5. ENVIRONMENTAL ISSUES

The current study included an Initial Environmental Examination (IEE), delineating the potential environmental impacts of the construction and operation of the bridge, with a description of mitigating measures and a cost estimate of these measures.

In Bangladesh, being a very densely populated country, most of its land surface is shaped, managed and exploited to a high degree by its population. This implies that the natural terrestrial ecosystem is mostly lost. This is also the case at the two selected corridors for the proposed Padma Crossing. Therefore, the impacts related to the construction and operation of the bridge primarily affect the conditions and livelihood people on the lands occupied by the works and of those in the direct vicinity.

The aquatic environment in the Padma River at the proposed project locations is relatively undisturbed by human interference. The construction of a bridge will certainly affect natural environmental conditions, notably the river's morphology and the floodplain's drainage conditions upstream of the works. The aquatic fauna may be affected to some extent during the construction phase. Other impacts due to the proposed works will be associated with the construction works. This implies that they are generally of limited spatial extent and of limited duration.

For both locations considered, the areas that may be affected are rural in character, on both sides of the river; on the left bank more commercial activities are found. Agriculture is the main activity. Some people are engaged in commerce, trade and day labour, while a small number find their livelihood in catch fisheries on the Padma River and in the floodplain. The average population density appears to be very high. The economic development in the Goalundo Corridor appears to be somewhat more advanced than in the Mawa Corridor.

According to information available, the selected corridors do not host any ecologically sensitive areas, nor are there any archeologically or culturally important sites.

The proposed works will affect the river morphology. The constriction of the river by river training works will cause backwater effects during flood conditions, combined with increased scour at and near the bridge crossing and increased sedimentation further downstream.

For the Mawa location, the phenomenon of backwater will result in increased flood discharges in the Arial Khan River, and potentially better inflow conditions into this river. On the other hand, higher flood flows may cause more erosion in this morphologically unstable river.

For the Goalundo location, increased sedimentation downstream may, in the long run, reduce the offtake capacity of the Arial Khan River. The presence of a road/railway embankment on the right bank may pose problems for the drainage of flood waters, causing more severe and prolonged waterlogged conditions than in the present situation. These impacts require further analysis and quantification using mathematical modelling.

The impact on the terrestrial ecosystem will remain limited to the removal of the current vegetation (mostly agricultural crops, trees and homestead vegetation) from project assigned land. During project construction, residential and migratory birds that use char land as feeding and breeding ground, may temporarily be driven away.

The impact on the aquatic ecosystem due to dredging and dredge spoil disposal is thought to be very limited. To what extent the behaviour of riverine fish is affected by the piling works is a subject that needs further analysis.

Preparatory studies within the full Environmental Assessment should include the following:

- A mathematical modelling study into the morphological aspects of construction of a bridge across the Padma River needs to be done. This would include the effects to be expected in the Arial Khan distributary.

- A Post Construction Evaluation Study of the Jamuna Bridge could reveal important information to be taken into account while preparing the Environmental Impact Assessment, to Environmental Management Plan and Environmental Guidelines for the construction of the Padma Bridge. Such a study would aim at the environmental issues, problems and adverse impacts, encountered during and after bridge construction.

- A wildlife baseline survey for the area and surroundings of the Padma Bridge should give special attention to the presence and behaviour of birds, and should indicate the importance and interest of the riverine environment as breeding ground and feeding area for local and migratory birds.

- An environmental base line survey within the framework of a final Environmental Impact Assessment. Additional baseline information needs to be gathered on the hydrological and geohydrological situation in the area affected by the bridge, as well as on agricultural practices and production, and on fishing practices and catches.

Two issues were identified that should be taken into account in the design phase of the project:

- investigate a feasible alternative for the use of hammer induced pile driving in order to reduce noise pollution (eg bored piles);
- provide for cross drainage of the floodplain, by ensuring for an adequate number of culverts with sufficient capacity under the approach road.

In the construction phase Environmental impacts or strains such as those listed below can already be limited or prevented to a large extent if Contractors operate the following good working practices. The impacts concerned are:

- noise pollution
- dust and air pollution
- pollution of surface water and/or ground water
- hindrance of riverine transport
- insecurity or traffic/road safety
- occupational health and safety
- social disruption
- disposal of wastes, and
- operation of the work site and labour camp

Clauses in the Contractors' contract should pinpoint his obligations, further elaborated in an Environmental Management Plan and Environmental Guidelines. The Contractor should adhere to these stipulations and to the environmental quality standards in force in Bangladesh; in the absence of Bangladeshi standards, internationally accepted standards should be met.

6. RESETTLEMENT ISSUES

The construction of the Bridge will require the acquisition of substantial areas of land on a permanent basis, and some on a temporary basis for construction proposes. Land will be needed for the construction of bridge end facilities and approach roads on both sides of the river. Engineering studies indicate the need for river training works, which will consist of one guide bund on the right bank (Southern bank) of the river for the Mawa crossing and guide bunds on both sides of the river for the Goalundo crossing. A temporary working area will be required on the right bank of the river.

The bridge itself will not require the relocation of people. Dredging of a slot along the axis of the bridge to facilitate pile driving might however call for specific mitigation measures due to the fact that Char people usually cultivate the sandbars.

Given the severe land scarcity in Bangladesh and the dependence on agricultural land, the relocation of large groups to resettlement sites would necessitate the acquisition of large areas of land elsewhere. This would create a snowball effect of recurrent acquisition and resettlement, an option to be avoided. In Bangladesh, it would seem that the only feasible option for large resettlement projects would be to facilitate people to relocate themselves, and simultaneously to provide relocation facilities at smaller resettlement sites for a limited number of people who fail to identify and purchase replacement land. It is important that:

- these smaller resettlement sites are located as close as possible to the project area;
- sufficient income generation opportunities exists within close range of such resettlement sites;
- basic infrastructure facilities are provided at the resettlement sites (water supply/sanitation/ drainage/health/education/ religion), and that resettlers are allowed to construct their own houses.

In 1999 population density may have reached 3,000 persons/sq km at some points in the project area. Population density on the left bank of the river is about double that of right bank. Based on the estimated population density of the project area, it is expected that more than 10,000 will need to be relocated from their homes.

Under current resettlement policies acceptable to most international cofinanciers, indirectly affected people (eg farm labourers, shop assistants, artisans, craftsmen, construction workers, drivers) are also eligible for compensation. The implication of such policies is that the total number of affected people is not limited only to those people who actually live in the affected areas, but includes the number of others whose livelihoods are adversely affected.

Experience of the Jamuna Multipurpose Bridge Project indicates that the total number of directly and indirectly affected persons (PAPs) was about five times that of the people relocated. In this case it can be postulated that the number of directly and indirectly affected persons (PAPs) for the Padma Project could be more than 50,000.

Compensation for lost assets at replacement cost be provided. Adequate assistance is needed for the displaced persons and their host communities, to improve their livelihoods and standards of living, or at least to restore them for in real terms to predisplacement levels.

In the land acquisition process, it should be investigated how to strengthen the DCs offices (training, motivation, incentives) to handle the land acquisition laws carefully and in the spirit of the resettlement program. Compensation for all nonland related losses should be fully taken into account to include replacement cost and adequate transition costs, and compensation should be determined on the basis of actual loss at replacement cost.

In cases where entitled persons are not able to present adequate land ownership documents the following should apply: (i) during verification of land documents, public consultation should be given greater importance; (ii) where procurement of documents is a costly and time consuming affair delaying the resettlement process, deliberate preplanning should be applied to the problem.

7. ESTIMATION OF INCREMENTAL COSTS

The basic data required in the estimation of costs includes the cost rates of materials; plant production rates; plant charter rates; availability of plant based on current market conditions; the availability of suitable materials; and the availability and hire rate for labour.

The database built up by the Consultants in recent years in relation to design and construction of major crossings in Bangladesh, has provided a considerable source of information. The database includes the following:

- Jamuna bridge project engineer's cost estimates
- contractors' tenders for the Jamuna bridge project
- engineer's estimates for the Paksey bridge and Bhairab bridge projects.
- trends in recent tenders in Bangladesh in relation to major bridge projects.
- current enquiries among major contractors with knowledge and experience of Bangladesh.

An indicative comparison of costs for the crossings at Mawa and Goalundo was made on the following basis:

ITEM	MAWA	GOALUNDO
Bridge Length	6.03 km	6.03 km
Approach roads (North & South)	2.5km and 13km	10km and 5km
River Training Works North	no guide bund	North guide bund
River Training Works South	South guide bund	South guide bund

The bridge length at the two locations is identical. The total approach road length (North plus South) is also similar at Mawa and Goalundo. A guide bund on the South bank is required at both sites, but a guide bund on the North bank is not required at Mawa. Thus a comparison of the basic costs the indicates that the crossing at Mawa provides a cost advantage over a crossing at Goalundo.

The following railway alignments for the crossing were assumed:

VIA MAWA

Dhaka-Narayanganj	approximate length 16km, existing line will require to be dualled.
Narayanganj-Talma	approximate length 80km, new construction required.
Talma-Faridpur	approximate length 16km, disused, will require rehabilitation.
Faridpur-Puradaha	approximate length 100km via Kushtia, existing line but will need to be upgraded to accommodate BG line.

VIA GOALUNDO

Tongi- Goalundo	approximate length 76km, new construction
Goalundo- Puradah	aapproximate length 84 km via Kushtia , upgrade existing line to accommodate BG.

For the purposes of estimating construction costs, the main bridge assumed to be similar in its form and method of construction, to the Jamuna bridge. A planning sheet was developed for the construction of all major components of the bridge, describing the major activities. The sequence of activities and activity durations was estimated from the works programme. For the construction of a given component, the key plant and labour requirements corresponding to each major activity were quantified. From the preliminary designs an estimate of the quantity of materials was made.

Overhead costs such as site establishment; general mobilisation and demobilisation; other fixed charges; value related charges (bonds and insurance); recurring charges; access dredging, and investigation and engineering were assessed for the whole project as a single entity. The estimate in relation to these items was based on information from the Jamuna bridge project, appropriately adjusted in the light of the consultants' experience.

The cost of railway trackbed and tracking on the bridge and approach viaducts, based on the Jamuna experience, is included from day one in the cost estimate for the configurations carrying BG rail.

Discussions with Petrobangla and BPDB offered no certainly regarding further energy transfer requirements in relation to the Padma crossing. In the engineering construction cost estimates for the bridge deck, an allowance has been made for the bridge to support interconnector and gas at a later date. The costs of pylons, conductors, and gas pipeline are not included.

