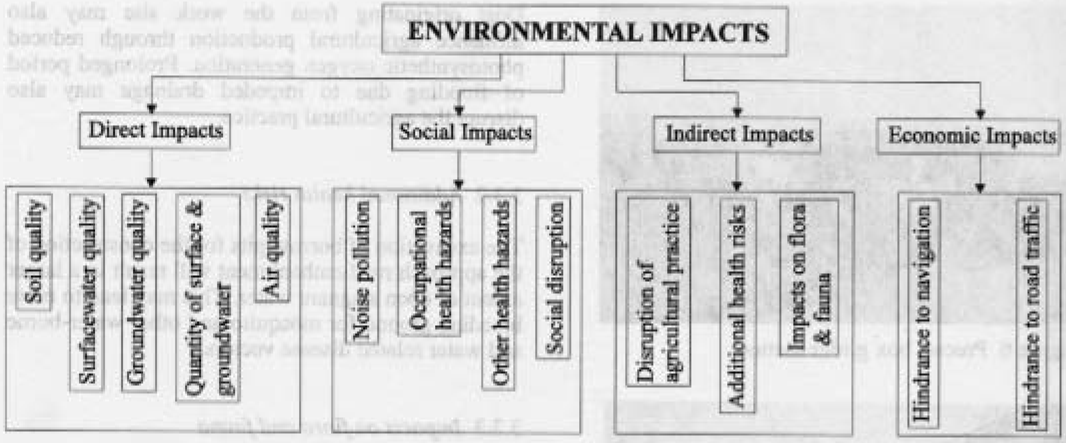

Figure 9 Potential impacts on different environmental compartments during construction

Bhuapur, have been hindered. This stretch of road is narrow, thus, increased use of this road by trucks and lorries have further deteriorated the existing vehicular flow. Traffic bottleneck condition prevail at the major crossings at *Tangail* and *Bhuapur*. This is caused by widespread disregard and violation of traffic laws by the bus drivers and rickshaw pullers. Figure 8 shows each group of potential impacts with the affected environmental compartment.

4 DISCUSSIONS AND RECOMMENDATIONS

In this paper the major environmental impacts related to the construction of the Jamuna Multipurpose Bridge have been identified. Some of the impacts are permanent in nature and some tend to persist only during the construction period. Lack of available data made it impossible to perform a quantitative assessment of the major impacts on the surrounding environment. Thus, the study was restricted to making qualitative assessment. Continuous monitoring of potential problem areas such as, dredged spoil storage and disposal sites, borrow pits, effluents from labour camps and solid waste disposal is imperative. Quantitative impact assessment will be facilitated through data collected by frequent testing of water, air and soil quality in the impact zone.

It should be remembered that the expected benefits resulting from this project by far outweighs the negative impacts which has led to realisation of the Jamuna Bridge. The major positive impacts of the project include improved communication between the north-western and eastern parts of Bangladesh. Reduced flood water level in the impact zone will also increase crop production in the vicinity of the bridge site. In addition, the second electric inter-connector, planned to run the bridge, is expected to supply power to the north-western regions. The Jamuna Bridge will also be used as the corridor for the gas lines. This will dramatically facilitate the economic development of those areas. These benefits will open the ways for integrated urban and rural development of the relatively less developed north-western region of Bangladesh.

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