

Summary Environmental Impact Assessment of the Jamuna Bridge Railway Link Project in the People's Republic of Bangladesh

Appendix 5

I. Introduction

An environmental impact assessment (EIA) for the Jamuna Bridge Project was first prepared as an integral component of the overall feasibility study in 1989 in order to identify and incorporate measures required to minimize or mitigate adverse effects of the Project. The EIA study has since then been revised/updated/supplemented with additional studies to incorporate additional measures in the project design.

The 1989 EIA study was based to a large extent on secondary data and information collected in Bangladesh in August 1988. The environmental impact study area included all areas where physical changes in the existing environment may be expected, but excluded more distant areas where economic changes are expected to occur as a result of the improvement of the transport network (regional development effects). Primary data were collected mainly on: (i) demographic and socioeconomic situation in the impact area, (ii) agriculture, (iii) fisheries, and (iv) navigation and water transport. A preliminary household survey was carried out as part of the EIA. Subsequent to the 1989 EIA, a more detailed survey was carried out for a compensation and resettlement plan. Additional field studies were also carried out to substantiate projected effects and develop mitigation plans for fisheries, wildlife, the closure of northern intake of the Dhaleswari River, and resettlement. This summary EIA has incorporated the outcome of these additional studies, which were conducted by the Government of Bangladesh (GoB) and the consultants from 1989-1993, as well as the original EIA.

II. Description of the Project

The Project objective is to connect the eastern and western parts of the country separated by the Jamuna River. Construction of a fixed crossing will reduce trans-Jamuna transport costs and result in significant electricity system cost savings. The proposed crossing will integrate the northwest region with the markets and energy sources on the eastern side of the Jamuna and facilitate the development of the northwest region. The project will consist of (i) construction of a bridge to initially carry a 4-lane roadway (with foundations adequate to carry a meter-gauge railway in the future) with provision to carry an electric power interconnector, telecommunication cables and a gas pipeline as needed in the future; (ii) construction of two guide bunds to regulate the river; (iii) construction of east and west approach roads; and (iv) measures to mitigate the Project's effect on the environment including resettlement. The Executing Agency for the Project will be the Jamuna Multipurpose Bridge Authority (JMBA). The Project is considered for financing by the Asian Development Bank, Overseas Economic Cooperation Fund (Japan) and the International Development Association (World Bank).

The main bridge will have a length of approximately 4,800 m. It is envisaged that there will be 50 spans of approximately 100 m, arranged in 5-span continuous modules, founded on 80-90 m long raking steel cylinder piles. Most of the materials and equipment will be transported directly to the site on barges via Jamuna River. A channel will be dredged where the bridge will cross sandbars (locally called *chars*) to provide access for floating cranes required for pile driving and installation of the complete bridge units.

The River Training Works (RTW) consist of guide bunds (fortified protection works) at both sides of the river, each having a length of approximately 2.2 km long and constructed perpendicular to the bridge axis. The RTW will be constructed on the floodplain or on *charland*. Dredging of approximately 25-30 Mm³ is required to facilitate the construction of the RTW. The dredged material is fine sand which will be used to fill the embankment of the approach roads. The dredging works will be carried out by large suction-dredgers during the low-river stages, i.e., when the

flood plain is dry. To protect the guide bunds against scour, slope protection works will be constructed about 30 m below the present flood plain level.

To make the approaches to the bridge across the flood plain, the existing ground level has to be raised by approximately 5 m. The dredged sand from the RTW will be used for this purpose and will be discharged by the dredger directly to the area of the future bridge end facilities. The excess sand from the construction works inside the flood plain will be used as fill materials for the approach roads outside the flood plain.

The approach roads will connect the bridge to the existing road networks. The Project provides for a 16 km road on the east bank and a 14 km road on the west bank.

The northern intake of the Dhaleswari River will have to be closed for safety of the RTW and other allied works of the main bridge, since a sudden onrush of floodwater which enters through the northern intake of the Dhaleswari River may outflank and cause irreparable damage to the bridge.

III. Description of the Environment

A. Surface Water Hydrology

Jamuna is a major river in the country and is one of the largest braided rivers in the world, with all the features of an unstable river course.

The Dhaleswari River is the second most important spill channel of the Jamuna River. It takes off from the left bank of the Jamuna River near Tangail and flows in a southeasterly direction, joining the Meghna River south of Dhaka. During high river stages it carries about 2 to 4 percent of the total Jamuna discharge measured at Bahadurabad. The Dhaleswari River is presently fed by two intake channels. The northern channel takes off from the Jamuna at a point between the proposed bridge site and the existing ferry ghat at Bhuapur. The southern intake is located near Porabari, about 20 km downstream of the bridge site. Approximately 30 km downstream of the southern intake the river bifurcates, the southern branch being known as Kaliganga. The two branches join again south of Savar. The

Kaliganga branch is the main channel carrying about 70 to 80 percent of the total river discharge.

Surface water hydrology was measured at Taraghat (Kaliganga) and Jagir (Dhaleswari) stations. The observation found that (i) the northern intake channel carries water only from early May till the end of November; (ii) the branch channels Pungli and Lohaganj carry no flow between November and May; (iii) the southern intake is deeper and carries water throughout the year; (iv) the average maximum depth of flooding along the Dhaleswari River is 1 to 1.5 m, about 25 percent of the upper basin is deeply flooded in a normal year and less than 5 percent of the area is flood-free; (v) when the Jamuna River is at flood stage (July till September), significant overbank flow between the northern and southern intake contributes to the flow in the Dhaleswari. The northern intake and the minor spill channels which feed the Dhaleswari River upstream of the southern intake contribute together about 45 to 50 per cent of the total flow in the middle Dhaleswari.

B. Erosion

The east bank of the Jamuna River at the project site eroded about 600 m from 1987 to 1988. West bank accretion had been observed until a recent unprecedented flood following which erosion of some 200 m was observed. Erosion is also significant near the ferry-ghat at Bhuapur.

C. Water Resources

Surface water irrigation represents only a very small proportion of the total irrigated area in the project area (1-2 percent). Irrigation water is commonly taken from tubewells as is domestic water supply of the villages. Dug wells and village ponds are also used for domestic supplies. Limited data on water quality of the Jamuna River are available.

D. Agriculture

The agricultural system and cropping pattern in Bangladesh primarily depend on the flood regime (*kharif* season) and water availability in the dry season (*rabi* season). The dominant crop in the area is rice, both broadcast and transplanted.

