Chapter 11 Socio-Economic Impacts

11.1 INTRODUCTION

The Padma Bridge will be one of the large-scale infrastructure projects in Bangladesh and its construction and operation will result in significant impacts on the various sectors of the economy at the national and regional levels. This Chapter deals with impacts of Padma Bridge focusing on the national / regional economic growth, promotion of international transport between surrounding countries, distribution of project benefits to poor groups and, influence on the Government financial balance due to the huge amount of investment expenditures. These socio-economic impacts will be assessed and, as far as possible, quantified based on the available data.

11.2 IMPACTS ON NATIONAL ECONOMY

11.2.1 Contents of Impacts

The benefits such as savings in vehicle operating costs and travel time savings accruing from the opening of Padma Bridge are defined, in general, as the "direct benefit or direct impact", which will be enjoyed by the direct users of Padma Bridge. On the other hand, impacts such as the increase in production and income based on the improvement of accessibility resulting from the direct benefits above are defined as "indirect impacts or induced impacts".

Although the Southwest Region is the area benefiting the most in the country, the impacts of Padma Bridge will spread over the whole country through the induced effects by its construction. These are multiplier effects of the huge amount of investment in Padma Bridge. These impacts will result in additional demand/output of production in related economic sectors, generation of additional factor income (Value Added) and creation of new job opportunities. These kinds of impacts are generated from the demand of input necessary during the construction of Padma Bridge and attributable not only to the Southwest Region but also to the whole country of Bangladesh. It should be noted, however, that the same type and the same volume of impacts will be possible by projects other than Padma Bridge if the same scale of investment is executed.

In addition to the above impacts, induced economic impacts after opening of Padma Bridge are more important because they are induced by using the Padma Bridge itself for daily economic activities and depend heavily on the function of Padma Bridge to integrate the Southwest Region with other areas of the country .This is particularly the case with the Central Region in which Dhaka is located. Induced (or indirect) impacts of this kind are estimated by specifying such a sector (transport sector, in this case) that the demands of the sector are expected to increase immediately after opening of Padma Bridge. Initial increase of demand in that sector will stimulate production demands in other related sectors and result in an increase of output, factor income, and creation of new additional job opportunities as well.

11.2.2 Estimation of Multiplier Effects of Investment

(1) Definition of the Impacts

Construction of Padma Bridge requires a huge amount of investment. When such an

autonomous or independent investment is executed, demands on intermediate inputs of other sectors of the national economy are stimulated and ripple effects will spread over the whole country. Theses effects are called Multiplier effects through which increases in production, factor income and job opportunities are expected to be realized.

(2) Methodology

In order to estimate the multiplier effects of investment, Input – Output Tables 2000 for Bangladesh was compiled with final demands. The latest version of input – output tables consists of 86 sectors and items of the final demands (Private consumption, Government consumption, Exports, Capital formation and stocks). The formula of multipliers is given:

<Balance formula>

$$X = AX + F(D) + F(E) - M(AX + F(D))$$

<Model formula>

$$X = [I - (I - M)A]^{-1}[(I - M)F(D) + F(E)]$$

Where,

- X: Output vector of sectors
- A: Input – Output Coefficient Matrix
- F(D): Final Demand Matrix (except for Export)
- F(E): Export vector
- M: Import Coefficient vector associated to domestic demands (AX + F(D)
- I: Unit Matrix
- $[\quad]^{-1}$: Inverse Matrix

In the above formula, an inverse matrix different from the "Leontief inverse (I – A)-1" is applied considering the leakage of import. The balance formula indicates that the total output (=X) is equal to the sum of intermediate demands (=AX), final domestic demands (=F(D) and Exports (=F(E) minus Imports (=M(AX+F(D)). Since the economic structure of Bangladesh depends largely upon imports, it is necessary to reflect the influence of imports in the balance formula. Not all the domestic demands can be supplied by domestic output and some portions come from outside the country (imports).

In the formula above, output (X) is an endogenous variable and the final demands (F(D) and F(E)) are exogenous variables.

(3) Input Structure of Construction of Padma Bridge

The Input – Output Tables 2000 include a sector on "Rural Road Construction". However, Padma Bridge is not a simple rural road. Therefore, input structure of construction and required quantities/amounts of major material necessary for the construction of Padma Bridge were calculated as shown in Table 11.2.1.

Table 11.2.1 Required Quantities and Amount of Major Material

Major materials	Unit	Required Quantity	Basic Price		Amount	
			Local (Taka)	Foreign(USD)	Local (Taka)	Foreign(USD)
Rock	ton	1,400,000		35	0	49,000,000
Cement	ton	750,000	4,570		3,427,500,000	0
Sand	cu m	2,200,000	480		1,056,000,000	0
Aggregate	cu m	210,000	1,600		336,000,000	0
Reinforcement	ton	45,000	37,000		1,665,000,000	0
PC strand	ton	12,000		3,500	0	42,000,000
Steel pipe pile (3.0m diameter)	ton	68,000		2,200	0	149,600,000
Steel pipe pile (0.8m diameter)	ton	17,000		1,500	0	25,500,000
Geotextile	sq m	840,000	90		75,600,000	0
Bitumen	lit.	2,500,000	20		50,000,000	0
Total					6,610,100,000	266,100,000
Total(USD)					110,168,333	266,100,000
Total(USD)						376,268,333

Total material costs were estimated at 376 million US Dollars (22,576 million Taka). Although each material cost is divided into the local and foreign portions, total cost is added to the final demand of related economic sectors in the existing Input-Output table of the whole country. Therefore, import portions of the above investment costs are decided by the Import Coefficients, which reflect the Input – Output structure of the country. According to the I-O table, about 55% of total domestic cement demands, for example, are imported although it belongs to the local portion in the above table.

(4) Simulation Scenario

The above amounts of major material were applied to the model formula as final demands (investment).

In addition to the investment multipliers, demand increase in the transport sector of the Southwest Region was also taken into account. The induced traffic demands of trucks on the Padma Bridge will increase by about 50% compared to normal traffic. It is estimated that the Southwest region accounts for 42% of the national transport services. This percentage was applied and considered a 20% increase (=50% x 0.42) in the final demand of national-level transport services. This 20% increase in final demand in the transport sector was also applied to the exercise of national Input – Output model.

(5) Simulation Results

(a) Induced Output

Results of the simulation for Induced Output are shown in Table 11.2.2.

The investment of 22,576 million Taka for the major material will induce an additional output of 54,486 million Taka and will push up the GDP growth rate of the country by 1.2%.

(b) Induced Value Added

Induced Value Added was estimated based on the above induced output and applying the Value Added Coefficient Matrix [V]. Simulation results are presented in Table 11.2.3. The construction of Padma Bridge will generate induced Value Added of 32,638 million Taka, which is higher by 1.4% than the base case (Without Project case).

(c) Induced Employment

Induced employment under the same simulation scenario was estimated applying the Labor Coefficient (Man-year per output) to the induced output estimated above. The labor coefficient data were taken from the "Input-Out Tables for Bangladesh, 1993-94". The results are shown in Table 11.2.4. Investment for Padma Bridge and demand increases in the transport sector will generate additional employment opportunities of 743,000 man-year (= 271.2 million man-days). This increase of employment corresponds to about 1.2 % of the total labor force of Bangladesh in FY 2000 (60.3 million).

It should be noted that the above induced impacts are not realized in a single year. It will take 4-5 years because the construction of Padma Bridge requires 4-5 years.

It is also noted that adopted Input-Output simulations were carried out under the assumptions of fixed prices even if output increases and no capacity constraints to produce induced demands exist.

Table 11.2.2 Results of Simulation for Multiplier Effects (Induced Output)

Activity (Sector)	Base (Million Taka)	Simulation (Mill. Taka)	% Change
1. Paddy Cultivation	242,854	242,950	0.040
2. Wheat Cultivation	29,671	29,701	0.102
3. Other Grain Cultivation	1,657	1,658	0.042
4. Jute Cultivation	26,718	26,767	0.182
5.Sugarcane Cultivation	28,433	28,441	0.027
6. Potato Cultivation	22,473	22,478	0.022
7. Vegetable Cultivation	21,620	21,623	0.012
8. Pulses Cultivation	22,612	22,638	0.115
9. Oilseed Cultivation	9,010	9,018	0.085
10. Fruit Cultivation	29,386	29,388	0.008
11. Cotton Cultivation	7,853	7,898	0.573
12. Tobacco Cultivation	7,116	7,116	0.002
13. Tea Cultivation	3,377	3,377	0.004
14. Spice Cultivation	6,331	6,334	0.047
15. Other Crop Cultivation	17,346	17,418	0.415
16. Livestock Rearing	104,883	105,299	0.397
17. Poultry Rearing	36,857	36,863	0.017
18. Shrimp Farming	43,659	43,680	0.049
19. Fishing	85,035	85,063	0.033
20. Forestry	53,953	54,036	0.154
21. Rice Millling	375,610	375,618	0.002
22. Grain Milling	48,030	48,058	0.057
23. Fish Process	100,533	100,659	0.125
24. Oil Industry	23,251	23,275	0.104
25.Sweetener Industry	46,784	46,798	0.029
26. Tea Product	4,759	4,759	0.007
27. Salt Refining	3,846	3,856	0.262
28. Food Process	36,137	36,219	0.229
29. Tanning and Finishing	29,558	29,806	0.838
30. Leather Industry	40,069	40,069	0.000
31. Baling	4,403	4,405	0.052
32. Jute Fabrication	36,652	36,671	0.053
33. Yarn Industry	41,853	41,944	0.218
34. Cloth Milling	34,289	34,307	0.053
35. Handloom Cloth	50,910	50,912	0.004
36. Dyeing and Bleaching	8,196	8,197	0.015
37. RMG	142,062	142,062	0.000
38. Knitting	64,440	64,440	0.000
39. Toiletries Mfg.	10,726	10,818	0.858
40. Cigarette Industry	14,380	14,380	0.003
41. Bidi Industry	2,424	2,424	0.000
42. Saw and Plane	20,108	20,279	0.849
43. Furniture Industry	20,434	20,636	0.988
44. Paper Industry	26,224	26,353	0.492
45. Printing and Publishing	11,107	11,247	1.262
46.Pharmacuticals Mfg.	20,542	20,556	0.070
47. Fertiliser Industry	34,449	34,470	0.060
48. Basic Chemical	14,188	14,435	1.739
49. Petroleum Ref.	57,348	57,799	0.787
50.Earthware Industry	9,769	9,783	0.147
51.Chemical Industry	6,821	6,900	1.157
52. Glass Industry	722	726	0.561
53. Clay Industry	9,610	9,656	0.479
54. Cement Mfg.	10,124	11,745	16.016
55. Basic Metal Mfg.	67,771	83,307	22.924
56. Metal Mfg.	27,589	27,754	0.600
57.Machinery and Equipments	70,554	70,912	0.508
58.Transport Equipments	33,981	34,102	0.355
59.Miscellaneous Industry	44,582	47,108	5.667
60.Urban Building	86,225	86,354	0.149
61.Rural Building	237,169	237,405	0.100
62.Power Plant Building	16,648	16,703	0.328
63.Rural Road Building	12,925	12,968	0.328
64.Port Road Railway Building	30,849	31,422	1.855
65.Canal Dyke Other Buildings	9,501	9,512	0.119
66.Electricity and Water Generation	34,994	35,485	1.403
67.Gas Extraction and Distribution	8,128	8,185	0.704
68. Mining and Quarrying	35,994	38,125	5.921
69. Wholesale Trade	147,068	148,390	0.899
70. Retail Trade	262,688	263,475	0.300
71. Air Transport	23,789	23,792	0.011
72. Water Transport	47,903	48,046	0.299
73. Land Transport	147,764	167,114	13.096
74. Railway Transport	2,398	2,405	0.296
75. Other Transport	73,382	74,670	1.755
76. Housing Service	283,610	284,800	0.420
77. Health Service	30,715	30,758	0.139
78. Education Service	78,268	78,281	0.017
79. Public Administration and Defense	128,473	128,805	0.258
80. Bank Insurance and Real estate	75,045	75,928	1.177
81.Profesional Service	147,932	148,860	0.628
82.Hotel and Restaurant	29,672	29,836	0.553
83.Entertainment	16,296	16,296	0.000
84.Communication	23,746	23,792	0.195
85.Other Services	102,125	102,793	0.654
86. Information Technology and ECom	4,480	4,558	1.737
Total	4,503,467	4,557,953	1.210

Note: Base case: Without investment of Padma Bridge, This means output in I-O Table 2000.

Table 11.2.3 Induced Value Added

Activity (Sector)	Base (Million Taka)	Simulation (Milli. Taka)	% Change
1. Paddy Cultivation	132806	132858	0.040%
2. Wheat Cultivation	14020	14034	0.102%
3. Other Grain Cultivation	1103	1103	0.042%
4. Jute Cultivation	16516	16546	0.182%
5.Sugarcane Cultivation	14050	14054	0.027%
6. Potato Cultivation	12561	12564	0.022%
7. Vegetable Cultivation	12239	12240	0.012%
8. Pulses Cultivation	14206	14222	0.115%
9. Oilseed Cultivation	4827	4831	0.085%
10. Fruit Cultivation	18151	18152	0.008%
11. Cotton Cultivation	4756	4784	0.573%
12. Tobacco Cultivation	3926	3926	0.002%
13. Tea Cultivation	1644	1644	0.004%
14. Spice Cultivation	3345	3347	0.047%
15. Other Crop Cultivation	10706	10750	0.415%
16. Livestock Rearing	34587	34724	0.397%
17. Poultry Rearing	12922	12924	0.017%
18. Shrimp Farming	20057	20067	0.049%
19. Fishing	43394	43408	0.033%
20. Forestry	34497	34550	0.154%
21. Rice Millling	73300	73302	0.002%
22. Grain Milling	10150	10156	0.057%
23. Fish Process	36299	36344	0.125%
24. Oil Industry	5080	5086	0.104%
25.Sweetener Industry	11954	11957	0.029%
26. Tea Product	1627	1627	0.007%
27. Salt Refining	1430	1434	0.262%
28. Food Process	7079	7095	0.229%
29. Tanning and Finishing	5730	5778	0.838%
30. Leather Industry	8239	8239	0.000%
31. Baling	1975	1976	0.052%
32. Jute Fabrication	16758	16766	0.053%
33. Yarn Industry	10956	10980	0.218%
34. Cloth Milling	13644	13651	0.053%
35. Handloom Cloth	22771	22772	0.004%
36. Dyeing and Bleaching	2464	2464	0.015%
37. RMG	45955	45955	0.000%
38. Knitting	37188	37188	0.000%
39. Toiletries Mfg.	4490	4528	0.858%
40. Cigarette Industry	5979	5979	0.003%
41. Bidi Industry	774	774	0.000%
42. Saw and Plane	11175	11270	0.849%
43. Furniture Industry	11266	11377	0.988%
44. Paper Industry	12692	12754	0.492%
45. Printing and Publishing	3763	3810	1.262%
46.Pharmacuticals Mfg.	10970	10978	0.070%
47. Fertiliser Industry	21778	21791	0.060%
48. Basic Chemical	5554	5651	1.739%
49. Petroleum Ref.	20286	20445	0.787%
50.Earthware Industry	3224	3229	0.147%
51.Chemical Industry	2341	2369	1.157%
52. Glass Industry	349	351	0.561%
53. Clay Industry	3892	3911	0.479%
54. Cement Mfg.	5463	6338	16.016%
55. Basic Metal Mfg.	39233	48227	22.924%
56. Metal Mfg.	15015	15106	0.600%
57.Machinery and Equipments	28934	29081	0.508%
58.Transport Equipments	21896	21974	0.355%
59.Miscellaneous Industry	19388	20486	5.667%
60.Urban Building	50266	50341	0.149%
61.Rural Building	139622	139761	0.100%
62.Power Plant Building	6994	7017	0.328%
63.Rural Road Building	7008	7031	0.328%
64.Port Road Railway Building	13238	13484	1.855%
65.Canal Dyke Other Buildings	4401	4407	0.119%
66.Electricity and Water Generation	22277	22589	1.403%
67.Gas Extraction and Distribution	6018	6060	0.704%
68. Mining and Quarrying	14267	15112	5.921%
69. Wholesale Trade	112733	113746	0.899%
70. Retail Trade	219823	220481	0.300%
71. Air Transport	13782	13784	0.011%
72. Water Transport	30920	31012	0.299%
73. Land Transport	101941	115290	13.096%
74. Railway Transport	1570	1574	0.296%
75. Other Transport	43911	44682	1.755%
76. Housing Service	161399	162076	0.420%
77. Health Service	12896	12914	0.139%
78. Education Service	43509	43516	0.017%
79. Public Administration and Defense	81282	81492	0.258%
80. Bank Insurance and Real estate	37056	37492	1.177%
81.Profesional Service	90792	91361	0.628%
82.Hotel and Restaurant	9946	10001	0.553%
83.Entertainment	6809	6809	0.000%
84.Communication	13214	13240	0.195%
85.Other Services	68366	68813	0.654%
86. Information Technology and ECom	1979	2014	1.737%
Total	2287392	2320030	1.427%

Note: Base case: Without investment of Padma Bridge, This means output in I-O Table 2000.

Table 11.2.4 Induced Employment

Activity (Sector)	Labor Coefficient (*) (Man Year /Mill.Taka)	Induced Output (Million Taka)	Induced Employment (Man Year)
1. Paddy Cultivation	33.38	96	3215
2. Wheat Cultivation	44.49	30	1343
3. Other Grain Cultivation	30.43	1	21
4. Jute Cultivation	40.80	49	1986
5.Sugarcane Cultivation	15.27	8	117
6. Potato Cultivation	11.63	5	59
7. Vegetable Cultivation	24.52	3	62
8. Pulses Cultivation	15.18	26	396
9. Oilseed Cultivation	37.09	8	285
10. Fruit Cultivation	6.89	2	15
11. Cotton Cultivation	13.51	45	608
12. Tobacco Cultivation	20.85	0	3
13. Tea Cultivation	11.70	0	2
14. Spice Cultivation	22.08	3	65
15. Other Crop Cultivation	16.84	72	1213
16. Livestock Rearing	84.98	416	35342
17. Poultry Rearing	67.21	6	420
18. Shrimp Farming	15.14	21	323
19. Fishing	19.33	28	536
20. Forestry	5.13	83	427
21. Rice Millling	1.58	8	13
22. Grain Milling	1.35	28	37
23. Fish Process	0.79	126	99
24. Oil Industry	0.59	24	14
25.Sweetener Industry	6.15	14	84
26. Tea Product	4.08	0	1
27. Salt Refining	6.98	10	70
28. Food Process	5.33	83	440
29. Tanning and Finishing	1.15	248	285
30. Leather Industry	2.62	0	0
31. Baling	2.36	2	5
32. Jute Fabrication	6.91	19	133
33. Yarn Industry	8.99	91	821
34. Cloth Milling	6.34	18	114
35. Handloom Cloth	17.58	2	32
36. Dyeing and Bleaching	2.77	1	3
37. RMG	7.27	0	0
38. Knitting	0.93	0	0
39. Toiletries Mfg.	35.35	92	3255
40. Cigarette Industry	0.64	0	0
41. Bidi Industry	20.75	0	0
42. Saw and Plane	8.79	171	1501
43. Furniture Industry	11.79	202	2380
44. Paper Industry	2.46	129	317
45. Printing and Publishing	7.70	140	1079
46.Pharmacuticals Mfg.	2.07	14	30
47. Fertiliser Industry	0.88	21	18
48. Basic Chemical	3.26	247	804
49. Petroleum Ref.	0.06	451	27
50.Earthware Industry	51.76	14	744
51.Chemical Industry	3.12	79	246
52. Glass Industry	3.80	4	15
53. Clay Industry	23.94	46	1101
54. Cement Mfg.	5.33	1,621	8643
55. Basic Metal Mfg.	1.37	15,536	21284
56. Metal Mfg.	7.23	166	1197
57.Machinery and Equipments	4.39	359	1574
58.Transport Equipments	2.72	121	328
59.Miscellaneous Industry	6.17	2,527	15589
60.Urban Building	7.50	129	965
61.Rural Building	0.90	236	212
62.Power Plant Building	0.86	55	47
63.Rural Road Building	10.95	42	465
64.Port Road Railway Building	20.00	572	11443
65.Canal Dyke Other Buildings	15.02	11	171
66.Electricity and Water Generation	2.47	491	1213
67.Gas Extraction and Distribution	0.93	57	53
68. Mining and Quarrying	4.43	2,131	9442
69. Wholesale Trade	20.52	1,322	27121
70. Retail Trade	20.52	787	16146
71. Air Transport	23.01	3	59
72. Water Transport	23.01	143	3299
73. Land Transport	23.01	19,350	445255
74. Railway Transport	23.01	7	163
75. Other Transport	23.01	1,288	29631
76. Housing Service	0.00	1,190	0
77. Health Service	6.79	43	291
78. Education Service	37.67	13	497
79. Public Administration and Defense	24.05	332	7975
80. Bank Insurance and Real estate	6.17	883	5450
81.Profesional Service	33.76	928	31339
82.Hotel and Restaurant	15.30	164	2509
83.Entertainment	-	0	
84.Communication	9.40	46	435
85.Other Services	60.64	668	40514
86. Information Technology and ECom	-	78	
Total			743423
Source: (*):An Input-Outpur Table for Bangladesh Economy 1993-94 (**):Kay Indicators Bangladesh, ADB		Labour Force in 2000 60.3 million (**)	Percentage to total labour force = 1.23 %

Note: Base case: Without investment of Padma Bridge, This means output in I-O Table 2000.

11.3 IMPACTS ON REGIONAL ECONOMY

11.3.1 Introduction

The Southwest Region will sustain the biggest impacts as a result of the construction of Padma Bridge and is provided with a smooth and permanent/all-weather road link over the Padma River to connect with the largest market (Dhaka city). Direct benefits such as savings in travel time (elimination of long waiting time at ferry ghats and reducing of river crossing time) will result in remarkable improvement of accessibility to/from other important cities and core facilities in the opposite side of the Padma River. This improvement of accessibility will contribute to regional economic development in terms of Gross Regional Product (GRP).

11.3.2 Methodology

Due to the lack of available data on the regional Input – Output table and in order to reflect the factor of improvement of accessibility explicitly in a model, a regression analysis was carried out for the alternative methodology to estimate the impacts on the Southwest Region's GRP.

The relationship between the travel time to/from Dhaka and GRP by district is shown in Figure 11.3.1. GRDP/km2 is a kind of index for "Productivity of land". In addition to this relationship, it is necessary to take into account one more factor to reflect the condition of regional infrastructures such as feeder roads. Therefore, an equation was estimated by the regression analysis as outlined below:

$$\text{Ln}(G) = 3.0453 - 0.5482\ \text{Ln}(T) + 0.4926\ \text{Ln}(F) \qquad (R = 0.902)$$

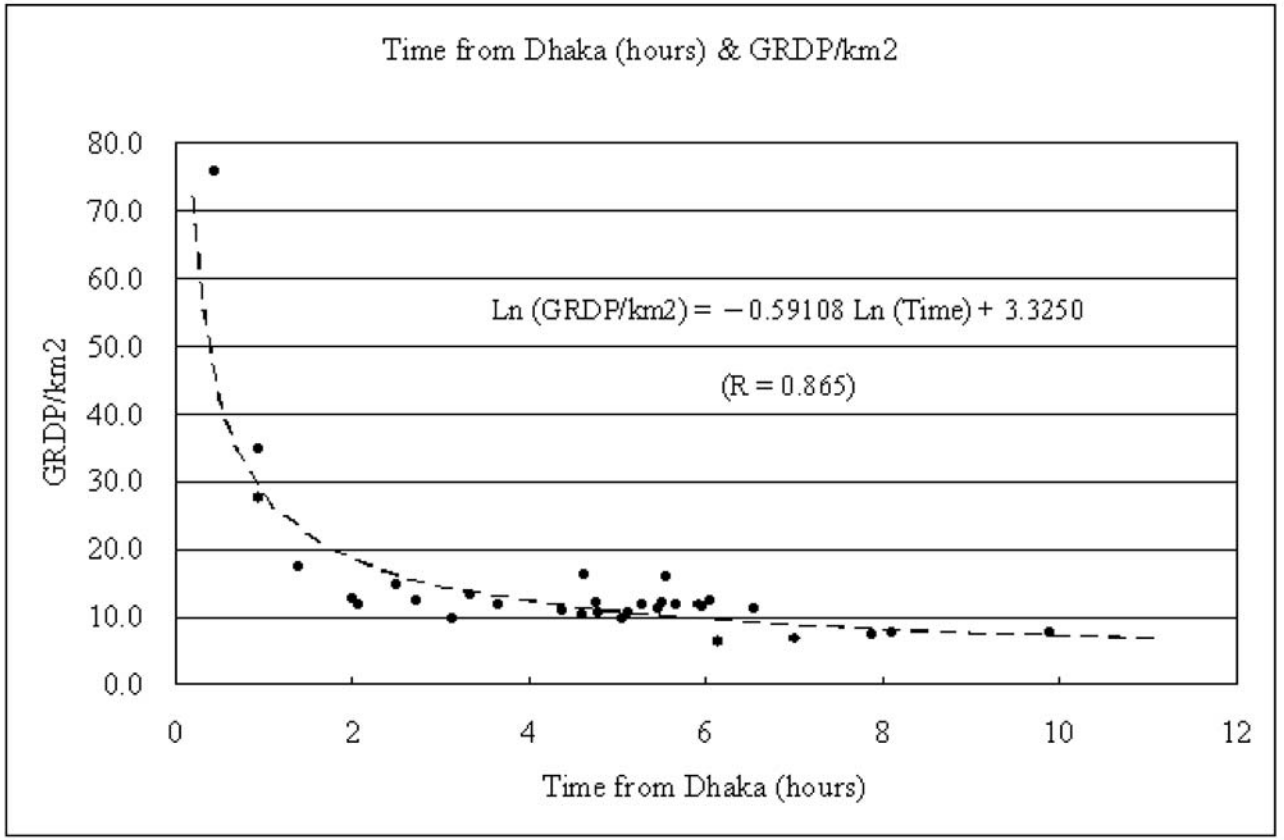
where:

- G: GRDP/km^2
- T: Time to Dhaka from districts in Southwest region (hours)
- F: Density of feeder roads (km/km^2)
- Ln: Natural Logarithm

Based on the above equation and applying the travel time in the "With Bridge Case" (density of feeder roads is fixed), the impact on the change in GRDP was estimated as shown in Table 11.3.1.

The results indicate that if the Padma Bridge is constructed, GRDP of the Southwest Region will increase by 35% compared to the "Without Bridge Case".

However, these impacts will not be realized in the first few years after the Bridge is opened and will require a long term period, 10 to 20 years after opening, before becoming fully apparent. If the Padma Bridge is fully utilized within 15 years of opening, impact rates will be 2.3% per year.