Operation and maintenance of a major crossing such as the Padma bridge will require an organisation dedicated solely to these activities, for the bridge, the river training works and the approach roads. It is assumed that the operation would be managed in the same way as that for the Jamuna bridge. Tasks would include inspection and preventative measures against erosion; periodic and predictable maintenance, such as road surfacing; surveillance and breakdown recovery; emergency services; security measures, and organisational management.

In determining the cost estimate for the operation and maintenance, reference has been made to Jamuna bridge project experience of actual maintenance requirements. In addition to routine annual maintenance, relatively large maintenance costs will be incurred at periodic intervals for such items as resealing or resurfacing roads, and replacing bearings and movement joints. Maintenance of river training works includes an allowance for a stockpile of repair material to be stored at site; for regular studies to forecast river changes, and sums for periodic contracts for remedial works.

The duration of the critical activities for the bridge construction, the longest contract on the project, have been estimated in the light of the experience gained on the Jamuna Bridge and other major projects. From the duration of the critical activities, an overall construction programme has been produced. With judicious planning and optimal resourcing, the segment casting and erection could be achieved over periods of 22 months each. The installation of piling, assuming the same level of productivity as on the Jamuna bridge, could be achieved over a 12 month period. The overall construction programme for the bridge is estimated at 48 months.

By awarding the contracts for the bridge and river training works to commence around late June/early July, but not later than 1st August, sufficient time is available for the RTW contractor to mobilise dredgers from say, the Gulf area, and to catch the low water season and construct the reclamation, work harbour and earth embankment on the North bank.

The timing of award of contract to the RTW contractor is critical if a delay to the project is to be minimised.

The South guide bund and reclamation is assumed to be constructed in the second low water season, and that with good planning and management the dredging involved could be achieved in a single season.

The award of the approach roads contract is expected to be delayed a year. This is consistent with the volume of work involved in the approach roads, and the phased awarding and associated possession of site would allow the settlement of earthwork embankments constructed by the RTW contractor. The 2.5km North approach road is not considered large enough to warrant a separate contract and it is

envisaged that the North and South approach roads would be packaged togather, thus reducing the overall project cost.

In the phased construction case, a cost estimate of widening the bridge from two lanes plus hard shoulders to four lanes is provided. The operation involves cutting the parapets and adding a 1.8m concrete strip together with an integral new parapet unit on both sides of the bridge. In order to make the bridge deck capable of accommodating widening, couplers and other hardware would have to be incorporated at day one. The estimated cost at day one is $1.26m, out of a total estimate for the widening of $ 29m.

The anticipated split between foreign and local currency expenditure, based on the Jamuna bridge experience, is estimated as follows:

	Foreign	Local
Main bridge & approach viaducts	80%	20%
River training works	88%	12%
Approach roads	49%	51%

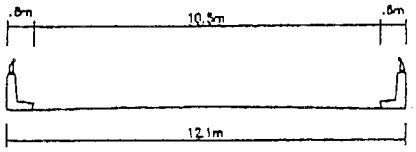
The anticipated time profile of the engineering construction expenditure is as below.

	Year 1	Year2	Year 3	Year 4
Main bridge & approach viaducts	20%	30%	30%	20%
River training works	15%	70%	15%	-
Approach roads	-	40%	40%	20%

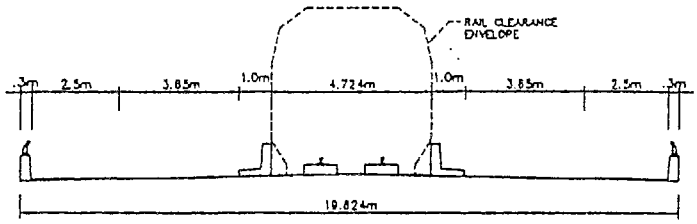
Padma Bridge Incremental Capital Costs (US$ m)

	Road Only		Road - Rail	
Mawa	2-Lanes	4-Lanes	2-Lanes	4-Lanes
Road Approaches	22.1	24.4	37.7	41.0
River Training	136.8	136.8	136.8	136.8
Main Bridge	225.7	237.5	282.9	297.8
Mobilisation and Related Items	116.8	116.8	116.8	116.8
Environmental Mitigation	1.0	1.0	1.0	1.0
Land and Resettlement	38.7	38.7	38.7	38.7
Provision for Interconnectors	1.0	1.0	1.0	1.0
Subtotal: Primary Costs	542.1	556.2	614.9	633.1
Contingencies (20%)	108.4	111.2	123.0	126.6
Total: with contingencies	650.5	667.4	737.9	759.7
Rail Approaches	-	-	175.0	175.0
Total Mawa Cost including Rail Access	650.5	667.4	912.9	934.7
Incremental Costs for Goalundo				
River Training	125.0			
Land and Resettlement	21.7			
Rail Approaches	-5.0			
Total Incremental Cost	146.7	146.7	141.7	141.7
Total Cost (Goalundo)	789.1	806.0	1,046.5	1068.3

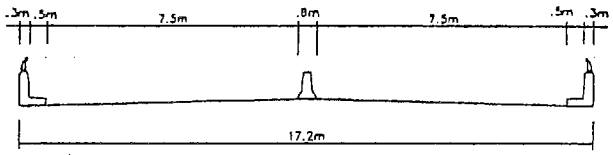
1. [BASE CASE] 2 - Lane Road and Hard Shoulders (or Breakdown Lane)



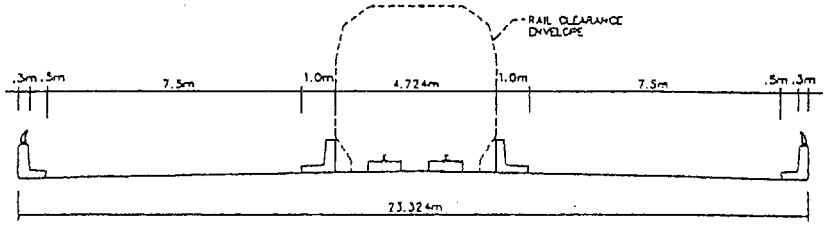
2. 2 - Lane Road and Hard Shoulders + BG Railway



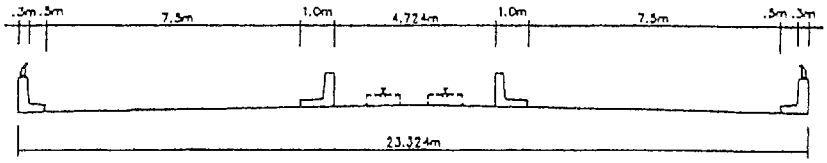
3. 4 - Lane Road



4. 4 - Lane Road + BG Railway



5. 4 - Lane Road with Future Provision for BG Railway



CONFIGURATION FOR INCREMENTAL COST ANALYSIS

8. TRAFFIC BENEFITS

The Mawa location is clearly superior to Goalundo on road traffic grounds. Distances between Dhaka and most places in the SW are considerably shorter via Mawa and it would attract considerably larger volumes of traffic, with correspondingly higher traffic benefits. These consist of three elements:

- Road user benefits, measured in the conventional way as the difference between the willingness to pay (the demand curve) and the price charged
- Operator surplus: in this case the toll rates levied by the Bridge Authority
- Net changes in indirect (sales) tax revenues arising from the transport sector

Additional road user benefits arise from the savings in time and distance possible with the Mawa route as compared with Goalundo. They accrue to both normal traffic, which would cross the river whichever bridge was built, and generated traffic, which arises in response to the time and distance savings. The larger volumes of traffic attracted to the Mawa Bridge also mean that both tax revenues and tolls would be higher. The Table below shows the road traffic benefits of Mawa compared to Goalundo.

Traffic Benefits of Mawa Location (US$ m p.a.)

Year	Trucks	Buses	Light Vehicles	Total
2005	21.4	74.8	6.2	102.5
2010	31.7	115.7	9.6	157.0
2015	44.7	169.2	14.1	228.0
2020	63.0	247.5	20.6	331.0
2025	88.8	361.9	30.1	480.8
2030	125.1	529.3	44.0	698.5
NPV				
10%				1,266.8
15%				385.2

Source: Consultants' estimates

There would be small savings on rail operating costs for the Goalundo location, at less than US$ 0.2 m per million tonnes carried. These would not be sufficient to compensate for the additional capital costs and reduced traffic benefits of Goalundo compared with Mawa.

Neither site has any significant advantage in energy system operation costs.

Traffic volume at opening a bridge at Mawa is estimated at a little over 9,000 vehicles per day (14,500 epcu), which can easily be accommodated on a two lane bridge. By 2015, this will have risen to nearly 21,000, and congestion will be experienced during peak hours. By 2020, traffic is forecast to be 30,000 vehicles per day. While this volume could easily be handled on a four lane road, there would be severe congestion for most of the day on the two lane bridge. There are three possible responses to this situation:

- Accept high and rising levels of congestion costs
- Widen the bridge (phased construction)
- Increase tolls to deter traffic

Phased construction would involve considerable traffic disruption during the widening works, at a time when traffic is close to capacity.

The Table below sets out the traffic levels, volume capacity ratio (VCR) of peak and offpeak periods and total additional vehicle time spent each year as a result of congestion. It can be seen from the table that even with a two lane road, delays are relatively small in the early years, but grow rapidly as capacity is reached and then exceeded. Providing a four lane road, either from the outset or by widening at some later date, would eliminate any significant delays until around 2030.

Traffic and Delay Time: Two lane Bridge

Year	2005	2010	2015	2020	2025	2030
Traffic Volume						
pcue / day	14,430	22,264	33,050	47,892	69,120	99,106
Volume Capacity Ratio						
2-lane						
Peak	0.41	0.65	0.94	1.37	1.98	2.83
Off-peak	0.25	0.40	0.59	0.86	1.23	1.77
4-lane						
Peak	0.14	0.23	0.33	0.48	0.69	0.99
Off-peak	0.09	0.14	0.21	0.30	0.43	0.62
Time (000 veh.hrs p.a.)						
2-lane	40.4	112.7	326.8	1,788.6	6,260.1	17,096.0
4-lane	0.0	0.0	0.0	1.4	34.3	381.2

Source: HDM-Q, Consultants estimates

Notes: Peak corresponds the 76 - 400th busiest hours. Off-peak corresponds to the 1001 - 4000th busiest hours.

The additional costs of providing a four lane road at opening are US$ 17.0 m. Provision for widening the bridge later (phased construction) can be made by investing an additional US$ 1.26 m now and a further US$ 27.7 m when the expansion is required.