E. Fisheries

It is estimated that the Jamuna River produces fry valued at Tk5 million per km/a (US\$1 is about Tk39). In the 1984 harvesting season the Jamuna River produced 10,400 mt of fish (141 kg/ha) and the local fry collection industry produced 40 percent of the national aquacultural requirement. However, there has been a declining tendency of spawn production in the Dhaleswari River during the period 1984-1988, most probably caused by natural sedimentation at the northern intake of the river. It is likely that spawn production in the Dhaleswari River will continue to decline with or without this Project.

The riverine fishery is based on large *cyprinids* (the major carps) as well as some *siluroids*, *ophicephalids* and *notopterids* and others of lesser importance. These fish live in the river in the dry season and migrate laterally onto the floodplain, during the floods, to spawn and feed. The natural spawning of the major carps occurs in the upstream part of the Brahmaputra River in Assam, India, but spawn and fry are collected downstream. These areas are the major source of spawn and fry for the culture fisheries in the country. In the years 1984-1987 more than 46,000 kg/yr of spawn were collected from the Brahmaputra, the Jamuna, and the Dhaleswari river system.

F. Wildlife

Part of the proposed project area provides food and breeding habitats (wintering grounds) for residential and migratory birds during the dry season. Resident and migratory birds identified include snipe, stork, ibis, spoonbill, gull, tern, heron, egret, widgeon, spotted duck, pintail duck, tufted

duck, common pochard, goose, whistling teal, garganey, shobellia, gad-wall and others.

G. Navigation

The Jamuna River is important for navigation. Ferries connect the west and east banks and many smaller boats are used by people for transportation. Navigation on the Dhaleswari River is less significant. At present a sandbar in the “off-take” prohibits boats from plying this route for about seven months/year while during about seven months/year the river carries no water at all.

H. Socioeconomic Conditions

There are 5 subdistricts (*upazilas*) in the project area: Raiganj, Kamarkhanda and Sirajganj are in the old Pabna District and Kalihati and Bhuapur in Tangail District. The populations of these districts are in the immediate catchment of the project area. Bangladesh Bureau of Statistics (BBS) predicts a high population growth for the old Tangail and Pabna Districts. In all cases the growth rate is higher than the national average of 2.32 percent per annum.

The socioeconomic study revealed the following salient characteristics in the project area: (i) the average holding of land is about 1.6 ha, (ii) the average number of housing compounds per village is about 20, (iii) the average number of families per housing compound is 3, (iv) the average family size is about 6, (v) about 80 per cent of the affected farming families farm their own land, and (vi) about 60 per cent of the affected farmers have lived in the area for more than 30 years.

The total land to be acquired for the Project is estimated at 2,784 ha and includes 1,554 ha on the east bank and 1,230 ha on the west bank. The land area that will be required for the actual works (guide bunds, roads, working areas, and bridge and facilities) amounts to 906 ha. Surplus dredged material should be adequate to fill a flood-free area of 250 ha for industrial activities or resettlement.

IV. Anticipated Environmental Impacts and Mitigation Measures

A. Construction Phase

1. Surface Water Hydrology

All major project earthworks may interfere with surface hydrology and water management. During construction some temporary works may have to be constructed such as cofferdams, access roads, stock piles and deviation channels. As a general rule, the contractors will be required to provide facilities to prevent any major disruption of surface drainage.⁶ Monitoring and construction supervision will ensure that no major disruption of surface drainage will occur.

As surface water irrigation represents only a very small proportion of the total irrigated area in the project area (1-2 percent) the total losses due to unavoidable closure of water supply channels are negligible.

It is possible that deep drainage will be necessary for the construction of bridges and box culverts in the approach embankments. This can cause disruption of the domestic water supply in adjacent settlements, because of a water level drawdown. In that case, the Project will require the contractors to prevent significant impact on the groundwater level by constructing sheet piled building pits.

2. Water and Soil Quality

For the implementation of the Project extensive dredging works have to be carried out, this includes: (i) dredging in the Padma and Jamuna to create a channel of sufficient depth and width from the Bay of Bengal to the bridgesite, (ii) dredging of a channel in *charland* along the bridge-axis, (iii) dredging for the river training works, (iv) possible dredging required for the widening and deepening of a spill channel to the Dhaleswari River. The total quantity of dredged material is estimated to be 25 to 30 Mm³. The intention is to use the total quantity of sand to reclaim the area

⁶ Effect of the Project on the Dhaleswari River regime is discussed in paras. 45-50.

required for the approach roads, bridge-end facilities and other facilities such as working areas; and possible future developments. As the majority of dredging works is carried out outside the Jamuna riverbed and dumping of dredged material into the river will be prohibited, the effects of the dredging works on water quality, river morphology and environment is negligible.

It is unlikely that dredged material from the Jamuna River will be contaminated by toxic chemicals or heavy metal, because as yet no heavy industries exist upstream of the bridge site. Dredged material samples will be analyzed prior to final decision on use of reclaimed areas for residential use.

Dredged sand will be used to raise the embankments for the bridge-end facilities. This reclamation will be carried out by hydraulic means. Significant environmental effects of these operations will be minimized by ensuring that the sand is deposited within temporary bunded areas. Further it is envisaged to start reclamation work as soon as the flood plains are "dry" and to have the operation completed before the next flood season.

Spillage of fuel, solvents, lubricants and paint by leakage of tanks or careless handling of disposal of chemical waste can cause severe pollution of soil, groundwater and surface water. Soil pollution and groundwater pollution by liquid wastes can have serious effects on the quality of drinking water in the working area for several years. Handling and storage of potential contaminants will be organized under strict conditions and preventive measures to avoid contamination during construction of the bridge.

3. Navigation

Impacts on navigation during construction will be insignificant because dredging work required for the construction of the River Training Works will mainly be carried out on the flood plains outside the navigation channel. Also the dredging of the channel to facilitate the installation of the bridge spans by floating crane will not obstruct navigation on the Jamuna River.

4. Road Transport and Traffic

The construction of the Jamuna bridge will generate additional traffic on the road from Dhaka to the bridge site but this traffic increase will not hamper the normal traffic flow. For local access to the construction site the contractors will make their own (temporary) access roads and the use by the contractors of existing tracks will be prohibited to avoid damage to these tracks, private properties and nuisance to villagers.

5. Agriculture

Permanent disruption of agricultural practices will occur in the area to be acquired for construction purposes. In the direct vicinity of the construction area, agricultural practices may be disrupted as a result of temporary but unavoidable disruption of surface hydrology. The extent of this effect, however, is moderate and will be dealt with.