Ln (GRDP/km2) = −0.59108 Ln (Time) + 3.3250 R = 0.865

Figure 11.3.1 Relationship between Time from Dhaka and GRDP

Table 11.3.1 Impact on Regional Economy

Impact on Regional Economy (GRDP) : Mawa Route (GRDP/km2, Time & Feeder Roads)

District	Zone No.	Time (W/O) (hours) X1	Feeder Road X2	GRDP /km2 Y	GRDP /km2 y (Estimate)	Y/y	GRDP Without (Million)	GRDP/km2 With Mawa	GRDP With Mawa	Impact (With / Without)
Dhaka	1									
Manikganj	2	2.01	1.60	12.8	18.1	0.706	17612	12.8	17612	1.00
Munshiganj	3	1.4	1.49	17.3	21.3	0.812	16492	17.3	16492	1.00
Narayanganj	4	0.45	2.17	75.8	47.7	1.587	57499	75.8	57499	1.00
Narshingdi	5	0.93	1.94	27.6	30.3	0.910	31440	27.6	31440	1.00
Gazipur	6	0.95	1.76	34.8	28.5	1.218	60518	34.8	60518	1.00
Tangail	7	2.08	1.43	11.8	16.8	0.705	40343	11.8	40343	1.00
Jamalpur	8	3.35	1.57	13.3	13.5	0.986	27074	13.3	27074	1.00
Sherpur	9	3.65	1.38	11.7	12.1	0.965	15946	11.7	15946	1.00
Mymensingh	10	2.5	1.67	14.6	16.4	0.893	63859	14.6	63859	1.00
Netrakona	11	3.13	1.28	9.8	12.7	0.777	27678	9.8	27678	1.00
Kishoreganj	12	2.73	1.43	12.2	14.4	0.848	32930	12.2	32930	1.00
Rajbari	13	4.39	1.84	10.8	12.6	0.856	12102	14.5	16231	1.34
Faridpur	14	4.6	1.42	10.3	10.8	0.950	21312	16.2	33554	1.57
Gopalganj	15	5.05	1.41	9.7	10.2	0.952	14510	14.5	21571	1.49
Madaripur	16	4.77	1.55	12.0	11.1	1.080	13710	18.4	21113	1.54
Shariatpur	17	4.78	1.82	10.5	12.0	0.880	12451	16.2	19100	1.53
Kushtia	18	4.63	1.62	16.2	11.5	1.408	26233	18.6	30205	1.15
Magura	19	5.46	1.68	11.4	10.7	1.062	11908	16.2	16942	1.42
Narail	20	5.13	1.67	10.5	11.1	0.953	10428	15.5	15364	1.47
Bagerhat	21	6.14	0.88	6.3	7.3	0.865	25048	8.6	33875	1.35
Khulna	22	5.96	0.85	11.5	7.3	1.585	50672	15.8	69265	1.37
Satkhira	23	7.01	1.17	6.9	7.8	0.886	26637	8.9	34300	1.29
Jessore	24	5.56	1.81	15.8	11.0	1.441	40781	22.3	57617	1.41
Jhenaidah	25	5.28	1.75	11.8	11.1	1.058	22967	15.2	29570	1.29
Chuadanga	26	6.04	1.61	12.3	9.9	1.235	14202	15.2	17586	1.24
Meherpur	27	5.51	1.84	12.2	11.1	1.094	8717	13.4	9601	1.10
Pirojpur	28	6.55	2.28	11.3	11.3	1.000	14724	14.8	19401	1.32
Barisal	29	5.67	2.35	11.7	12.4	0.946	32626	16.4	45670	1.40
Jhalakhati	30	5.93	2.13	11.8	11.5	1.022	8909	16.1	12224	1.37
Barguna	31	9.89	1.81	7.6	8.0	0.949	13922	9.0	16456	1.18
Patuakhali	32	8.11	1.67	7.5	8.6	0.878	24129	9.3	29794	1.23
Bhola	33	7.88	0.81	7.3	6.1	1.187	24743	9.1	30816	1.25

GRDP (W/O Bridge)		GRDP (With Bridge)		Impact Ratio
SW Region	430731	SW Region	580255	1.35
Bangladesh	2049154	Bangladesh	2198678	1.07
Regional Share %	21.0%	Regional Share %	26.4%	2.3% perr year

Model

Ln (GRDP/km2) = 3.0453 −0.5482 Ln (Time) + 0.4926 Ln (Feeder Road/km2)

(R = 0.902)

11.4 IMPACTS ON INTERNATIONAL TRANSPORT BETWEEN SURROUNDING COUNTRIES

11.4.1 Introduction

Padma Bridge is expected to generate significant impacts not only on the domestic/local economy but also on the promotion of international trade between neighboring countries such as India, Nepal, Bhutan and Myanmar. In this section, an overview of socio-economic impacts of Padma Bridge is presented focusing on this aspect. Topics of international trade and cross-border traffic are also covered.

However, unlike the impacts on the domestic economy, impacts on international traffic or cross-border traffic will not be easily or automatically realized simply by construction of Padma Bridge. There are many institutional/ technical constraints to be eliminated to allow expansion of international trade with surrounding countries (such as bilateral agreements and interchange between BG and MG). In this Section, the surrounding counties are defined as an area of the "Eastern Region of the Indian Sub-continent".

11.4.2 Present Situation

(1) International Transport

Because of its geographical location, Bangladesh is strategically situated to provide international links to neighboring countries as listed below:

- Linking India, Bhutan and Nepal
- Providing access to major ports from landlocked countries
- Transit routes for India to its eastern states of Tripura, Manipur and Mizoram

(2) Present Situation of International Trade

Major destinations of Bangladesh's exports are the USA, EU countries and Canada. Exports to SAARC countries in fiscal year 2001 were only 1.0%. On the other hand, imports from SAARC countries were 12.3% in the same year. Imports from India have grown rapidly in the past five years with a 7.8% growth rate per year from 1998 to 2003 and total imports from India to Bangladesh also represent the highest proportion at 14%. Although Bangladesh and India have been traditional trading partners, imports from India previously exceeded exports for many years and the trade situation shows a chronic imbalance between the countries.

(3) Trade Routes

Bangladesh has three kinds of entry/exit routes for international trade, sea, air and land (roads and railways). These entry/exit points via roads and railways are shown in Figure 11.4.1 and Figure 11.4.2.

Imports and exports via sea were 84.5% and 98.3%, respectively, in fiscal year 2000 (in monetary terms). On the other hand, imports via land accounted for only 4.3% and exports were negligible in 2000. Considering the impacts of Padma Bridge on international trade, this small share of imports/exports via land (especially imports from India) is expected to grow substantially if institutional framework and technical issues related to the cross-border traffic (interchange of BG and MG) are improved with its construction.

Table 11.4.1 Imports/Exports by Trade Routes (Million Taka, FY2000)

	via Sea	via Air	via Land	Total
Import	314,338 (84.5%)	41,555 (11.2%)	16,129 (4.3%)	372,022 (100%)
Export	243,169 (98.3%)	4.246 (1.7%)	-	247,415 (100%)

Source: Statistical Yearbook 2000, Bangladesh Bureau of Statistics (BBS)

(4) Institutional Framework for Cross-border Traffic

(a) Economic Cooperation

SAARC (South Asian Association for Regional Co-operation)

SAARC consists of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka and is aimed at promotion of economic and social development in the region. However, SAARC has limited itself to broad policy declaration rather than program development and the charter precludes any discussions on bilateral issues. Therefore, the issue of cross-border transportation is not discussed on the table of SAARC, since such issues are always bilateral.

SASEC (South Asia Sub-regional Economic Co-operation)

SASEC sub-region is defined as Bangladesh, Bhutan, 13 of the north, east and northeast states of India (West Bengal, Bihar, Uttar Pradesh, Orissa, Jharkhand, Assam, Meghalaya, Manipur, Tripura, Mizoram, Nagaland, Arunachal Pradesh, and Sikkim), and Nepal. Two sequential technical assistance initiatives (RETAs) by ADB have helped to establish the Working Groups and institutional framework in support of the SASEC Program. There are five Working Groups at present covering the following areas:

- Power and Energy Working Group
- Transportation
- Tourism
- Environment
- Trade and Investment, Private Sector Co-operation

Asian Development Bank (ADB) has raised five types of potentials in this sub-region, namely: 1) Large workforce, 2) Fertile rice fields, 3) Energy potential, 4) Other natural resources (mineral, forest, livestock and marine resources), and 5) Ports (Network of ports in Chittagong, Mongla, Kolkata and Haldia).

It is noted that the Transportation Working Group has called for a review of existing bilateral transit agreements, simplification of cross-border inspections, and standardization of documentation. These movements will contribute to realize smooth cross-border traffic and the necessary precondition to promote intra-sub-regional trade.

BIMST-EC (Bangladesh – India – Myanmar - Sri Lanka – Thailand - Economic Co-operation)

BIMST-EC was established in June 1997 to promote socio-economic cooperation in the sub-region. In February 2004, Bhutan and Nepal also joined as new members and the name of this regional cooperation was changed to “Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation”, but with the same abbreviation of “BIMST-EC”. The cooperation covers six priority fields, namely:

- Fisheries
- Energy
- Trade and Investment
- Technology
- Transportation and Communication
- Tourism

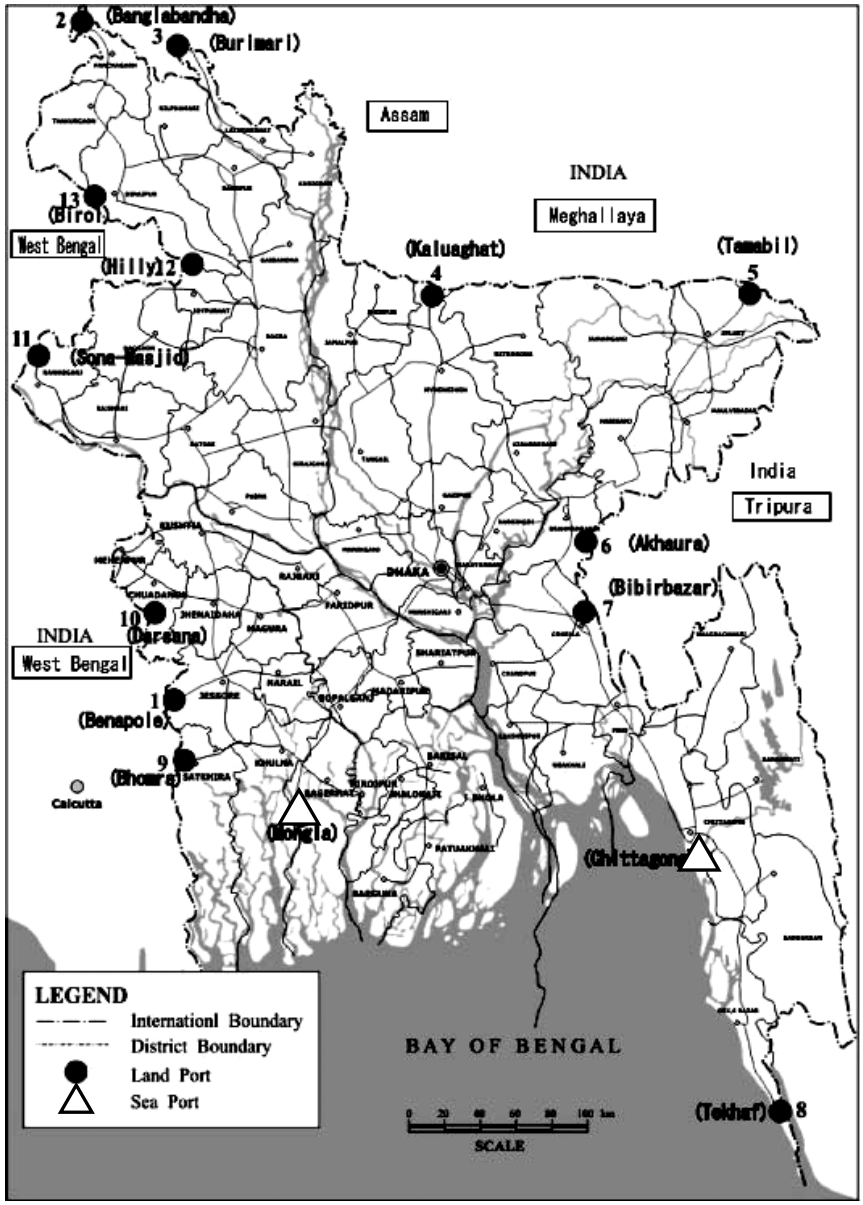
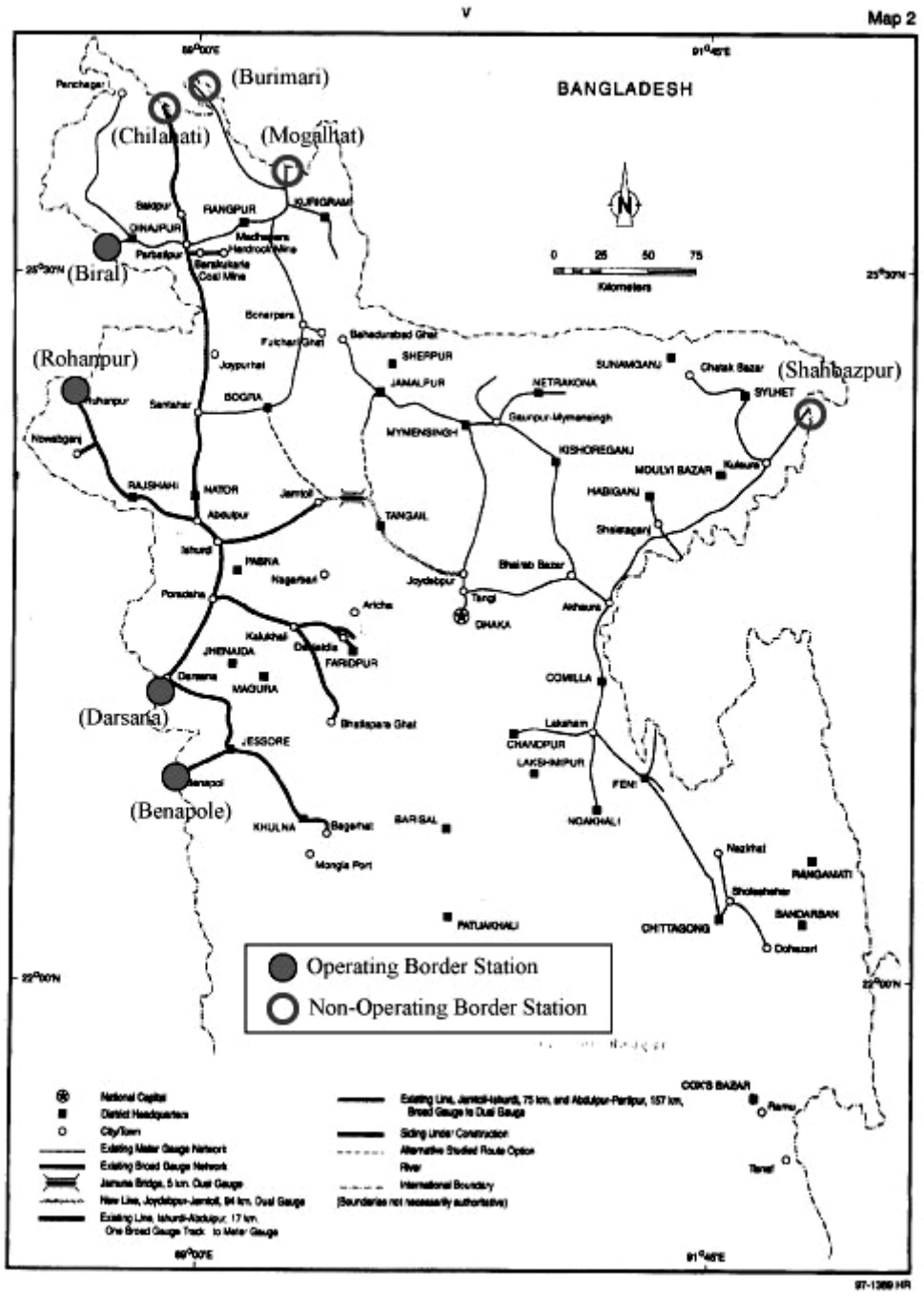


Figure 11.4.1 Cross-border Check Points: Land Port (via Road)



Source: Base map was extracted from "Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of Bangladesh for the Jamuna Bridge Railway Link Project", ADB, September 1997, RRP: BAN 26451.

Figure 11.4.2 Cross-border Check Points (via Railway)

BIMST-EC aims at increasing the trade among member countries by taking advantage of their geographical location in the region of the Bay of Bengal and the eastern coast of the Indian Ocean.

The most important points related to the context of sub-regional impacts due to the Padma Bridge are as follows:

- Discussions have been held with regard to building a "Trans Asian Highway" linking the capitals of member countries.
- A study on major surface routes and border crossings is undertaken by India in the field of Transportation and Communication.

(b) Asian Highway (AH)

The Asian Highway Project was initiated by ESCAP (Economic and Social Commission for Asia and Pacific, former ECAFE) in 1959, aiming at promotion of international road transport in Asia to facilitate international trade and tourism. Since the commencement of the project, remarkable progress has been achieved under the assistance of UNDP, donor countries and cooperation of the participating countries. This progress was, however, slowed at one time when funding from UNDP was stopped in 1975. In the late 1980s, rapid economic growth in the ESCAP region occurred resulting in strong demands for reliable road transport infrastructure. At the same time, development of container technology provided the basis for inter-modal/ multimodal transportation.

Under these circumstances, ESCAP proposed a new project in 1992 called the "Integrated Asian Land Transport Infrastructure Development (ALTID)" project, which comprises the Asian Highway and Trans-Asian Railway projects.

The criteria of route selection for both road and rail networks are as follows:

- Existing and potential trade flow (demands of international traffic)
- Capital to capital links (for international transport)
- Connections to main industrial and agricultural centers
- Connections to major sea and river ports (integration of land and water transport)
- Connections to major inland container terminals and depots (integration of rail and road transport)

The following three routes (Figure 11.4.3) are designated as parts of the Asian Highway in Bangladesh:

- Asian Highway (AH) A-1: International route: Myanmar (Yangon) – Meghalaya (northeastern India) – Tamabil (Sylhet in Bangladesh) – Dhaka – National Highway No.8 – Padma Bridge site – Jessore – Benapole– Calcutta (India) – New Delhi

- Asian Highway A-2: International route: Dhaka – Jamuna Bridge – Banglabandha in Panchagar – Nepal – New Delhi

- Asian Highway A-41: Sub-regional route: Tekhaf in Cox Bazar – Chittagong – Dhaka – Jamuna Bridge – Paksey Bridge – Mongla Port

The proposed Padma Bridge site is located on the Asian Highway A-1. This route is a short cut transit corridor connecting landlocked states of northeastern parts of India ("Seven sisters") with West Bengal and the remaining Indian states. In this study, this route is tentatively identified as the "Trans-Padma Corridor".

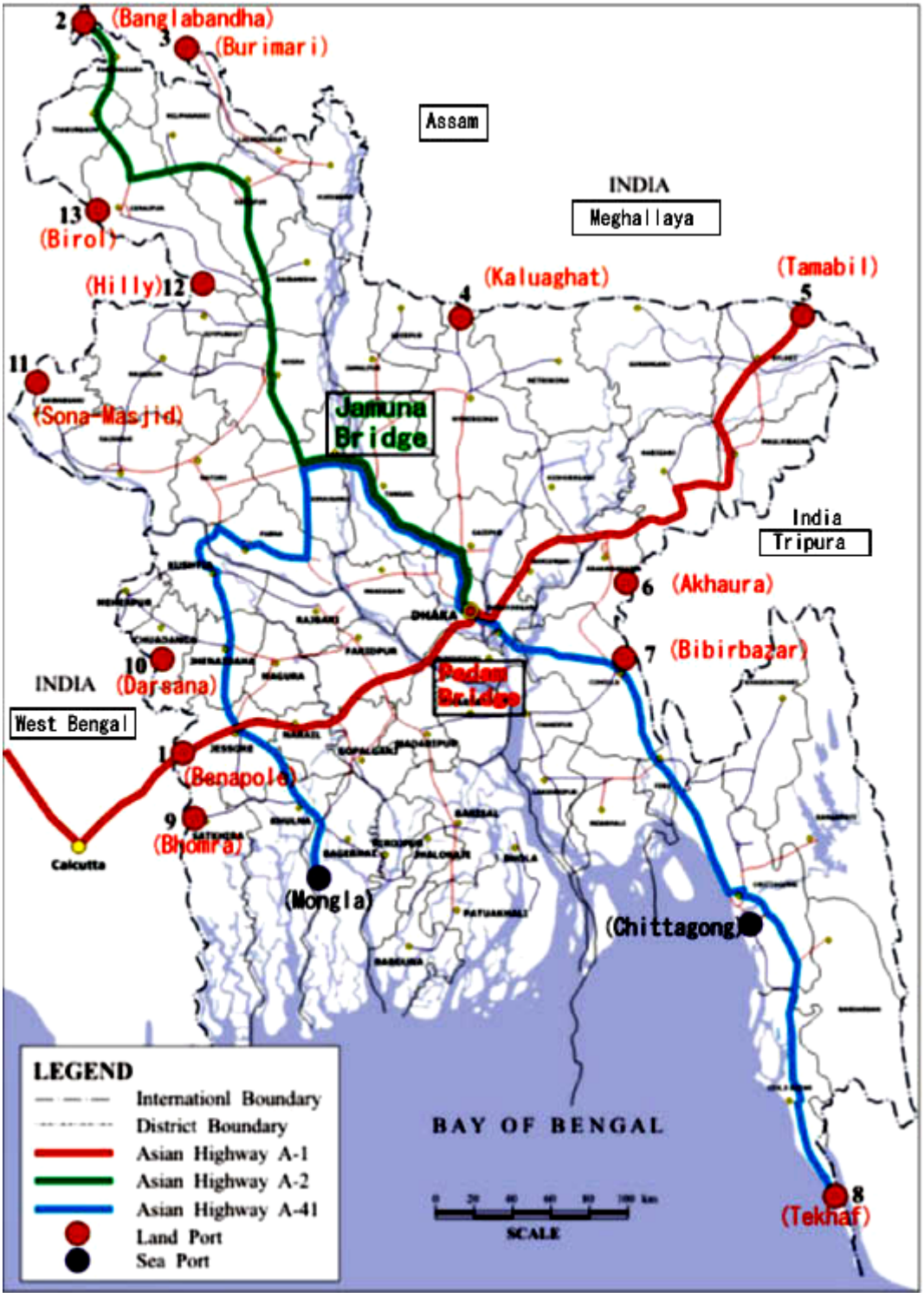


Figure 11.4.3 Asian Highway Routes in Bangladesh

(c) Trans-Asian Railway (TAR)

Bangladesh is located on the Southern Corridor of the Trans-Asian Railway, which is one of three Asia – Europe rail land bridges studied by ESCAP within the framework of the ALTID project. At present, the following five routes are designated as parts of the Trans – Asian Railway Network in Bangladesh (Figure 11.4.4).

- TAR Bn 1: International Route: Mashisasan (southern part of Assam State of India) – Shahbazar (in Moulvi Bazar of Bangladesh) – Akhaura – Bhairab Bazar – Joydepur – Jamuna Bridge – Jamtoil – Ishurdi – Darsana – Calcutta (India) = Total length 522 km.

- TAR Bn 2: Dhaka – Tongi – Akhaura – Chittagong = Total length 321 km.

- TAR Bn 2a: Chittagong – Dohazari – Gundhum (Myanmar border) = Total length 192 km.

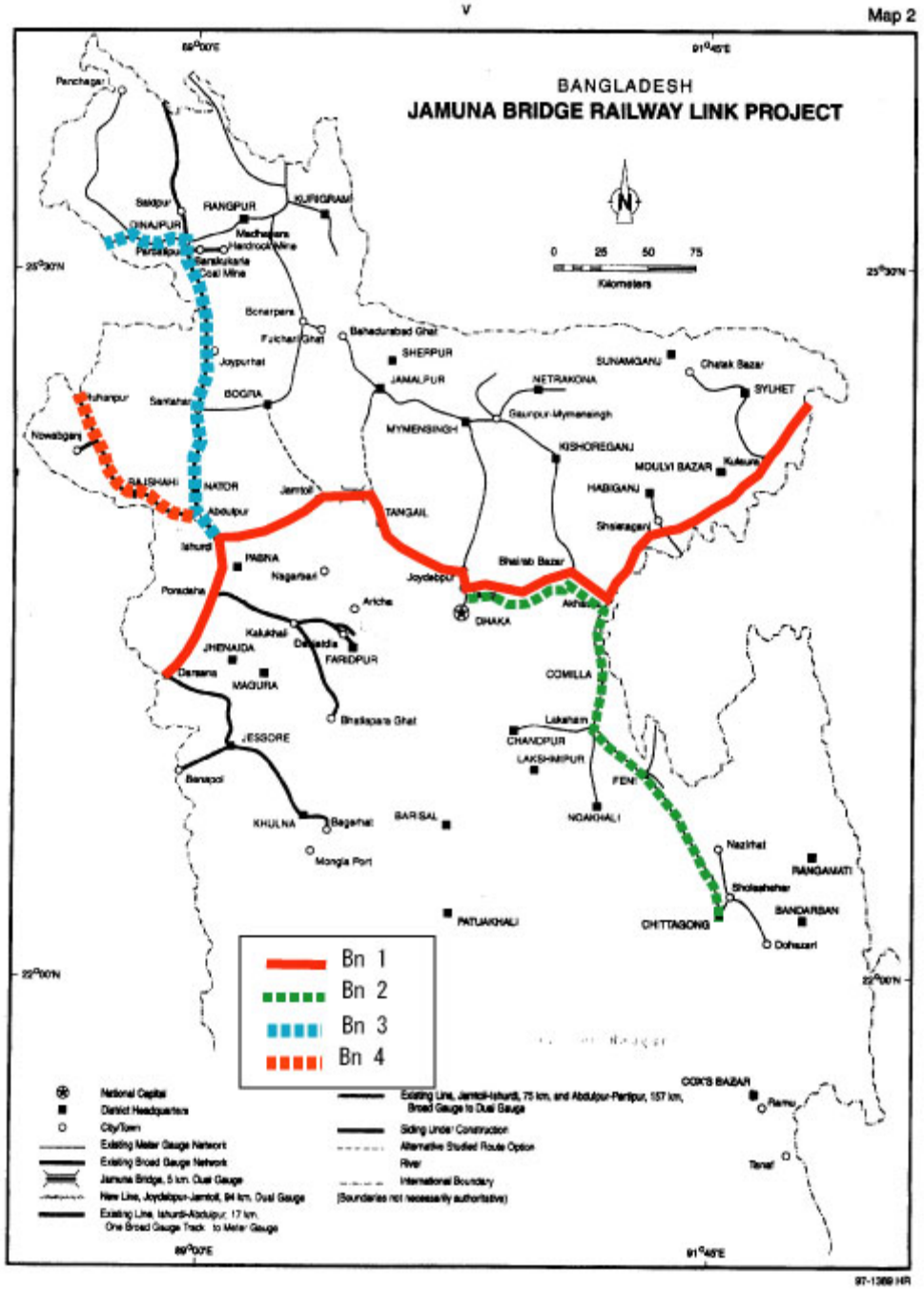
- TAR Bn 3: International Route: Ishardi – Abdulpur – Parbatipur – Dinajipur – Kanchan – Biral – Indian border = Total length 219 km.

- TAR Bn 4: International Route: Abdulpur – Rajshahi – Rohanpur – Indian border = Total length 104 km.

Among the five routes above, Route Bn 1 is a "Trans – Jamuna Corridor in railway network" connecting the northeastern part of India with West Bengal state by transiting through the territory of Bangladesh. However, the eastern part of this route up to Dhaka is the Meter Gauge (1000 mm) and it is necessary to transship cargo from meter gauge to broad gauge (1676 mm) and vise-versa.

(d) Trans-Padma Corridor Proposed by Bangladesh Railway (BR)

At present, there is no "Trans – Padma Corridor" on the railway network in Bangladesh as occurs in Asian Highway A-1. If the railway provision on the Padma Bridge is to be realized in future, it is necessary to effectively connect the rail link on the bridge with the existing railway network. Bangladesh Railway (BR) has prepared a conceptual plan for the short- and long-terms showing the new railway alignments for the rail provision on Padma Bridge as presented in Figure 11.4.5.



Source: Base map was extracted from "Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of Bangladesh for the Jamuna Bridge Railway Link Project", ADB, September 1997.

Figure 11.4.4 Trans – Asian Railway in Bangladesh

According to the information from BR, "the origin and destination points in the short-term will be Dhaka – Darsana international route, which will connect the north-eastern part of India – Dhaka –

Padma Bridge – Pukaria – Faridpur – Rajbari – Poradaha – Darsana – Ranaghat – Kolkata. It will require construction of only 70 km of railway lines. Land for substantial portions of railway line has already been acquired for construction of 70 km of railway track."

Source: Information from Bangladesh Railway. Base map was extracted from "Program Performance Audit Report on the Railway Recovery Program", ADB, (Loan 1310 – BAN) in Bangladesh, August 2002.

Figure 11.4.5 Conceptual Plan of Railway Trans-Padma Corridor Proposed by Bangladesh Railway (BR)

In the long-term, the origin and destination points via Padma Bridge will be Dhaka – Jessore. This is an international route which will connect the north-eastern part of India – Dhaka – Padma Bridge – Jessore – Benapole – Kolkata. About 160 km of railway track has to be constructed to connect Dhaka and Jessore.

In order to realize the above plans, BR has to implement the ADB's "Rail Recovery Project (RRP)" continuously and effectively and has to improve its financial condition through restructuring/ reforming the organization.

As explained above, development of the international road network (Asian Highway) and railway network (Trans-Asian Railway) as a transport infrastructure has been promoted under the ALTID project. However, in actual fact smooth trade flows at cross-borders are controlled or delayed by the customs inspection, cargo transshipments from trucks of one country to another, and rail interchange to/from Meter Gauge from/to Broad Gauge.

(5) Bilateral Agreements

(a) Bangladesh – India

Movement of Indian goods to or through Bangladesh (or vice-versa) is governed by: i) a bilateral trade agreement (signed in October 1980 and revised most recently in October 2001), and in addition to this agreement, another agreement, ii) "a Running Power Agreement" between the two railways in the case of railways. The following descriptions are found in the trade agreement:

> "The two Governments agree to make mutually beneficial arrangements for the use of their waterways, railways and roadways for commerce between the two countries and for passage of goods between two places in one country through the territory of the other."