An initial four lane configuration is much superior to a two lane bridge which becomes congested, with net benefits of US$ 105 m (at a discount rate of 10%) and of US$ 30 m (at 15%). Widening the bridge in 2015 (phased construction) shows marginal benefits compared with providing the excess capacity of four lanes at opening. The traffic costs of widening are almost certainly understated, and the proposal would pose considerable practical implementation problems. In the light of these considerations, the Consultants do not recommend pursuing the phased construction option.

The construction costs of a road rail bridge would be significantly higher than for a road only bridge, at around US$ 60 m plus contingencies for the four lane road example. The road approaches would also be more expensive, by around US$ 16 m, plus contingencies, as they accommodate the shallower approach slopes required by rail, giving a total additional project cost of US$ 92.3 m.

A potential advantage of a new rail crossing would be that it would permit full BG loadings, unlike the Jamuna Bridge, where both weight and speed restrictions are imposed as the Bridge was designed for the lower MG loadings. While the weight restrictions do not affect passenger or container trains, the largest general freight wagons in use on Indian Railways would exceed the current load restrictions. This could become important if the expected growth in Indian transit traffic were to make use of general cargo wagons rather than containers.

The costs of providing the rail link across the Bridge would be substantial, since:

- the capital costs of the Padma Bridge would be significantly higher, due to the higher loads imposed by the BG railway
- new rail lines would have to be constructed to connect the Bridge with the existing BG system.

BR would have to make its own arrangements to finance the new rail access lines. BR would also be expected to contribute to the incremental capital costs of providing for a rail line on the Bridge. This could be through the payment of an annual access fee, as is done for the Jamuna Bridge.

The costs of the improvements to existing lines and construction of new lines is estimated to be around US$ 175 m for the preferred Mawa site, giving a total incremental cost (including contingencies) of providing for a rail connection across the Padma Bridge at Mawa of around US$ 267 m.

The benefits of a rail connection on the Padma Bridge fall into two categories:

- Operating cost savings for container (and possibly passenger) services due to the shorter distance between the SW and the East zone using the Padma Bridge
- Improved payloads for general cargo traffic

There are no container services on the BG system at present, and so the estimates have been based on BR figures for BG general cargo. BR estimated their direct operating costs in 1995 - 96, including overheads, to be Tk 0.36 (US 0.9 cents) per tonne km. On this basis, potential savings per million tonnes of cargo carried would be:

Goalundo:	33 km x US$ 0.009 x 1,000,000	=	US$ 315,000
Mawa:	17 km x US$ 0.009 x 1,000,000	=	US$ 153,000

Indian container traffic (both transit and import/export) is expected to total around 5 m tonnes p.a. by 2016, giving a total potential saving for container traffic on a Mawa bridge of approximately US$ 0.8 m p.a.

A purpose built and designed BG rail link across the Padma could permit the higher Indian Railways train loadings over the whole journey, provided other bridges and sections of line were suitable for the higher loads. Payload per wagon could be increased from 42.0 to 55.5 tonnes, and direct costs per tonne reduced.

On this basis, the increased payload would reduce operating costs by around US$ 1 m per million tonnes of general cargo carried.

Further analysis is required at full Feasibility Study level before any final conclusion can be drawn about the economic case for a rail link on the Padma Bridge. However, some general points can be made:

- The capital costs of providing a rail link to and over the Padma will be large, in excess of US$ 267 m.
- Unit operating cost savings of using a Padma link in preference to the Jamuna Bridge are likely to be small
- A rail link will only be worthwhile if it can attract large volumes of traffic
- Indian transit and the Trans Asia corridor may provide large volumes of traffic, but can only be fully developed in the long term.

Given the high costs of linking the Bridge to the rest of the railway system, and uncertainties about future traffic growth, Bangladesh Railways may wish to preserve an option on a rail link across the Padma Bridge, rather than building the new lines now. The additional expenditure to link the bridge to the BG system could be made as and when the traffic justifies it.

In the light of this, BR should be given an opportunity to contribute to the additional structural costs of providing for a rail link across the Bridge, the Bridge structure and road approaches should be designed to accept a rail link at some time in the future.

The costs of providing for future installation of gas and electricity interconnectors is relatively small, around US$ 0.5 m each. Costs of installation on the bridge and connection to the rest of the system are more substantial, but will only be incurred at a date when their need is demonstrated.

It has been clearly established that the Power Board has no intention or desire to construct an electricity interconnector across the Padma in the foreseeable future. In the longer term, however, there will be a requirement for a second interconnector (to supplement the one across the Jamuna at Aricha); Mawa would be the preferred location.

Similarly, Petrobangla have made it clear that they see no requirement for a gas pipeline across the Padma. However, their position depends heavily on the current view about reserves, which are thought to be inadequate to meet demand in those parts of the country already served with gas. If more reserves are discovered, there may be a future case for providing a gas pipeline on the bridge.

9. CONCLUSIONS AND RECOMMENDATIONS

The Consultants' Conclusions from their work on the Prefeasibility Study are that:

- the traffic base for the bridge is substantial, and it is likely that a full economic evaluation will find the project viable
- the choice of site on the Padma is limited to two, Goalundo and Mawa, and of the two Mawa is indisputably superior.
- Goalundo suffers from higher road journey costs, higher resettlement costs, and the requirement for a second guide bund
- the possibility of a tunnel option should be excluded on grounds of technical impracticability and extreme cost
- the engineering conditions for the bridge are similar to those which have proved soluble by the Jamuna design
- environmental damage in such a highly cultivated area is limited to moderate impacts on the river morphology, and probably temporary impacts on aquatic ecology
- resettlement will be required on a significant scale, and lessons learned at Jamuna will need to be applied on the Padma
- the use of the bridge for power and gas connectors may be of possible technical advantage in the longer term, but no significant early value should be ascribed to them
- connections into the BG rail network will be expensive and will show only modest short term advantage: however, there are long term possibilities of the bridge being a railway asset and BR should be given the opportunity to subscribe to the rail component
- traffic growth is likely to require a four lane roadway within 10 years of opening, and possibly six lanes after 2030. It is preferable to provide four lanes from the outset rather than to attempt widening relatively soon after opening
- the project is proposed in a period when development of the Southwest is encouraged by the expansion of road access: a fixed link into the East and North will be a constructive step in promoting this process
- the Terms of Reference do not require a Cost/Benefit Analysis of the project, nor is it possible at the Prefeasibility Stage of the work to conduct a full calculation of all the various benefit impacts. However, as a simple extension of the Incremental Costs Analysis it proved possible to produce a one page approximation of the road traffic returns on the likely investment. This is included in Annex A, Appendix 3, and suggests an NPV of US $ 1,083 m at 15 percent discount rate, and an IRR of 23.9 percent, over a 30 year evaluation period.
- if this conclusion is supported by the full Feasibility Study, the project could form the basis for the attraction of private finance as well as multilateral participation.

The consequent Recommendations are that:

- the Padma Bridge Project should be actively progressed, with Mawa as its superior site.
- a full Feasibility Study should be undertaken as soon as is practical, in order to define the technical details and demonstrate its economic justification.
- the base case for detailed study should be a four lane road bridge with facilities for future BG rail, power and gas lines.
- early action should be taken to define the population entitled to resettlement in the project area, and to progress the process of land acquisition.
- post-implementation reviews should be undertaken of environmental and resettlement impacts at Jamuna, as a matter of process enhancement at Padma.

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Mahbub Haque	Deputy Project Director
F. Carvajal Monar	Project Manager
M. A. Aziz	Deputy Project Manager

- Economics

Jeff Ody	Director Economics
G.R. Gleave	Transport Economist
Robert J. Laver	Development Economist
Rafiqul Islam	Transport Economist

- River Engineering

G. te Slaa	River Engineer (Structure)
J. H. Laboyrie	River Morphologist
M. M. Kamal	River Engineer (Hydr. + Drainage)
Teun Op ten Noort	Hydrologist
Nazim Uddin	Hydrologist

- Bridge Engineering

J. M. Barr	Bridge Engineer
S. M. Hossain	Bridge Engineer

- Approaches and Road Engineering

J. Allan Foulds	Highway Engineer
Golam Mostafa	Highway Engineer

- Geotechnical Investigations

S. Fort	Geotechnical Engineer
Pronab Pratim Das	Geotechnical Engineer

- Environmental Study

Ad de Goffau	Environmentalist
Nahid Amin	Environmentalist

- Resettlement Study

Roy Timmer	Sociologist
Hafiza Khatun	Sociologist

- Other Specialist Support

Abdul Farooq	Cost Engineer
Zahanul Haque Chowdhury	Cost Engineer
R. K. Chowdhury	Electrical Engineer

C. COUNTERPART PANEL OF EXPERTS APPOINTED BY JMBA

Prof. Ben Gerwick Jr.
Prof. Fumio Nishino
Prof. J. R. Chowdhury
Prof. M Shahjahan
Prof. Ainun Nishat
Prof. M Shafiullah
Prof. F Ahmed

平成 13 年 11 月 20 日

国際協力事業団
社会開発調査部
社会開発調査第一課

バングラデシュ国パドマ橋建設計画調査
事前調査（S/W 協議）対処方針

1.調査目的

バングラデシュ政府の要請に基づき、ダッカークルナ間のパドマ川渡河位置（マワ付近）にて建設予定の橋梁のフィージビリティ調査を実施する。今回は、関係機関との協議、現地踏査を行い調査内容、調査実施体制を確認すると共に、S/W を協議・署名・交換するため、事前調査（S/W 協議）を実施する。

2.調査概要

(1)調査団構成

総括/交通計画---------- 赤塚　雄三（東洋大学国際地域学部、教授）
橋梁計画---------- 塚原　修（本州四国連絡橋公団、長大橋技術センター）
道路計画---------- 江良　嘉宏（日本道路公団、総務部情報システム室）
河川計画---------- 服部　敦（国土総合政策研究所、河川研究室）
調査企画/事前評価---------- 田中　顕士郎（JICA 社調一課）
橋梁構造/施工計画---------- 望月　晃海（片平エンジニアリングインターナショナル）
河川構造/自然条件/環境---- 寒河江　武司（基礎地盤コンサルタンツ）

詳細は、別添 1 参照

(2)調査行程

赤塚、田中---------- 平成 13 年 11 月 22 日～12 月 6 日
塚原、江良、服部---------- 平成 13 年 11 月 23 日～12 月 6 日
望月、寒河江---------- 平成 13 年 11 月 23 日～12 月 13 日

詳細は、別添 2 参照

(3)先方協議機関（カウンターパート機関）

Jamuna Multi Purpose Bridge Authority,　Ministry of Construction (JMBA)