Agricultural activities may further be disrupted in the vicinity of the construction area due to temporary earthworks. Agricultural land required for stockpiling of fill, access roads or borrow pits outside the designated areas will cause loss of production during the construction period. Even after the dismantling of such temporary earthworks, agricultural production will be reduced for some time due to damage to the soil structure. Contractors will be required to restrict the location of temporary works to designated areas (land permanently acquired for the Project), thus minimizing the temporary loss of agricultural production, i.e., about 20 ha on each river bank. Agricultural losses expected are: (i) losses due to impeded drainage during construction period (3 years) – Tk540,000; (ii) losses due to temporary occupation of agricultural land during construction (3.5 years) – Tk1,217,400 and yield reduction after construction (3 years) – Tk504,000; (iii) other crop damages (10 ha) – Tk540,000, or total loss of income amounting to Tk2,801,400.

6. Wildlife

The areas for river training works, bridge and facilities and proposed working areas for contractors are food and breeding habitats for residential and migratory birds during the dry season (winter time). Construction activities like dredging, earth compaction, transportation, etc. will disturb the wildlife habitat in the directly affected area and the adjacent environment. The contractors will be required to ensure that their workers do not illegally hunt wildlife or unnecessarily degrade habitat. A Wildlife Action Plan which covers survey and monitoring activities has been approved and will be implemented during the project implementation.

7. Fisheries

Impacts on fisheries during construction and related mitigation measures are described in paras. 53-58.

8. Occupational Health

Occupational health risks are those related to major construction activities, primarily accidents. The contractors will be required to minimize occupational health risks and provide medical facilities on-site in accordance with Bangladesh laws and regulations.

9. Noise

Construction activities will raise the noise level to which the population is exposed. Noise pollution can be caused by transportation, dredging, electricity generation and pile-driving. It is expected that the noise caused by these activities will still be within acceptable levels.

10. Water Supply and Sanitation

The contractors labor camp will house up to 1,500 people. The contractors will be required to secure a safe and adequate supply of potable

water. The wastewater containing excreta and sullage will be treated prior to discharge using septic system or a secondary wastewater treatment facility. The contractors will also be required to provide adequate drainage to eliminate any possible public health hazard. Solid waste (refuse, garbage, etc.) will be collected regularly and stored in covered containers. Final disposal will be by sanitary landfill.

11. Social Impacts

Some impacts in the area are likely due to the introduction of a large labor force employed for the Project. The labor group, mostly from outside the project area, will enjoy better economic conditions than the local people particularly those displaced. This condition could disrupt the local economy and social order. Continuous public participation and general recognition for the need for the Project (demonstrated by the Jamuna Bridge Tax) has already served to bring about an atmosphere of cooperation. In addition to fair compensation and resettlement, the Government will assist the local people by ensuring equitable utilization by local people of social developments such as markets, mosques, movie theaters, and banks, particularly at the larger camps.

B. Operational Phase

1. Changes of the Jamuna River Regime

a. Backwater Effect

During peak discharges the increased water levels may have two major impacts: (i) increased probability of failure of flood embankments along the Jamuna River, and (ii) increased inundation levels in the floodplain of the river with subsequent impact on crop production and water management. Modelling studies show that the effects will be of little significance. Simulation studies show that backwater effects will extend to about 50 km upstream and 10 km downstream of the bridge site. During a high flood (1 in 10 year) the maximum backwater effect is less than 0.2 m. It is

estimated that during average floods the maximum effect is less 0.1 m. For “standard” discharges (not exceeded during 18 days per year) the backwater effects are negligible.

The river training works will result in less than 10 cm increase in water levels due to backwater effects during average floods and during standard high water the effects will be negligible. The frequency of failure of the Brahmaputra flood embankment would theoretically increase as a result of the backwater effect, however, a 1 in 50 year flood height will be increased by only 0.25 m. Furthermore, river training works will also provide some additional protection to the flood embankment, resulting in less erosion damage.

b. Erosion

In order to protect the bridge and the approaches against outflanking channels, guide bunds (2.2 km long) will be constructed on the east and west bank at the location of the bridge. These guide bunds will fix the river banks in between the bridge abutments. Some 8 km upstream, at Sirajganj on the west bank, a fixed point is formed by the existing town protection works and on the east bank at the ferry ghat a second fixed point will be created by bank protection works incorporated in the project. The guide bunds together with the fixed points at Sirajganj and Bhuapur (ferry ghat) are adequate for the protection of the bridge and approaches against outflanking channels, but will not change the erosion of the river banks between the bridge and the fixed points.

The various river training works along the Jamuna will reduce erosion over a distance of approximately 10 km at each bank, reducing erosion damage by about Tk2 million per year.

c. Surface Runoff and Drainage

Natural surface runoff will be disrupted by the construction of the approach roads and bridge-end facilities. As a consequence the natural drainage and runoff from about 4,000 ha of floodplain upstream of the bridge site will be disrupted. Impeded drainage will change the flood situ-

ation as follows: (i) in the pre-monsoon, before the Jamuna reaches its bankfull stage, local rainfall excess would accumulate in the low-lying areas and spill channels, resulting in increased water levels; (ii) at the end of the monsoon the natural drainage will be impeded and periods of high water levels will be extended increasing the occurrence of stagnant water; and (iii) sedimentation will increase (in particular in the creeks and spill channels). The number of affected households is approximately 1,600 and consequent income reduction is estimated to be Tk10,600 per family. Provision of drainage facilities for agricultural land in the Jamuna floodplain upstream of the bridge will minimize this impact.

d. Water Quality

The construction of an approach embankment across the floodplain without cross-drainage facilities is likely to create stagnant water which will be polluted by domestic wastes, washing, jute retting, etc. Nonetheless, because of the low population density in the floodplain north of the embankment and the few industrial activities, the natural assimilative capacity should be adequate and no significant increase of pollution in the area is expected. Environmental monitoring will be undertaken to ensure that if a pollution problem becomes serious, drainage improvements will be implemented.