However, at present such cooperation is limited to interchange of cargo at the border check-points resulting in long handling time/days. Transit traffic from India through Bangladesh is not permitted at present. Cargo from India is transshipped to BR wagons only when it is scheduled to cross the Jamuna Bridge, since current loading limits within India for IR wagons is higher than permitted on the bridge.

(b) Bangladesh – Nepal (via India)

Movement of Nepalese goods through Bangladesh (or vice-versa) by road or rail is governed by a bilateral transit agreement. The latest version signed in 1997 describes the following six entry/exit points:

- Khulna (later changed to Mongla)
- Chittagong
- Biral (rail and road)
- Banglabandha (road)
- Chilahati (rail)
- Benapole (rail and road)

Nepal has implemented a policy requiring approximately 25% of the portion of Nepalese third country imports and exports to be routed through Bangladesh via Chittagong or Mongla ports. Therefore, the possibility of using Padma Bridge for cargo to/from Nepal will be low considering the location of Padma Bridge and direction to the Chittagong and Mongla ports.

(c) Bangladesh – Bhutan (via India)

Under the 1988 trade agreement between Bhutan and Bangladesh, traffic between these countries moves across India in Bhutanese or Indian trucks via a 110 km transit corridor, with Indian Customs escort. Entry/exit into Bangladesh from Bhutan is solely permitted at Burimari. Most third-country trade with Bhutan passes through the port of Calcutta.

However, Bhutan has also used the Mongla Port on occasion and would like to expand use of this route. For the same reason as Nepal, the main purpose of Bhutanese transit traffic through Bangladesh is to access Mongla port for third country imports/exports, hence the possibility of using Padma Bridge may be low.

11.4.3 Impacts of Padma Bridge on International Transport

(1) Potential of Cross-border Traffic Demand

Cargo volumes imported from India via road and rail are shown in Table 11.4.2 and Table 11.4.3. Benapole is the busiest land port via road and Darsana is the main gate for railway traffic to/from India. Both border stations are connected to Calcutta. However, imports via Darsana have declined from 90% in 2000 to 55% in 2004 due to capacity constraints. On the other hand, Benapole commenced railway services from 2001 and at present its share of handling import cargo among the four land ports is around 17%.

Table 11.4.2 Volume of Imports from India by Land Port (via Road)

Land Port	Imports (tons/year)	%
Tamabil (*)	650,000	31.1
Benapole (**)	**1,140,700**	**54.6**
Hilli (*)	300,000	14.3
Total	2090,700	100%

Source: (*): Eastern South Asia Region Cooperation in Transport Communications, ADB, 2000.
(**): Bangladesh Land Port Authority (BLPA)

Table 11.4.3 Volume of Imports from India (via Railway) (tons/year)

Fiscal Year	Darsana	Rohanpur	Benapole	Birol	Total
1998	1,056,680	119,062		37,836	1,213,578
1999	1,326,487	167,373		70,912	1,564,772
2000	836,252	59,177		1,855	897,284
2001	1,058,653	219,332	95,227	47,776	1,420,988
2002 (*)	1,344,092	418,550	194,428	33194	1,990,264
2003	1,134,118	471,904	679,702	66,177	2,351,901
2004	971,573	382,332	303,476	87,343	1,744,724
Growth Rate (% p.a)	－1.4%	21.5%	47.2%	15.0%	6.2%
Composition %	Darsana	Rohanpur	Benapola	Birol	Total
1998	81.7%	9.8%		3.1%	100%
1999	84.8	10.7		4.5	100
2000	93.2	6.6		0.2	100
2001	74.5	15.4	6.7%	3.4	100
2002	67.5	21.0	9.8	1.7	100
2003	48.2	20.1	28.9	2.8	100
2004	55.7	21.9	17.4	5.0	100

Source: 1998 – 2002: Extracted from "Regional Rail Traffic Enhancement Project 'RRTEP), 2003-04 : from BR.
2003 – 2004: Bangladesh Railway
Note: Benapole started railway services from 2001. (*): Estimate.

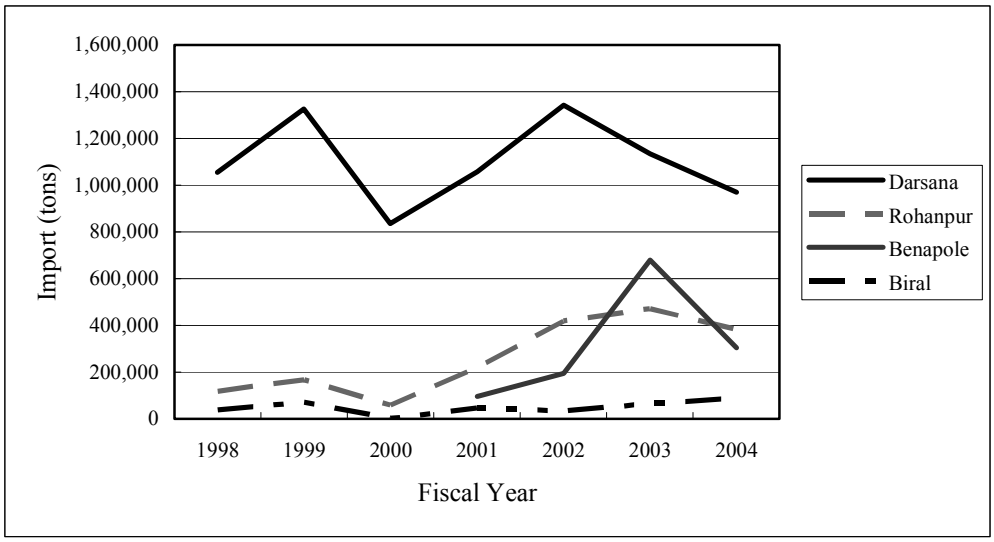


Figure 11.4.6 Imports from India via Railway (tons/year)

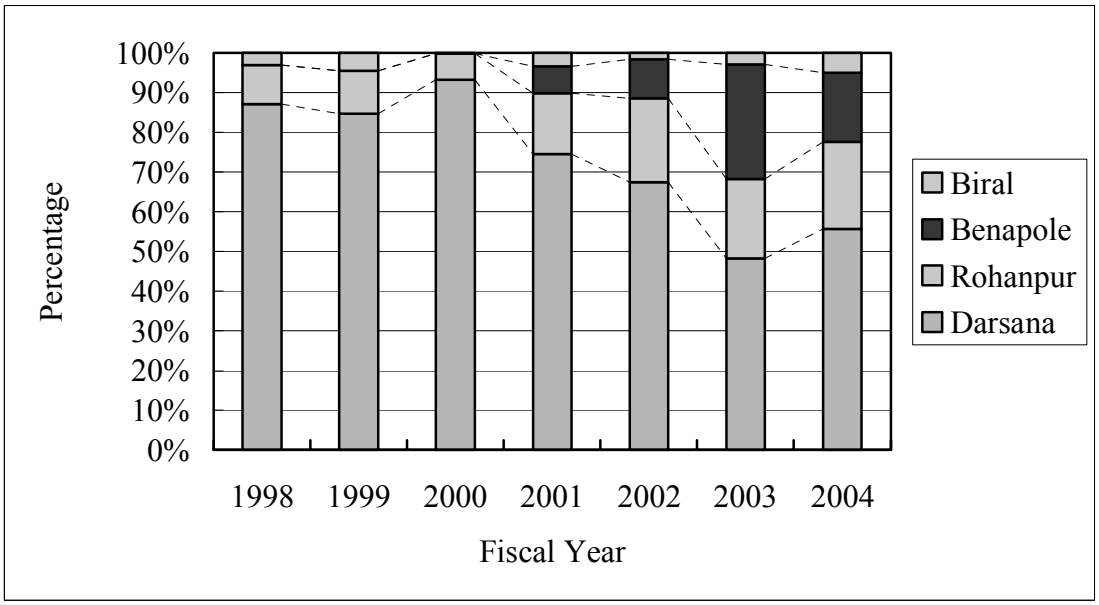


Figure 11.4.7 Composition of Import Volume by Land Port (via Railway)

Road cross-border traffic at Benapole Land Port for the recent five years is summarized in Table 11.4.4. Imports from India through Benapole have been increasing at 22.4% per annum.

Table 11.4.4 Road Traffic Data of Benapole Land Port

		Fiscal Year					Average Growth Rate
		1999-00	2000-01	2001-02	2002-03	2003-04	
Tons of Goods	Import Export	806,478 177,168	1,140,746 167,679	1,334,315 110,976	1,724,023 199,263	1,810,055 N.A.	22.4% p.a.
No. of Trucks/vans	Per Year (Day traffic)	104,373 (286)	135,059 (370)	149,114 (409)	197,217 (540)	186,358 (511)	15.6% p.a.
No. of buses	2 buses arriving and departing per day to and from Bangladesh.						
Carrying Passengers	Bangladeshi		Indian		Foreigner		Total (Arr.+Dep.)
	Departing	Arriving	Departing	Arriving	Departing	Arriving	
1999	215,103	137,045	26,370	22,039	1,682	2,169	404,408
2000	249,271	215,775	29,110	28,395	2,110	2,143	526,804
2001	283,692	251,018	33,296	32,248	1,945	2,188	604,387
2002	262,961	253,952	39,240	37,904	2,250	2,291	598,598
2003	284,817	263,970	38,437	37,557	2,304	2,304	629,389
Growth Rate	7.3% p.a.	17.8%	9.9%	14.3%	8.2%	1.5%	11.7%

Source: Bangladesh Land Port Authority (BLPA)

Import volume via road and rail by each land port is illustrated in Figure 11.4.8.

The recent trend of cross-border traffic demand shows that the corridor of Benapole – Jessore – Mawa – Dhaka has the highest potential.

Photo 1 A queue of trucks at Benapole Land Port

Photo 2 Immigration Office of Benapole Land Port

It is judged from the above analysis that the corridor of Benapole Land Port – Padma Bridge – Dhaka is the most important from the aspect of international trade between India and Bangladesh.

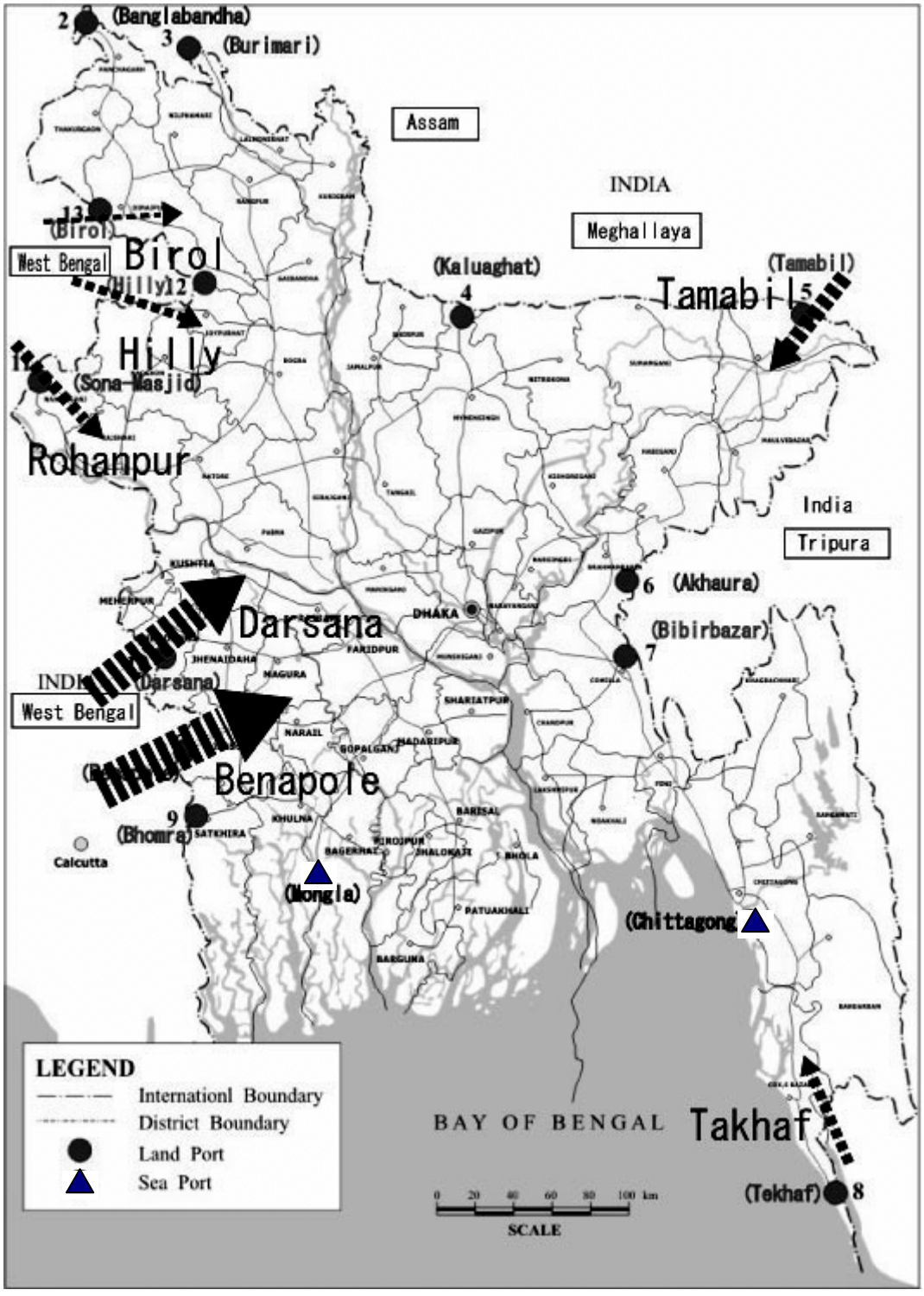


Figure 11.4.8 Import Volume by Land Port (Road+Rail, Tons)

(2) Benefits from Rail Provision

The following benefits are expected from the Rail Provision for Padma Bridge from the aspects of sub-regional trade:

- A new railway link that connects Dhaka – Padma Bridge – Jessore – Benapole will shorten the distance between Dhaka – Kolkata via Benapole – Petorapole interchange route (distance from Darsana to Dhaka via Jamuna Bridge – 403 km, from Benapole to

Dhaka via Jamuna Bridge – 518 km and from Benapole to Dhaka via Padma Bridge – 200 km).

- Movement of freight traffic from Benapole will be quicker and cheaper.
- It will lower transportation costs by avoiding extra haulage and transportation costs involved thereof.
- Quick transportation will result in quick return on investment and increase of traffic.
- It will open up a new era in the surface communication sector between Dhaka and southern part of Bangladesh including Mongla Port.

(3) Revenues of Bangladesh Railway from Cross -border Traffic

As explained above, there are three Broad Gauge (BG) and one Meter Gauge (MG) interchange points between Bangladesh Railway (BR) and Indian Railways (IR). They are Darsana – Gede (BG), Benapole – Petropole (BG), Rohanpur Singhabad (BG) and Birol – Radhikapur (MG). The earnings of BR from transporting cross-border traffic are discussed below.

Earnings of Bangladesh Railway from handling cross-border traffic were 540 million Taka in 2002-03 and 488 million Taka in 2003-04. Theses amounts correspond to about 10% of the total operating revenues of Bangladesh Railway. They are also equal to 6.5-7 times the yearly charges for the use of Jamuna Bridge now paid by BR to JMBA (75 million Taka per year).

Table 11.4.5 Earnings of BR from Cross Border Traffic

Fiscal Year	Route	No. of Trains Received from IR	No. of Wagons Received	M.Tons	Earnings ('000 Taka)
2002-03	Darsana (BG)	635	51,698	1,134,118	301,920
	Rohanpur (BG)	294	21,018	471,904	23,784
	Benapole (BG)	142	16,863	679,702	96,977
	Birol (MG)	130	5,209	66,177	117,636
	Total	1,201	94,788	2,351,901	540,317
2003-04	Darsana (BG)	537	44,243	971,573	258,028
	Rohanpur (BG)	237	17,175	382,332	120,927
	Benapole (BG)	206	13,673	303,476	83,002
	Birol (MG)	132	5,992	87,343	25,899
	Total	1,112	81,083	1,744,724	487,856

Source: Bangladesh Railway

As the cross-border traffic from India via Benapole is rapidly increasing, earnings from this source will greatly contribute to the improvement of the financial condition of BR when the Padma Bridge route ("Trans-Padma Corridor by Railway") proposed by BR is constructed. At the same time, traders on the Indian side will also gain benefits due to the lower transport costs and from time savings.

During the financial year 2003-04, about 57,915 IR wagons were received through Darsana and Benapole interchange routes of which 25,738 wagons (45%), containing about 570,000 metric tons of imported cargo, were handled at Noapara (25 km to the south-east of Jessore). About 80% of the cargo handled at Noapara is bound for Dhaka and adjoining areas and transported by river ways after transshipment, which is disapproved of by the traders as it involves extra time, wastage of contents and extra costs for transshipment. Hence with the provision of a direct rail link from Gandaria (near Dhaka) to Jessore via Padma Bridge at Mawa, being the shortest route between Benapole and Dhaka will boost interchange traffic. It will also be the shortest route from Dhaka to Kolkata to operate international train services (both passengers and freight including future potential of international transport container traffic).

(4) Impacts on Transit Traffic (Cross-country Traffic) through Bangladesh

(a) Background

When East Pakistan (now Bangladesh) was created in 1947 by carving out this area from India in the east, it almost isolated India's far north-eastern region, leaving it landlocked and surrounded by 4,500 km of borders with Bhutan, China, Myanmar and Bangladesh.

This area consists of India's 7 states (referred to as "Seven Sisters") of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. This area, with a population of 40 million, is connected to the rest of the country by a narrow corridor (22 km wide at the thinnest point known as Siliguri's neck).

(b) Economic Conditions

The economic conditions of this area are less developed than other parts of India. There is very little industry and productivity of agriculture is low. However, the region has oil and gas, coal and forest resources.

The poor condition of transport in the region is one of the difficult issues facing the north-east states.

The north-east region of India is heavily dependent on the supply of food-grains, oil seeds, sugar and other civil supplies from the other parts of India, which is mainly by rail due to the long distance. The transport demands by rail to the north-east states of India at present are 7.8 million tons.

(c) Impacts of Transit Route through Bangladesh

India appears to want to transport cargo to its north-eastern states across Bangladesh. By transiting through Bangladesh, Indian traffic can save a distance of 350 to 400 km and travel time and costs will be significantly lowered. If the Indian traffic from Calcutta to Agartala (capital city of Tripura State) can pass through the "Trans-Padma Corridor", more reductions in distance and transportation costs will be realized (Figure 11.4.9). These benefits will be enjoyed not only by India but also by Bangladesh, receiving business opportunities for BR and other related business fields.

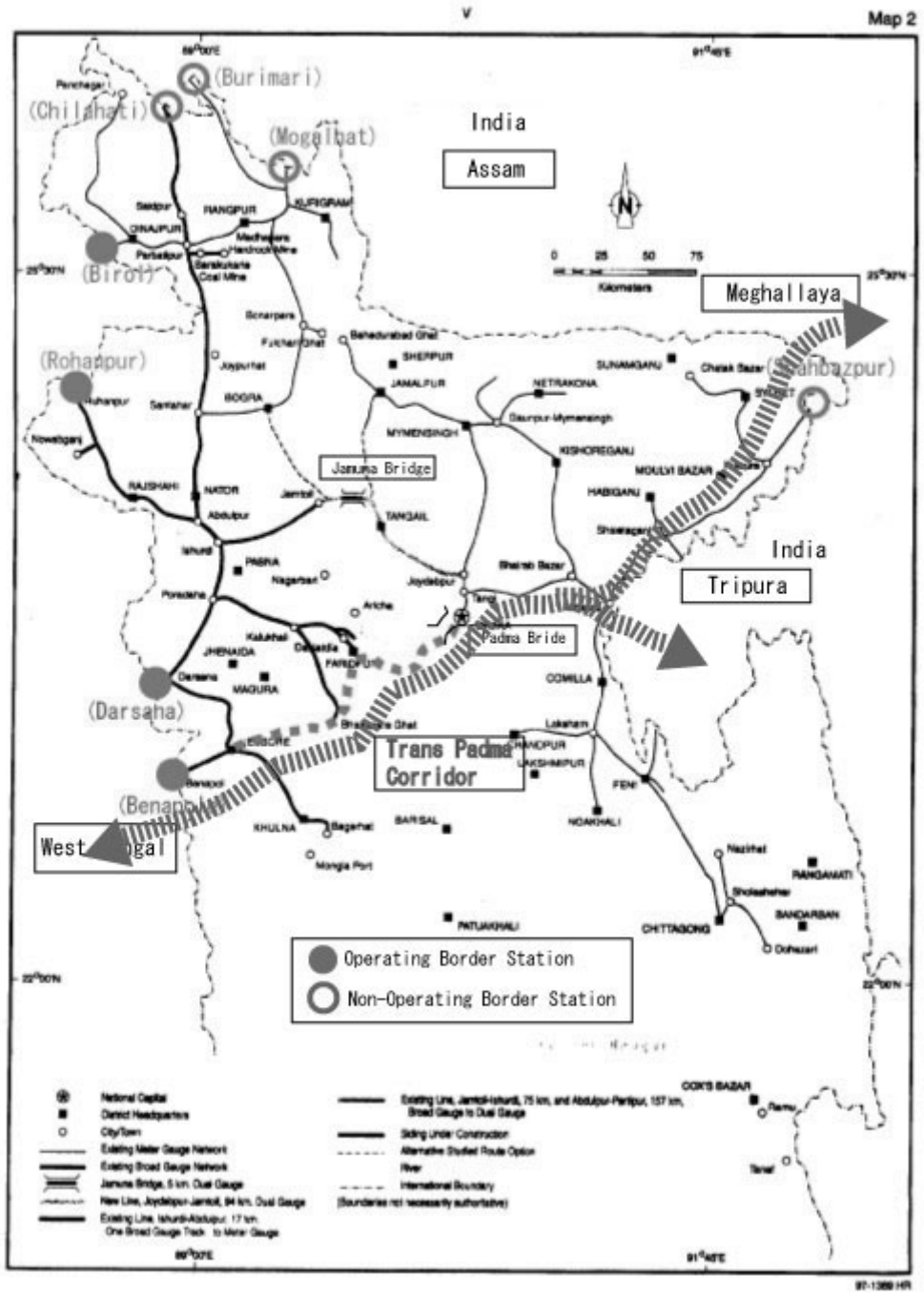


Figure 11.4.9 Proposed Trans-Padma Corridor for Road and Rail

11.4.4 Recommendations to Realize Impacts

In order to realize the impacts discussed above, the following recommendations are presented to the Government of Bangladesh and surrounding countries as well relevant organizations concerned:

1) Firstly, reviews and improvements of existing bilateral transit agreements are necessary to realize smooth cross-border traffic. At present, it takes about 1 week or 10 days for

crossing the border at Benapole Land Port, for example. These delays at the border will completely offset the effects of Padma Bridge. The improvements should include simplification of cross-border inspections and standardization of documents, which the Transportation Working Group of SASEC is now studying.

2) It is necessary, at the same time, to improve domestic regulations/laws related to transportation to be able to transit through the territory of Bangladesh. At present, transit of Indian cargoes is not permitted through Bangladesh on roads or railways (or vice-versa).

3) In addition to improving institutional constraints, there exist some technical constraints at cross-border points. Now, much time is consumed for transshipment of cargoes on trucks from Indian to Bangladeshi trucks (or vice-versa). The situation is also observed in the case of train cargoes. Furthermore, it also takes a long time and involves a very complex procedure for rail-interchange from the Indian BG to Bangladesh MG at land ports. Therefore, it is necessary to technically improve this situation to handle cargoes more efficiently/ effectively.

4) In relation to the above improvement, it is also necessary to expand/ improve the facilities in land ports to handle trucks or cargos in order to reduce delays. For example, Darsana land port has already reached its capacity and can not handle increasing cargo from India. Under this situation, some cargo trains are diverted to Benapole land port.

5) The Government of Bangladesh should make necessary arrangements to patronage the domestic transport sector (including truck companies and Bangladesh Railway) to handle such transit cargoes from India in order to obtain benefits from transportation of cross-border/transit cargoes and provide business opportunities.

6) Finally, in order to realize the Railway Trans-Padma Corridor as presented in the future new railway links to Faridpur and Jessore, Bangladesh Railway (BR) has to implement the ADB's "Rail Recovery Project (RRP)" continuously and efficiently and must improve its financial conditions. This is the necessary precondition to realize the railway provision via Padma Bridge.

11.5 DISTRIBUTION AND POVERTY IMPACT ANALYSIS

11.5.1 Objectives

The main objective of this section is to analyze how the benefits accrued from the Project will be distributed among stakeholders such as road users and the government (distribution analysis), and to estimate Poverty Impact Ratio (PIR) that expresses the proportion of net economic benefits accruing to the poor (Poverty impact analysis). The results of these analyses can help clarify who are the major beneficiaries and losers of the project and can answer the critical issue of whether the project will contribute to the poor or not.

11.5.2 Scope and Methodology

Based on several assumptions and the results of financial and economic analysis, both distribution and poverty impact analysis are conducted here. The selected case and key assumptions for the analyses are as follows:

Case selected: Road bridge with railway provision, extra-dozed girder type

Key assumptions:

Evaluation Period:	40 years
Total Project Cost:	1,257 million US$ (2004 price)
Foreign Loan:	880 million US$ (70% of Total project cost),
Government funding	377 million US$ (30% of Total project cost)
Poverty Line:	1,174 Taka per person per month (to be converted to 2004 price)[1]

The analysis procedure is briefly explained as follows[2]:

First step:	Estimate the present value of net financial benefits by stakeholder.
Second step:	The differences between net benefits by stakeholder at economic and financial prices are added to net financial benefits by stakeholders to give the distribution of net economic benefits by stakeholders.
Final step:	The net economic benefits are distributed to the poor, according to the proportion of each stakeholder who is poor. A poverty impact ratio, expressing the proportion of net economic benefits accruing to the poor, can be calculated by comparing net economic benefits to the poor with net economic benefits to the project as a whole.

11.5.3 Results of Analysis

The right-hand section of Table 11.5.1 summarizes gains and losses to different project stakeholders. Also, the results of poverty impact analysis are shown in the lower half of Table 11.5.1.

(1) Brief Overview of Financial and Economic Analysis

The domestic price numeraire was used in both financial and economic flow calculations and a discount rate of 12 percent was applied to calculate net present values (NPVs) of both flows.

[1] Source: A National Strategy for Economic Growth, Poverty Reduction and Social Development (Interim-Poverty Reduction Strategy Paper), Annex Table5

[2] For more detail, see Box-3 of *Handbook for Integrating Poverty Impact Assessment in the Economic Analysis of Projects* (ADB).

Financial revenue for the bridge is based on the toll revenues from normal and induced traffic, utility tariff revenues and the usage charges for the railway operator. Toll tariffs for the three types of vehicles (LV, bus an truck) are set as discussed in the financial evaluation section. Financial costs are the investment cost plus operation and maintenance costs of the bridge. The financial NPV is positive, showing financial viability of the Project.

Economic benefits of the Project include: (i) the savings in vehicle operating costs (VOCs) gained by normal traffic; (ii) the value of time saved for existing passengers and traffic; (iii) the value of waiting time saved at ferry terminals; iv) the freight value deterioration saving due to network improvement and at ferry terminals; v) the value of operation and maintenance cost saved by not maintaining the current ferry system at Mawa/Charjanajat ghats; vi) the value of the investment saved by not constructing a stand-alone utility bridge that carries power transmission line, gas pipeline and telephone line; and vii) the environmental benefits of preventing embankment erosion in areas close to the river training facilities and as a result enhances the original land values by promoting a transition to high value added agriculture and/or to high intensity of land use.

As explained, economic pricing was done under the domestic price numeraire. Initial investment costs and recurrent costs were first segregated into foreign and local cost components. The foreign exchange component, which was assumed to consist of tradable items, was shadow priced using a shadow exchange rate. All other local currency costs were expressed in economic values following their financial values. The economic NPV is positive, showing economic viability.

(2) Distribution Analysis

For distribution analysis, seven main stakeholders were identified: (i) LV passengers, (ii) bus passengers, (iii) truckers, (iv) utility companies, (v) Government (and the rest of the economy including lenders), (vi) railway operators, and (vii) the locality in the vicinity of the Project area, among which the projected net benefits estimated in the section on economic evaluation were distributed.

In the Project, the difference between financial and economic flows is mainly attributable to two factors: (i) some project inputs and outputs having conversion factors different from unity; and (ii) the Project generates economic benefits that are not captured as financial benefits.