（運輸省ジャムナ多目的橋公団）

(4)現地調査項目

ア. 先方政府の意向及び調査実施体制の確認

(ア) 調査のカウンターパート機関の体制

・ JMBA の本調査の実施体制について議論し（C/P 配置、S/C 設置）、協議議事録（Minutes of Meeting, M/M）に記載する。

(イ) 関係機関及び関係機関相互の役割分担

・ JMBA は「バ」国における長大橋梁の計画・設計・維持管理を目的とするのに対し、本調査に含まれる接続道路（Highway クラス）については道路局（Roads & Highway Department, RHD）の管理下にある。調査実施にあたり、両者の役割分担と協議窓口、調整方法について確認する。

(ウ) 本格調査団に対する便宜供与事項

・ ルプシャ橋 F/S 実施時と同等の便宜供与が得られるよう、確認する。

・ S/W 案における「バ」国側手配事項で、先方が対応困難とする場合には、その旨 M/M に記載する。

(エ) 技術移転の内容と対象

・ C/P 研修：調査期間中に 1～2 名の C/P 研修受入を実施する。（橋梁、道路、河川）
なお、協議では調査団より C/P 研修制度について紹介し、「バ」側の C/P 研修の要請を関係部署に伝達するものとする。

・ 技術移転セミナー：IC/R 時に日本の橋梁技術一般を紹介するもの、DF/R 時に調査と技術移転の成果を広く知らしめるための技術移転セミナーを実施する。なお、IT/R には架橋位置や橋梁形式等のセンシティブな内容が含まれるため、同時期にセミナーは実施しない。

・ なお、M/M には、C/P 研修は JICA 本部の関係部署に伝達する旨、技術移転セミナーはでは開催時期・回数を限定せずに実施を検討する記載する。

イ. 要請背景の確認

・ TAPP の内容確認をする際に、各項目について要請背景を確認する。

・ パドマ橋の位置付け（「バ」国中央部と南西部を結ぶ「バ」国最重要橋梁の一つであると共に、インド亜大陸東部地域全体を結びつける重要な橋梁であること）を確認する。

・ 特に、鉄道併用橋については「バ」側の真意を確認する。

ウ. カウンターパート機関を含む関係機関の実施能力及び財政状況

(ア) 関連分野に対する国際機関、他国援助機関、NGO などの援助動向

・ かねてより、ADB はパドマ橋建設に対する支援に関心を示しており、訪「バ」前に ADB 本部の関連部署（Division West 2, Programs Department West, Transport and Communications Division West）を訪問し、パドマ橋 F/S に関する意見交換を実施する。また、ADB ダッカ事務所も訪問し、意見交換を実施する。

・ ADB 本部での応答にかかる対処方針は次の通り。

→ パドマ橋の F/S は全面的に JICA にて実施するものの、ADB にて実施済みの既存の道路・鉄道整備計画、「バ」国とインド亜大陸東部地域への社会的・経済的インパクト検討、ジャムナ橋建設と関連施設整備の計画・評価等との整合性を確保するため、各種資料提供をお願いする。また、必要に応じて今後とも意見交換・調整を実施する。

→ 本調査にて交通需要予測や経済分析を実施する際にはジャムナ橋への影響（交通量と経済効果）を同時に検討することとし、両プロジェクトのフィージビリティを総合的に評価することとする。（ジャムナ橋の EIRR が 12%以下となるようなパドマ橋整備オプションは採用しない）

・ 世銀からもパドマ橋建設に対する支援の意向がある旨伝えられており、本調査にて世銀ダッカダッカ事務所を表敬し、情報交換を実施する。

(イ) 調査の必要性と期待される効果

・ パドマ橋により「バ」国を含めたインド亜大陸東部地域に広域交通網を構築され、飛躍的な増加が予想される物流・人流により地域経済の発展をもたらされると共に、「バ」国を含めたインド亜大陸東部地域の貧困層の底上げに多大なる貢献をすることが期待される。

エ. 調査の範囲及び内容の確認

(ア) 上位計画・関連計画との関係・位置づけ

・ 全国規模の道路、鉄道、電気、ガス、通信開発計画における位置づけを確認する。

・ 周辺諸国との間で、パドマ橋建設とそれに関連する協議（道路整備、国境施設・通関手続きの改善等）が実施されているかどうかについて確認する。（ESCAP、ADB、世銀等への確認も必要）

・ 「バ」国内にてジャムナ橋にかかる評価等が実施されているかどうかについて確認する。

(イ) 調査対象及び調査精度

・ 調査内容は、パドマ橋の F/S に要する、自然・社会・経済条件調査、需要予測、橋梁機能の検討、架橋位置・橋梁形式の決定、概略設計、周辺道路整備計画、環境影響調査、施工計画、住民移転計画、概略積算、環境影響調査（EIA）、維持管理計画、事業実施計画、経済的・社会的インパクト分析、経済・財務分析、総合評価と提言とする。

・ 調査精度は、F/S の精度（一般に概略積算精度は、D/D の実施設計の±20%程度）とするものの、事業規模を鑑み、より概略積算の精度を高めることができるよう、努力こととする。（先方との協議では当方からは言及しない）

(ウ) 調査・計画策定対象地域

橋梁建設位置の検討範囲

・ パドマ橋建設位置の選定は、パドマ橋を長期間供用できる位置とすることを第一条件とし、河道の最も安定した地点に架橋することとする。Pre-F/S にてマワ付近の橋梁建設位置が設定されているものの、Pre-F/S での設定条件は十分とは言えず、本格調査に当たってはマワ付近のある程度を範囲にて最適架橋地点を選択する必要がある。マワ付近にて地形学的・河川工学的に最適架橋地点を選定できるよう、事前調査での現地調査・資料調査を通じて、検討範囲を設定することとする。

社会・経済条件調査（交通量調査を含む）、交通需要予測、経済・社会的インパクトの検討と経済分析の対象範囲

・ 経済的・社会的インパクトの検討と、それを考慮した経済分析には、「バ」国のみではなく、インド亜大陸東部地域を広域的に勘案することとする。そのため、その前提となる社会・経済条件調査と需要予測は「バ」国のみではなく、インド亜大陸東

部地域を対象として実施する。なお、交通需要予測には誘発交通を考慮することとする。

周辺道路整備計画の策定範囲

・パドマ橋のコスト算定に当たっては、広域的な経済的・社会的インパクトを勘案するための条件として、同時に周辺道路整備計画が必要である。ADB 等により既存整備計画が存在する路線についてはそれを参考とし、存在しない場合には本調査にて周辺道路整備計画を策定する。

(エ) 計画目標年次

・交通需要予測の予想年次は 2025 年までとする。
・橋梁の償却年数は 50 年とし、開業後 50 年にわたる経済・財務分析を実施する。
・橋梁の耐用年数は 100 年とする。
・ジャムナ橋の F/S 時に設定された計画目標年次とその背景を十分に理解し、本調査での適用を検討する。

(オ) 調査期間

・現況調査から架橋位置・構造形式の選定までを約 1 年間、概略設計から総合評価と提言までを約 1 年間とする、約 2 年間の調査期間とする。
・既存地形図等を十分に活用できることが明らかになった場合、現況調査に要する工期が短くなる可能性がある。
・IT/R にて報告される架橋位置・構造形式の選定について、選定結果に対する「バ」国側の意思確認のための期間を要する可能性がある。

(カ) 調査実施体制

・Steering Committee (S/C) を設置し、関係機関と JICA 側との協議を実施できるようにする。S/C の構成者は「バ」側で検討してもらうこととなるが、ERD、運輸省ジャムナ橋総局、JMBA、RHD の他、 バングラデシュ国鉄、海運省（内水路運輸公団、内水路管理部局）、灌漑・水資源省（河川、洪水対策部局）、エネルギー・鉱物資源省（電力、ガス担当部局）、郵便・電気通信相（通信インフラ部局）等から構成されることが予想される。
・S/C の下に Technical Committee（専門部会）を設置し、S/C 参加省庁と本格調査団との間の技術的課題の検討・協議を実施するものとする。

・以上は、S/W 協議時の Minute of Meeting (M/M) に明記することとする。

オ. 情報・資料の収集

別添 3 による

カ. ローカル及び外国コンサルタントに関する現状把握（調査実施能力）

(ア) 想定される現地再委託業務

・地形図作成（河川測量含む）、地質調査、水文調査、既存インフラ調査、交通量調査、現地社会調査、環境影響調査、住民移転（NGO）等

(イ) 現地再委託業者の調査

・役務コンサルタントにより、現地再委託が可能な業者と、調査実施能力・概略費用を調査する。なお、「バ」国ではこれまでの多くの橋梁整備事業を通じて優秀なローカルコンサルトが育ちつつあり、積極的な活用が望ましい。

キ. 現地踏査

(ア) 地上路線踏査

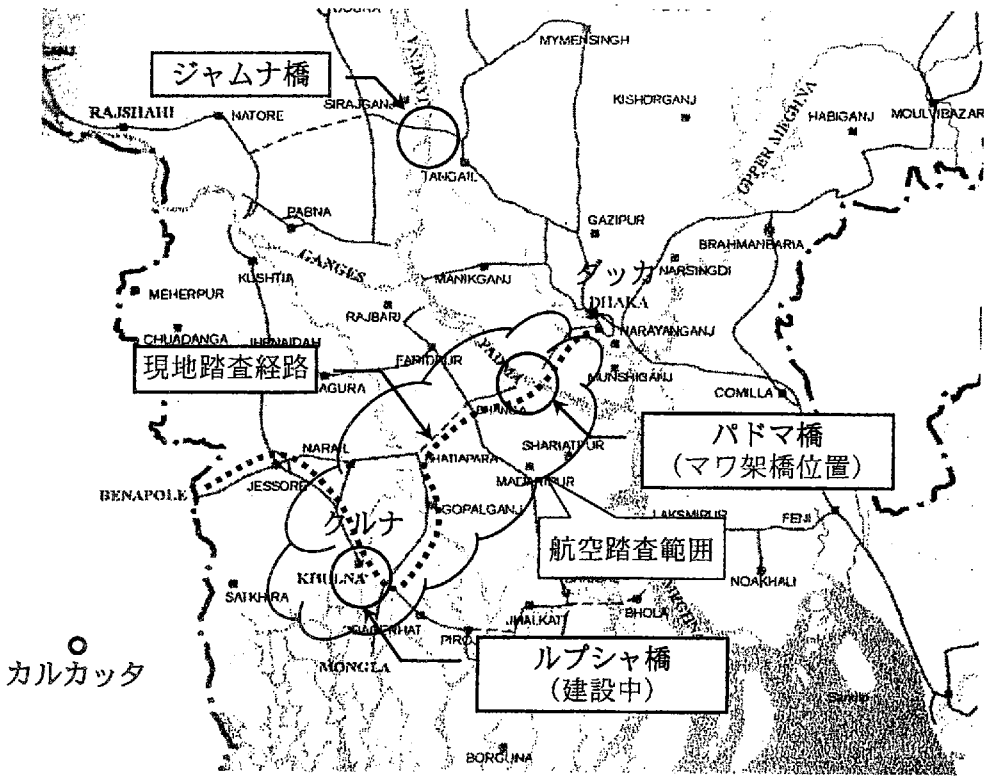
・次に示す路線を踏査し、既存道路交通と道路整備の現況を把握する。
→ ダッカーマワーバティアパラークルナ間（ダッカークルナ間道路）
→ ベナポールージェソール間（アジアハイウェイ 1 号線道路の一部）
→ ダッカージャムナ橋間（ジャムナ橋アクセス道路）