2. Closure of the Dhaleswari River Intake

Closure of the northern intake channel of the Dhaleswari River by the construction of the east approach embankment is expected to have a significant hydrological impact on the catchment areas of upper Dhaleswari, Pungli, Louhajang and Elangjani rivers (600 km²) and a minor impact on the middle Dhaleswari basin (1,860 km²) but no impact on the lower Dhaleswari basin beyond Savar (Appendix 2, page 3). A special study, undertaken to delineate measures to mitigate such impacts, concludes that direct impacts of the closure would be:

- (i) a reduction in average depths of flooding ranging from one meter in the upper Dhaleswari and Pungli rivers, decreasing southward to a negligible amount in the vicinity of Mizapur towns and the southern Dhaleswari intake;
- (ii) total annual discharges in the upper Dhaleswari, Pungli, Louhajang and Elangjani would be significantly reduced in both volume and duration. The most affected channels would include the upper Dhaleswari and Pungli where annual discharges would be reduced from 40,000 Mm³ and from 15,000 Mm³ to 22,000 Mm³ and 7,000 Mm³ respectively, with the duration of flow reduced from six to four months;
- (iii) overbank and spill channel discharges from the Jamuna to the upper Dhaleswari would be increased by 83 percent from 12,000 to 22,000 Mm³ which is likely to give rise to increased erosion of areas of land supporting rainfed cropping between the Jamuna and Dhaleswari Rivers;
- (iv) groundwater recharge would not be reduced significantly and maximum depths of pumping lift would remain unchanged although potential recharge would be reduced by 40 percent; and
- (v) a reduction in the area available for fish spawning and refuge of 11,000 ha and a corresponding reduction in annual fish production from 1,250 to 750 tons.

Mitigation measures have been considered to reduce the negative impacts of closure on the present surface water regime and eliminate the risks of erosion of lands lying between the Jamuna and Dhaleswari Rivers. The options studied for the maintenance of the present surface water regime included the retention of the present northern intake channel, the provision of an alternative intake channel and the enlargement of the southern intake channel. However, it was concluded that these options would

not provide a satisfactory technical solution. A mitigation plan based on the construction of a guide embankment between the Jamuna and Dhaleswari Rivers was therefore recommended. Implementation of the plan would reduce/eliminate the risks of the loss of land through erosion due to overbank spill between the Jamuna and Dhaleswari although it would have little effect on the erosion taking place along the east bank of Jamuna. Agricultural benefits would be increased and benefits would also arise from reduced flood damage in the impact area.

The overall impact of the mitigation plan would be:

- (i) a reduction in average depths of flooding ranging from 2 m in the upper Dhaleswari and Pungli Rivers decreasing in a south-easterly direction towards Mirzapur and the southern Dhaleswari intake;
- (ii) total annual discharges in the upper Dhaleswari, Pungli, Louhajang and Elangjani would be further reduced in volume and duration. The most affected rivers would be the upper Dhaleswari and Pungli;
- (iii) overbank and spill channel discharges from the Jamuna to the upper Dhaleswari would be eliminated thus protecting areas of rainfed cropping between the Jamuna and Dhaleswari Rivers; and
- (iv) groundwater resources and pumping levels would be minimal. Future increases in the use of irrigation will increase pumping lifts and may necessitate the use of tubewells.

The indirect impacts of the mitigation plan would be:

- (i) the reduction in flooding would enable agricultural productivity to be increased through the adoption of higher yielding cropping systems over an area of about 29,200 ha;

- (ii) the benefits to the 36,500 farming households in the impact area would represent an average of Tk6,000 per family per year or a 50 percent increase in income, although the range would vary considerably. This increase in agricultural activity would also increase employment opportunities for the landless and poorer sections of the community; and
- (iii) the net annual economic benefits of the intake closure are estimated to be Tk107 million after allowing for increases in agricultural output of Tk98 million and reduced flood damage of Tk25 million to be offset by decreases in fish production of Tk16 million and land lost to construction of the embankment of Tk0.13 million.

The full social impact of the closure is difficult to evaluate in detail because of the natural demographic changes which are already occurring within the structure of rural society in Bangladesh. There will be income losses to the professional fisherfolk and to rural households involved in opportunistic fishing. Increased agricultural production and the generation of 2.3 million man-days of employment may compensate for these losses, although clearly the losers may not be identical to the gainers. The detailed social impact can only be assessed as the result of the activities to be undertaken by the proposed Project Monitoring Cell.

The total cost of the Dhaleswari Mitigation Plan including physical and financial contingencies is estimated to be Tk129.3 million of Tk76.9 million would be in local currency and Tk52.4 million in foreign exchange.

3. Disruption of Communication

a. Navigation on Jamuna River

An analysis has been made of the river channels that occurred during the last 20 years at the location of the bridge in order to optimize the bridge profile which will slope from the approach road level at the abutments up to the level required for navigation clearance. The result of this

analysis shows a minimum of 170 m channel width, which meets the requirements for Class-A waterways will be available all of the time. Therefore no mitigation measures are required.

b. Navigation on Dhaleswari

The extent of navigation on the affected part of the northern Dhaleswari during the 3 months that it is navigable is very limited. About 50 small local cargo boats travel each day from the Jamuna through the northern intake channel, Dhaleswari and Pungli to Elenga. Closure of the northern intake would mean that boats would have to detour to 25 km upstream and 34 km downstream when using the southern Dhaleswari intake channel. The improved land transport made possible by the Jamuna Bridge will offset this local and unavoidable impact.

4. Impairment of Ecological Resources

a. Fisheries

Construction of the Jamuna Bridge, especially the closure of the northern intake of the Dhaleswari river, will affect riverine fisheries over the river system of the area within and surrounding the Project. Fish habitat, such as flood plains, canals, ponds and low-lying areas (*beels*) directly fed by the Dhaleswari River, will also be affected. Some negative impact on fish production and fish catch in the area is expected to occur which will require adequate mitigatory measures. The mitigation plan aims to at least restore the present condition of the affected people, and to the extent possible, will improve their present condition.

The impact area covers a total of 11,308 ha, which includes 1,144 ha of aquaculture ponds and 10,164 ha of open water fisheries area. In addition to capture fishery, there is a carp spawn and fry collection industry in the impact area. The collection of carp spawn is important because fresh water aquaculture in closed water bodies is largely dependent on the supply of captured fry and fingerlings which gain entrance into the floodplains through the link channels. In addition to the loss of permanent fishing

grounds comprising rivers and estuaries, *beels* and ponds there is an additional loss of seasonal floodplain fishery area, about 20 percent in the upper and 10 percent in the middle Dhaleswari basins, respectively. Therefore, closure of the northern intake of Dhaleswari will cause significant impacts on fish production.

Estimated annual loss of fisheries vary in the impact area from 1000 to 1260 tons and the loss of fry will be about 120 kg/year. About 5,600 – 9,000 fisherfolk will be adversely affected. The income loss of each fisherman has been estimated to be varying from Tk1,000 to Tk2,000 per annum. The Fisheries Mitigation Action Plan briefly described below is conservative in that it is designed to compensate/offset fisheries losses of about 3,300 tons per year.