The analysis of allocation of the difference of economic from financial NPV is presented in Table 11.5.1. Light vehicle passengers, bus passengers, truckers, utility companies and the locality gain from the Project whereas the Government (including lenders) and the railway operator lose. Light vehicle passengers and truckers would gain TK5,535 million and TK5,779 million, respectively. Bus passengers would be the largest gainer and realize savings of about TK19,716 million. The locality in the vicinity of the bridge crossing site and river training facilities is estimated to gain TK1,731 million in environmental benefits from enhanced land use and agricultural production due to the prevention of embankment erosion.

The Government/lenders would be the significant net loser, mainly due to the loans and the government grant to be invested into the implementation of the Project. This result highlights the important issue that one needs to consider the extent of fiscal impact of the huge amount of investment and fiscal sustainability of the recurrent costs of the Project. In order to tackle this issue, financial burden on the government budget was discussed in the section on fiscal affordability of GOB.

(3) Poverty Impact Analysis

For the purpose of poverty impact analysis, net economic benefits accruing to each stakeholder are allocated between the poor and non-poor. The following assumptions were made:

Government/Economy: Considering the fluctuating nature of the economic transformation under way in the short run compared to the long project life, the simple rule of thumb of 10% recommended by the ADB Handbook[3] is applied. The ratio is applied to the utility companies (electricity, telephone and gas) and railway operators because they are the governmental agencies and similar.

Light Vehicle Passengers: Referring to passenger's income profiles investigated in the consultant's traffic survey[4], the consultant estimated that 23.4 percent of light vehicle passengers who will be the user of the Padma Bridge are the poor, using the poverty line estimated in the Interim-PRSP[5] and in the Household Income and Expenditure Survey (HIES)[6].

Bus Passengers: Based on the survey result and the poverty line, the consultant estimated that 55.4% of the net benefits for bus passengers would accrue to the poor.

Trucker: Again, with the same procedure as above, it is estimated that 11.2% of the net benefits to truckers will accrue to the poor.

Locality: Land value enhancement benefits will accrue to the locality in the vicinity of the Project area. Based on the income profile of these people[7] and the poverty line of the area, it is found that 42.8% of them are the poor.

The result of poverty impact analysis is shown in the lower half of Table 11.5.1. Based on the above assumptions, the Project benefits going to the poor below the poverty line are estimated at 10,578 million Taka (in domestic price numeraire). The Poverty Impact Ratio (PIR) for the Project, which represents the proportion of net project benefits that accrue to the poor, is greater than unity (4.25). This extreme result is partly attributable to the outstanding feature of the Project (passengers being a significant gainer and Government being a significant loser) combined with the differential proportions of the poor applied to these two stakeholder's gains and losses (11% to 55% for passengers and 10% for the Government). The interpretation from this result is that the Project has an "ultra-pro-poor" nature and its benefits accruing to the poor are more than significantly greater than their income share in GDP (assumed as 10 percent), easily qualifying as poverty interventions.

Due to somewhat uncertain assumptions, sensitivity analysis has been performed on a key parameter. The PIR can be tested on the poor proportion of the government/economy net loss. For the parameter of incidence of marginal government expenditure/income between the poor and non-poor, 28.8% derived from Table A7.1 in ADB's handbook, instead of the rule of thumb of 10%, is applied. The result is demonstrated in Table 11.5.2. The PIR is 1.97, which is lower than the base case, due to the assumption that a higher proportion of the government net loss will be borne by the poor outside the project influence area. However, it was found that the proportion of benefits to the poor was greater than unity even applying this pessimistic assumption.

[3] Handbook for Integrating Poverty Impact Assessment in the Economic Analysis of Projects, ADB, July 2001
[4] This survey was conducted in 2003, the first year of this study.
[5] A National Strategy for Economic Growth, Poverty Reduction and Social Development (Interim-Poverty Reduction Strategy Paper), Ministry of Finance, March 2003
[6] Household Income and Expenditure Survey (HIES) 2000, Bangladesh Bureau of Statistics, March 2003
[7] See Social Impact Assessment (SIA) section of this study.

It should be noted, however, that the Government will also becomes a gainer in the long-term through realization of indirect and induced impacts of Padma Bridge on the national economy.

Table 11.5.1 Results of Distribution and Poverty Impact Analysis (Base Case)

Unit: million Taka

Item	Financial PV at 12 %	Economic PV at 12%	Economic minus Financial	Light Vehicle Passengers	Bus Passengers	Truckers	Utility (Power, Telephone & Gas) Companies	Government (and rest of economy)	Railway Operators	Locality
Benefits										
Vehicle Operation Cost Savings (VOCS)										
LV		1,778.8	1,778.8	1,839.8				(61.0)		
Bus		6,355.6	6,355.6		6,512.1			(156.5)		
Truck		1,858.7	1,858.7			1,910.4		(51.7)		
Travel Time Cost Savings (TTCS)										
LV		923.8	923.8	923.8						
Bus		3,300.8	3,300.8		3,300.8					
Truck		965.3	965.3			965.3				
Ferry Waiting Time Savings (FWTS)										
LV		2,771.5	2,771.5	2,771.5						
Bus		9,902.8	9,902.8		9,902.8					
Truck		2,896.1	2,896.1			2,896.1				
Freight Value Deterioration Savings (FVDS)		6.9	6.9			6.9				
Ferry Operation and Maintenance Cost Savings (FOMS)		7,171.7	7,171.7					7,171.7		
Utility Facility Benefit (UF)		329.0	329.0				329.0			
Land Value Enhancement Benefit (LVE)		1,731.1	1,731.1							1,731.1
Residual Value										
Revenues										
Toll Revenues										
LV	2,461.8	2,461.8	0.0	0.0						
Bus	17,871.1	17,871.1	0.0		0.0					
Truck	6,260.3	6,260.3	0.0			0.0				
Utility Tariff Revenues	19.8		(19.8)				(19.8)			
Railway Charge	226.9		(226.9)						(226.9)	
Foreign Loan	22,664.4		(22,664.4)					(22,664.4)		
Government Expenditure	10,885.7		(10,885.7)					(10,885.7)		
Total Benefits	**60,389.9**	**66,585.3**	**6,195.4**	**5,535.1**	**19,715.7**	**5,778.7**	**309.2**	**(26,647.5)**	**(226.9)**	**1,731.1**
Initial Investment Costs										
Construction (Bridge, approach roads and river training)	(29,954.6)	(33,663.0)	(3,708.4)					(3,708.4)		
Land acquisition	(2,868.9)	(2,868.9)	0.0					0.0		
Technical assistance (Detailed design and tendering)	(726.5)	(726.5)	0.0					0.0		
Operation and Maintenance Costs	(1,353.0)	(1,353.0)	0.0					0.0		
Total Costs	**(34,903.0)**	**(38,611.4)**	**(3,708.4)**	**0.0**	**0.0**	**0.0**	**0.0**	**(3,708.4)**	**0.0**	**0.0**
Net Benefits	**25,486.9**	**27,973.9**	**2,487.0**	**5,535.1**	**19,715.7**	**5,778.7**	**309.2**	**(30,355.9)**	**(226.9)**	**1,731.1**
Proportion of the Poor				0.234	0.554	0.112	0.100	0.100	0.100	0.428
Net Benefits for the Poor				1,295.2	10,922.5	647.2	30.9	(3,035.6)	(22.7)	740.9
Total Benefit to the Poor			**10,578.5**							
Poverty Impact Ratio			**4.25**							

Note: For the definition of each benefit, see Section 9.1.
Figures in braket indicate negative values.
Assumptions:
Evaluation Period: 40 years
Total Project Cost: 1,257 million US$ (2004 price)
Amount of Foreign Loan: 880 million US$ (70% of Total project cost), GOB funded: 377 million US$ (30% of Total project cost)

Table 11.5.2 Results of Distribution and Poverty Impact Analysis (Pessimistic Case)

Unit: million Taka

Item	Financial PV at 12 %	Economic PV at 12%	Economic minus Financial	Light Vehicle Passengers	Bus Passengers	Truckers	Utility (Power, Telephone & Gas) Companies	Government (and rest of economy)	Railway Operators	Locality
Benefits										
Vehicle Operation Cost Savings (VOCS)										
LV		1,778.8	1,778.8	1,839.8				(61.0)		
Bus		6,355.6	6,355.6		6,512.1			(156.5)		
Truck		1,858.7	1,858.7			1,910.4		(51.7)		
Travel Time Cost Savings (TTCS)										
LV		923.8	923.8	923.8						
Bus		3,300.8	3,300.8		3,300.8					
Truck		965.3	965.3			965.3				
Ferry Waiting Time Savings (FWTS)										
LV		2,771.5	2,771.5	2,771.5						
Bus		9,902.8	9,902.8		9,902.8					
Truck		2,896.1	2,896.1			2,896.1				
Freight Value Deterioration Savings (FVDS)		6.9	6.9			6.9				
Ferry Operation and Maintenance Cost Savings (FOMS)		7,171.7	7,171.7					7,171.7		
Utility Facility Benefit (UF)		329.0	329.0				329.0			
Land Value Enhancement Benefit (LVE)		1,731.1	1,731.1							1,731.1
Residual Value										
Revenues										
Toll Revenues										
LV	2,461.8	2,461.8	0.0	0.0						
Bus	17,871.1	17,871.1	0.0		0.0					
Truck	6,260.3	6,260.3	0.0			0.0				
Utility Tariff Revenues	19.8		(19.8)				(19.8)			
Railway Charge	226.9		(226.9)						(226.9)	
Foreign Loan	22,664.4		(22,664.4)					(22,664.4)		
Government Expenditure	10,885.7		(10,885.7)					(10,885.7)		
Total Benefits	**60,389.9**	**66,585.3**	**6,195.4**	**5,535.1**	**19,715.7**	**5,778.7**	**309.2**	**(26,647.5)**	**(226.9)**	**1,731.1**
Initial Investment Costs										
Construction (Bridge, approach roads and river training)	(29,954.6)	(33,663.0)	(3,708.4)					(3,708.4)		
Land acquisition	(2,868.9)	(2,868.9)	0.0					0.0		
Technical assistance (Detailed design and tendering)	(726.5)	(726.5)	0.0					0.0		
Operation and Maintenance Costs	(1,353.0)	(1,353.0)	0.0					0.0		
Total Costs	**(34,903.0)**	**(38,611.4)**	**(3,708.4)**	**0.0**	**0.0**	**0.0**	**0.0**	**(3,708.4)**	**0.0**	**0.0**
Net Benefits	**25,486.9**	**27,973.9**	**2,487.0**	**5,535.1**	**19,715.7**	**5,778.7**	**309.2**	**(30,355.9)**	**(226.9)**	**1,731.1**
Proportion of the Poor				0.234	0.554	0.112	0.288	0.288	0.288	0.428
Net Benefits for the Poor				1,295.2	10,922.5	647.2	89.0	(8,742.5)	(65.3)	740.9
Total Benefit to the Poor			**4,887.0**							
Poverty Impact Ratio			**1.97**							

Note: For the definition of each benefit, see Section 9.1.
Figures in braket indicate negative values.
Assumptions:
Evaluation Period: 40 years
Total Project Cost: 1,257 million US$ (2004 price)
Amount of Foreign Loan: 880 million US$ (70% of Total project cost), GOB funded: 377 million US$ (30% of Total project cost)

11.5.4 Conclusions

The result of distribution analysis shows that light vehicle passengers, bus passengers, truckers, utility companies and the locality gain from the Project whereas the Government would be the significant net loser. The Poverty Impact Ratio (PIR) for the Project was estimated as greater than unity (4.25), implying that the Project has an "ultra-pro-poor" nature and benefits accruing to the poor are more than significantly greater than their income share in GDP. Sensitivity analysis shows that the proportion of benefits to the poor will still be greater than unity even when applying pessimistic assumptions.

11.6 FISCAL AFFORDABILITY OF GOVERNMENT OF BANGLADESH

11.6.1 Objectives

The Project will require more than US1,200 million and it is anticipated that it will have a substantial impact on the government's budget. In this section, with an estimation of a statement of the direct impact of the Project on government expenditure flows, national affordability for this Project will be discussed in the context of investment possibilities for the nation as a whole.

11.6.2 Scope of Analysis

For the purpose of confirming the degree of financial burden on the government budget, a statement of the direct impact of the Project on government revenue and expenditure flows is being estimated. The Project will also have a direct effect on the availability of foreign exchange sources of the government, however; the analysis of burden on foreign exchange flow will not be conducted here as it was outside the scope of the TOR for this study.

As already explained, a road bridge with railway provision with extra-dozed girder type, may be recommended as a conceivable alternative for the Project and was selected for this analysis.

Additionally, based on the discussion presented in the financial evaluation, the most probable method of financing for the Project would be public financing by the Government of Bangladesh and international lenders. In this analysis, therefore, no other financing schemes such as public-private partnership will be considered.

11.6.3 Methodology

(1) Overall Methodology

Firstly, the degree of financial burden induced by: i) the operation and maintenance cost and ii) loan repayment of US$900 million will be calculated, referring to the level of toll revenue and other tariff revenues. The aim of this calculation is to confirm whether the revenue from the toll and other tariffs can cover the recurrent cost of the Project and to check the government's affordability for the recurrent cost due to the Project.

Secondly, possible financing schemes for the procurement of the local portion of US$400 million will be recommended, with reference to those in developed countries. As is often the case with large infrastructure projects, the biggest challenge is fund procurement during the construction and it always becomes a critical task for the success of projects. The development budget could be the main resource for this, but it is important to note that around 45% of the development budget is still supported by foreign aid and loans although the dependency ratio has tended to decrease more recently.

(2) Procedure of Analysis

First: Estimation of future stream of budgets

For the estimation of a future stream of government budgeting, a simple financial model was developed. The following outlines the procedure of the modeling:

Sub-step 1: the correlation between size of national budget (both Development and Non-Development) and GDP will be calculated. GDP is extrapolated applying an assumed future growth rate.

Sub-step 2: Development budget of MOC was estimated using the percentage share of the Development budget of MOC to that of the nation. The Non-Development budget of MOC was calculated in the same way.

Second: Calculation of repayment amount of loans

The total amount of funds necessary, yearly drawdown, amounts of loans by international lenders, condition of loans including interest rate, repayment and grace period were set out. Annual amounts of repayments of principal and interest, including interest during the construction period, by lenders were calculated throughout the total redemption period.

Third: Estimation of financial burden of annual O&M costs and annual repayment amount of loans

Annual operation and maintenance costs and annual loan repayment amounts were summed and the total amounts were compared with the annual revenues from the toll and other tariffs, in order to confirm the affordability in terms of recurrent cost of the Project.

Final: Considerations for financing schemes of initial investment cost during construction

Possible financing schemes for the procurement of the local portion of US$400 million will be recommended, with reference to those in developed countries.

11.6.4 Key Assumptions

(1) Foreign financing

As stated, the most probable method of financing for the Project would be public financing by the Bangladesh Government and international lenders. Based on the cost disbursement schedule shown in the economic evaluation, the loan disbursement profile for this analysis was assumed as follows:

Table 11.6.1 Loan Disbursement Profile (Assumed)

Unit: million US$, 2004 price

Fiscal Year	Lender A	Lender B	Lender C	Foreign Sub.Total	GOB Sub.Total	Total
2004-05						
2005-06						
2006-07					33.68	33.68
2007-08					33.68	33.68
2008-09					25.64	25.64
2009-10	45.00	45.00	45.00	135.00	39.58	174.58
2010-11	120.00	120.00	120.00	360.00	117.17	477.17
2011-12	70.00	70.00	70.00	210.00	69.32	279.32
2012-13	50.00	50.00	50.00	150.00	36.21	186.21
2013-14	8.26	8.26	8.26	24.78	21.78	46.55
Total	293.26	293.26	293.26	879.78	377.05	1,256.83

Source: Consultant's estimates.

It is assumed that 30 percent of total project cost, covering the local portion of the required investment, will be borne by the Bangladesh Government. The remainder of the required investment, 70% of total project cost, will be financed by international lenders in a similar manner to that for the Jamuna Bridge project.

Interest rate, repayment and grace period were assumed as follows:

Table 11.6.2 Conditions of Loan (Assumed)

Lender	Annual Interest (percent)	Pepayment Period (years)	Grace Period (years)	Repayment Method
Lender A	1.00	40	10	equal principal
Lender B	0.80	40	10	equal principal
Lender C	1.20	30	10	equal principal

With construction of the bridge starting in the year 2010, the first repayment of principal was assumed to be in the fiscal year 2019-20.

(2) Price Base and Exchange Rate

The analysis was undertaken at constant prices, with the price base assumed to be late 2004. Foreign exchange rates applied here are shown in the following table:

Table 11.6.3 Foreign Exchange Rates

Fiscal Year	Taka per US Dollar
1986-87	30.80
1987-88	31.20
1988-89	32.27
1989-90	32.93
1990-91	35.68
1991-92	38.15
1992-93	39.14
1993-94	40.00
1994-95	40.20
1995-96	40.84
1996-97	42.70
1997-98	45.46
1998-99	48.06
1999-00	50.31
2000-01	53.96
2001-02	57.43
2002-03	57.90
2003-04	58.94
2004-05	60.00

Note: Period average of Official Rates
Source: Bangladesh Bank Annual Report, IMF Annual Report

11.6.5 Results of Analysis

(1) Estimation of Future Stream of Budgets

Along with the methodology elaborated in the previous Section, a future stream of government budgets at national and ministry level (Ministry of Communication in this case), consisting of Development and Non-Development categories, was estimated throughout the redemption period. Tables 11.6.6 to 11.6.7 show the results of simulation.

(2) Calculation of Repayment Amount of Loans

Based on key assumptions, annual amounts of repayment of principal and interest including interest during the construction period by lenders were calculated throughout the total redemption period. Detailed results of estimation can be seen in Tables 11.6.8 to 11.6.10.

(3) Financial Burden of O&M cost and Loan Repayment

Together with i) the estimation results of annual operation and maintenance costs[8] and ii) the results of simulations regarding annual repayment of loan amounts based on the assumed disbursement schedule, the total amount of these financial burdens was firstly compared with the annual amount of revenues from tolls and other tariffs estimated in the section of financial evaluation. This was undertaken in order to confirm the affordability in terms of recurrent cost of the Project. Table 11.6.4 shows the results.

The results explicitly demonstrate that the Project will generate sufficient revenue to cover recurrent costs (O&M, loan repayment and interest during the construction). As a result, it can be concluded that affordability in terms of recurrent cost of the Project is confirmed.

[8] For more detail of cost estimation, see Chapter 11.

Table 11.6.4 Comparison of Recurrent Costs and Revenues

Unit: million US$

Fiscal Year	Operation & Maintenance Costs (1)	IDC (Interest During Construction)				Repayment				Total Burden (1)+(2)+(3) =(4)	Revenue from Bridge Toll and Other Tariffs (5)	Surplus (5)-(4)
		Lender A	Lender B	Lender C	Sub.Total (2)	Lender A	Lender B	Lender C	Sub.Total (3)			
2004-05												
2005-06												
2006-07												
2007-08												
2008-09												
2009-10		0.45	0.36	0.54	1.35					1.35		(1.35)
2010-11		1.65	1.32	1.98	4.95					4.95		(4.95)
2011-12		2.35	1.88	2.82	7.05					7.05		(7.05)
2012-13		2.85	2.28	3.42	8.55					8.55		(8.55)
2013-14		2.93	2.35	3.52	8.80					8.80		(8.80)
2014-15	11.16	2.93	2.35	3.52	8.80					19.96	100.96	81.00
2015-16	11.16	2.93	2.35	3.52	8.80					19.96	107.80	87.84
2016-17	11.16	2.93	2.35	3.52	8.80					19.96	115.11	95.15
2017-18	11.16	2.93	2.35	3.52	8.80					19.96	122.94	102.98
2018-19	11.16	2.93	2.35	3.52	8.80					19.96	131.30	111.34
2019-20	6.70					12.71	12.12	18.18	43.01	49.71	140.25	90.54
2020-21	6.70					12.61	12.04	18.01	42.66	49.36	149.82	100.46
2021-22	6.70					12.51	11.96	17.83	42.31	49.00	160.05	111.04
2022-23	6.70					12.41	11.89	17.65	41.96	48.65	171.00	122.34
2023-24	6.70					12.32	11.81	17.48	41.60	48.30	182.70	134.40
2024-25	6.70					12.22	11.73	17.30	41.25	47.95	195.22	147.27
2025-26	6.70					12.12	11.65	17.13	40.90	47.60	208.62	161.02
2026-27	6.70					12.02	11.57	16.95	40.55	47.24	222.94	175.70
2027-28	6.70					11.93	11.50	16.77	40.20	46.89	238.27	191.38
2028-29	6.70					11.83	11.42	16.60	39.84	46.54	254.66	208.12
2029-30	6.70					11.73	11.34	16.42	39.49	46.19	272.20	226.01
2030-31	6.70					11.63	11.26	16.25	39.14	45.84	290.96	245.12
2031-32	6.70					11.53	11.18	16.07	38.79	45.49	311.03	265.54
2032-33	6.70					11.44	11.10	15.89	38.44	45.13	332.50	287.37
2033-34	6.70					11.34	11.03	15.72	38.08	44.78	337.78	293.00
2034-35	6.70					11.24	10.95	15.54	37.73	44.43	337.78	293.35
2035-36	6.70					11.14	10.87	15.37	37.38	44.08	337.78	293.70
2036-37	6.70					11.05	10.79	15.19	37.03	43.73	337.78	294.05
2037-38	6.70					10.95	10.71	15.01	36.68	43.37	337.78	294.41
2038-39	6.70					10.85	10.64	14.84	36.33	43.02	337.78	294.76
2039-40	6.70					10.75	10.56		21.31	28.01	337.78	309.77
2040-41	6.70					10.66	10.48		21.13	27.83	337.78	309.95
2041-42	6.70					10.56	10.40		20.96	27.65	337.78	310.13
2042-43	6.70					10.46	10.32		20.78	27.48	337.78	310.30
2043-44	6.70					10.36	10.24		20.61	27.30	337.78	310.48
2044-45	8.93					10.26	10.17		20.43	29.36	337.78	308.42
2045-46	8.93					10.17	10.09		20.25	29.18	337.78	308.60
2046-47	8.93					10.07	10.01		20.08	29.01	337.78	308.77
2047-48	8.93					9.97	9.93		19.90	28.83	337.78	308.95
2048-49	8.93					9.87	9.85		19.73	28.66	337.78	309.12
Total	267.87	24.90	19.92	29.87	74.69	338.71	329.62	330.21	998.55	1,341.10	9,112.80	7,771.70

Note: at 2004 prices
Loan disbursement schedule is subject to change.

Assumptions:
Detailed Design Period: 2006 to 2009
Construction Period: 2010 to 2014
Bridge Open: 2015

(4) Considerations for Financing Schemes of Initial Investment Cost during Construction

Possible financing schemes for the procurement of the local portion of US$400 million will be recommended, with reference to those in developed countries. Financial resources for capital investments in infrastructure projects are usually raised through combinations of various financial sources. For reference, the cases of Mass transit railway construction in European countries and the U.S. are shown in Table 11.6.5. The general fund sources are summarized as follows:

Capital Contributions

The capital investment by project implementing entities, whose shares are usually owned by the central and/or local governments, is an important source of direct investment. However, the amount of investment from this capital alone is often not enough to meet the entire initial investment requirement.

Bonds

The project implementing entities and/or related public authorities can possibly issue bonds to finance their investment fund. However, a bond issue is effective for those cases in which the operating income or increment of property value can be obtained. In general, bond issues for constructing infrastructure is not easy in developing countries because of fund shortages.

Private Bank Loans

Loans from private banks are available. However, in Bangladesh loans from these banks are very difficult for the improvement of infrastructure since inflation rate and interest rate are very high. Basically, private banks cannot foresee lending for long-term projects.

Subsidies

The central and local government subsidies are often an important financial resource for capital investment. As shown in Table 11.6.5, subsidies cover the major portion of cost to construct transport infrastructures. In the case of England, approximately 80% of subway construction costs in 1995/96 were financed by central government subsidies. The ratio was almost the same in the case of metro construction in Ile de France region. In Germany, 40% of urban railway construction costs have been financed by central government subsidies. However, considering the depressed Bangladesh economy, it would be difficult for government or Municipality to provide relatively large subsidies to the Project.

Earmarked Tax

Earmarked taxes, such as fuel taxes, are generally used for road construction and maintenance. However, in Germany and the US, some of those revenues are legally admitted for use in urban railway construction. Other types of earmarked revenues, such as road traffic and parking fines, are used to improve pedestrian facilities to connect different transport modes in Ile de France region. The introduction of these taxation methods will become important in the future.

Value Capture

As another way of raising funds for capital investment, value capture methods, such as property tax, development tax, etc. can be carried out. In the case of the US, the method called Tax Incremental Financing (TIF) is adopted on the West Coast. This method involves issuance of bonds to cover construction costs based on an increase in property tax revenues in the station area. Japanese private urban railway companies have engaged in diversified business operations including real estate development. However, prudent examination is necessary before introducing this method, since it is not easy to determine the size of benefits.

In the case of Padma Bridge, issuing government bonds that are guaranteed by the future toll revenue of the bridge is considered as a practical financing method for the procurement of the local portion of US$400 million. As explained in the previous Section, the Project

will generate financial surplus sufficient to cover the recurrent costs (O&M, loan repayment and interest during construction) and the surplus can be utilized for financing. Of course the bond issue for infrastructure projects in developing countries is quite difficult, but detailed consideration of this would be worthwhile.

Table 11.6.5 Financial Resources for Urban Mass Transit Railway in Developed Countries

Measures to Secure Financial Resources	England	France	Germany	U.S.A.
Fare Revenue (accumulated funds, internal reserves)	Covers only part of operation cost, not for repayment of initial construction cost	Covers only part of operation cost, not for repayment of initial construction cost	Covers only part of operation cost, not for repayment of initial construction cost	Covers only part of operation cost, not for repayment of initial construction cost
Subsidy from Governmental General Account (general tax revenue)	London Regional Transport receives subsidy from national general fund.. Subsidy from national government covers majority of capital investment.	Subsidies from general account of central, regional, and local government for both construction and operation.	A part of construction cost is covered by general accounts of central and local governments.	Both construction and operation are covered by general accounts of federal, state, and local governments.
Subsidy from Governmental Special Account (earmarked tax revenue, i.e. oil tax, car registration tax, consumption tax, property tax, area licensing tax, other various surcharges)	No earmarking revenue exists. A residential tax increase was proposed to reduce public transport fares in London (1981), but rejected as illegal.	Fare discounts are compensated by payroll charges from private companies in Paris and local cities. Local additional taxes are temporarily collected for improvement and construction of station in Paris and local cities.	Oil tax (national tax) is earmarked by Local Transport Subsidy Act. Oil tax is appropriated as subsidy for operation costs by Local Decentralization Act. Increased revenue of oil tax has been allocated to repayment of railway debt since 1994.	Rule of diversion of gas tax (road construction fund) to railway based on ISTEA, 1991. Los Angels City raised fund from special benefit tax with SAD. Los Angels County raised fund from increased revenue of sales tax by local referendum.
Collection of Indirect Development Benefit (i.e. development charge, connecting passage construction charge, special assessment district (SAD), tax increment financing (TIF), internalization of development profit by real estate development, etc.)	None	None	None	Los Angels City collected tax from business alongside railway as a special benefit tax (tax from special assessment district, SAD).
Fund Raising (governmental soft loan, bond issue, overseas aid organization loan, special business revenues)	None	Regional government supplies low-interest loan to operators.	None	Various kinds of bonds were issued in New York (revenue bind, collateral bond for railway facilities). State railway bonds were issued in Los Angels by local referendum.