(イ) 航空路線踏査

・航空機を用いてマワ付近のパドマ川を航空踏査することにより、パドマ川の現況を把握する。

(ウ) 橋梁視察

・ジャムナ橋と現場事務所、ルプシャ橋建設現場と事務所、および、メグナ橋、メグナムグティ橋を視察し、整備の現況を把握する。



ク. 事業実施の可能性

(ア) 資金調達の見直し

・ JBIC と ADB が事業実施にかかる借款供与に前向きである。

・ 世銀も借款供与の考えを持っているようであるが、その真意は不明である。

・ 一部の関連周辺道路整備計画がないため、パドマ橋建設事業実施時に併せて整備事業実施が必要となる。(現時点ではドナー未決定)

・ パドマ橋開業後に巨額の債務が発生するため、債務が国家財政に与える影響を十分に評価する必要がある。

・ 調査の中で、民間資金導入についての検討も実施する。

(イ) 事業実施体制（計画、実施、運営、維持管理)、業務実施主体の技術レベル

・ ジャムナ橋公団にて、対応可能。

(ウ) 事業用地・資機材の確保

・ ジャムナ橋建設事業実施時の経験を活かすことが可能である。

ケ. S/W、M/M にかかわる協議、確認、署名

・ ルプシャ橋の例より、ERD、運輸省ジャムナ橋総局、ジャムナ橋公団が署名者にな

るものと考えられる。

・我が方は事前調査団長を署名者とする。

コ. その他の協議、確認事項および留意点

・S/W 案の構成とその内容は別添の通りとするが、協議の結果「バ」国側より修正・追加等の変更を求められ、その内容が調査の本質にかかる変更や調査工程・調査経費に多大な影響を及ぼす等の重大な変更である場合には、東京へ請訓の上対処することとする。それ以外の軽微な変更については、調査団内の判断で対応することとする。

・調査結果について、JICA 事務所及び在「バ」日本大使館に報告すると共に、公電発出を依頼する。

3.論点の整理

(1)Pre-F/S 結果について

・調査内容は既存のデータを元にして橋梁形式を比較検討し、概略事業費を算出したものである。測量や水文調査、内陸水上交通調査を新たに実施したものではなく、地質調査、交通量調査は限定的である。また、経済・財務分析は実施されていない。また、橋梁建設位置の設定についても、詰めが甘いように見受けられる。

・しかしながら、ジャムナ橋の計画・設計・施工監理を実施した業者による調査であり、各社が「バ」国内での経験と豊富な資料を用いて作成した報告書であること等を勘案し、本報告書は本格調査時の参考資料として取り扱うこととする。

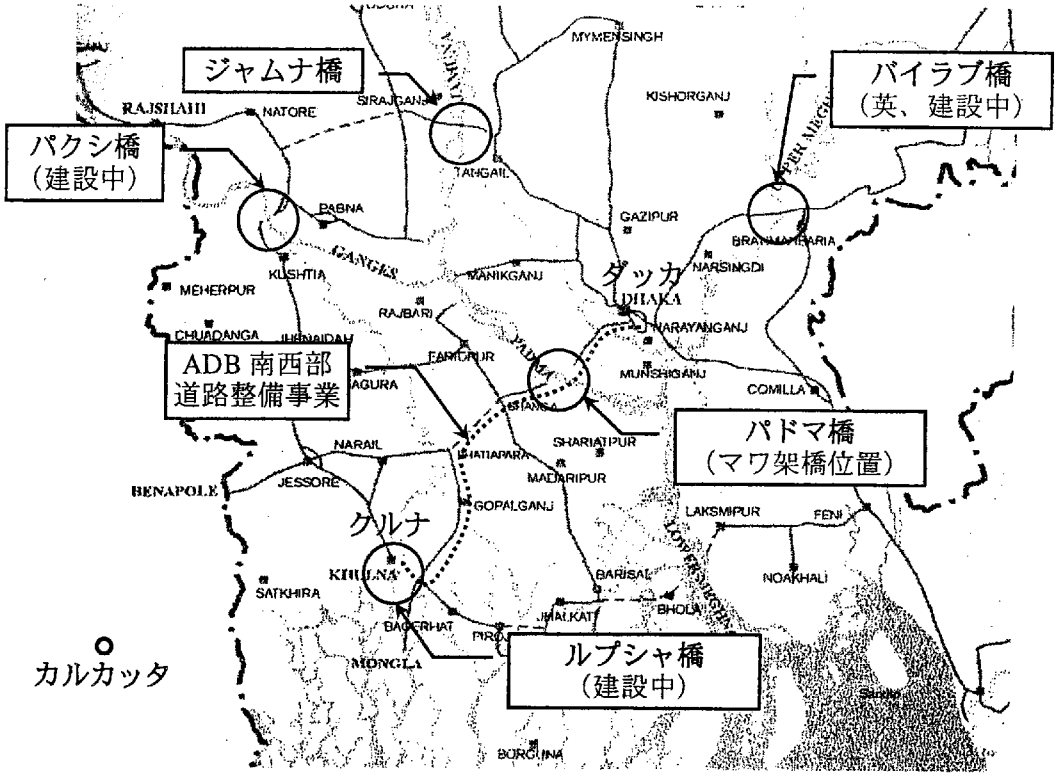
(2)自然条件調査について

・自然条件調査（測量、地質調査、水文調査）の範囲と規模は、既存資料の充実度と事前調査での現地踏査結果により判断するものとする。

・水文調査は乾期と雨期の２回にわたって実施する。

(3)需要予測について

・現行のパドマ川を渡河する道路交通のみでなく、内陸水運の道路交通への移行（モーダルシフト）も需要予測に含めることとする。



・現在事業実施中もしくは近年に実施された他橋梁（ジャムナ橋、パクシ橋、ルプシャ橋、バイラブ橋など）や既存道路計画（南西部道路整備事業（ADB））での需要予測にかかる各種条件や結果を十分に考慮することとしする。

・「バ」国内のみでなく、パドマ橋建設に伴う広域域内交通（カルカッタ・クルナーダッカーアッサム等）の発生も想定することとする。

・交通需要予測には、パドマ橋開業に伴う誘発交通を考慮することとする。

(4)架橋位置について

・本調査では、本格調査での架橋位置検討にかかる検討範囲を決定する。架橋位置はマワ付近とし、架橋検討範囲は事前調査での地形図・地質図等の判読結果と現地踏査結果により設定する。

(5)橋梁機能の検討について

・TAPP ではパドマ橋を道路、鉄道、電力、ガスパイプラインの用途に供することが求められているものの、S/W 協議では通信用途にも供することを提案する。

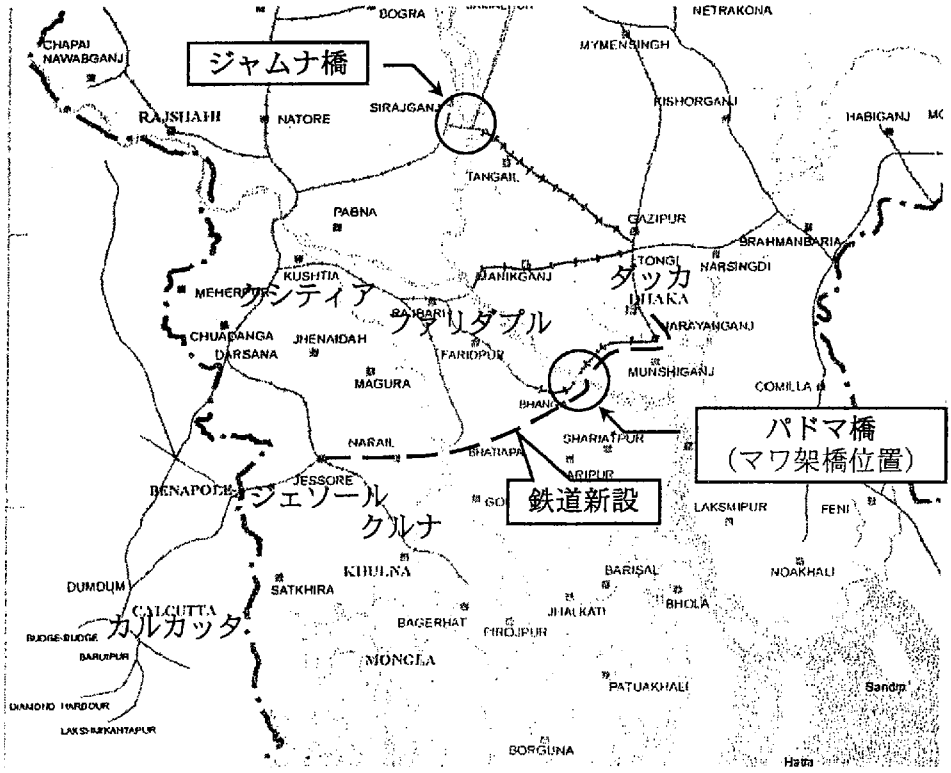
(6)鉄道併用橋について

・ TAPP では本検討にて鉄道併用橋の検討を実施することとなっているものの、調査対象年限内にパドマ橋に接続する鉄道整備計画は存在しないものと考えられる。従って、本項目については次に示す対処方針をもって「バ」側と協議を実施することとする。