Three options were considered for fisheries impact mitigation, viz. (i) construct an approach bridge over Dhaleswari River, (ii) develop a stocking program along the line of IDA's third Fisheries Project (TFP) or ADB's Second Aquaculture Project (SAP) and/or, (iii) expand pond aquaculture in the project area. Among the three options, pond culture development appears to be the most viable and achievable. A recent estimate shows that there are about 1,144 ha of unused ponds in Tangail and Manikgonj District of which 810 ha would be developed. A field level survey undertaken jointly by the DOF and NGOs would identify and develop about 5,720 ponds, with an equal number of fisheries associations. Cost of mitigation with pond aquaculture and *bee*/stocking, supplemented by a Hatchery Improvement project to supply fingerlings is estimated as follows.

(i) Pond development, 810 ha	Tk	911.25	lac
(ii) Beel restocking, 17,000 ha	Tk	112.50	lac
(iii) Hatchery improvement 8 nos at the rate of Tk25.00	Tk	200.00	lac
(iv) Supply of fingerling at the rate of 1.25 lacs per ton	Tk	850.00	lac
	Tk	<u>2,073.75</u>	<u>lac</u>

(1 Lac = 100,000)

NGOs will be invited by JMBA to assist in implementation of the Fisheries Mitigation Action Plan by providing training and managing a fisheries credit facility. The main objective of the training program will be to educate the fisherfolk about modern pisciculture concepts as well as improving the traditional methods. NGOs will train the fisherfolk in groups at DOF's expenses. The cost has been estimated at Tk25 lacs. The cost estimate for post-training loans is estimated at Tk144 lacs. The credit facility will enable affected fisherfolk to continue their aquaculture activities, thereby enabling the landless group to improve their livelihood.

Fisheries management and monitoring plans have been prepared. The primary function of fisheries management will include: (i) collecting fisheries data in the impact area, (ii) conducting training programs for the field level fisheries officers and fisherfolk by fisheries experts and NGOs, (iii) providing training to the aquaculture group in fisheries technology, (iv) organizing fisherfolk and landless groups and unemployed youth, (v) distributing fisheries equipment among the trained fisherfolk groups, and (vi) processing of the credit facility documents by NGOs. The Fisheries Monitoring Program will include: (i) collection of environmental data relating to fisheries during and after construction; (ii) submission of periodic reports on fisheries-related affairs, during and after the Project is completed; and (iii) evaluation of fisheries management.

b. Wildlife

The construction of bridge and facilities and river training works will cause some loss of habitat for wildlife. However, considering that such habitat occurs extensively in the other parts of the Jamuna River, the impact of loss of habitat will not be very significant. No particular mitigation measures will be adopted; nonetheless the JMBA has planned the preparation of a wildlife action plan in the area.

The impact area is almost entirely used for agricultural purposes or human settlements. There is very little natural vegetation left and no precious natural resources exist in the impact area. Thus, there will not be any environmental impact.

c. Natural vegetation

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5. Land Acquisition and Resettlement

a. Land to be acquired

The total area of land to be acquired for the project is estimated at 2,784 ha and includes 1,554 ha on the east bank and 1,230 ha on the west bank.

b. Resettlement program

A compensation and resettlement planning study (supplement to EIA study) has defined the Project Affected Population (PAP) and develop a Resettlement Action Plan (RAP). A total of 6,156 households are being affected due to loss of land while 5,906 households are indirectly affected. The following Resettlement Policy Matrix summarizes information on the number of affected.

Compensation and mitigatory measures proposed in the RAP are intended not only to rehabilitate PAPs in their old profession or economic activity, but proposes imparting new skills with new economic and employment opportunities. To allow smooth operation of the resettlement action plan, efficient liaison and grievance redressal procedures through formation of village committees will be established with participation of representatives of PAPs, social leaders, village elders, interested NGOs and members of the local administration.

Out of 2,300 ha to be acquired for the Project, a substantial quantity of land beyond the permanent structures will become surplus (about 121.46 ha) after the bridge is completed. An intensive plantation program will be undertaken (including short and long maturation trees as well as fruit trees,

Resettlement Policy Matrix, March 1993

Description of PAP Category	Number of Households		
	Tangail	Sirajganj	Total
<i>1. PAPs Losing Homestead Agricultural Land</i>	<i>1,070</i>	<i>296</i>	<i>1,366</i>
<i>2. PAPs Losing all or Parts of Agricultural Land, but not Homestead</i>	<i>2,474</i>	<i>1,399</i>	<i>3,873</i>
<i>3. PAPs Losing Homestead Only</i>	<i>470</i>	<i>330</i>	<i>800</i>
<i>4&7. Weaving, Business, Industries, Shopkeepers Losing Place of Employment</i>	<i>40</i>	<i>50</i>	<i>90</i>
<i>5. Tenant Farmers</i>	<i>312</i>	<i>249</i>	<i>561</i>
<i>6. Farm Laborers</i>	<i>1,645</i>	<i>816</i>	<i>2,461</i>
<i>8. Squatters and Landless</i>	<i>743</i>	<i>1,432</i>	<i>2,175</i>
<i>9. Households Already Relocated</i>	<i>418</i>	<i>313</i>	<i>731</i>
<i>10. Non-Farm Laborers</i>	<i>88</i>	<i>530</i>	<i>618</i>
<i>Total</i>	<i>7,260</i>	<i>5,415</i>	<i>12,675</i>

fuel wood and timber) along the road and embankment slopes and periphery of other structures. Another area of about 404.86 ha will be available for agricultural development. A total of 1,000 PAP households could be accommodated in this manner. The plantation program is tentatively estimated to cost Tk30 million. Renewable leases of surplus and road side land are likely to accommodate up to 1,000 share-cropper/agricultural households. A similar number of temporary jobs will be created for afforestation.

The benefit package for the PAPs described below is in addition to cash compensation to which they are entitled under the land acquisition laws.