Source: Research Institute of Development Assistance, the Overseas Economic Cooperation Fund, "Urban Railway Projects in Bangkok: Measures for Securing Financial Resources" August 1998

Note: Special Assessment District (SAD) in the U.S. is the district approved by the state law, where indirect development benefits are levied based on the assessment of the local public transport development

Table 11.6.6 Future Steam of Non-Development Budgets (Projected)

Year	Fiscal Year	GDP (95 price, million Taka)	Budget (Non-Dev.+ Dev.) (95 price, million Taka) **1	Non-Development Budget (95 price, million Taka)**2	MOC Non-Development Budget (95 price, million Taka)**3	MOC Non-Development Budget (04 price, million Taka)**4	MOC Non-Development Budget (04 price, million US$)**5
1	2004-05	2,560,581	468,806	302,324	9,623	13,114	218.56
2	2005-06	2,699,155	494,177	318,685	10,144	13,823	230.39
3	2006-07	2,845,279	520,930	335,937	10,693	14,572	242.86
4	2007-08	2,999,368	549,142	354,131	11,272	15,361	256.01
5	2008-09	3,161,859	578,891	373,316	11,883	16,193	269.88
6	2009-10	3,333,213	610,264	393,547	12,527	17,071	284.51
7	2010-11	3,513,918	643,348	414,883	13,206	17,996	299.93
8	2011-12	3,704,487	678,239	437,383	13,922	18,972	316.20
9	2012-13	3,905,462	715,035	461,112	14,678	20,001	333.35
10	2013-14	4,117,416	753,840	486,137	15,474	21,087	351.44
11	2014-15	4,340,953	794,767	512,529	16,314	22,231	370.52
12	2015-16	4,576,711	837,931	540,365	17,200	23,439	390.65
13	2016-17	4,825,362	883,455	569,723	18,135	24,712	411.87
14	2017-18	5,087,617	931,470	600,687	19,120	26,055	434.26
15	2018-19	5,364,225	982,113	633,345	20,160	27,472	457.87
16	2019-20	5,655,978	1,035,529	667,792	21,256	28,966	482.77
17	2020-21	5,963,710	1,091,870	704,125	22,413	30,542	509.04
18	2021-22	6,288,303	1,151,299	742,450	23,633	32,205	536.74
19	2022-23	6,630,687	1,213,985	782,874	24,920	33,958	565.97
20	2023-24	6,991,846	1,280,107	825,516	26,277	35,808	596.79
21	2024-25	7,372,814	1,349,857	870,496	27,709	37,759	629.31
22	2025-26	7,774,687	1,423,435	917,945	29,219	39,817	663.61
23	2026-27	8,198,621	1,501,051	967,998	30,812	41,988	699.80
24	2027-28	8,645,833	1,582,929	1,020,799	32,493	44,278	737.97
25	2028-29	9,117,613	1,669,305	1,076,502	34,266	46,694	778.24
26	2029-30	9,615,318	1,760,428	1,135,265	36,137	49,243	820.72
27	2030-31	10,140,384	1,856,560	1,197,259	38,110	51,932	865.54
28	2031-32	10,694,325	1,957,979	1,262,661	40,192	54,769	912.82
29	2032-33	11,278,740	2,064,977	1,331,662	42,388	57,762	962.70
30	2033-34	11,895,318	2,177,863	1,404,461	44,705	60,920	1,015.33
31	2034-35	12,545,840	2,296,965	1,481,267	47,150	64,251	1,070.86
32	2035-36	13,232,189	2,422,626	1,562,303	49,730	67,767	1,129.44
33	2036-37	13,956,351	2,555,209	1,647,804	52,451	71,475	1,191.25
34	2037-38	14,720,424	2,695,100	1,738,016	55,323	75,388	1,256.47
35	2038-39	15,526,621	2,842,704	1,833,203	58,353	79,517	1,325.28
36	2039-40	16,377,283	2,998,447	1,933,639	61,550	83,874	1,397.89
37	2040-41	17,274,876	3,162,784	2,039,616	64,923	88,470	1,474.51
38	2041-42	18,222,009	3,336,191	2,151,443	68,482	93,321	1,555.35
39	2042-43	19,221,433	3,519,171	2,269,443	72,239	98,439	1,640.66
40	2043-44	20,276,056	3,712,257	2,393,961	76,202	103,841	1,730.68
41	2044-45	21,388,945	3,916,012	2,525,358	80,385	109,540	1,825.67
42	2045-46	22,563,342	4,131,027	2,664,017	84,798	115,555	1,925.91
43	2046-47	23,802,668	4,357,930	2,810,342	89,456	121,902	2,031.69
44	2047-48	25,110,536	4,597,382	2,964,760	94,371	128,600	2,143.33
45	2048-49	26,490,762	4,850,082	3,127,721	99,558	135,668	2,261.14
46	2049-50	27,947,375	5,116,767	3,299,701	105,033	143,128	2,385.47
47	2050-51	29,484,630	5,398,216	3,481,202	110,810	151,001	2,516.68
48	2051-52	31,107,020	5,695,253	3,672,755	116,907	159,310	2,655.16
49	2052-53	32,819,289	6,008,745	3,874,920	123,342	168,079	2,801.31
50	2053-54	34,626,449	6,339,610	4,088,288	130,134	177,334	2,955.56
51	2054-55	36,533,790	6,688,817	4,313,485	137,302	187,102	3,118.37
52	2055-56	38,546,902	7,057,390	4,551,170	144,868	197,412	3,290.20
53	2056-57	40,671,686	7,446,407	4,802,039	152,854	208,293	3,471.56
54	2057-58	42,914,375	7,857,012	5,066,830	161,282	219,779	3,662.98
55	2058-59	45,281,551	8,290,408	5,346,319	170,178	231,902	3,865.04
56	2059-60	47,780,166	8,747,869	5,641,326	179,569	244,698	4,078.31
57	2060-61	50,417,562	9,230,738	5,952,719	189,481	258,205	4,303.42
58	2061-62	53,201,494	9,740,437	6,281,413	199,943	272,463	4,541.05

Note 1 18.31% of GDP
Note 2 64.49% of Total Budget (Non-Development Budget + Development Budget)
Note 3 3.18% of National Non-Development Budget
Note 4 1.3627 times of 95 price
Note 5 1US$= 60 Taka
Estimated by the Study Team

Table 11.6.7 Future Steam of Development Budgets (Projected)

Year	Fiscal Year	GDP (95 price, million Taka)	Budget (Non-Dev.+ Dev.) (95 price, million Taka) **1	Development Budget (95 price, million Taka)**2	MOC Development Budget (95 price, million Taka)**3	MOC Development Budget (04 price, million Taka)**4	MOC Development Budget (04 price, million US$)**5
1	2004-05	2,560,581	468,806	166,482	27,905	38,026	633.77
2	2005-06	2,699,155	494,177	175,492	29,415	40,084	668.07
3	2006-07	2,845,279	520,930	184,993	31,008	42,254	704.23
4	2007-08	2,999,368	549,142	195,011	32,687	44,542	742.37
5	2008-09	3,161,859	578,891	205,576	34,458	46,955	782.59
6	2009-10	3,333,213	610,264	216,717	36,325	49,500	825.00
7	2010-11	3,513,918	643,348	228,466	38,294	52,184	869.73
8	2011-12	3,704,487	678,239	240,856	40,371	55,014	916.89
9	2012-13	3,905,462	715,035	253,923	42,561	57,998	966.64
10	2013-14	4,117,416	753,840	267,704	44,871	61,146	1,019.10
11	2014-15	4,340,953	794,767	282,238	47,307	64,466	1,074.43
12	2015-16	4,576,711	837,931	297,566	49,876	67,967	1,132.78
13	2016-17	4,825,362	883,455	313,733	52,586	71,659	1,194.32
14	2017-18	5,087,617	931,470	330,784	55,444	75,554	1,259.23
15	2018-19	5,364,225	982,113	348,768	58,459	79,662	1,327.69
16	2019-20	5,655,978	1,035,529	367,737	61,638	83,994	1,399.91
17	2020-21	5,963,710	1,091,870	387,745	64,992	88,564	1,476.07
18	2021-22	6,288,303	1,151,299	408,849	68,529	93,385	1,556.41
19	2022-23	6,630,687	1,213,985	431,110	72,260	98,469	1,641.16
20	2023-24	6,991,846	1,280,107	454,592	76,196	103,833	1,730.55
21	2024-25	7,372,814	1,349,857	479,361	80,348	109,490	1,824.84
22	2025-26	7,774,687	1,423,435	505,490	84,728	115,458	1,924.31
23	2026-27	8,198,621	1,501,051	533,053	89,348	121,754	2,029.23
24	2027-28	8,645,833	1,582,929	562,130	94,221	128,395	2,139.92
25	2028-29	9,117,613	1,669,305	592,804	99,363	135,402	2,256.69
26	2029-30	9,615,318	1,760,428	625,163	104,787	142,793	2,379.88
27	2030-31	10,140,384	1,856,560	659,301	110,509	150,590	2,509.84
28	2031-32	10,694,325	1,957,979	695,317	116,546	158,817	2,646.94
29	2032-33	11,278,740	2,064,977	733,314	122,914	167,495	2,791.59
30	2033-34	11,895,318	2,177,863	773,403	129,634	176,652	2,944.20
31	2034-35	12,545,840	2,296,965	815,698	136,723	186,313	3,105.21
32	2035-36	13,232,189	2,422,626	860,323	144,203	196,505	3,275.09
33	2036-37	13,956,351	2,555,209	907,406	152,095	207,259	3,454.32
34	2037-38	14,720,424	2,695,100	957,084	160,421	218,606	3,643.44
35	2038-39	15,526,621	2,842,704	1,009,501	169,207	230,579	3,842.98
36	2039-40	16,377,283	2,998,447	1,064,809	178,478	243,212	4,053.53
37	2040-41	17,274,876	3,162,784	1,123,168	188,260	256,541	4,275.69
38	2041-42	18,222,009	3,336,191	1,184,748	198,581	270,607	4,510.11
39	2042-43	19,221,433	3,519,171	1,249,728	209,473	285,449	4,757.48
40	2043-44	20,276,056	3,712,257	1,318,297	220,966	301,111	5,018.51
41	2044-45	21,388,945	3,916,012	1,390,654	233,094	317,638	5,293.96
42	2045-46	22,563,342	4,131,027	1,467,010	245,893	335,078	5,584.63
43	2046-47	23,802,668	4,357,930	1,547,588	259,399	353,483	5,891.38
44	2047-48	25,110,536	4,597,382	1,632,622	273,652	372,905	6,215.09
45	2048-49	26,490,762	4,850,082	1,722,361	288,693	393,402	6,556.71
46	2049-50	27,947,375	5,116,767	1,817,066	304,567	415,034	6,917.23
47	2050-51	29,484,630	5,398,216	1,917,014	321,320	437,863	7,297.72
48	2051-52	31,107,020	5,695,253	2,022,498	339,001	461,956	7,699.27
49	2052-53	32,819,289	6,008,745	2,133,825	357,661	487,384	8,123.07
50	2053-54	34,626,449	6,339,610	2,251,322	377,355	514,222	8,570.36
51	2054-55	36,533,790	6,688,817	2,375,332	398,141	542,547	9,042.45
52	2055-56	38,546,902	7,057,390	2,506,220	420,080	572,443	9,540.71
53	2056-57	40,671,686	7,446,407	2,644,368	443,235	603,997	10,066.61
54	2057-58	42,914,375	7,857,012	2,790,182	467,676	637,302	10,621.70
55	2058-59	45,281,551	8,290,408	2,944,089	493,473	672,456	11,207.60
56	2059-60	47,780,166	8,747,869	3,106,543	520,703	709,562	11,826.03
57	2060-61	50,417,562	9,230,738	3,278,019	549,445	748,728	12,478.81
58	2061-62	53,201,494	9,740,437	3,459,023	579,784	790,071	13,167.86

Note 1 18.31% of GDP
Note 2 35.51% of Total Budget (Non-Development Budget + Development Budget)
Note 3 16.76% of National Development Budget
Note 4 1.3627 times of 95 price
Note 5 1US$= 60 Taka
Estimated by the Study Team

Table 11.6.8 Repayment Amount of Loans (Lender A)

Lender: Lender A
Loan Period: 40 Years including Grace Period
Grace Period: 10 Years
Interest Rate: 1.00 per cent per year
Total Draw Down: 293.26 million US$

Year	Fiscal Year	Draw Down	Loan Disbursement (mil. US$)	Repayment Year	Principal Loan (mil. US$)	Principal Payment (mil.US$)	Principal Loan Left (mil.US$)	Interest Payment (mil.US$)	Debt Service (mil.US$)
	2004-05								
	2005-06								
	2006-07								
	2007-08								
	2008-09								
1	2009-10	1	45.00						
2	2010-11	2	120.00						
3	2011-12	3	70.00						
4	2012-13	4	50.00						
5	2013-14	5	8.26						
6	2014-15	6	0.00						
7	2015-16	7	0.00						
8	2016-17	8	0.00						
9	2017-18	9	0.00						
10	2018-19	10	0.00						
11	2019-20			1	293.26	9.78	283.48	2.93	12.71
12	2020-21			2	283.48	9.78	273.71	2.83	12.61
13	2021-22			3	273.71	9.78	263.93	2.74	12.51
14	2022-23			4	263.93	9.78	254.16	2.64	12.41
15	2023-24			5	254.16	9.78	244.38	2.54	12.32
16	2024-25			6	244.38	9.78	234.61	2.44	12.22
17	2025-26			7	234.61	9.78	224.83	2.35	12.12
18	2026-27			8	224.83	9.78	215.06	2.25	12.02
19	2027-28			9	215.06	9.78	205.28	2.15	11.93
20	2028-29			10	205.28	9.78	195.51	2.05	11.83
21	2029-30			11	195.51	9.78	185.73	1.96	11.73
22	2030-31			12	185.73	9.78	175.96	1.86	11.63
23	2031-32			13	175.96	9.78	166.18	1.76	11.53
24	2032-33			14	166.18	9.78	156.40	1.66	11.44
25	2033-34			15	156.40	9.78	146.63	1.56	11.34
26	2034-35			16	146.63	9.78	136.85	1.47	11.24
27	2035-36			17	136.85	9.78	127.08	1.37	11.14
28	2036-37			18	127.08	9.78	117.30	1.27	11.05
29	2037-38			19	117.30	9.78	107.53	1.17	10.95
30	2038-39			20	107.53	9.78	97.75	1.08	10.85
31	2039-40			21	97.75	9.78	87.98	0.98	10.75
32	2040-41			22	87.98	9.78	78.20	0.88	10.66
33	2041-42			23	78.20	9.78	68.43	0.78	10.56
34	2042-43			24	68.43	9.78	58.65	0.68	10.46
35	2043-44			25	58.65	9.78	48.88	0.59	10.36
36	2044-45			26	48.88	9.78	39.10	0.49	10.26
37	2045-46			27	39.10	9.78	29.33	0.39	10.17
38	2046-47			28	29.33	9.78	19.55	0.29	10.07
39	2047-48			29	19.55	9.78	9.78	0.20	9.97
40	2048-49			30	9.78	9.78	0.00	0.10	9.87
Total			293.26			293.26		45.46	338.71

Source: Consultant's estimates

Table 11.6.9 Repayment Amount of Loans (Lender B)

Lender: Lender B
Loan Period: 40 Years including Grace Period
Grace Period: 10 Years
Interest Rate: 0.80 per cent per year
Total Draw Down: 293.26 million US$

Year	Fiscal Year	Draw Down	Loan Disbursement (mil. US$)	Repayment Year	Principal Loan (mil. US$)	Principal Payment (mil.US$)	Principal Loan Left (mil.US$)	Interest Payment (mil.US$)	Debt Service (mil.US$)
	2004-05								
	2005-06								
	2006-07								
	2007-08								
	2008-09								
1	2009-10	1	45.00						
2	2010-11	2	120.00						
3	2011-12	3	70.00						
4	2012-13	4	50.00						
5	2013-14	5	8.26						
6	2014-15	6	0.00						
7	2015-16	7	0.00						
8	2016-17	8	0.00						
9	2017-18	9	0.00						
10	2018-19	10	0.00						
11	2019-20			1	293.26	9.78	283.48	2.35	12.12
12	2020-21			2	283.48	9.78	273.71	2.27	12.04
13	2021-22			3	273.71	9.78	263.93	2.19	11.96
14	2022-23			4	263.93	9.78	254.16	2.11	11.89
15	2023-24			5	254.16	9.78	244.38	2.03	11.81
16	2024-25			6	244.38	9.78	234.61	1.96	11.73
17	2025-26			7	234.61	9.78	224.83	1.88	11.65
18	2026-27			8	224.83	9.78	215.06	1.80	11.57
19	2027-28			9	215.06	9.78	205.28	1.72	11.50
20	2028-29			10	205.28	9.78	195.51	1.64	11.42
21	2029-30			11	195.51	9.78	185.73	1.56	11.34
22	2030-31			12	185.73	9.78	175.96	1.49	11.26
23	2031-32			13	175.96	9.78	166.18	1.41	11.18
24	2032-33			14	166.18	9.78	156.40	1.33	11.10
25	2033-34			15	156.40	9.78	146.63	1.25	11.03
26	2034-35			16	146.63	9.78	136.85	1.17	10.95
27	2035-36			17	136.85	9.78	127.08	1.09	10.87
28	2036-37			18	127.08	9.78	117.30	1.02	10.79
29	2037-38			19	117.30	9.78	107.53	0.94	10.71
30	2038-39			20	107.53	9.78	97.75	0.86	10.64
31	2039-40			21	97.75	9.78	87.98	0.78	10.56
32	2040-41			22	87.98	9.78	78.20	0.70	10.48
33	2041-42			23	78.20	9.78	68.43	0.63	10.40
34	2042-43			24	68.43	9.78	58.65	0.55	10.32
35	2043-44			25	58.65	9.78	48.88	0.47	10.24
36	2044-45			26	48.88	9.78	39.10	0.39	10.17
37	2045-46			27	39.10	9.78	29.33	0.31	10.09
38	2046-47			28	29.33	9.78	19.55	0.23	10.01
39	2047-48			29	19.55	9.78	9.78	0.16	9.93
40	2048-49			30	9.78	9.78	0.00	0.08	9.85
Total			293.26			293.26		36.36	329.62

Source: Consultant's estimates

Table 11.6.10 Repayment Amount of Loans (Lender C)

Lender: Lender C
Loan Period: 30 Years including Grace Period
Grace Period: 10 Years
Interest Rate: 1.20 per cent per year
Total Draw Down: 293.26 million US$

Year	Fiscal Year	Draw Down	Loan Disbursement (mil. US$)	Repayment Year	Principal Loan (mil. US$)	Principal Payment (mil.US$)	Principal Loan Left (mil.US$)	Interest Payment (mil.US$)	Debt Service (mil.US$)
	2004-05								
	2005-06								
	2006-07								
	2007-08								
	2008-09								
1	2009-10	1	45.00						
2	2010-11	2	120.00						
3	2011-12	3	70.00						
4	2012-13	4	50.00						
5	2013-14	5	8.26						
6	2014-15	6	0.00						
7	2015-16	7	0.00						
8	2016-17	8	0.00						
9	2017-18	9	0.00						
10	2018-19	10	0.00						
11	2019-20			1	293.26	14.66	278.60	3.52	18.18
12	2020-21			2	278.60	14.66	263.93	3.34	18.01
13	2021-22			3	263.93	14.66	249.27	3.17	17.83
14	2022-23			4	249.27	14.66	234.61	2.99	17.65
15	2023-24			5	234.61	14.66	219.94	2.82	17.48
16	2024-25			6	219.94	14.66	205.28	2.64	17.30
17	2025-26			7	205.28	14.66	190.62	2.46	17.13
18	2026-27			8	190.62	14.66	175.96	2.29	16.95
19	2027-28			9	175.96	14.66	161.29	2.11	16.77
20	2028-29			10	161.29	14.66	146.63	1.94	16.60
21	2029-30			11	146.63	14.66	131.97	1.76	16.42
22	2030-31			12	131.97	14.66	117.30	1.58	16.25
23	2031-32			13	117.30	14.66	102.64	1.41	16.07
24	2032-33			14	102.64	14.66	87.98	1.23	15.89
25	2033-34			15	87.98	14.66	73.31	1.06	15.72
26	2034-35			16	73.31	14.66	58.65	0.88	15.54
27	2035-36			17	58.65	14.66	43.99	0.70	15.37
28	2036-37			18	43.99	14.66	29.33	0.53	15.19
29	2037-38			19	29.33	14.66	14.66	0.35	15.01
30	2038-39			20	14.66	14.66	0.00	0.18	14.84
31	2039-40			21					
32	2040-41			22					
33	2041-42			23					
34	2042-43			24					
35	2043-44			25					
36	2044-45			26					
37	2045-46			27					
38	2046-47			28					
39	2047-48			29					
40	2048-49			30					
Total			293.26			249.27		26.92	276.19

Source: Consultant's estimates

11.6.6 Conclusions

With regard to recurrent costs consisting of operation and maintenance cost, loan repayment of US$900 million and its interest after opening, the simulation result clearly shows that the Project will generate financial surplus to sufficiently cover the recurrent costs. Considering this, it can be concluded that the fiscal affordability in this regard is no longer in question.

On the other, looking at the rest of the project cost, which is a local portion of US$400 million to be procured by the Government of Bangladesh, it would be urgently required that the Government secure the initial investment amount by attempting to provide a variety of financing resources. The development budget could be the main resource for this, but it is a fact that around 45% of the development budget is still supported by foreign aid and loans, although the dependency ratio has tended to decrease nowadays. In this section, possible financing schemes will be recommended with reference to those in developed countries.

11.7 CONCLUSIONS AND SUGGESTIONS FOR REALIZATION OF IMPACTS

11.7.1 Concluding Remarks

1) Padma Bridge will generate remarkable impacts for the entire country of Bangladesh and contribute to economic development of the Southwest Region by eliminating the bottleneck of Padma River crossings.

2) Results of simulation using the Input-Output Table 2000 indicates that the multiplier effects of construction of Padma Bridge and increase in the demands of the transport sector in the Southwest Region will push up GDP by 1.2% in total.

3) In the context of international transport between surrounding counties, Bangladesh is strategically situated to provide essential international links to neighboring countries. At the same time, the proposed Padma Bridge is also situated at the best location to form an international road network providing strong links along Asian Highway A-1. If rail provision on Padma Bridge is effectively connected with the existing railway network, as proposed by Bangladesh Railway, Padma Bridge can contribute to the formation of a multi-modal international transport network for the Eastern Region of the Indian Subcontinent and will have the possibility of providing transit routes for India to its eastern states (Seven Sisters).

4) Poverty impact analysis of Padma Bridge shows that the major portion of direct benefits will go to the poor with the Poverty Impact Ratio (PIR) ranging between 1.97 and 4.25. This result reflects the actual situation that passengers currently crossing Padma River by launch will divert to bus services on Padma Bridge (proportion of poor is about 55%).

5) Regarding fiscal affordability of the Government of Bangladesh for the implementation of the Project, the simulation results shows that the Project will generate financial surplus to sufficiently cover the recurrent costs (operation and maintenance cost, loan repayment and interest during the construction). However, the local portion of US$ 400 million for the initial investment should be generated from the Government's development budget. Issuing government bonds that are guaranteed by the future toll revenue of the bridge may be one of practical methods for procurement of the local portion.

11.7.2 Suggestions for Realization of Impacts

The regional development impacts of the Padma Bridge will not be realized only by the construction of the Bridge. Some supporting policies through Government initiatives are necessary to realize those impacts. In order to realize and promote the impacts on national and regional development by Padma Bridge, the following actions are recommended to be taken by the Government of Bangladesh:

1) Promotion of construction/ improvement of regional highways and feeder road network to be well connected with the Bridge so the benefits of the Bridge can extend over rural areas

2) To make use of the Service Area effectively as a "Roadway Station (Michi no Eki)"along the approach roads for revitalization of associated rural areas

3) Promotion of private investment and to attract industries and commercial facilities to the associated rural areas

5) As recommended in ADB's Jamuna Bridge Impact Study, it is also proposed that the Padma Bridge provides shuttle services at a lower cost across the Bridge connecting the two major points on both sides of the Bridge so that the poor are better able to afford the crossing.

Chapter 12 Implementation Program

12.1 DESCRIPTION

In this Study, International Competitive Bidding (ICB) is considered for the procurement method of implementation.

This chapter describes the implementation scheme, procurement methods, required activities and implementation schedule towards the completion of the Project. The operation and maintenance arrangement for post-construction period is discussed in the subsequent Chapter 13.

12.2 GENERAL FLOW OF IMPLEMENTATION SCHEME

This section outlines the general flow of the implementation scheme of the Project following this JICA feasibility study. It is noted that ADB is scheduled to conduct an "ADB TA" in the year 2005/2006, a supplementary study to this JICA feasibility study.

The implementation scheme for the construction of the Padma Bridge contains the following steps ranging from the GOB's approval of the Project to the completion of the construction.

1) GOB's approval of the Project: The Project would have to be approved through PCP (Project Concept Paper) and PP (Project Proforma).
2) Financial arrangement: The funds required for the design, LAP, RAP and EMP and construction would have to be provided for both foreign and local currency portions.
3) Preparation, finalization and execution of LAP, RAP and EMP
4) Design: The Owner would have to procure design firm(s) for the facility designs of the Project.
5) Construction: The Owner would have to procure construction firm(s) and consulting firm(s) for the construction of the facilities of the Project.

Regarding items 4) and 5) above, two different contracting methods are examined for the future implementation of the Project: Conventional Contracting in which the design and construction are executed by different entities, and Design-Build, in which the design and construction are executed by the same entity.

The general flow of the Conventional Contracting method is shown in Figure 12.2.1 and that of Design-Build is in Figure 12.2.2.