① まず、パドマ橋は道路橋を前提として調査したい旨、先方に伝える。

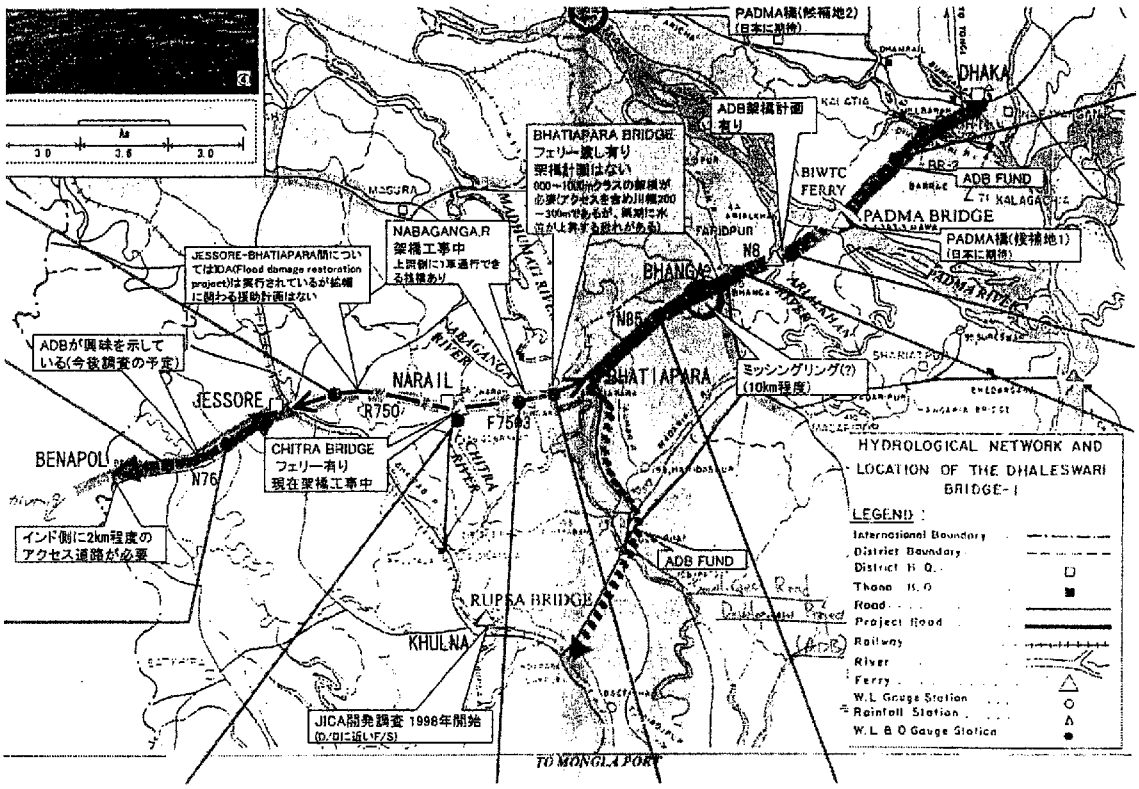
② どうしても、鉄道併用橋として調査してほしい旨の要請を受けた場合、「本調査に鉄道計画を含めた場合、2年間の調査工期が大幅に延びる可能性が高いこと」「ジャムナ橋での鉄道輸送実績がなく、将来輸送量を想定することは時期尚早であること」を理由に鉄道計画と結びつけた鉄道併用橋の検討が困難である旨、先方に伝える。

③ 右の説明にも関わらず、先方より、本調査の需要予測期間内の鉄道整備は現時点では未定であるものの、長期に渡ってパドマ川に架橋されることがないことを勘案して、鉄道併用橋としての検討をしてもらいたい旨の要請があった場合は、道路橋としてパドマ橋のフィージビリティを確認した後に、列車荷重を考慮して補強した構造をもってフィージビリティを確認することは可能である旨、先方に伝える



(7)周辺道路整備計画について

- パドマ橋はダッカークルナ間だけの交通量ではフィージブルとはならず、ダッカーカルカッタ間の広域交通を考慮して初めてフィージブルになることと予想される。そのため、現在整備の進められているダッカーマワーバティアパラークルナ間の道路整備（ADB 南西部道路整備事業、2005 年竣工予定）だけでなく、将来の整備が見込まれるジェソールーベナポール間、現在整備計画のないバティアパラージェソール間の道路整備事業（1000m クラスのバティアパラ橋も含む）の実施がパドマ橋がフィージブルになる前提であると言える。
- 従って、TAPP には含まれないものの、本調査の中で既存周辺道路整備計画をレビューすると共に、整備計画のないバティアパラージェソール間（バティアパラ橋も含む）の整備計画を策定することとする。
- パドマ橋のフィージビリティは、ジャムナ橋と同様に周辺接続道路整備が条件であり、パドマ橋の整備と合わせてこれらが整備されるべきものであることを、「バ」側に説明し、十分に理解してもらう必要がある。



(8)広域経済・社会的インパクトの推定について

- パドマ橋建設はバングラデシュの経済・社会に非常に大きなインパクトを与えるだけでなく、周辺各国（インド、ネパール、ブータン）を含めたインド亜大陸東部地域へ大きなインパクトを与えることが予想される。
- 例として、現在、西ベンガル州とインド東北諸州の連絡はバングラデシュとネパールに挟まれた幅21kmほどのシリグリ回廊を通って北に大きく迂回しているものの、パドマ橋が開通することにより、カルカッターダッカーアッサムの広域道路網が完成し、東北インド諸州と西ベンガル州との物流が飛躍的に増加すると共に、政治的に不安定な東北インド諸州の政治的安定に繋がることが予想される。
- また、インド亜大陸東部の同地域は、約5億の人口を有する**"世界最大の貧困地域"**（Forging Sub-regional Links in Transportation and Logistics in South Asia, WB, Jan. 2001）と呼ばれている。同地域の物流を劇的に改善するパドマ橋の建設は、同地域の貧困解消の大きな力となることが予想される。
- 本格調査では、定量化できるものと定量化できないものの両者にについて、パドマ橋建設が「バ」国とインド亜大陸東部の広域に与える経済的・社会的インパクトの検討を実施し、パドマ橋のフィージビリティ検討に資することとする。

(9)住民移転計画について

- パドマ橋建設に伴い、大規模な住民移転が生じることが予想される。本調査では、ジャムナ橋建設時の住民移転に際して現地NGOの協力を得たことを鑑み、住民移転計画の策定段階より現地NGOの協力を得ることとする。

(10)経済分析の比較検討案について

- 経済分析時の比較検討案として、現時点では次が考えられる。
  - ① 現況の状態に手を加えないケース（withoutケース）
  - ② 既存渡河手段を増強し（フェリー施設拡充・フェリー増強、ジャムナ橋鉄道施設増強充）、将来の渡河交通増加に対応するケース
  - ③ パドマ橋建設ケース（道路橋のみ）
- 「(6)鉄道併用橋について」で述べたように、「バ」側から鉄道併用橋検討の強い要請がある場合には、経済分析にて道路橋がフィージブルと確認された後、鉄道荷重に対応した構造をもって検討を実施することとする。

(11)財務分析について

・パドマ橋建設が「バ」国財政に与える影響は極めて大きいため、借款返済能力と返済時の財政・経済・社会への影響を十分に見極める。
・通行料金の設定は、ジャムナ橋の通行料金水準設定基準・方法等を考慮して設定する。
・民間資本の参入可能性の検討を実施する。

(12)計画目標年度について

・パドマ橋の償却年数を50年、耐用年数を100年と設定するものの、原則として、ジャムナ橋計画時に設定した年数に揃えることとする。

(13)ジャムナ橋への影響について

・パドマ橋が鉄道併用橋として建設され、早期に接続鉄道が整備される場合には、ジャムナ橋のフィージビリティに大きな影響を与えることが懸念されるが、パドマ橋が道路橋として整備される場合にはパドマ橋建設に伴う誘発交通が生じること、ジャムナ橋の通行車両がもっぱらダッカと「バ」国北西部・ネパール間の交通であることを考慮すると、パドマ橋建設がジャムナ橋のフィージビリティに大きく影響を与えるまでもないものと考えられる。
・本格調査では、パドマ橋開業に伴う、ジャムナ橋交通量の変化を把握することで、ジャムナ橋のフィージビリティを損なわないように計画を策定することとする。

(14)本格調査工程について

・前述の通り、２年間とする。しかしながら、既存データの整備状況により第１年次の調査期間は大きく変わりうる。
・第１年次の成果となるIT/Rにて橋梁建設位置と橋梁形式の比較検討結果が報告さる。第２年次にて概略設計に取りかかる前に、比較検討結果への「バ」側の合意が必要であり、合意を直ちに得られない場合は、工期が延びる可能性がある。

(15)借款実施について

・パドマ橋建設の事業化に当たっては、JBICとADBの協調融資が想定されているが、本調査の実施は融資の実施を確約するものではない。先方から供与金額や時期等についての問い合わせがなされた場合、今回の調査団のマンデイとには含まれていない旨の説明をする。

4.本格調査における調査項目案

(1)現状分析

ア. 既存データの収集・分析
イ. 開発計画・上位計画のレビュー
ウ. 架橋候補地点での地形図作成
エ. 自然条件調査（地質、水文）
オ. 交通量調査
カ. 経済・社会条件調査（既存インフラ現況調査を含む）

(2)フィージビリティスタディ

ア. 需要予測
イ. 橋梁機能の検討
ウ. 設計基準の設定
エ. 橋梁形式・架橋位置の検討
オ. 概略設計（橋梁、アプローチ部、橋梁護岸）
カ. 概略周辺道路整備計画策定
キ. 住民移転計画策定
ク. 環境影響評価（EIA）
ケ. 維持・管理計画策定
コ. 概略事業費積算
サ. 経済分析・財務分析（広域経済インパクトの検討を含む）
シ. 組織・制度の整備
ス. 事業実施計画の策定

(3)総合評価、提言

26 Nov., 2001

JICA Team's Strategy for Feasibility Study of Padma Bridge

Preparatory Study Team, F/S of Padma Bridge
Japan International Cooperation Agency

1 Main Functions of Padma Bridge

- While Padma Bridge will be studied mainly for road traffic, feasibility of loading transmission lines of electric power, telecommunications and natural gas will be considered as additional load factors.

2 Location of Padma Bridge

- River crossing point shall be selected with due consideration for the long term stability of the embankment and foundation of Padma Bridge.
- The scope of site selection surveys, including literature and field surveys, shall be clearly defined in the Scope of Work as much as possible. Currently Mawa area has been proposed as the most suitable site. However the alternative sites will be also examined along with Mawa.

3 Socio-Economic Impacts of Padma Bridge

- Padma Bridge, when completed, will become one of the most important bridges in Bangladesh to integrate central and southwest regions of the country.
- Padma Bridge, when completed, will likely bear substantial roles for socio-economic development of the northeastern parts of South Asia, encompassing Dhaka-Calcutta and Dhaka-Assam sub-regional areas.
- Padma Bridge, when completed, will likely induce development activities in local communities if provided with adequate feeder road services to be connected with the bridge and its road systems, with possible supports for rural poor.