- (i) JMBA/GOB agree in principle that a PAP, being adversely affected by the acquisition of his or her property, cannot be expected to go into debt in order to replace his/her assets by borrowing money from any bank, however, soft loan terms might be. JMBA/GOB have agreed to enhance the premium to 50 percent for all land losing PAPs, whether agriculture of homestead land. Further, there will be a safety net provided by JMBA for the PAP in the event that the total cash compensation provided is not adequate to purchase an equivalent parcel of land. The socioeconomic survey identified 6,156 directly affected households. The payment of premium and provision for safety net would cost Tk200 million.
- (ii) The socioeconomic survey identified 504 households who had pre-acquisition more than 33 decimals agricultural land per person but have post-acquisition residual land of less than 33 decimals per person. This group of PAPs is considered as most vulnerable. Compensation received by this group has to be used to purchase equivalent land. JMBA proposes to keep a fixed deposit of Tk32 million in selected banks as guarantee for the loans to be given to PAPs.
- (iii) There are about 2,745 PAP households who have expressed their willingness to be relocated at their own place of choice. JMBA-RU (Resettlement Unit) intends that these affected householders be given enhanced cash compensation to purchase homestead plots of their own choice. The RAP aims to assist the homestead losers with some financial assistance to build their houses which will be in addition to the cash compensation received for the lost homestead. Such self-relocation by PAPs will help to retain the village culture and family unity. JMBA-RU would assist in transportation during migration from one place to resettlement sites or to the place where a PAP wants to relocate. The cost of transportation will be borne by JMBA-RU. A preliminary cost estimate is Tk1.00 million.

- (iv) Two resettlement sites, one on each bank of the river located at village Sratia, Jamtaildas, Jamtailkhirpur and Dukhiabari in Sirajganj *thana* (sub-districts) (87.45 ha) and village Palsia and Nikrail in Kalihati *thana* (127.94 ha) will be established. Plots of 300 and 600 sq m will be allotted for homestead at a price of Tk4,000 and Tk8,000 respectively, payable in ten years. Families having six members or more will be allotted the larger plots.

The socioeconomic survey has identified 3,014 land-losing PAP households who have expressed their willingness to move to resettlement sites and 397 land-losing PAPs were found indecisive about moving to resettlement sites.

The resettlement sites will be elevated by digging ponds and the dug material as landfill. If necessary, dikes will be constructed to keep resettlement sites flood-free. Common services and facilities like primary school, secondary school, road, mosque, health center including maternity and child care center, tube well, etc., will be provided by units in resettlement sites. Such services and facilities will be provided/extended by RU in the host population areas where concentration of the migrating PAPs would be most dense. This is expected to ease tension among the host population and the new settlers.

- (v) Due to closure of northern intake of Dhaleswari River, about 151.82 ha of *khas* land will be reclaimed which will be leased out to land losing PAPs permanently in blocks up to 0.81 ha per family.
- (vi) There are 561 sharecroppers among the PAPs. This category is also a priority group and in addition to a one-time cash grant for 45 days' wage (Tk40 x 45 = Tk1,800), the sharecroppers will get preference in allotment of JMBA's surplus land. Renewable lease of surplus land at 0.40 ha per household will be given

to them at a very nominal rent and they will essentially become landholders.

- (vii) Weavers, industrial workers, shopkeepers and artisans will be given cash compensation to move their businesses and establish their enterprises elsewhere. Shopkeepers will be given preferential allotment of commercial plots at bridge-end areas.
- (viii) Farm laborers and tenant shopkeepers losing their seasonal income will be given one-time cash grants amounting to 45 days wage ($\text{Tk}40 \times 45 = \text{Tk}1,800$) per household to minimize immediate difficulties. In addition, about 2,461 farm laborers and tenant shopkeepers will undergo intensive training. Post-training assistance through NGOs for self-employment will also improve their status.
- (ix) Other than the squatting places in resettlement sites, the squatters and landless will be entitled to a one time cash grant of Tk1,800. They will have additional benefit such as training and subsequent loan, preferential allotment of commercial plots for landless and job opportunities from the project contractor.
- (x) Training in occupations like weaving, garment manufacturing/tailoring, rural health works, pisciculture, poultry/livestock farming, automobile/mechanics, improved agricultural works, professional training (deed writing, computer, typewriting, etc.), cottage industry, etc., will enable the trainees to develop their skills and improve self-employment opportunities. Tk40 million has been proposed to provide training to some 16,000 persons under the RAP. Tk30 million has been proposed for providing loans to trained PAPs which would benefit them in self-employment.
- (xi) The construction contractors will be urged by RU to engage PAPs as unskilled or skilled labor. The construction of the

Jamuna Bridge would enable the employed PAPs to receive on-the-job training and develop their skills.

- (xii) Though not foreseen, it is possible that some other adverse impacts may be caused which may require immediate mitigation. A fund will be established under the control of RU to identify and implement necessary additional mitigatory activities.

6. Future Settlement and Urbanization in the Project Area

a. Possible changes in land use and economic development

With the construction of the bridge, the land use pattern of the area near the approach road and near the bridge end facility on the east bank will change rapidly. Common to most national highways near large towns in Bangladesh, a ribbon development of industries and settlements can be expected in the near future along the road as well as development of urban centers at vantage places at a later date. The short term, significant social effect will be the transfer of the land from small farmers to big holders and land speculators. The long-term effects, unless regulatory measures are taken in time, will be uncontrolled urbanization, environmental pollution from industries and innumerable places of access to the road leading to traffic congestion/hazards.

Therefore, the Government will institutionalize effective controls on the growth of settlements on the roadside land. One of the measures will be to have exclusion zone of about 100 m depth on each side of the road where no building or structure would be allowed to be erected and no access from any individual building/property will be allowed directly on to the road.

b. Effect on land and water resources

The expected future urbanization and industrial development in the bridge project area will have an impact on land and water resources. The extent of the impact will depend upon the ability of the Government to

enforce pollution control regulation. Monitoring by the Project Monitoring Unit will provide feedback to the Government so that enforcement efforts can be strengthened, if required, to minimize avoidable impacts on land or water quality.

c. Traffic-related pollution hazard

Traffic density of vehicles crossing the bridge is estimated to increase from 1,442 vehicles/day (at project completion) to 8,720 vehicles/day (by the year 2020). Degradation due to surface runoff is shown to be insignificant. However, the project will have a localized effect on air quality, noises and will pose risks due to transport and hazardous materials.

7. Other Environmental Issues

a. Gas transmission and distribution to the west

Estimates of savings of fuelwood due to gas distribution in the North-West region of Bangladesh which will be facilitated by the bridge vary from 161,000 and 343,000 tons/year, which is 4-11 per cent of the total industrial and domestic fuelwood consumption in Bangladesh (1983/1984).