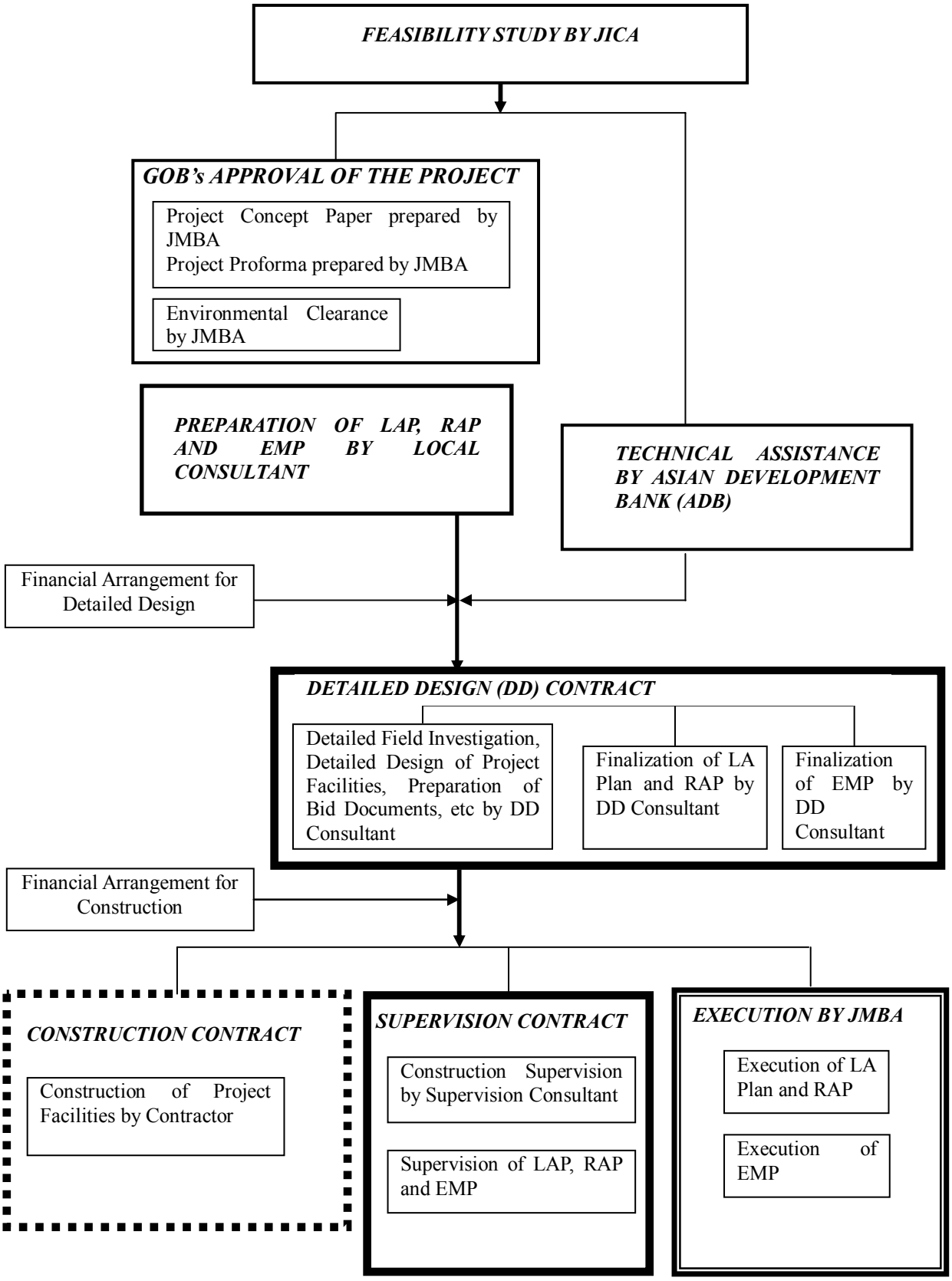


Figure 12.2.1 General Flow of Conventional Contracting Method

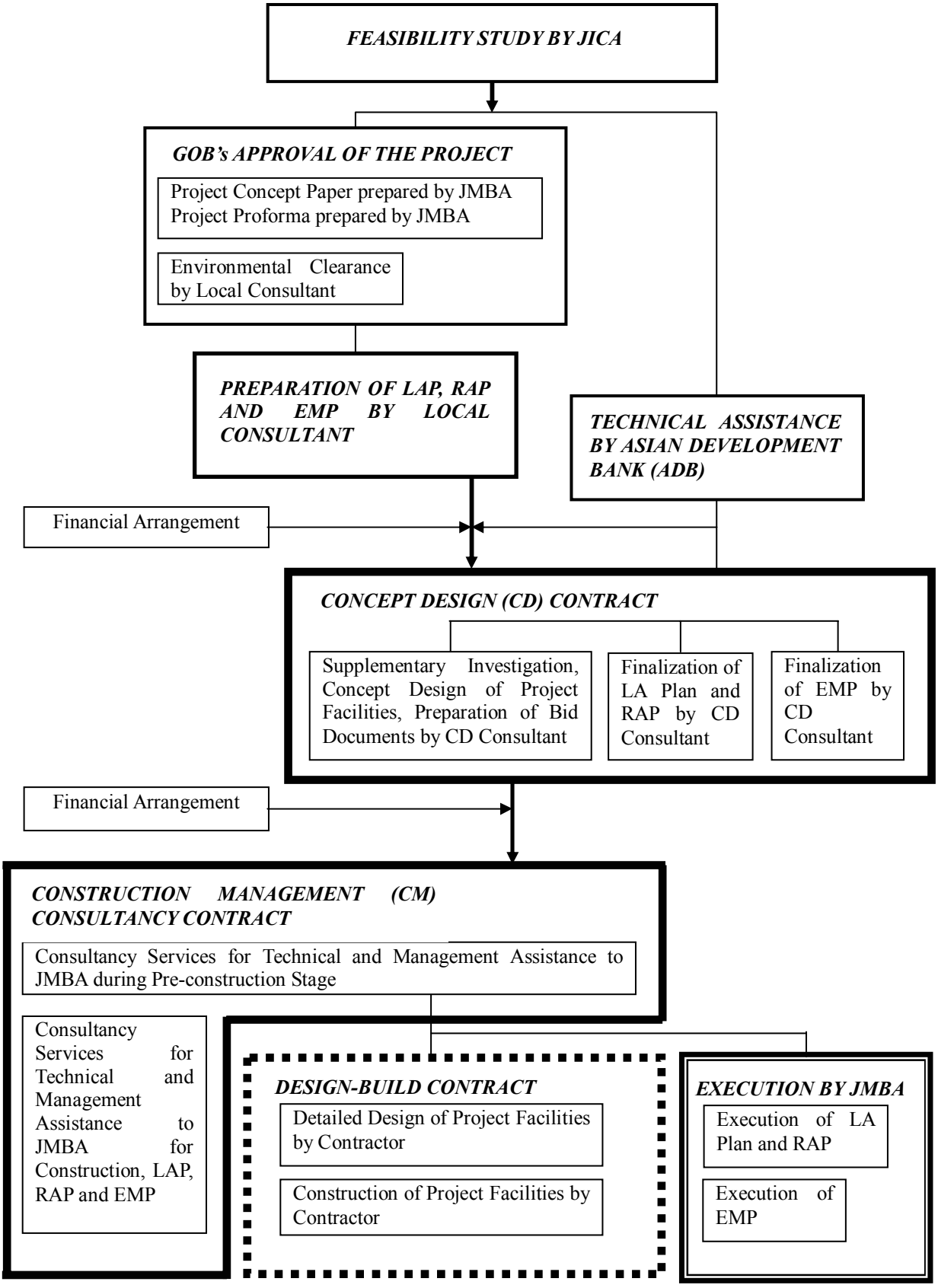


Figure 12.2.2 General Flow of Design-Build Method

12.3 PROCUREMENT METHOD

Outline of Conventional Contracting and Design-Build is discussed in the Sections 12.3.1 and 12.3.2.

Comparison of these two methods is summarized in Section 12.3.3 and conclusions on the procurement method are in Section 12.3.4.

12.3.1 Conventional Contracting

(1) Feature of Conventional Contracting

In the "conventional contract" the Owner, JMBA, employs a design consultant firm to design the facilities such as Padma Bridge, approach road and associated toll facilities, river works and public utilities. This is ordinarily referred to as a Detailed Design Contract.

Once the design is at or near completion, the Owner procures a contractor to construct the project facilities according to the detailed design. This is ordinarily called a Construction Contract.

During the course of construction, the Owner procures a consultant firm to supervise the quality, quantity, safety and progress performed by the Contractor. This is ordinarily called a Construction Supervision Contract.

The Design Consultant and Construction Supervision Consultant have a role to design the Project that meets the Owner's budgetary and functional needs and attempts to obtain from the Contractor full compliance with the express and implied intent of plans and specifications. The Contractor's primary goal is typically to complete the Project as quickly and efficiently as possible, in order to meet its cost objectives. As a result, the Consultant and the Contractor often find themselves working at cross-purposes, particularly on issues relating to ambiguities over scope of work and specifications.

(2) Components of Contracting

(a) Detailed Design Contract

Detailed design would be conducted by the Design Consultant and would include the following:

- Review of Feasibility Study
- Preparation of definitive plan of bridge, approach roads, toll plaza, junctions, river training works, service roads, etc.
- Topographic and bathymetric surveys
- Detailed geotechnical investigation including mechanical boring by using floating barges in the river
- Natural environmental study
- Social impact and resettlement studies for LA plan, RAP, etc.
- Mathematical model test for river training works
- Physical model test for river training works
- Bridge wind tunnel model test
- Design of Padma Bridge
- Design of approach roads and associated facilities, e.g. junctions, frontage roads, etc.
- Design of approach road bridges (inland bridges)
- Design of toll facilities, service area with parking lots and buildings

- Design of electrical facilities, e.g. road/bridge lighting, navigation light, etc.
- Design of river training works
- Design of public utility provision, e.g. electric transmission power line, gas pipeline, telecom fiber optics
- Environmental impact study and finalization of mitigation measures (EMP: environmental management plan)
- Study on social impact and finalization of LA plan and RAP
- Design of relocation and residential areas along with infrastructure
- Quantity calculation, construction methods, construction plan, cost estimate
- Tariff study and financial analyses
- Implementation plan and schedule
- Preparation of pre-qualification and bid documents

(b) LA Plan, RAP and EMP

Preparation of LA Plan, RAP and EMP will be conducted before the Detailed Design. Finalization of LA Plan, RAP and EMP will be included in the Detailed Design as discussed in (i) above. Execution of LA Plan and RAP will be fulfilled by the Owner, JMBA, before the commencement of construction while execution of EMP will be during construction.

As discussed in Chapter 8 Social Impact / Resettlement Studies, the following are envisaged:

- Land acquisition area: 620 ha (cf. 2,860 ha in the Jamuna Bridge case)
- Nos. of households to be resettled: 3,150 houses (cf. 16,000 houses in the Jamuna Bridge case)
- Directly affected population: 19,000 persons (cf. 105,000 persons in the Jamuna Bridge case)

One of the key issues to implement the Project is to acquire the land prior to the commencement of the construction works of the Project. Regarding the arrangement for land acquisition, the following activities are required before the construction works start:

i) Preparation of LA Plan, RAP and EMP by Local Consultant following the JICA Feasibility Study

- Preparation and submission of LA (Land Acquisition) plan and RAP (Resettlement Action Plan)
- Preparation of EMP (Environmental Management Plan)

ii) Finalization of LA Plan, RAP and EMP during Detailed Design Stage by Detailed Design Consultant

- Finalization of LA (Land Acquisition) plan and RAP (Resettlement Action Plan)
- Finalization of EMP (Environmental Management Plan)

iii) Execution of LA Plan, RAP and EMP before Commencement of Construction by JMBA

- Joint verification of assets for the affected persons
- Payment to the affected persons
- Construction of relocation and residential sites
- Relocation of affected persons
- Execution of action plan proposed in EMP

(c) Construction Supervision Contract

JMBA would employ a Construction Supervision consultant with the major tasks being:

- To conduct technical and management assistance to JMBA during pre-construction stage including review of pre-qualification and bid documentation prepared in the Detailed Design, preparation of bid evaluation criteria, bid evaluation, etc.
- To supervise the Contractor's activities, which include quality control, safety control, progress control of the Project being conducted by the Contractor.
- To assist JMBA for the execution of LA plan, RAP, and EMP.
- To prepare various reports such as monthly progress report, annual report, completion report, as-built drawings and other required reports.
- To evaluate the claims from the Contractor(s).

(d) Construction Contract

JMBA would employ the Contractor(s) to construct the following facilities according to the specifications, drawings and other documents prepared by the Design Consultant:

- Padma Main Bridge
- Approach roads along with toll facilities and Service Area
- River Works

(3) Indicative Timetable of Conventional Contracting

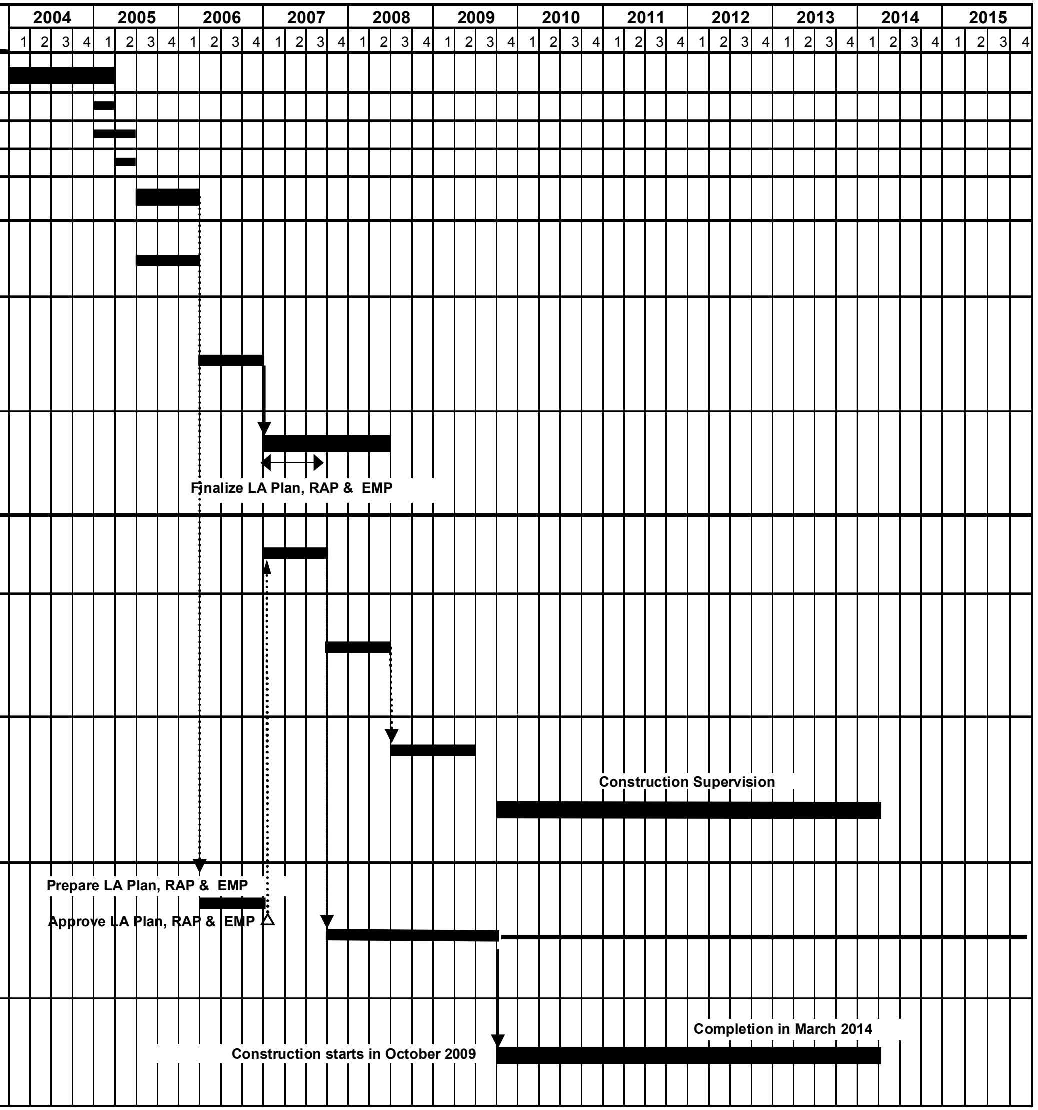
An indicative timetable was studied for the Conventional Contracting case and is summarized in Figure 12.2.1, in which major items have no overlapping of each other (referred to as an end-to-end condition). From the figure, it is anticipated that construction will start in October 2009 and completion of the Project would be in March 2014, based on the assumptions mentioned below:

- JMBA has already started to prepare the application documents of PCP, PP and Environmental Clearance.
- ADB committed to carry out a TA program for the Padma Bridge Project after this JICA Feasibility Study: approximate TA period is from July 2005 to March 2006.
- In parallel with ADB TA, GOB would have to conduct financial arrangements for the detailed design.
- JMBA will prepare LA plan, RAP and EMP by employing a local consultant following the ADB TA.
- JMBA or international donor agency will procure the detailed design (DD) consultant, and then DD consultant will conduct DD services from January 2007 to June 2008. In this DD, finalization of LA plan and RAP is included. The preparation of the LA plan and RAP will be completed by September 2007.
- JMBA would have to start the execution of the LA plan and RAP in October 2007 soon after finalization of the LA plan and RAP is completed. Execution of LA plan and RAP will end in September 2009.
- After completing execution of the LA plan and RAP, JMBA will start the pre-construction activities to procure the Contractor(s). These activities might require 12 months. Accordingly, the commencement of the construction will be in October 2009 and be completed in March 2014.

Figure 12.3.1 Indicative Time Table

Conventional Contracting Case (End to end condition)

Phase	Activities / Required Months	
Study Phase	**JICA Feasibility Study**	Underway
Study Phase	PCP approval by GOB	3 months
Study Phase	Environmental Clearance by GOB	6 months
Study Phase	PP approval by GOB	3 months
Study Phase	**ADB Supplementary TA**	9 months
Detailed Design Phase	Financial arrangement for DD - Foreign currency (application, appraisal, loan agreement) - Local currency	9 months
Detailed Design Phase	Procurement of DD Consultant by JMBA - Shortlist and invitation for DD proposal - Proposal from consultants - Evaluation of proposal - Negotiation & signing of DD	9 months
Detailed Design Phase	**Detail Design and bidding document preparation** by DD Consultant	18 months
Construction Phase	Financial arrangement for Construction - Foreign currency (application, appraisal, loan agreement) - Local currency	12 months
Construction Phase	Procurement of Construction Supervision (CS) Consultant by JMBA - Shortlist & invitation for CS proposal - Proposal from consultants - Evaluation of proposal - Negotiation & signing of CS	9 months
Construction Phase	Pre-construction activities and construction supervision by CS Consultant - Pre-qualification - Invitation for bid - Bid opening - Negotiation & signing of contract	12 months
Construction Phase	Land acquisition / Resettlement - Approval of LA plan and RAP - Joint verification of assets - Payment of compensation - Construction of relocation & residential sites - Relocation of affected persons	24 months
Construction Phase	**Construction by Contractors for Padma Bridge, Approach Roads, River Works**	54 months



12.3.2 Design-Build

(1) Feature of Design-Build

In a "design-build" contract the Owner, JMBA, employs a Contractor who conducts the detailed design and construction of the project facilities through the bidding process. In the bidding process, the bidders produce detailed designs based on the design parameters and concept design prepared by a Concept Design Consultant.

The overall effect of design-build is to create a single entity with whom the Owner deals, thus easing coordination between the contracting parties. When the designer and the Contractor are members of the same team, design decisions can be made quickly and in a more congenial atmosphere, even after construction has commenced. However, the Owner may loose some of its input into the design and construction processes. Bidders of the Design-Build Contract may propose their designs that contain many departures from the Concept Design, and also offer conditionality for unclear project definition, scope of work, design parameters, etc. related to the Concept Design.

(2) Components of Contracting

(a) Concept Design Contract

The Project includes relatively large scale resettlement and land acquisition proceedings. In the case that the design-build method is applied, the following engineering studies would have to be completed by the Concept Design (CD) Consultant before the bidding of the design-build contract:

- Supplementary investigation
- Determination of design parameters, and preparation of concept design with performance specifications including definitive plans of facilities, etc.
- Preparation of pre-qualification and bid documents for Design-build Contract.
- Environmental impact study and finalization of mitigation measures (EMP: environmental management plan)
- Finalization of LA plan and RAP.

(b) LA Plan, RAP and EMP

Preparation of LA Plan, RAP and EMP will be conducted before Concept Design. Such preparation work will be carried out by Local Consultant.

Finalization of LA Plan, RAP and EMP will be included in the Concept Design of (i) above, and execution of LA Plan and RAP will be fulfilled before the commencement of construction while execution of EMP will be during the construction, as with Conventional Contracting.

(c) Construction Management (CM) Consultancy Contract

JMBA would employ a CM consultant with major tasks being:

- To conduct advisory services for technical and management assistance to JMBA during pre-construction stage including review of pre-qualification and bid documentation prepared in the Concept Design, preparation of bid evaluation criteria, bid evaluation, etc.
- To conduct advisory services for technical and management assistance to JMBA during design and construction stage by the Contractor including verification of the

Contractor's detailed design, quality assurance of facilities being constructed by the Contractor, progress monitoring, expenditure monitoring, etc.
- To conduct advisory services for technical and management assistance for the execution of LA plan, RAP, and EMP.
- To prepare reports and documents during the construction stage.

(d) Design-Built Contract

JMBA would employ the Contractor(s) to design and construct the following in accordance with the Concept Design, specifications, and other documents prepared by the Concept Design Consultant:

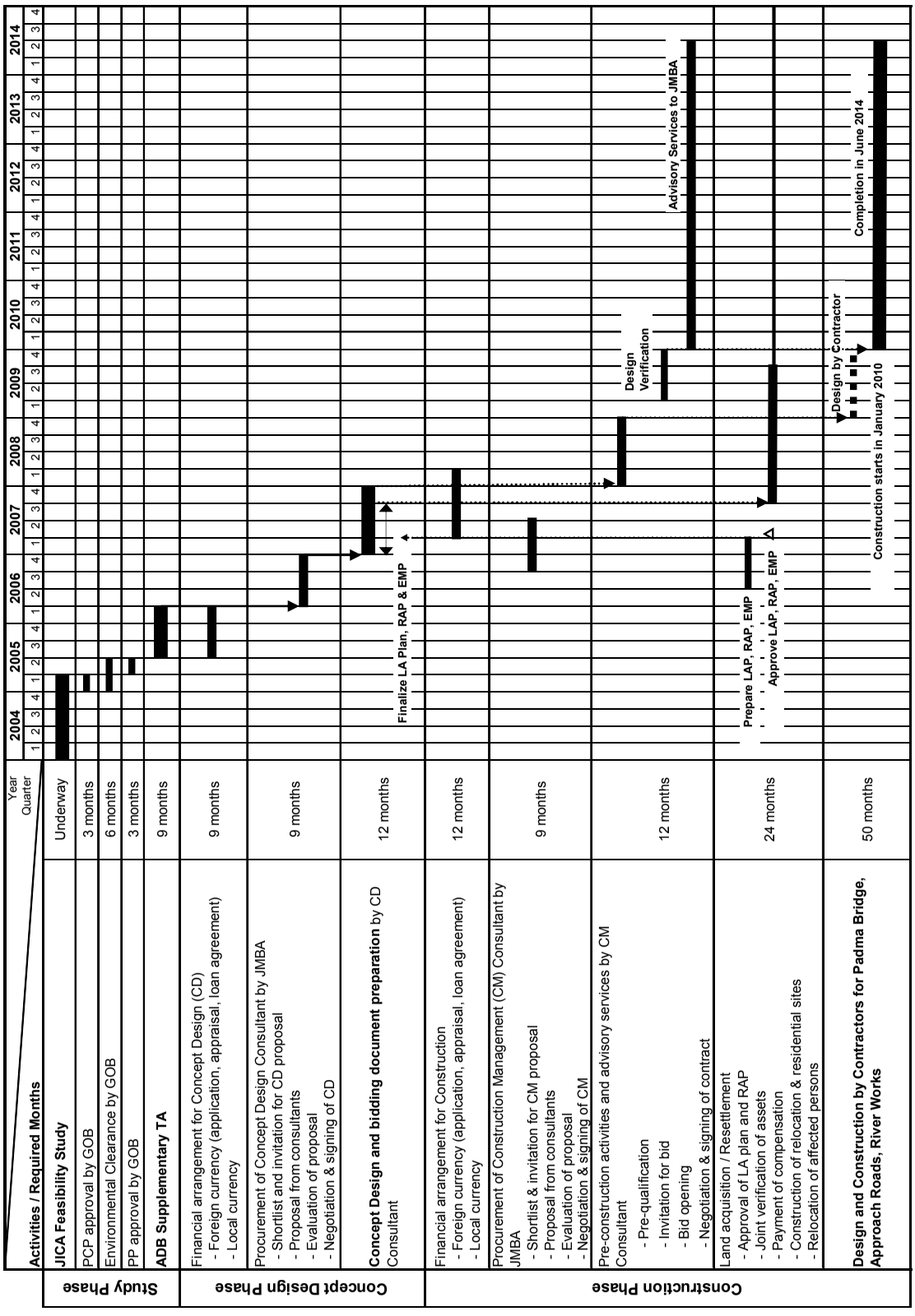
- Padma Main Bridge
- Approach roads along with toll facilities and Service Area
- River Works

(3) Indicative Timetable of Design-Build Case

An indicative timetable was studied for the Design-Build case and is summarized in Figure 12.2.2, in which major items have no overlapping, referred to as an end-to-end condition. From the figure, it is anticipated that the construction will start in January 2010 and be completed in June 2014, based on the assumptions mentioned below:

- JMBA has already started to prepare the documents required for PCP, PP and Environmental Clearance.
- ADB will carry out a TA program for the Padma Bridge Project after this JICA Feasibility Study: approximate TA period is from July 2005 to March 2006.
- In parallel with ADB TA, GOB would have to conduct financial arrangements for the Concept Design.
- JMBA will prepare the LA Plan, RAP and EMP by employing a Local Consultant.
- JMBA will procure the concept design (CD) consultant, and then CD consultant will conduct CD services from January 2007 to December 2007. In this CD, finalization of LA plan and RAP is included. The finalization of LA plan and RAP will be completed by September 2007.
- JMBA would have to start the execution of the LA plan and RAP in October 2007 soon after finalization of the LA plan and RAP is completed. Execution of LA plan and RAP will end in September 2009.
- GOB would have to procure the Construction Management (CM) consultant in parallel with the financial arrangements for construction. Financial arrangements will probably be finished by March 2008, and procurement of CM consultant will be completed in June 2007.
- After signing of CM consultancy services, the pre-construction activities will start in January 2008 and the Contractor of Design-Build will sign the contract in December 2008. The detailed design will be conducted by the Design-Build Contractor. Accordingly, the commencement of the construction will be in January 2010 and completion in June 2014.

Figure 12.3.2 Indicative Time Table
Design-Build Case (End to end condition)



12.3.3 Comparison of Conventional Contracting and Design-Build

The following are regarded as evaluation items to compare the advantages and disadvantages between Conventional Contracting and Design-Build Contracting for the Padma Bridge Project:

- Time required before construction commencement after F/S completion
- GOB's fund requirement
- Owner's control of design process and construction process
- Fairness in bidding process for Contract

(1) Time Required to Construction Commencement and Completion Time

As the Project is a high priority development project in the country (so-called national project), GOB desires to commence construction as soon as possible. From the indicative timetables in Figures 12.3.1 and 12.3.2, the commencement of construction is as follows:

- Conventional Contracting Case
  Commencement: October 2009 (Required time = 54 months after this Feasibility Study)
  Completion of the Project: March 2014
- Design-Build Case
  Commencement: January 2010 (Required time = 57 months after this Feasibility Study)
  Completion of the Project: June 2014

In general, Design-Build is a faster method, but in the case of the Padma Bridge Project, it would require a longer period for the LA Plan and RAP. The required time of the Design-Build is no shorter than Conventional Contracting.

However, GOB has been expecting to commence the construction in the Bangladesh fiscal year 2006/2007, some 3 years earlier than the forecast commencement time in both the cases.

(2) Likelihood of Cost Increase

In the bid preparation period of the Design-Build, each bidder would have to conduct the detailed investigation by himself, i.e. mechanical borings using rotary boring machine on floating barge to identify subsoil conditions for foundation design, etc. Such detailed investigation may require expenditure and time consumption of the bidders and the bid prices may include the detailed investment costs, while some bidders may decline to submit bids. In this regard, the actual number of bidders will be limited. A severe case might occur when a bidder offers the lowest bid price without conducting the detailed investigation.

As the DD Consultant will prepare, in the case of the Conventional Contracting, the detailed design on the basis of detailed investigation, such claims may not arise from the Contractor.

In this regard, the Conventional Contracting is advantageous for the Owner.

(3) Owner's Control of Design Process and Construction Process

In Conventional Contracting, the Owner can control the Design Consultant to meet the Owner's budgetary and functional needs. Detailed geotechnical investigation including rotary boring in the river and various physical model tests to clarify the river characteristics are conducted during the detailed design stage.

On the other hand, the Owner might find it difficult to control the design process in the

Design-Build. Usually, the Concept Design Consultant will produce, in a relatively short time such as 12 months shown in Figure 12.3.2, a concept design and prepare the bid documents based on the feasibility study and supplementary investigations. However, the bidders might face severe difficulties in conducting the detailed design since the information and data would be reduced. This is especially the case regarding subsoil conditions of the Padma River and river characteristics. In the case of the Padma Bridge, detailed geotechnical investigation is required using rotary boring machines, which are used internationally for bridge foundation design, mounted on a floating barge in the river. Otherwise the bidders cannot offer appropriate designs. Furthermore, detailed studies such as mathematical modeling and physical modeling are necessary for the design of river works. Moreover, the Owner would have to safeguard the design base against the alternative design in which the bidders propose quite different appearances of the project facilities from those shown in the concept design.

In the course of construction under Conventional Contracting, the Contractor will carry out the works in strict compliance with the specifications prepared by the Design Consultant and under supervision of the Supervision Consultant.

On the other hand, the Owner may face more difficulties in imposing varied requirements when Design-Build is adopted.

Accordingly, it can be said that Conventional Contracting is advantageous from the viewpoints of the Owner's control of design and construction processes.

(4) Fairness in Bidding Process for Construction Contract

In Conventional Contracting, the bidders of the construction contract would offer their bids in accordance with the drawings, quantities, specifications, etc. prepared by the Detailed Design Consultant. When the bids are opened, the lowest bidder is selected as the successful bidder.

In the Design-Build, the bidders of the design-build contract would offer their bids in accordance with drawings prepared by them along with conditionality resulting from performance specifications, design parameters, definition and scope of works prepared by the Concept Design Consultant. The Owner may receive various designs during bid opening time and may face difficulties in comparing the respective designs and bid prices. Therefore there is no clear standard to define the best bid.

Taking into consideration the fairness in the bidding process, the Conventional Contracting is advantageous for the Owner.

The following shows the summary of the comparison. As a result, the JICA Study Team recommends the procurement method of Conventional Contracting from the viewpoints of the nature of the Project, time requirement, fund requirement and Owner's control of the design and construction processes.