4 Associated Road Development Projects

- The road access to Padma Bridge shall be carried out in the Study. Due consideration will be made for not only road traffics diverted from ferry services but also from road traffics which will be generated because of the Padma Bridge construction and development activities in the associated regions.
- Any options which will likely adversely affect the viability of other development projects in progress will be carefully examined and if needed excluded from the scope of the study with due note on regard.

5 Impact of Macro Balance of the Country

- Serious concerns have been expressed by the Asian Development Bank and Japan Bank for International Cooperation on the massive fundings, successively done, for huge bridge projects, including Jamuna Bridge, Paksey Bridge, Rupsa Bridge and most likely Padma Bridge, the largest. Under such circumstances, impacts of such investments on the macro fiscal balance will be thoroughly examined with a view to confirming viability of the project.

6 Private Sector Participation

- Possibility of the private sector participation will be critically examined so as to minimise the adverse impacts of the projects on the fiscal balance of the government, with a view to developing a recommendation on a possible modality of private sector participation.

END

SCOPE OF WORK

FOR

FEASIBILITY STUDY OF PADMA BRIDGE

IN

THE PEOPLE'S REPUBLIC OF BANGLADESH

AGREED UPON BETWEEN

ECONOMIC RELATIONS DIVISION OF THE MINISTRY OF FINANCE

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

Dhaka, 4 December 2001

MR. MD. NURUZZAMAN BHUIYAN
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BRIDGE AUTHORITY
GOVERNMENT OF THE PEOPLE'S
REPUBLIC OF BANGLADESH

1 INTRODUCTION

In response to the request of the Government of the People's Republic of Bangladesh (hereinafter referred to as "Bangladesh") for the Feasibility Study on Construction of the Bridge over the river Padma at Mawa (hereinafter referred to as "the Study" and "Padma Bridge"), the Government of Japan has decided to conduct the Study in accordance with the relevant laws and regulations in force in Japan.

Accordingly, Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, will undertake the Study in close cooperation with the government of Bangladesh.

The present document sets forth the Scope of Work for the Study.

2 OBJECTIVES OF THE STUDY

The objectives of the Study are as follows;

(1) to conduct a feasibility study on the new bridge construction over the Padma river near Mawa and

(2) to pursue technology transfer in the course of implementation of the Study.

3 STUDY AREA

The study area shall be the area proposed for the new bridge construction and associated regions. However, the socio-economic impact of bridge construction on Bangladesh due to cross border traffic to/from neighbouring countries, India, Nepal, Bhutan and Myanmar, will also be studied.

4 SCOPE OF THE STUDY

4.1 The Basic Policy of the Study

(1) Main Functions of Padma Bridge

- While Padma Bridge will be studied mainly for road traffic, feasibility of loading transmission lines of electric power, telecommunications and natural gas will be considered as additional load factors.

(2) Location of Padma Bridge

- River crossing point shall be selected with due consideration for the long term stability of the river course, the embankments and foundations of Padma Bridge and which will give maximum benefit to the country.
- The scope of site selection surveys, including literature and field surveys, shall be clearly defined in the Scope of Work as much as possible. Currently Mawa area has been proposed as the most suitable site. However, the alternative sites will be also examined along with Mawa.

(3) Socio-Economic Impacts of Padma Bridge

- Padma Bridge, when completed, will become one of the most important bridges in Bangladesh to integrate central and southwest regions of the country.
- Padma Bridge, when completed, will likely bear substantial roles for socio-economic development of the northeastern parts of South Asia, encompassing neighbouring countries.
- Padma Bridge, when completed, will likely induce development activities in local communities if provided with adequate feeder road services to be connected with the bridge and its road network, with possible supports for rural poor.

(4) Associated Road Development Projects

- The road access to Padma Bridge shall be carried out in the Study. Due consideration will be made for not only road traffics diverted from ferry services and existing road network but also from road traffics which will be generated because of the Padma Bridge construction and development activities in the associated regions.
- Any options which will likely adversely affect the viability of other development projects in progress will be carefully examined and if needed excluded from the scope of the study with due note on this regard

(5) Impact of Macro Balance of the Country

- Serious concerns have been expressed by the Asian Development Bank and Japan Bank for International Cooperation on the massive fundings, successively done, for huge bridge projects, including Jamuna Bridge, Paksey Bridge, Rupsa Bridge and most likely Padma Bridge, the largest. Under such circumstances, impacts of such investments on the macro fiscal balance will be thoroughly examined with a view to confirming viability of the project.

(6) Private Sector Participation

- Possibility of the private sector participation will be critically examined so as to minimise the adverse impacts of the projects on the fiscal balance of the government, with a view to developing a recommendation on a possible modality of private sector participation

4.2 Items of the Study

In order to achieve the objectives mentioned above, the Study shall cover the following items.

(1) Analysis of Existing Conditions

(a) Collection and review of existing data, information and reports related to the Study

- Socio-economic, natural and environmental conditions
- National, regional and other associated plans, reports and studies for infrastructure, transport development and river training
- Development plans for the cities along relevant roads
- Traffic data on land transport, river crossing ferries and inland water/marine transport including international cross border traffics from/to India, Nepal, Bhutan and Myanmar.
- Inventory and engineering data of roads, railways, bridges, ports, levees and relevant facilities for transport infrastructure in the study area
- Laws and regulations related to transports, transport infrastructures, river and river structures
- Financial situation of the government and relevant agencies
- Other data and information relevant to the Study

(b) Social condition survey

- Survey on existing roads, railways, bridges, ports and relevant facilities for transport infrastructure in the study area
- Traffic survey on land transport, river crossing ferries and inland water/marine transport including international cross border traffics from/to India, Nepal, Bhutan and Myanmar
- Survey on general conditions of land use and issues related to land acquisition of possible project sites
- Socio-economic survey around the possible project sites and along the link roads.

(c) Natural condition survey around the possible project sites

- Topographic survey
- Soil and geological survey
- Hydrological and hydraulic surveys (including river bed variation, river course migration, flood, siltation and velocity in flood flow, inundation survey and scouring)
- Other necessary natural condition survey

(2) Feasibility Analysis for Padma Bridge Construction

(a) Traffic demand forecast

- Zoning and projection of socio-economic framework (including sub-regional countries)
- Projection of the future traffic with the target year of 2025 (including cross border traffic to /from India, Nepal, Bhutan and Myanmar)

(b) Study of the locations and alignments of Padma Bridge

- Formulation of alternative plans
- Comparison analysis of the alternatives

(b) Study of the locations and alignments of Padma Bridge
- Formulation of alternative plans
- Comparison analysis of the alternatives

(c) Study of the link road network to Padma Bridge
- Review of existing link road projects
- Study of necessary relevant link road projects

(d) Study of the function of Padma Bridge

(e) Establishment of design criteria and design standards

(f) Comparison analysis of structures

(g) General design (bridge, approach, river training works and embankments)

(h) Environmental impacts assessment (EIA)
- Impacts on social environments
- Impacts on natural environment
- Residents' resettlement plan
- Preparation of an environmental management plan

(i) Study of the operations and the maintenance plan

(j) General cost estimation of the projects

(k) Economic and financial evaluation
- Analysis on national and sub-regional socio-economic impacts
- Economic evaluation with national and sub-regional socio-economic impacts
- Study of the toll system
- Study of procurement of finance
- Study of private sector participation
- Financial evaluation
- Impact on macro balance of the country

(l) Study of the implementation plan of the projects

(m) Study of the possibility of including the provision for broad gauge railway as an alternative design

(3) Conclusion and Recommendation

5 STUDY SCHEDULE

The Study shall be carried out in accordance with the attached tentative schedule.

6 REPORTS

JICA shall prepare and submit the following reports in English to the Government of Bangladesh

(1) Inception Report
Thirty (30) copies at the commencement of the Study

(2) Progress Report (1)
Thirty (30) copies within 8 months after commencement of the Study

(3) Interim Report
Thirty (30) copies within 12 months after commencement of the Study.

(4) Progress Report (2)
Thirty (30) copies within 18 months after commencement of the Study

(5) Draft Final Report
Thirty (30) copies within 22 months after commencement of the Study Bangladesh side shall submit its written comments to JICA on the draft final report within four (4) weeks after receipt of the draft final report.

(6) Final Report
Fifty (50) copies within two (2) weeks after receipt of the written comments on the draft final report from Bangladesh side

7 UNDERTAKING OF THE GOVERNMENT OF BANGLADESH

The Government of Bangladesh will accord privileges, exemption and other benefits to Japanese Study Team (hereinafter referred to as "the Team").

(1) To facilitate smooth conducts of the Study, the Government of Bangladesh shall take the following necessary measures:
(a) to secure the safety of the Team,
(b) to permit the members of the Team to enter, leave and sojourn in Bangladesh for the duration of their assignment therein, and exempt them from foreign registration requirements consular fees,
(c) to exempt the members of the Team from taxes, duties and other charges on equipment, Machinery and other materials brought into and out of Bangladesh for the implementation of the Study;

(d) to exempt the members of the Team from income tax and other charges of any kind imposed on or in connection with any emoluments or allowance paid to the member of the Team for their services in connection with the implementation of the Study;
(e) to provide necessary facilities to the Team for the remittance as well as utilisation of the fund introduced into Bangladesh from Japan in connection with the implementation of the Study;
(f) to secure permission for entry into private properties or restricted areas for the conduct of the Study;
(g) to provide the Team with all data and document (including maps and photographs) related to the Study, and to secure permission for the Team to take all of them out of Bangladesh to Japan; and
(h) to provide medical services as needed, the expenses or such being chargeable to the member of the Team.

(2) The government of Bangladesh shall bear claims, if any arises against the members of the Team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or wilful misconduct on the part of the members of the Team

(3) Jamuna Multipurpose Bridge Authority (hereinafter referred to as "JMBA") under the Ministry of Communication (hereinafter referred to as "MOC") of the Government of Bangladesh shall act as the counterpart agency to the Team and the Ministry of Communication shall chair the steering committee comprising other organisations concerned for the smooth implementation of the Study.

(4) MOC, at its expense, provide the Team with the followings, in cooperation with other related organisations concerned
(a) available data and information related to the Study,
(b) counterpart personnel necessary for the Study,
(c) suitable office space with necessary furniture in Dhaka, and
(d) credentials or identification cards.

8 CONSULTATION

JICA and the MOC shall consult with each other in respect of any matter that may arise from or in connection with the Study.