V. Alternatives

Two alternatives were considered during the preparation of the Project, viz: (i) improving the existing ferry service currently connecting the west and east bank of the Jamuna River, and (ii) construction of a bridge in the same location. Since the bridge will replace an existing ferry service, the economic analysis focused on whether the bridge would be justified in comparison with the alternative of improving the ferry system to cope with the traffic likely to be developed. The analysis clearly showed that the proposed alternative is the optimal one for ensuring the flow of increasing traffic especially during the flood season, reducing the hazards of ferry transport including possible accidents, with loss of human lives, etc.

VI. Cost-Benefit Analysis

The feasibility consultants in 1988 estimated the EIRR on the Project at about 16.7 percent. The EIRR for the Project has now been recalculated at 11.0 to 14.0 percent, depending upon the ferry system improvement costs taken into account and based on an estimated project cost of \$690 million. The Government funding will come from the Jamuna Bridge Tax fund. The costs include all environmental mitigation and resettlement/compensation costs. The benefits of the Project taken into consideration were mainly the benefits to traffic from eliminating waiting time for ferries, reduced vehicle operating costs, and the cost savings from providing a power connector on the bridge instead of building a stand-alone facility. In addition to these benefits, estimated savings from carrying natural gas from east to west across the bridge after the year 2000, when the current shortage in gas production capacity may be overcome, may be included (likely to add roughly 1 percent to the EIRR). However, the evaluation has not attempted to quantify the environmental benefits resulting from reduced fuel wood demand, and non-quantifiable environmental damages.

VII. Institutional Requirements

The Project will support a Project Monitoring Cell (PMC) for a period of five years. The PMC will coordinate the monitoring of the mitigation plan including the commissioning of base line and annual surveys of surface and groundwater resources, agriculture, fisheries, and socioeconomic effects including health and nutrition. The PMC will be attached to the JMBA.

JMBA-RU with 56 full-time personnel will be established and headed by a Director with full financial and administrative powers under the overall supervision of the Executive Director of JMBA. JMBA-RU will also recruit 116 staff, preferably from among the RAPs (one male and one female from each of the 58 affected villages) to work as Village Resettlement Workers (VRWs). These VRWs will work as JMBA agents in the village to assist PAPs and to maintain the communication links with the local resettlement office

and they will provide the necessary local input and participation by the villagers in resettlement decision-making processes. These VRWs will also assist the grievance redressal committee. Two offices under the RU will be set up, one at the east and other at the west bank, preferably at Bhuapur and Sirajganj, respectively.

VIII. Public Involvement

The Project has received a lot of media coverage and several views both in support and against the Project have been expressed. Substantial public consultation and involvement has taken place during the EIA and other planning studies, especially during the socioeconomic/population surveys. Consultation included visits to the project sites and discussions with the project affected people (PAP) about their ideas for the project. Responses of the PAP were noted and analyzed, and used for the preparation of the Resettlement Action Plan. Local public involvement will be a continuous process through the RUs, VRWs and PMC. In addition, the "Jamuna Bridge Tax" has ensured public awareness of the project at the national level. Finally, NGOs have been and will continue to be consulted and involved in project planning and implementation.

IX. Summary

The most significant environmental impact resulting from the proposed Jamuna Bridge Project is (i) resettlement of the population living around the project site, and (ii) modification of the flow regime of the Dhaleswari River and consequent effects on fisheries and land use. These and other environmental impacts of less significance will be minimized to the extent possible and offset by implementation of appropriate mitigation measures. The summary matrix of environmental impacts is attached as Appendix 3. The environmental issues are currently being discussed with the Bank's Appraisal Mission.

RESETTLEMENT POLICY MATRIX

No	Description of Category	Provisions and Entitlement	Comments
1	<i>Land owners losing only a portion of their agricultural land, left with residue of two or more acres with H/H of 6 persons. A fraction thereof for each additional person.</i>	<ol style="list-style-type: none"> 1. cash compensation for land. 2. Or as for categories 2 and 3 below 	<i>Land owning categories who are full-time farmers (and not landlords) are extremely vulnerable to land acquisition of significant magnitude as they rarely have secondary sources of income.</i>
2	<i>Owners of ag. land with up to 6 H/H members who will be left with less than two acres, or proportionately more for each additional person.</i>	<ol style="list-style-type: none"> 1. cash compensation for land acquired. 2. CHBA through a financial institution advances cash to enable PAP to purchase ag. land. <p><i>N.B. Cash compensation to be used exclusively for purchasing another equivalent piece of agricultural land.</i></p>	<i>PAPs to be informed that they can look for agricultural land for sale, individually or in groups. Having identified the land and ascertained its price, JMBA will assist them to purchase the land.</i>
3	<i>Owners losing all their land</i>	<i>as for category 2. Above.</i>	<i>As for 1. and 2. above.</i>
4	<i>Sharecroppers with no land.</i>	<ol style="list-style-type: none"> 1. receives cash compensation for homestead and house. 2. receives priority offer to lease land along approach roads and other available/suitable areas. 3. proposals for vocational training to be prepared with help of NGOs. 	
5	<i>Shopkeepers, kiosk and stall owners.</i>	<i>cash compensation for moving business.</i>	
6	<i>Homestead owners losing house and land on which it stands.</i>	<ol style="list-style-type: none"> 1. can compensation for (a) land; (b) house, both at replacement value. 2. JMBA advances cash to: (a) enable plot purchase; (b) construct house in phased manner through installment, i.e., for foundation, walls, then roof. 	<i>This category could include members of any and all other categories. One wed per 10 H/H to be provided and access tracks to be provided by JMBA. Formula to be worked out for upgrading of services, e.g., schools to accommodate additional population in area.</i>

No	Description of Category	Provisions and Entitlement	Comments
7	<i>Squatters and farm laborers.</i>	<ol style="list-style-type: none"> 1. receives cash compensation for homestead and house. 2. receives priority offer to lease land along approach roads and other available/suitable areas. 3. proposals for vocational training to be prepared with help of NGOs. 	
8	<i>Weavers and other industries and artisans.</i>	<ol style="list-style-type: none"> 1. cash grant. 2. vocational training. 3. some land will be made available by JMBA on both sides and at optional settlement sites. 	
9	<i>People adversely affected by bridge, i.e., change in water levels upstream or downstream, or in unforeseeable ways.</i>	<i>cash compensation and assistance to reestablish workshops at new sites selected by themselves.</i>	<i>Legal agreement between JMBA and GOB or other entity to be drawn up to protect interests of all persons who may be adversely affected by the bridge and allied civil works.</i>
10	<i>Persons whose property has already been acquired for the Project.</i>	<i>assistance to mitigate impacts, e.g., through provision of pumps.</i>	
11	<i>Persons whose property has already been acquired for the Project.</i>	<i>after tracing, to be offered the same benefits as others in the same category.</i>	
12	<i>Any other category yet to be identified.</i>		

N.B.: Categories are not mutually exclusive and any one PAP may receive more than one benefit.