Table 12.3.1 Comparison Summary of Conventional Contracting and Design-Build

	Conventional Contracting	Design-Build
Time required before construction commencement after F/S completion (March, 2005)	- 54 months after JICA F/S (Commencement: October 2009, but still about 3 years later than GOB's expectation) ***Advantageous for the Owner***	- At least 57 months after JICA F/S (Commencement: January 2010, but prolonged negotiation with a successful bidder may delay the commencement due to a number of conditionality to be offered by bidders)
Likelihood of cost increase	- Claims for cost increase during construction due to adjustment to the site conditions are probable, but the total increase is relatively small.	- Bidding price may increase due to unforeseen physical, geotechnical and hydrological conditions.
Owner's control of design process and construction process	- Claims due to unforeseeable physical condition will be decreased. - Not so difficult to control design and construction process. ***Advantageous for the Owner***	- Control of the design process is more difficult, because the extent to which detailed studies on geotechnical and hydrological conditions/behavior are undertaken is judged by the bidders. - Construction expertise is available during the design. - A variety of detailed design outputs may be produced from the alternative designs by the bidders. - Difficult control of construction process due to varied requirements from the Contractor.
Fairness in the bidding process for Construction	- Easy to evaluate the successful bidder with prescribed scope of work. ***Advantageous for the Owner***	- Difficult to evaluate various designs among the bidders fairly even though two-envelope method is applied. - Competition is provisional without complete contract documents. - Difficult to decide the successful bidder only by the bid prices (no clear standard is available).
Overall Evaluation	**Conventional Contracting is more advantageous, but special arrangements may be required to shorten the time to commencement of construction.**	

12.3.4 Conclusion of Procurement Method

As discussed in Section 12.3.3, the Conventional Contracting is advantageous. However, it requires a longer formality and proceedings until commencement of construction than was expected by the GOB, which had assumed commencement by the Bangladesh fiscal year 2006/2007.

Discussions up to Section 12.3.3 are based on the end-to-end case of required formalities and proceedings. In order to facilitate project implementation, the following is recommended:

- Procurement method is Conventional Contracting from the viewpoints of relatively lower cost increases, easy control of design process and construction process by the Owner (JMBA), and fairness in bidding process for contract.
- Special arrangements should be considered to commence construction as early as possible since GOB has been expecting construction to begin in the Bangladesh fiscal year 2006/2007. Overlapping activities in the proceedings before commencement of construction would have to be studied.

12.4 CONVENTIONAL CONTRACTING WITH OVERLAPPING ACTIVITIES FOR EARLY IMPLEMENTATION

12.4.1 Overlapping Activities to be Considered

As already discussed, GOB expected the construction to commence in the Bangladesh fiscal year 2006/2007. The Study Team has pursued an earlier possible implementation case by considering some overlapping activities ranging from the financial arrangement to the execution of LA plan and RAP. The Overlapping Condition is as follows:

- Overlapping of ADB TA and Detailed Design. In this case, the Detailed Design would have to start in October 2005 on condition that the Owner proceeds the financial arrangement with GOB's own funds or under assistance from international funding/donor agencies.
- Overlapping of land acquisition/resettlement and construction since development of the construction yard can start before entire completion of land acquisition and resettlement activities.

12.4.2 Recommended Indicative Timetable for Implementation

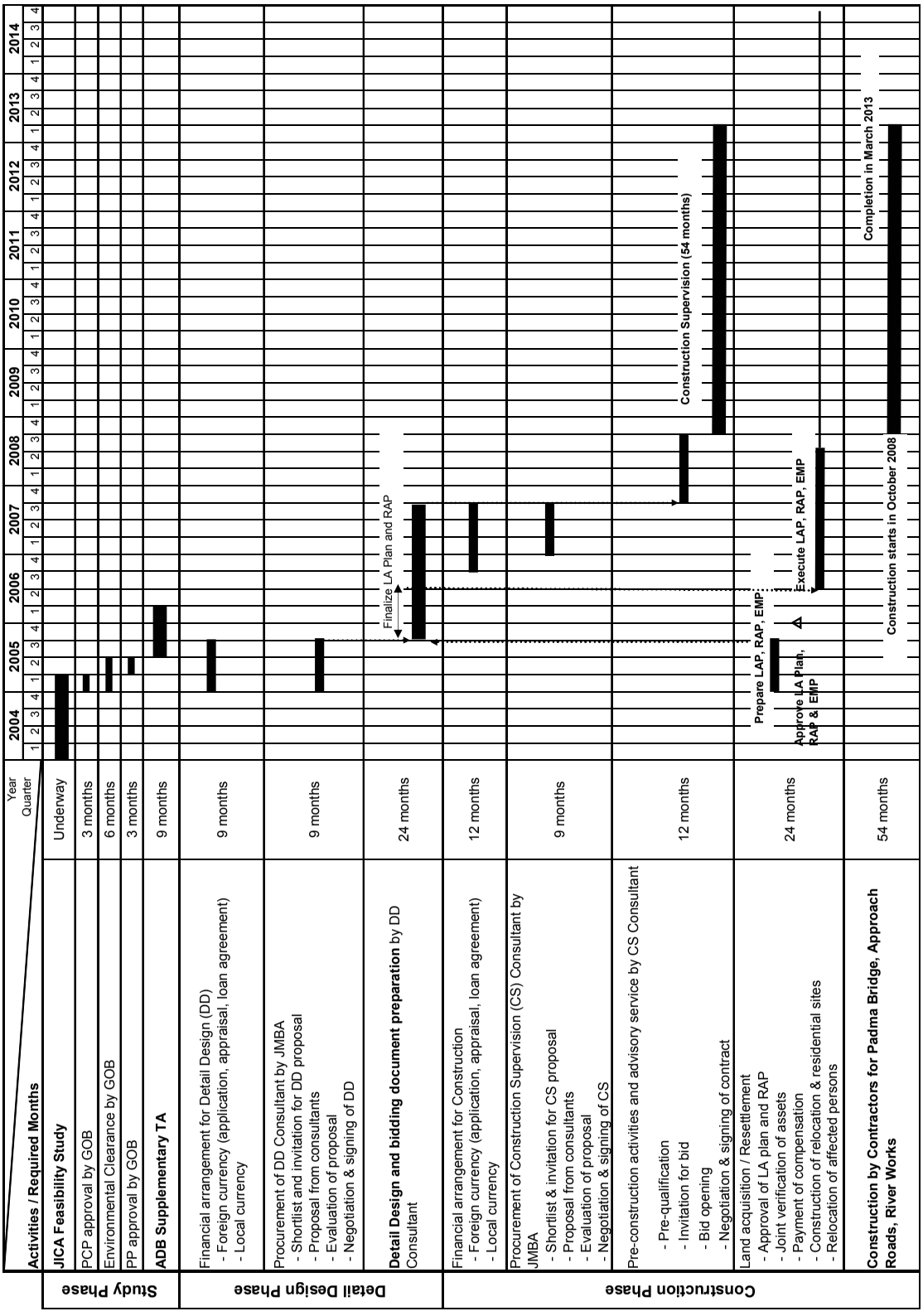
Based on discussions presented in Section 12.4, an indicative timetable is recommended in Figure 12.4.1.

From the figure, it is anticipated that construction would start in October 2008 and completion of the Project would be in March 2013 because of the following:

- ADB may carry out a TA program for the Padma Bridge Project after this JICA Feasibility Study: approximate TA period is from July 2005 to March 2006.
- In parallel with ADB TA, GOB would have to implement financial arrangements for the detailed design.
- JMBA will procure the detailed design (DD) consultant unless international funding/donor agencies conduct DD, and then DD consultant will conduct DD services from October 2005 to March 2007. In this DD, preparation of LA plan and RAP is included. The preparation of LA plan and RAP will be completed by June 2006.
- JMBA will start the execution of the LA plan and RAP soon after the preparation of LA plan and RAP is completed. Execution of LA plan and RAP will start in July 2006 and end in June 2008.
- GOB would have to procure the Construction Supervision (CS) consultant soon after the financial arrangements for construction are in place. Financial arrangement will have to be finished by September 2007, at which time procurement of CS consultant will also be completed.
- After signing of CS consultancy services, the pre-construction activities will start in October 2007 and the Contractor of Construction Contract will sign the contract in September 2008. Accordingly, the commencement of construction will be in October 2008 soon after the contract signing, and completion will be in March 2013.

Figure 12.4.1 was prepared referring to the guidelines of procurement of consultants and contractors publicized by the donor agencies such as ADB, WB, and JBIC as well in order to propose, as much as possible, the most reasonable and the shortest time table for the implementation. However, in actual situation, delays in schedule may be happened in the process of procurement due to, for example, complex procedures and required time for negotiations and approvals.

Figure 12.4.1 Indicative Time Table
Conventional with Overlapping Case



12.5 REQUIRED UNDERTAKING BY GOB AND IMPLEMENTATION SCHEDULE

The Conventional Contracting method is recommended by the Study Team in Section 12.4, which indicated construction would commence in October 2008 and be completed in March 2013.

This Section describes what actions are necessary for GOB to implement the Project on the basis of the Study Team's recommendation.

12.5.1 Required Undertaking by GOB

(1) GOB's Approval on the Project

i) Preparation of PCP by JMBA and Submission to Planning Commission under MOP for PCP Approval
This work requires about 3 months, ranging from the preparation of the project concept paper (PCP) by JMBA to the approval by Planning Commission.
Start of preparation: January 2005
Approval by Planning Commission: March 2005

ii) Environmental Clearance consisting of Site Clearance and Environmental Clearance
Start of preparation by JMBA: January 2005
Approval by DOE: June 2005

iii) Preparation of PP (Project Proforma) and Submission to ECNEC (Executive Committee for National Economic Council) under MOP for PP Approval
Start of preparation by JMBA: April 2005
Approval by ECNEC: June 2005

(2) Financial Arrangement

The Project requires approximately US $1.3 billion, in which the foreign currency portion is 70% and the Bangladesh currency portion is 30%. For the foreign currency arrangement, joint financing by plural international funding agencies is required. On the other hand, GOB would have to procure the Bangladesh currency portion, approximately US $390 million or Bangladesh Taka 23 billion.

i) Request to International Funding Agencies, Donor Agencies
GOB would have to request loans amounting to approximately US $910 million from international funding agencies, covering the cost for Detailed Design Consulting Services, Construction Management Consulting Services, and Construction of the project facilities.

Start of request by ERD to international funding agencies for loan and to international donor agencies for grant: January 2005

Approval by international funding agencies and international donor agencies:

For Detailed Design: September 2005
For Construction Management & Construction: September 2007

ii) Arrangement of Local Currency Funds
GOB would have to assure the budget of the Project amounting to approximately Bangladesh Taka 23 billion, covering the cost for establishment of the project office,

land acquisition and RAP, Construction Management Consulting Services, and Construction of the project facilities.

Start of financial arrangement: January 2005
Approval by GOB for land acquisition and RAP: September 2005
For Construction Management and Construction: September 2007

(3) Procurement of Detailed Design Consultant

When the Detailed Design Consultancy is conducted using GOB's own budget, GOB would have to complete the financial arrangement, covering both foreign currency and Bangladesh currency portions until September 2005, unless international funding/donor agencies are not available to conduct the detailed design. Afterwards, the following actions would have to be taken until September 2005:

i) Notice for EOI (Expression of Interest) for Detailed Design Consultancy Services
ii) Receiving EOI from Consulting Firms and Conclusion of Short-list
iii) Distribution of TOR for Detailed Design Consultancy Services to Short-listed Firms
iv) Receiving of Proposals from Short-listed Consultants and Evaluation
v) Negotiation and Signing of Detailed Design Consultancy Services

(4) LA Plan, RAP and EMP

i) Preparation of LA Plan, RAP and EMP, based on the Feasibility Study Reports and additional studies as proposed. This work will be carried out by JMBA with its own resources.
Start of preparation: April 2005
End of preparation: September 2005

ii) Submission of LAP, RAP, and EMP to MOC/MOL for review and approval (with comments)
October 2005

iii) Updating and finalization of LAP, RAP and EMP by DD consultants
Start Date: October 2005
Completion Date: March 2006

iv) Submission of Revised LA Plan, RAP and EMP for Approval by MOC/MOL
Submit to MOC/MOL: April 2006
Approval by MOC/MOL: June 2006

v) Establishment of Separate Resettlement & Environmental Unit in JMBA
Establishment of unit: between October and December 2005

vi) Notification under Section 3 of LA Act by DC(s) to land owners for acquisition
Start Date: July 2006
Date of Completion; September 2006

vii) Joint Verification of Acquired Assets
JMBA organize a joint verification team consisting of Deputy Commissioner (DC), JMBA staff and NGO for assessment and valuation of the acquired assets in Mawa and Janjira.
Joint verification: From October - December 2006

viii) Submission of LA cost estimate to JMBA/MOC by DC(s) – between January and

March 2007

ix) Payment of compensation: From July 2007 to June 2008

x) Announcement for Bid for Construction of Relocation and Residential Sites and bid open for construction of Relocation and Residential Sites, Evaluation, Contracting
Public notice to bid: July 2006
Bid open and evaluation: September 2006
Negotiation and contracting: December 2006
Construction work: From January 2007 and December 2007

xi) Relocation of Affected Persons: January 2008 and June 2008

xii) Supervision and monitoring of LAP, RAP and EMP: between October 2008 and March 2013 which are included in CS consultancy services

(5) Procurement of CS Consultant and Construction Contractor

i) Invitation for CS Consultant for Short-list and Evaluation
Public notice: January 2007
Receive EOI from consulting firms, and evaluation for short-list: February 2007

ii) Distribution of TOR for CS: March 2007

iii) Selection of CS Consultant
Receive proposals from the short-listed consulting firms: June 2007
Evaluation of proposals and selection of CS consultant: between July and August 2007
CS consultancy services: between October 2007 and March 2013

iv) Public Notice for PQ of Construction Contracts by Packages: October 2007

v) Distribution of Pre-qualification (PQ) Documents: between October 2007

vi) Receipt of PQ Documents and PQ Evaluation:
Receive PQ document: November 2007
PQ evaluation: between November and December 2007

vii) Distribution of Bid Documents: February 2008

viii) Holding of a Pre-Bid Meeting: April 2008

ix) Bid Open, Evaluation: between June and July 2008

x) Selection of Successful Bidders: July 2008

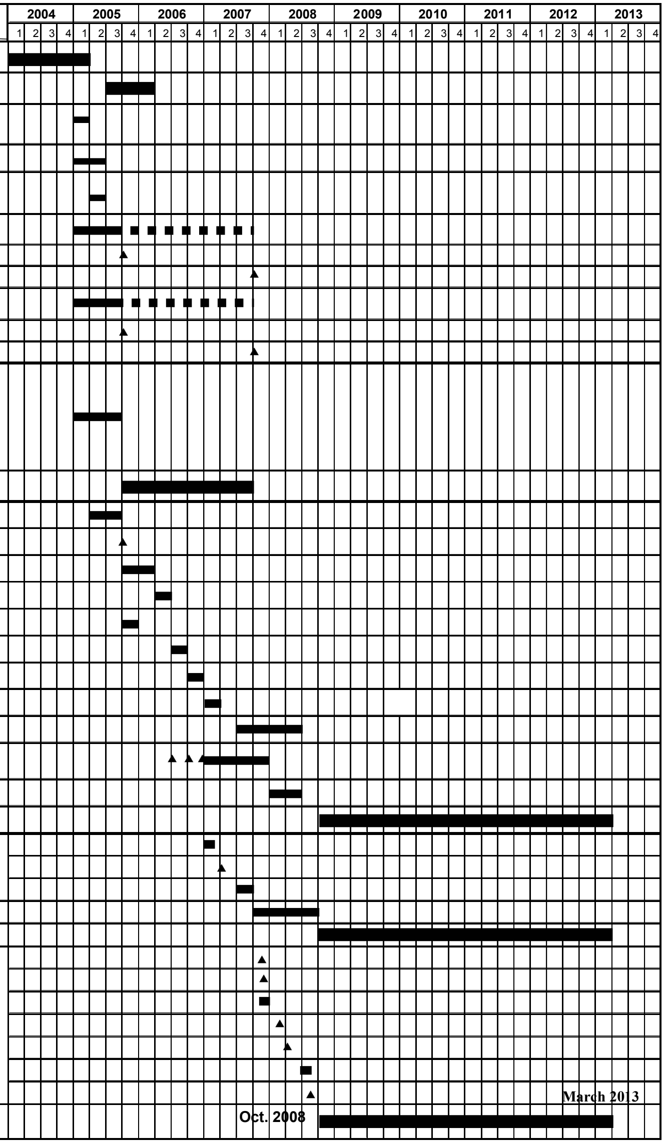
xi) Signing of Contracts by Contract Packages: September 2008
Construction by the Contractors: between October 2008 and March 2013

12.5.2 Implementation Schedule

The overall implementation schedule is presented in Figure 12.5.1, which shows the required actions for GOB after this Study and up to the completion of the Project. In this schedule, the installation works of electric power transmission line, gas pipeline and telecom line are excluded. These works would have to be considered by the related entities.

Figure 12.5.1 Implementation Schedule under Conventional Contract with Overlapping Activities

Activities / Required Months		Year / Quarter
	JICA Feasibility Study	Underway
	ADB Supplementary TA	9 months
(1) GOB's Approval on the Project	i) Preparation of PCP by JMBA and Submission of Planning Commission Under MOP for PCP Approval	3 months
	ii) Environmental Clearance consisting of Site Clearance and Environmental Clearance	6 months
	iii) Preparation of PP (Project Pro forma) and Submission to ECNEC (Executive Committee for National Economic Council) under MOP for PP Approval	3 months
(2) Financial Arrangement	i) Request to International Funding Agencies, Donor Agencies	9months
	-Approval by international funding agencies and international donor agencies for Detailed design	
	-Approval by international funding agencies and international donor agencies for Construction	
	ii) Arrangement of Local Currency Funds	9 months
	- Approval by GOB for Land acquisition and RAP	
	- Approval by GOB for Construction	
(3) Procurement of Detailed Design Consultant	i) Notice for Expression of Interest for Detailed Design Consultancy Services ii) Receiving Expression of Interest from Consulting Firms and Conclusion of Short List iii) Distribution of TOR for Detailed Design Consultants iv) Receiving of Proposals from short-listed Consultants and Evaluation v) Negotiation and Signing of Design Consultancy Services	12months
	vi) Detailed Design by DD Consultants	24 months
(4) LA Plan, RAP and EMP	i) Preparation of LA plan, RAP and EMP	6 months
	ii) Submission of LAP, RAP and EMP to MOC/MOL for review and comments	
	iii) Updating and finalization of LAP, RAP and EMP by DD consultants	6 months
	iv) Submission of Revised LA Plan, RAP and EMP for Approval by MOC/MOL	3 months
	v) Establishment of Separate Resettlement & Environmental Unit in JMBA	3 months
	vi) Notification under Section 3 of LA Act by DC(s) to land owners for acquisition	3 months
	vii) Joint Verification of Acquired Assets	3 months
	viii) Submission of LA cost estimate to JMBA/MOC by DC(s)	3 months
	ix) Payment of compensation	12 months
	x) Announcement for Bid for Construction of Relocation and Residential Sites and Bid open for Construction of Relocation and Residential Sites, Evaluation, Contraction	12 months
	xi) Relocation of Affected Persons	6 months
	xii) Supervision and monitoring of LAP, RAP and EMP	54 months
(5) Procurement of CS Consultant	i) Invitation for Short List for CS Consultant and Evaluation ii) Distribution of TOR for CS Consultant iii) Selection of CS Consultant	9 months
	iv) Pre-construction by CS Consultant	12 months
	iv) Construction Supervision by CS Consultant	54 months
(6) Construction Contract	i) Public Notice for PQ Construction ii) Distribution of pre-qualification (PQ) Documents iii) Receipt of PQ Documents and PQ Evaluation iv) Distribution of Bid Documents for Construction v) Holding of a Pre-Bid Meeting for Construction x) Bid Open Evaluation for Construction vi) Selection of Successful Bidders for Construction	12 months
	vii) Construction by Contractor	54 months



Chapter 13 Operation and Maintenance Plan

13.1 METHODOLOGY OF OPERATION AND MAINTENANCE PLANNING

13.1.1 Objectives

The study covers the operations and maintenance for the future Padma Bridge aiming at the most appropriate methods and systems considering technical, operational and financial aspects. From the maintenance and management viewpoint of the project highway (future Padma Bridge and its approach roads), and river training facilities, it is essential to set up a program of operations and maintenance that covers the establishment of organization and procedures for the routine maintenance and repair works in relation to cost control for maintenance work, and the preparation for a budgetary arrangement.

13.1.2 Planning of Operations and Maintenance

The operations and maintenance program should include the cost for maintenance of the facilities and budget allocation for all Operations and Maintenance (O&M) actions for the project facilities. And the costs and budget for the O&M actions are to be reflected for economic and financial analyses for assessing project feasibility (economic viability), in terms of life cycle years, in this study. To plan the program of O&M for the Padma Bridge requires a basic understanding existing bridge management in Bangladesh by examining the, arrangements for bridges such as the Jamuna, the Bhairab and Paksey bridges, which are being operated as toll roads. Meanwhile, envisaging that private sector participation would be likely for the Padma Bridge Project, O&M by a private consortium should be studied.

Generally, highway operation includes more traffic-oriented activities conducted by a highway operator, while highway maintenance consists of more engineering-oriented tasks, which, broadly speaking, cover the routine maintenance, repair works, and rehabilitation / improvement. Among them, usually, the routine maintenance and operation of the highway is implemented directly by the highway operator, and the repair works are contracted out to specialized contractors on a long-term basis, such as annual, but the rehabilitation and improvement works are conducted by contractors selected by competitive bidding. Accordingly in this chapter, the rehabilitation / disaster prevention works are excluded from the scope of O&M for the project highway.

13.2 OPERATIONS AND MAINTENANCE FOR THE JAMUNA BRIDGE

13.2.1 Outline of the Jamuna Bridge

The Jamuna Bridge, for which construction started in October 1994 and was completed in June 1998, across the Brahmaputra River with a bridge length of 4.8 km, viaduct bridges 2x128m, East Guide Bund 3.07 km, West Guide Bund 3.26 km, Bhuapur hard point 1.7 km, is a continuous concrete box girder type bridge. The JMBA has the responsibility to ensure that the O&M of the works and facilities of the Jamuna Bridge are carried out.

13.2.2 Operations and Maintenance under the First Five Years Contract

The O&M of the Jamuna Bridge was operated under a contract with JOMAC for the first five years since it was open to the public. The O&M of the Jamuna Bridge includes routine inspection and maintenance, security, and management of toll collection, but excludes the

maintenance of the utilities encroached in/on the bridge such as gas pipeline, electricity transmission line, telecommunication cable/line, etc., which are managed by other concerned authorities independently.

The O&M of the Jamuna Bridge are conducted on an international competitive contract-basis, which has advantages such as fairness of contract, reliability of quality and international standards, and economizing on the O&M costs. JOMAC is responsible for advice and assistance in the management, administration and supervision of the O&M of the Jamuna Bridge.

Toll Gate of Jamuna Bridge

Maintenance Vehicle of Jamuna Bridge

(1) Management of the O&M Services

The major management functions for the O&M services by JOMAC when interviewed by the JICA Study Team were as follows:

- Technical inspections and preventative measures managed periodically and predictably under the normal level of O&M
- Operation and management of the toll collection system, the maintenance equipment, computer software/hardware, vehicles, and all assets of the complex
- Employment of the security staff (security guards), excluding the police and army group which were provided to the site directly by the Government
- In case of emergency or extreme damage to the facilities caused by such as vessel collision or earthquake, JOMAC has only responsibility for documentation and reporting on the damaged status to JMBA
- Documentation and submission of the Monthly Report concerning the service activities and issues to JMBA.

(2) Toll Collection System

The toll collection system for the Jamuna Bridge is manually operated with tickets for which prices are classified in accordance with the seven (7) vehicular types, but computerized recording of the traffic is handled by inserting the ticket-cards in the toll booths. Beneath the canopy of the toll booths, there are several closed circuit television (CCTV) cameras for observing the traffic conditions and on the bridge deck as well. The toll fare is exempted for the vehicles belong to the organizations related to the Jamuna Bridge operations, i.e., MOC, JMBA, JOMAC, etc.

(3) Facilities Encroached on the Bridge

The facilities encroached on/in the bridge structures such as gas pipeline, electricity transmission line, telecommunication cable/line, etc. Those are deemed to be the responsibility of other concerned authorities and outside of the services under the O&M

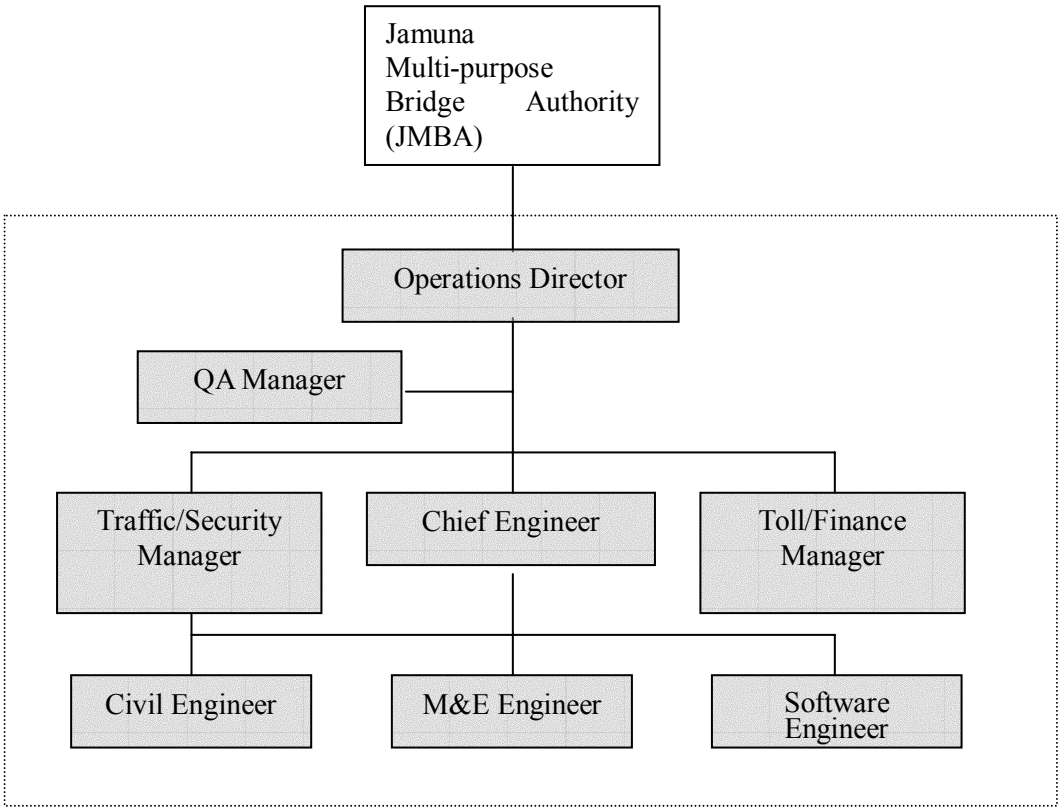
management by JOMAC. However, in the case of the maintenance activities for the encroached facilities, JOMAC cooperates by undertaking assistance tasks, mainly for safe traffic control on the bridge.

Encroachment (Electricity Posts)

Encroachment (Gas Pipe Line)

(4) Organizational Structure of the O&M

The following organizational structure was established to provide the services to fulfill continuous, satisfactory and cooperative relations to JMBA in the ownership line of the Government of Bangladesh.



QA: Quality Assurance

M&E: Maintenance of Mechanical and Electronic Equipment

(5) Staffing of JOMAC

Staffing of JOMAC for the classified sections based on the Employee List (as of June 2003) is as below:

	Classified Sections	Number of Staff
1)	Engineering, Main Bridge & Roads	22
2)	Complex Asset and Account/Adm.	27
3)	Toll Collection	29
4)	Safety & Patrol	24
5)	Weigh Scale/Camp Facilities	12
6)	River Training Works	7
7)	Work Shop/Camp Facilities	60
8)	Worker's Pool	9
9)	Restaurant & Shop	5
	Total	195 Staff

13.2.3 Operations and Maintenance under the Second Five Years Contract

Jamuna Multipurpose Bridge Authority (JMBA) signed an agreement with Jasa Marga Net One Limited on 30th of March. 2004 for the Management, Operation and Maintenance of Jamuna Multipurpose Bridge for the next five years. According to the contract, Jasa Marga Net One Limited, called the Operator, will be responsible to administer the overall O & M services of Jamuna Bridge. Jasa Marga Net One Limited is a joint venture of PT Jasa Marga and Net One Solution Ltd.

In general, the responsibilities of the operator include:

- Operation
- Maintenance of facilities
- Collection of tolls

Operation

Among other things the operator is responsible for the following activities:

- To ensure all roads and all traffic lanes within the JMBA area remain opened to traffic for 24 (twenty-four) hours in each day.
- Certain parts of the JMBA area shall remain closed to the general public.
- Foot, animal, non-motorized traffic and three wheeled vehicles are excluded from crossing the Bridge and approach viaducts.
- To manage and operate the JMBA area to the satisfaction of JMBA.
- To introduce and implement the traffic management and traffic management schemes approved by JMBA.
- The operator shall not close any part of the JMB area except for some special reasons.
- To establish procedures for ensuring wind strength is monitored at all times by using the existing meteorological recording stations.
- In the event of breaking down vehicles and traffic accidents or fire within the JMB area the time taken for the first operational staff to arrive at an accident shall not be more than (i) 10 minutes-Bridge and (ii) 15 minutes-Approach road.
- To ensure traffic signs, signals and road marking are in place.
- Impounding, removal and storage of vehicles.
- Exercise of proper and efficient control.
- Provision of first aid equipment.
- Fire services.