Attachment 1

TENTATIVE SCHEDULE

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Work in Bangladesh																								
Work in Japan																								
Repport Presentation	△ IC/R								△ PR/R(1)			△ IT/R							△ PR/R(2)				△ DF/R		△ F/R

IC/R: Inception Report
PR/R(1): Progress Report (1)
IT/R: Interim Report
PR/R(2): Progress Report (2)
DF/R: Draft Final Report
F/R: Final Report

MINUTES OF MEETING

FOR

FEASIBILITY STUDY OF PADMA BRIDGE

IN

THE PEOPLE'S REPUBLIC OF BANGLADESH

AGREED UPON BETWEEN

ECONOMIC RELATIONS DIVISION OF THE MINISTRY OF FINANCE

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

Dhaka, 4 December 2001

MR. MD. NURUZZAMAN BHUIYAN
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MINISTRY OF COMMUNICATION
GOVERNMENT OF THE PEOPLE'S
REPUBLIC OF BANGLADESH

4/12/01

MR. MD ABDUR RAUF
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GOVERNMENT OF THE PEOPLE'S
REPUBLIC OF BANGLADESH

1 INTRODUCTION

Japan International Cooperation Agency (JICA) dispatched the Preparatory Study Team (hereinafter referred as "the Mission") for Feasibility Study of Padma Bridge, headed by Dr. Yuzo Akatsuka, from 22 November to 6 December 2001.

The Mission had a series of meetings to discuss the Scope of Work for the Study from 25 November to 4 December with related agencies, viz. the Economic Relations Division (ERD) of the Ministry of Finance, Planning Commission, the Ministry of Communications (MOC), Jamuna Multipurpose Bridge Authority (JMBA), Roads and Highways Department (RHD), Bangladesh Railway (BR) and Bangladesh Water Development Board (BWDB)

This Minutes of Meeting summarises the results of discussions. The list of participants is shown in the Attachment.

2 RESULTS OF DISCUSSIONS

2.1 Main Functions of Padma Bridge

- Bangladesh side strongly requested to include rail-cum-road bridge in the Study. However, the Mission did not agree to the inclusion of such a study component, instead, suggested that the study scope be expanded to examine the possibility of including the provision for broad gauge railway as an alternative design

2.2 Location of Padma Bridge

- Based on the existing data and information made available to the Mission, Mawa is considered as one of the candidates for locating Padma Bridge but it is too premature to conclude Mawa point as the optimum location at this stage.
- The Mission are of the view that careful engineering studies are needed to decide the location of Padma Bridge which will last for 100 years

2.3 Socio-Economic Impacts of Padma Bridge

- Both sides agreed that Padma Bridge is important for long-term development of the sub-region
- Bangladesh side requested the study of socio-economic impact on Bangladesh due to cross border traffic to/from neighbouring countries including Myanmar to be included. The Mission pointed out the difficulties of field surveys in the northeastern states of India and Myanmar. Both sides agreed it may be inevitable to limit the study scope to literature surveys if the site survey is not possible in the above mentioned areas
- Bangladesh side expressed their concern on the resettlement of residents in the project-affected area. The issue will be examined carefully in the Study

2.4 Associated Road Development Projects

- Bangladesh side expressed their desire for inclusion of Aricha-Mawa road-cum-embankment as a link road project. The Mission was of the view that such an inclusion would most likely

jeopardise viability of Padma Bridge entirely

2.5 Impact of Macro Balance of the Country

- The Mission stressed the necessity of the study to cover the impact of the Padma Bridge project on the macro balance of the country.

2.6 Findings of the Field Study

(1) Approach to the Site Selection for Padma Bridge

- Dynamic topographical changes, such as riverbank erosion and sand bar migration have occurred in the Padma River. The Mission observed that such changes are predominant in the Padma River, and the site selection shall be made with due consideration to the stability of the river course
- The river bank alignments have been shifting from year to year It is desirable to identify indicators which are suitable for expressing such changes quantitatively during the forthcoming Study The site selection of possible locations should be made first applying such indicators.
- As the following steps, the selection of the best location among the possible locations should be made on account of geography, soil conditions, bridge structure, road alignment, social/environmental aspects, financial feasibility and so on
- Most advanced technology in the fields of river engineering and river morphology should be applied for the site selection of the bridge and the improvement of guide bank design

(2) Ground Conditions

- The ground conditions, from a viewpoint of geotechnical engineering, are rather poor in the section from Jamuna-Padma confluence to Meghna-Padma confluence The composition of the soil varies frequently. Sand-rich ground changes to silt-rich ground or vice versa in a short distance.
- In terms of the strength of the ground, despite of the frequent changes in the soil composition, thick layers of loose sand and silt or soft clay cover the ground consistently in the above-mentioned section
- The depth to the top of the pile-bearing layer is great in the section It is probably well exceeding 50m There might be a localised area where the pile-bearing layer is shallow. However, the presence of such area was not confirmed based on the available soil investigation data and the results of the site reconnaissance

(3) Foundation Pile Scouring

- Because of the sandy riverbed materials, the scouring problems including scouring protection work should be carefully studied in consideration of the experience in Rupsa, Meghna, and Jamuna Bridges

(4) Number of Lanes for Padma Bridge

- Padma Bridge will provide an uninterrupted connection from Dhaka-Chittagong Road at the East Zone through National Highway Route 8 to Jessore-Benapole Road at the West Zone

The bridge is expected to constitute a part of Asian Highway Route 1 in future.

- The daily traffic volume on Meghna and Meghna-Gumti Bridges, located on Dhaka-Chittagong Road, is currently more than 8,000vpd for both ways, and the development project for the second Meghna and Meghna–Gumti Bridges are under active consideration at the upstream of the Meghna river.
- National Highway Route 8, now under operation as a 2-lane road, is said to be expanded to a 4-lane road under ADB funding to meet the increasing traffic demands between Dhaka and Khulna.
- The daily traffic volume on Jamuna Bridge with 4-lanes is currently about 3,200vpd for both ways, which is 10-15% more than the forecast at the stage of planning.
- The above-mentioned points will be duly considered in the alignment and structural design.
- In the light of the Mission's findings as mentioned above, Bangladesh side expressed their view that Padma Bridge should have 4-lanes for road traffic

(5) Substructure

- Regarding the substructure of Padma Bridge, various types of foundations should be carefully studied. It is recommended to verify the bearing capacity of such a foundation whatever type is selected.

(6) Superstructure

- Regarding the type of superstructure, various types of possible designs will be studied with due consideration to the span length, the hydraulic conditions of the Padma River, climatic and other natural conditions at the site, maintenance work and other relevant factors.

(7) Social and Environmental Impacts

- It is less likely that the construction of the bridge brings any significant environmental impact on the ecological system around the bridge site. The recovery of the ecological system is expected to be fast even if there are environmental effects on the ecological system. In any way, the environmental impact assessment shall be carried out properly without any preconception.

2.7 Implementation of the Study

(1) Steering Committee

- Both sides agreed that the Steering Committee will be organised under the chairmanship of Ministry of Communications, consisting of members of relevant ministries and organisations such as ERD, Planning Commission, JMBA, RHD, BR, BWDB and so on

(2) Counterpart Personnel

- Counterpart personnel who will cooperate with the Study Team will be selected from the related ministries and organisations on a parttime basis in the following fields, having one full-time Team Leader from JMBA;
  - (a) Road engineer,
  - (b) Bridge engineer,
  - (c) Railway engineer,
  - (d) River engineer,
  - (e) Geotechnical engineer,
  - (f) Transport economist,
  - (g) Social development specialist,
  - (h) Environmental specialist,
  - (i) Regional development specialist,
  - (j) Fiscal Specialist,
  - (k) Quantity Surveyor, and,

  Chief Engineer of JMBA will act as a coordinator

(3) Technical Sub-Committees

- Both sides agreed that the Technical Sub-Committees would be organised to discuss technical issues in concerned fields respectively. The core members of Technical Sub-Committees will be organised with counterpart personnel and the Study Team

(4) Meetings of the Organisations and Parties Concerned

- To facilitate coordination and cooperation, if necessary, among concerned organisations and parties, the Mission expressed the desire that MOC should hold periodical meeting among organisations and parties concerned such as Japan Bank for International Cooperation, Asian Development Bank, World Bank and others, if any

(5) Dissemination of the Study findings

- In order to inform the results of the Study to related ministries and organisations, seminars will be held by JICA at the important stages of the Study

(6) Facilitation of the Study

- To keep smooth implementation of the Study, the Mission requested MOC to provide appropriate office space in Dhaka for the Study Team

(7) Counterpart Training

- The Mission explained about the Counterpart Training Program of JICA, and Bangladesh side is willing to participate in that programme. The Mission undertook to convey that request to JICA HQ.

Attachment I. List of Participants

Attachment 1

PARTICIPANTS OF THE MEETING

Bangladesh Side

Md. Nuruzzaman Bhuiyan	Joint Secretary, ERD, MOF
Md. Moqsed Ali	Deputy Secretary, ERD, MOF
Md Eakub Ali	Senior Assistant Chief, ERD, MOF
Md Mohsen Ali Khandaker	Sr Assistant Chief, Planning Commission
Md Abdur Rauf	Chief Engineer, JMBA, MOC
A K M Shamsuzzoha	Director, Planning, JMBA, MOC
Md Shah Jahan	Project Director, JMBA, MOC
Md. Abdul Malek	Additional Director (Roads & Bridges), JMBA, MOC
Md Abdus Satter	Additional Chief Engineer, Technical Services, RHD
Abdul Halim Miah	Chief Planning Officer, BR
Md. Liaquat-Al-Faruque	Director, Planning, BWDB

Japanese Side

JICA Preparatory Study Team

Yuzo AKATSUKA (Leader / Transport Planning)	Professor, Faculty of Regional Development Studies, TOYO University
Osamu TSUKAHARA (Bridge Planning)	Deputy Manager, Engineering Information Division, Long-span Bridge Engineering Centre, Honshu-Shikoku Bridge Authority
Yoshihiro ERA (Road Planning)	Information Systems Division, General Affairs Department, Japan Highway Public Corporation
Atsushi HATTORI (River Planning)	Senior Researcher, River Division, River Department, National Institute for Land and Infrastructure Management, Ministry of Land, Infrastructure and Transport
Kenshiro TANAKA (Study Planning)	First Development Study Division, Social Development Study Department, JICA
Terumi MOCHIZUKI (Bridge Structure / Construction Planning)	Director, Special Project Department, Katahira & Engineers International Co., Ltd
Takeshi SAGAE (River Structure / Natural Condition / Environment)	Manager, Overseas Department, Kiso-Jiban Consultants Co., Ltd

Hajime NABETA	Residence, JICA Bangladesh Office
Hirofumi UEMURA	JICA Expert, Road and Bridge Advisor, RHD

END