SUMMARY OF IMPACTS MATRIX

Project Phase/ Activities	Potential Impact	Mitigation Measures	Degree of Impact
<i>I Construction</i>	<i>interference with surface drainage</i>	<i>construction of temporary works such as cofferdams, access water, stock piles and deviation channels mounting and construction supervision</i>	<i>Moderate</i>
	<i>construction of bridges and box culverts can cause disruption of the domestic water supply in adjacent settlements because of water level drawdown</i>	<i>construction of sheet piled building pits</i>	<i>Negligible</i>
	<i>dredging and reclamation are envisioned to have minimal impacts on the environment</i>	<i>dredging will be carried out outside the Jamuna Riverbed and dumping of dredged material into the River will be prohibited; depositing sand within temporary bunded areas; and undertake reclamation work only during dry season</i>	<i>Negligible</i>
	<i>spillage of fuel, solvents, lubricants and paint by leakage, tanks or careless handling of disposal of chemical wastes can cause severe pollution of soil, groundwater and surface water</i>	<i>handling and storage of potential contaminants will be organized under strict conditions and preventive measures will be undertaken to avoid contamination during the construction of the bridge.</i>	<i>Negligible</i>
	<i>impact to navigation during construction</i>	<i>dredging will be carried out on the flood plains outside the navigation channel</i>	<i>Negligible</i>

Project Phase/ Activities	Potential Impact	Mitigation Measures	Degree of Impact
	<i>impact to normal traffic flow, damage to existing tracks, and nuisance to villages</i>	<i>contractors will make their own temporary access road and use by the contractors of existing tracks be prohibited.</i>	<i>Negligible</i>
	<i>permanent disruption of agricultural activities in the immediate vicinity of the project site. Agricultural losses are expected from impeded drainage, temporary occupation of agricultural land, yield reduction after construction and other crop damages.</i>	<i>affected villagers will be compensated as stipulated in the project's Resettlement Program</i>	<i>High</i>
	<i>disturbance of the habitats of residential and migratory birds</i>	<i>a Wildlife Action Plan will be implemented during project implementation</i>	<i>Moderate</i>
	<i>occupational/health risks</i>	<i>provision of in-site medical facilities, safe and adequate supply of potable water, toilet facilities; and disposal of solid wastes to a sanitary landfill</i>	<i>Negligible</i>
	<i>exposure of nearby population to increased noise level</i>	<i>unavoidable impact but one which is expected to be still within acceptable levels</i>	<i>Negligible</i>

Project Phase/ Activities	Potential Impact	Mitigation Measures	Degree of Impact
	<i>migration of a large labor force into the area may cause disruption on the local economy and social order</i>	<i>fair compensation, resettlement, giving access of social services, i.e., provided to labor force to local people giving equitable access to social services to both local communities and the labor force</i>	<i>Moderate</i>
<i>II. Operational Phase</i>	<i>increase in the probability of failure of flood embankments along the Jamuna River; increase in the inundation levels in the floodplains of the river with subsequent impact on crop production and water management</i>	<i>river training works will result in less than 10 cm increase in water levels due to backwater effects and provide additional protection to the flood embankment, resulting in less erosion damage</i>	<i>Negligible</i>
	<i>erosion of the river banks</i>	<i>construction of fixed points and guide bunds on both banks at the location of the bridge</i>	<i>Moderate</i>
	<i>disruption of natural surface run-off will change flood situation, leading to increase in water levels, occurrences of stagnant water, and sedimentation (the number of affected households as approximately 1,000 and consequent income reduction is estimated to be Tk10,000 per family)</i>	<i>provision of drainage facilities for agricultural lands in the Jamuna flood plain upstream of the bridge will minimize the impact</i>	<i>Moderate</i>

Project Phase/ Activities	Potential Impact	Mitigation Measures	Degree of Impact
	<p><i>construction of an approach embankment will create stagnant water which will be polluted by domestic wastes, washing, jute retting, however, no significant increase of pollution is expected</i></p>	<p><i>natural assimilative capacity should be adequate to address the problem; monitoring will be undertaken to ensure that if a pollution problem becomes serious, drainage improvements will be implemented</i></p>	<p><i>Negligible</i></p>
	<p><i>closure of the Dhaleswari River intake will cause the following impacts:</i></p> <ul style="list-style-type: none"> <i>(i) reduction in the average depths of flooding;</i> <i>(ii) reduction in volume and duration of the total annual discharges in the upper Dhaleswari, Pungli, Louhajang and Elangani;</i> <i>(iii) increase in the overbank and spill channel discharges from the Jamuna to the upper Dhaleswari;</i> <i>(iv) reduction in the potential recharge although groundwater recharge, would not reduce significantly; and</i> <i>(v) reduction in the area available for fish spawning.</i> 	<p><i>Mitigation Plan based on the construction of a guide embankment between Jamuna and Dhaleswari Rivers will be implemented. This would not only reduce flood damage but will also increase agricultural production in the impact area</i></p>	<p><i>Moderate</i></p>

Project Phase/ Activities	Potential Impact	Mitigation Measures	Degree of Impact
	<i>Closure of the northern intake would require boats to detour several kilometers going upstream and downstream of the River.</i>	<i>Improved land transport because of the Jamuna Bridge will offset this unavoidable impact</i>	<i>Moderate</i>
	<i>Closure of the northern intake will affect riverine fisheries through the loss of permanent fishing grounds and seasonal floodplain fishery area. Annual loss of fisheries will vary from 1,000 to 1,260 tons, and about 5,600-9,000 fisherfolk will be adversely affected.</i>	<i>A Fisheries Mitigation Action Plan will be implemented.</i>	<i>Moderate</i>
	<i>loss of habitat for wildlife</i>	<i>will be addressed by the Wildlife Action Plan</i>	<i>Negligible</i>
	<i>land acquisition will directly affect a total of 6,156 households; another 5,096 households will be indirectly affected</i>	<i>Resettlement Action Plan will be implemented.</i>	<i>High</i>
	<i>future impacts would be: changes in land use and economic development, increase in land and water resource needs, and traffic-related pollution hazards</i>	<i>Government to institutionalize effective controls on the growth of settlements along the roadside such as the designation of an exclusion zone on each side of the road where no building or structure would be allowed to be erected.</i>	<i>Moderate</i>