Maintenance

The operator, among other things, shall responsible for the following maintenance work:

- To maintain the facilities in safe, reliable and serviceable condition by monitoring, inspecting, remedying and repairing all parts.
- The operator will be responsible for the regular maintenance of the JMB area.
- The operator shall monitor and supervise the progress of the works carried out by any subcontractor.
- Routine maintenance.
- To take full responsibility for adequate safety of all activities in the JMB area.
- Ensure provision of tools, spare parts, instruments and workshop facilities.
- Lane closure and associated lighting, signing and guarding for maintenance work.

Toll Collection

- To collect toll based on the Toll Collection System installed accurately and efficiently to the satisfaction of JMBA.

Comparison between First Five Year and Second Five Year Contracts

The major conditions for the new contract compared to the first stage contract were:

- Basic policies for the O&M operations were not different from the first stage. The scheduled activities, however, were reduced compared to the first stage schedule. This is because the Bangladeshi contractors have developed to be capable to carry out such works as road maintenance.
- The new organization for the O&M in principle is the same as that of the first stage. However, the positions for O&M Director, Chief Engineer and Toll/Finance Manager are from an Indonesian firm, while the other four Managers/Engineers are from a Bangladeshi firm. The number of staff is approximately 200, which is nearly equal to the first stage.
- Some major systems and equipment such as Asset Management System, CCTV incident and Toll Detection System and Vehicles (except the reverted vehicles) have been procured during the previous stage and have been installed/provided on the site. Therefore, these systems and equipment were not included in the new contract.
- During the first five years, non-routine repairs or maintenance, including River Training Works, were not necessary and therefore were not carried out. Approximately 80% of the specified additional plant and equipment was actually procured, but none of the Pending Optional Plant Requirements were procured.

The contract price for the second stage O&M was approximately 40 % of the first contract, because major management systems and vehicles, which were higher cost items, were installed and provided in the first five years. This reduction of the costs and conditions for the second stage, after five years, is to be considered for the O&M Planning for the Padma Bridge.

13.3 OPERATIONS AND MAINTENANCE FOR THE BHAIRAB BRIDGE

13.3.1 Outline of the Bhairab Bridge

The Bhairab Bridge crossing the Meghna River was constructed and opened to the public in September 2002 with a construction period of 33 months. The bridge is located 110m upstream of the existing railway bridge. The main bridge length is 929 m with 19.6 m width.

The viaducts before and after the main bridge are 141.5 m and 12.5 m respectively. The river training works are 640 m on the Bhairab side and 430 m on the Ashugamj side. The required navigational clearances are 12.76 m vertical and 76.2 m for each horizontal span.

Main Bridge of Bhairab

Viaduct of Bhairab Bridge

13.3.2 Management of the O&M Services

The Road and Highway Department (RHD) has the responsibility of the O&M of the Bhairab Bridge, and its Operations and Maintenance are based on a 5-year contract from August 2002 to July 2008. The O&M covers the following activities under the O&M organization and staff.

1) Operations:
   - Toll operation by manual ticketing with recording by computer
   - Traffic safety
   - Project area security, except for work done by police provided by the Government
2) Maintenance:
   - Routine maintenance with daily visual inspection
   - River training works as routine maintenance, with the exception of damage repair
   - Riverbed survey

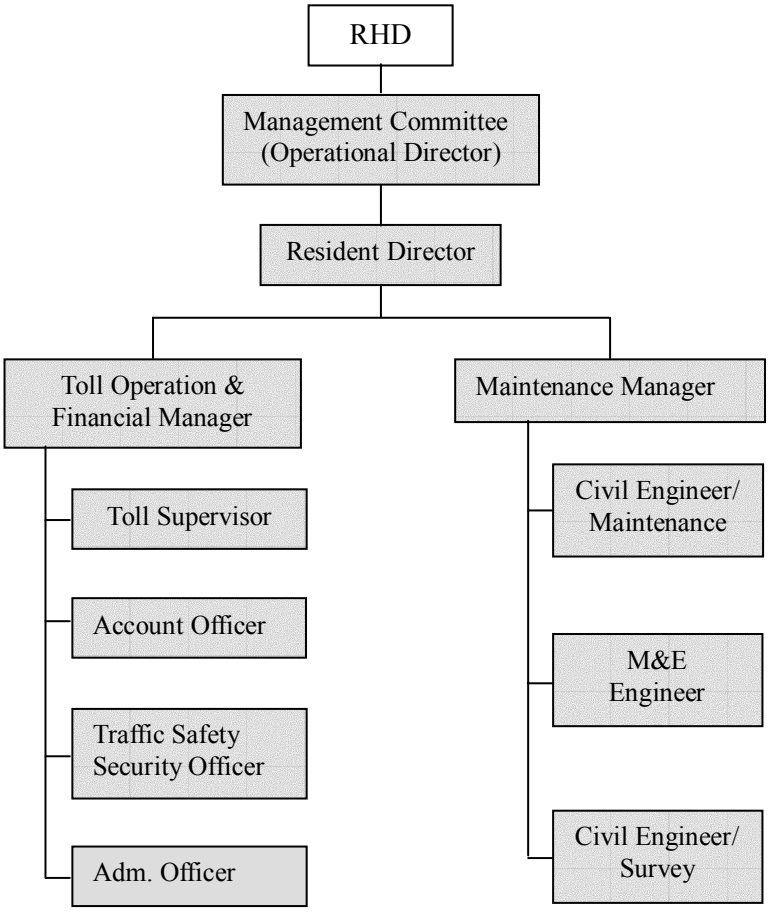
Toll Plaza of Bhairab Bridge

River Training Works of Bhairab Bridge

There are 104 staff for O&M in total of which 35 are for security. According to the five-year contract for the O&M of the Bhairab Bridge, the maintenance cost ratio to the construction cost is 1.27% annually.

(1) Organization and Staffing for O&M

The O&M for the bridge and approach roads is being carried out with a five-year contract between SIGMA-RCL JV and RHD. The organization of the O&M is as below:



Note: RHD: Roads and Highways Department
M&E Engineer: Mechanical & Electrical Engineer

(2) Staffing of SIGMA-RCL JV

Staff of SIGMA-RCL JV is as below:

Classified Sections/Positions	Number of Staff
1) Operation Director	1
2) Resident Director	1
3) Toll/Finance	18
4) Maintenance	9
5) Security	47
6) Administrative, including Drivers	7
7) General Workers	22
Total	105 staff

13.4 OPERATIONS AND MAINTENANCE OF THE PAKSEY BRIDGE

The Paksey Bridge is 1.8 km long with four-traffic lanes, and precast concrete segmental structure supported by foundation piles of 3.0 m diameter and 90 m deep into the silt of the riverbed. The construction was completed in March 2004. The location is immediately downstream (300m) of the Harding Bridge constructed by the British in 1910-1915. The maintenance operations were contracted out to BROMAS JV (Malaysia and Bangladesh). The contract is for 1.5 years. The River Training Works are excluded from the scope of works of the O&M contract. The bridge is operated under a Toll Bridge System with computerized toll operation equipped with CCTV (Closed Circuit Television).

Toll Gate of the Paksey Bridge

Toll Operation System

13.5 HIGHWAY OPERATION

13.5.1 General

The target of the O&M is to preserve serviceability and load-carrying capacity of the project highway, assure the safety of road users and keep the traffic flow as smooth as possible. Tasks and activities for highway operation, as described in the following sections, are traffic-oriented, in contrast to the tasks of highway maintenance, which require technical or engineering work.

13.5.2 Asset Management

The highway operator must always grasp the contents and condition of their own highway assets. Management of road assets should be properly undertaken based on the accurate updated inventory together with other relevant documentation.

13.5.3 Traffic Control and Surveillance

A highway operator conducts traffic management using a remote control and surveillance system, which can collectively control all relevant information. The activities include:

- receipt of traffic information about on-the-road incidents, weather conditions and traffic flows provided by reports from patrol cars, toll plazas, police troops and other highway authorities, data collected by traffic detectors and meteorological measurement devices, and visual images from CCTV cameras,
- processing this information with a computerized automatic event judgement system, as well as by manual judgement,
- monitoring of the processed information displayed on the graphic panel,
- provision of necessary information to motorists and the public through a variety of media such as variable message signs , highway radios and commercial broadcasting,
- instruction and/or request of traffic control measures ,such as temporary roadway closure, traffic regulation, temporary speed limiting, detour guidance, and temporary entrance closure, to the relevant organizations and dispatch of personnel to the site, and
- request of needed ambulance and/or fire activities, etc.

Those tasks are carried out at the traffic control center manned by shift all day long throughout the year. As will be described in the following sections, information management, emergency management, patrols, breakdown services, over-dimension vehicle regulation and disaster management are all closely related with the traffic control and surveillance.

13.5.4 Information Management

(1) General

A variety of information on highway operation and the traffic situation must be collected, transmitted, processed, monitored, relayed to relevant activity points, and provided to motorists and the public. Principal components of the information management system are real-time collection, processing and provision of data and information.

(2) Information Collection

Roadway and traffic information and data, which generally include traffic volumes, average travel speeds, degree of congestion, weather conditions, visual traffic flow conditions, and any incidents such as accidents, breakdowns, road works and disasters, are transmitted to the traffic control unit from various sources such as follows:

- Traffic detectors such as in-the-pavement inductive loop coil detectors, over-the-road ultrasonic sensors, etc.
- Traffic monitoring devices by CCTV
- Roadside meteorological measurement devices
- Patrol cars and maintenance vehicles on the road
- Toll plazas
- Relevant authorities such as police, fire departments, municipalities, other road operators, etc.

(3) Information Processing and Integration

Oral information or request is responded to by a control operator on duty and input to the processing system, if necessary. Transmitted data and information are immediately processed and displayed on the traffic control unit. Necessary information is reported to relevant authorities, while internal instructions are issued to relevant O&M subsections and toll plazas through the dedicated communication system, if necessary. All information is integrated by the traffic control unit for coordination with relevant authorities.

(4) Information Provision

The traffic control unit should preferably provide essential information to motorists on the road and to the public. One mode of providing motorists with timely on-site information is through the variable message signs at selected locations such as on the roadway, entrance to the interchange, upstream of the off-ramp, toll gates, and rest areas.

13.5.5 Emergency Management

In case of emergencies, such as accidents, fires and disasters, the highway operator is responsible for traffic control and safety measures on site. Once an incident is detected, the report must be immediately transmitted to the operator's relevant O&M station as well as to relevant authorities including the police, fire departments, ambulance services, other relevant road operators, garages, and municipalities.

In coordination with these agencies, the highway operator must carry out traffic management on site, such as temporary roadway closure and partial lane regulation, assistance to emergency activities by the police, ambulance, fire departments, and others, removal of disabled vehicles, cleanup of site, and so on.

Also, evacuation of endangered motorists and prevention of sequentially induced disasters

are the highway operator's important responsibility. To achieve this the highway operator should establish disciplined procedures, as well as adequate facilities.

13.5.6 Patrols

Periodic patrols of the roadway by dedicated personnel on shifts all day throughout the year with easily recognizable vehicles should be conducted. Their duties cover necessary activities to report traffic flow conditions, detect and report extraordinary incidents on the roadway, such as traffic accidents, vehicle breakdowns, traffic congestion, malfunction of road facilities, and unexpected disasters; offer assistance to motorists in trouble and remove dropped objects that can be potential risks to motorists.

13.5.7 Breakdown Service

When vehicle breakdown in need of assistance is detected, a repair crew of the contracted garage is dispatched upon the request of the user to the site. If the breakdown is too serious to recover on site, the vehicle is towed away to the selected garage.

13.5.8 Over-Dimension Vehicle Regulation

Vehicles of an illegal size (height, width and length) or illegal weight (total load and axle load) are not allowed to use public roads. In reality, however, it is sometimes observed that a number of over-dimension vehicles use the existing road network.

Generally, a particular major concern is the damage to structures and pavement caused by very heavy commercial vehicles. A highway operator should have measures to restrict the use of the highway by overweight vehicles to protect the highway, save on repair/rehabilitation cost and prolong its life.

Ideally, every highway O&M unit should have at least one weighbridge at a roadside location to check the actual load of commercial vehicles. But if it is physically or economically unrealistic, an alternative is the weigh-in-motion (WIM) system, which is a dynamic axle load measurement system. The WIM system can provide a statistical recording of heavy-vehicle loads and be of assistance to the enforcement agency by identifying actual overloaded vehicles at the site.

13.5.9 Toll Collection

Toll collection including maintenance of toll collection equipment obviously constitutes one of the most important activities of toll highway operation. The toll collection system can have a variety of configurations, depending upon:

- the toll rate principles such as flat rate, segmental flat rate and traveled-distance dependent rate;
- the physical features of the highway, whether it constitutes a network, or a singular highway with a single or multiple section(s);
- the number and distribution of interchanges;
- the classification of toll-charged vehicles;
- the type and location of the highway, whether it is urban or rural;
- the toll collection method to be adopted, whether automatically by modern electronic equipment or manually with labor-collective manpower, etc.

For an independent single-section toll highway, the simple flat-rate ticketing system with a single toll gate in one direction is most practical. But even in this case, the toll collection

system should be equipped with an automatic toll audit and record device with vehicle-type identification and counting functions, if manual toll collection is adopted.

13.5.10 Disaster Management

Once an abnormal incident or situation, such as earthquake, extraordinary rain, intense wind, tsunami, etc., has taken place, or is very certainly anticipated to take place, the highway operator must be alert to prevent possible disasters of any kind from occurring. For this purpose, the most urgently required task for the operator is traffic control on their highway to avoid or minimize human disaster. Major traffic controls to be taken are:

- Speed control, lowering the regulatory speed limit to a safer level, and
- Roadway closure, closing the highway sections where disasters are likely.

In reference to Japanese expressway practice, a suggestion for the traffic control criteria for disaster mitigation for the Padma Project highway is shown in Table 13.5.1.

Table 13.5.1 Traffic Control Criteria for Disaster Mitigation

Cause of Disaster	Operation by Highway Operator		
	Special Patrol	Alert Operation	Emergency Operation
		Speed Control Lower the regulartory speed (ex. to 50km/h)	Roadway Closure
Earthquake	Subject to Earthquake Inspection Manual	Over 50 gal	Over 80 gal, or Actual damage confirmed
Heavy Rain	Accumulated Rain between 100mm and 150mm	Accumulated Rain > 150mm, or Hourly Rain > 30mm	Accumulated Rain > 300mm, or Hourly Rain > 50mm after Accumulated Rain reaches 220mm
Strong Wind	—	Storm Warning Issued	Maximum Wind Speed > 25m/s
Dense Fog	—	Visibility between 50m and 100m	Visibility less than 50m
Others	—	Disasters probable	Closure judged to be necessary

13.5.11 Equipment Operation

The electrical, mechanical and communication equipment and devices installed on the highway and/or in the associated facilities for safety, comfort and convenience of motorists are automatically operated but monitored all day long by dedicated staff. The equipment includes:

- CCTV
- Traffic detectors
- Wireless communication system
- Weather observation devices
- Power receivers/distributors
- Diesel generators, and so on.

Once an emergency arises, however, emergency facilities such as variable message signs are immediately placed under the manual control of the personnel responsible for decision-making. Likewise, automatic operation of some of the equipment and devices is also replaced partially by manual operation. Equipment operation, information provision and emergency management should be coordinated with each other and systematically implemented.

13.6 ROUTINE MAINTENANCE OF THE PROJECT HIGHWAY

13.6.1 Inspection

(1) General

Inspection of the highway aims to accurately monitor and evaluate the present condition of the roadway in order to maintain safe and smooth traffic and prevent damage to motorists. As the most common classification, the three levels of inspection are as below, while the parts for inspection for the Project highway are summarized in Table 13.6.1.

(2) Routine Inspection

Routine, visual, on-vehicle inspection on or outside the expressway by technicians from a moving patrol vehicle

Typical frequency: once a day for inspection on the expressway, and two to four times a year for that from outside the expressway.

(3) Periodic Inspection

Periodic, close visual or telescopic, on-foot inspection of by a group of engineers and technicians

Typical frequency: once a year.

(4) Special Inspection

Intermittent, close visual and aural, detailed, on-foot inspection of a specific site by a team of professional engineers and technicians to obtain actual data needed to establish a repair program.

Typical frequency: once in every five years maximum, but at any time as needed.

Table 13.6.1 Objects of Inspection for Padma Bridge Project

Objects \ Level		Routine Inspection		Periodic Inspection	Special Inspection
		On Highway	Outside Highway		
Pavement	Pavement	○	—	○	—
	Curb	○	—		—
	Surface Drainage	○	—		○
Slope	Bank Slope	○	○	○	○
	Special Slope	○	○		○
	Masonry	○	○		○
	Retaining Wall	○	○		○
	Slope Drainage	○	○		○
Bridge	Concrete Bridge	○	○	○	○
	Concrete Deck	○	○		○
	Substructure	○	○		○
	Bearings	—	○		○
	Inspection Path	—	○		○
	Expansion Joint	○	○		○
	Guard Wall/Curb	○	○		○
	Bridge Drainage	○	○		○
	Girder Linkage	—	—		○
Culvert	RC Box Culvert	○	○	○	○
	RC Pipe Culvert	—	○		○
	Corrugated Pipe	○	○		○
Traffic Safety Facility	Guard Fence	○	—	○	○
	Anti-glare Net	○	—		○
	Median Split Net	—	○		○
	Anti-throw Fence	○	○		○
Traffic Control Facility	Traffic Signs	○		○	○
	Outer Guide Signs	—	○		○
	Road Marking	○	—		—
	Delineator	○	—		○
	Kilometer Posts	○	—		○
River Facilities & Others	Revetment	—	○	○	○
	Outer Drainage	—	○		○

13.6.2 Cleaning

(1) General

The roadway is cleaned to restore its functions, preserve the environment and improve the amenities of the roadway and areas along it.

The time, means and frequency of cleaning are substantially dependent on traffic volume, heavy-vehicle composition, weather condition, ongoing activities in areas along the roadway, and incidents that have taken place on the roadway. Generally, however, special attention must be paid to such cases as under very windy weather, before an anticipated heavy rainfall and at harvest time in agricultural areas along the roadway.

For safety and efficiency, most cleaning must be implemented with a complementary traffic regulation.

(2) Cleaning of Roadway Surface

Both right and left shoulders of the divided carriageway and the ramp are cleaned mechanically by a brush or vacuum-type sweeper or by a water sprinkler. Other parts can be supplemented with manual cleaning.

(3) Cleaning of Associated Facilities

Paved and landscaped areas of the interchange and rest area are cleaned manually.

Buildings and lavatories are cleaned manually.

(4) Cleaning of Road Accessories

Road accessories are cleaned as follows:

- Guardrails, manually or mechanically with a water sprinkler
- Traffic signs, manually with an expandable boom lifter
- Drain pipes, mechanically by a high-pressure washer or manually
- Gutters, mechanically by a vacuum-type sweeper
- Median inlets, manually
- Catch basins, manually or mechanically by a vacuum-type sweeper
- Bridge joints, mechanically by a high-pressure washer or manually with a water sprinkler
- Bridge catch basins, mechanically by a high-pressure washer or manually with a water sprinkler

13.6.3 Vegetation

(1) General

Highway vegetation is provided to preserve the environment, improve the landscape and enhance safety.

The time and means used in vegetation works heavily depend on the types of vegetation planted and their state of growth.

Highway vegetation works are classified into three types – tree/forest control, lawn control and slope vegetation.

For safety and efficiency, some vegetation works must be implemented together with a complementary traffic regulation.

(2) Tree/Forest Control

Tree/forest control consists of the following:

- Plant pruning
- Plant fertilization
- Insecticide spraying
- Weed and vine clearing
- Irrigation
- Prop renovation
- Damaged tree removal

- Weed cutting
- Tree felling

(3) Lawn Control

Lawn control consists of the following:

- Lawn mowing

Lawn fertilization

- Manual weeding
- Chemical spraying
- Insecticide spraying
- Top dressing

(4) Slope Vegetation

Slope vegetation works consist of the following:

- Weeding
- Slope fertilization

13.6.4 Traffic Accident Recovery Works

Except for major works to be contracted out, the highway operator conducts minor recovery works for damage caused by traffic accidents on roadway components, which usually include replacement of:

- Guardrails,
- Boundary fences,
- Anti-glare nets/plates,
- Delineators,
- Kilometer posts, and
- Traffic signs.

13.6.5 Traffic Regulation

A portion of the roadway cross-section must be temporarily secured for implementing on-road activities such as road works, cleaning, traffic accident investigation and inspection. Traffic regulation for any of these purposes is a highway operator's important responsibility.

13.6.6 Monitoring Program

(1) General

The monitoring actions are to be considered for the following subjects, including careful attention to faults and defects where repair works were done previously on the facilities.

(2) Special Monitoring on the Previous Repair

If there is a repair carried out during construction, it is necessary to ensure that unexpected deterioration to these repaired members has not occurred. For these portions special monitoring is desirably required.

(3) Bridge Deck Level Monitoring

Continuous monitoring on the bridge deck level should be carried out referring to the as-built survey results with a proper interval (6 months). An abnormal behavior or deflection on the bridge deck shall be reported immediately for further investigation.

(4) Riverbed Scour Monitoring

The chars or alluvial islands are unstable and frequently change their shape and location, depending upon the movements of the river due to river discharge, outer bend and confluence scour. Therefore, as general information on the river morphology or course, collection of satellite image data and yearly analysis of them should be considered, along with the riverbed level monitoring along the bridge line on a yearly interval observation basis after each flood season (May to September).

13.6.7 Maintenance of Utilities and Equipment

The utilities and equipment of the Padma Bridge would be divided into two categories. One part is the electric, mechanical, communication and building utilities and equipment to be inspected, tested, maintained, repaired and replaced by the Operator itself. Those are:

- Power receiver/distributor
- Auto generators
- Roadway lighting
- Meteorological measurement devices
- Variable message signs
- Water supply and sewage system

Major check points for the utilities and equipment include unusual appearance, loose connections and fittings, abnormal noise, overheating, lubrication, rust, loose grounding terminals, and so on.

The other part is the public utilities loaded on the superstructure of the Padma Bridge. Those are to be managed by the authorities concerned, as described below:

- 400kv Transmission Line, including Oil Supply Facility and Switch Yard for Power Supply related to the Power Grid Company of Bangladesh Ltd. (PGCB)
- Natural Gas Pipe Line related to the Gas Transmission Co. Ltd. (GTCL)
- Communication Lines related to the Bangladesh Telegram & Telephone Board (BTTB)

The Operator for the Project highway would only provide associated services for the public utilities loaded on the Padma Bridge through patrol actions. These associated services include document preparation for reporting and security actions for the traffic in maintaining the loaded public utilities.

13.7 REPAIR WORKS FOR PROJECT HIGHWAY

13.7.1 Pavement Renovation

Minor damages to the pavement must be repaired immediately or as promptly as possible by various means such as patching, crack seal, spot replacement of the pavement, correction of rugged road surface, surface treatment and repainting of road markings.

13.7.2 Repair of Bridges and Structures

Some components of the structures must be periodically renovated and/or repaired, responding to the inevitable progress of deterioration with time. Those include repair of expansion joints, partial repair of bridge deck, repair of guard walls and re-galvanization of guard rails.

13.8 MAINTENANCE OF RIVER FACILITIES

13.8.1 Maintenance Activities

It is a common approach for river facilities to design and construct at a certain safety level and then maintain the function after construction by partial repairs during the service period. This approach enables the works to be economical and effective as a whole project cycle. However, this approach must be supported by well-planned and timely maintenance activities.

The maintenance activities for the river works may include 1) monitoring, 2) study and planning, 3) maintenance works, and 4) administration including budgeting. The activities should be executed according to the maintenance manual, which is to be prepared in the detail design stages and to be revised in the course of operation based on experience.

13.8.2 Monitoring

The conditions of the river and structures should be monitored from wide and local area viewpoints. The monitoring results of wide area consideration would suggest a long-term view on the changes of river conditions in the future, and the result of local area consideration will give reliable data to decide actions to be taken now. The expected monitoring activities are presented below.

1) **Whole Padma River:** From the Jamuna-Ganges confluence to the Meghna-Padma confluence activity would be mainly collection and integration of following data:

   - Satellite images: yearly
   - Cross section surveyed by BWDB
   - Hydrological observation data
   - Reports and information on bank erosion and river works

2) **Riverbank Conditions around Bridge Site:** Periodical riverbank surveys should be executed every dry season to monitor the changes of bank-lines and their conditions as described below.

   a) To establish and maintain survey stakes for periodical survey: It is important that surveys are conducted at the fixed section periodically so as to quantify the changes.
   b) To conduct riverbank surveys: Indicative scopes of work are shown below.

Stretches	Activities
Left bank of the Padma R. from Lohajang to Dohar	• Cross section survey: Length 500m*: Land 200m & river 300m Section interval: 500m • Descriptions on riverbank conditions (erosion, sedimentation, river works, etc.)
Right bank of the Padma R. from the opposite bank of Lohajang to confluence of the South Channel	• Cross section survey: Length 800m*: Land 500m & river 300m Section interval: 500m • Descriptions on riverbank conditions (erosion, sedimentation, river works, etc.)
Right bank of the South Channel from the Padma confluence to the Arialkhan R.	• Cross section survey: Length 500m*: Land 200m & river 300m Section interval: 500m • Descriptions on riverbank conditions (erosion, sedimentation, river works etc.)

(NOTE) * Extent of land side survey can be shortened for the sections of bank protection structures.

c) To conduct bathymetric surveys for the following stretches and delineate a contour lines map of the riverbed:
- The Padma River: From Lohajang to Dohar
- The South Channel: From the Padma River to the Arialkhan River.

3) **Conditions of Bank Protection Works:** Monitoring of the bank protection works are classified into two, i.e., dry season monitoring and flood season monitoring.

a) Dry season monitoring: Cross section surveys should be carried out for the bank protection works and neighboring riverbed periodically at the ends of dry and flood seasons (in March and November indicatively). In parallel with the cross section surveys, intensive inspection of the bank protection works should also be performed to diagnosis the soundness of the riverbank against erosion.
b) Flood season monitoring: In order to provide reliable information to decide the actions to be taken in the flood season, conditions of bank protection works and the neighboring riverbed should be surveyed employing appropriate sounding devices. As to the frequency of monitoring, it should be done at least once a month during flood months from May to September, and more frequently at high flood times as the occasion demands.

13.8.3 Study and Planning

All the monitoring, study and planning activities are intended to formulate measures to maintain the structures and thus the function of the bank protection works to be executed both in dry season and flood season.

1) **Geomorphologic Prediction:** The prediction of geomorphologic features of the Padma River is duly necessary to prepare the maintenance program for the coming flood season. Satellite images, periodical survey data and other river data as available are used to predict the trend of geomorphologic changes of the Padma River around the bridge site.
2) **Diagnosis of Bank Protection Works:** Based on the intensive inspection, present conditions of the bank protection works, places requiring repairs and works for preparedness, etc. are studied.
3) **Yearly Maintenance Program:** A maintenance program will be prepared yearly based on the study results of geomorphologic prediction and diagnosis of the bank protection works, in consideration of logistic and budgetary arrangements as well.
4) **Design and Procurement:** Works for the maintenance repair and preparedness will be

designed and the necessary documents and arrangements for procurement should be prepared in accordance with the yearly maintenance program.

13.8.4 Maintenance works

Dry Season Works: Most of the works for maintenance repair should be carried out during the dry season under better working conditions such as low water level, gentle river flow, good land accessibility, etc. These works will be executed based on the maintenance program.

Flood Season Works: In addition to the dry season works, works for emergency repair may become necessary during the flood season, according to the monitoring results during high flood times. As most of the sites that may need urgent repair are inaccessible from land, repairs by working vessel should be considered. Equipment and materials for these repairs should be prepared before the flood season and on standby for the operation. A party for the emergency works should also be organized. The party should picket the bank protection works during high flood times.

13.8.5 Administrative Affairs

Maintenance Unit: The maintenance unit for river facilities should be organized as a permanent setup in the maintenance office to be established for Padma Bridge. The unit shall handle all the matters relevant to the river maintenance of Padma Bridge, keeping contact with, and in coordination with, related agencies such as BWDB, JMBA, etc.

Budgeting: Steady and timely budgetary support is inevitably required for the maintenance activities. Institutional arrangements to allocate maintenance budget from toll would be worthy of consideration.

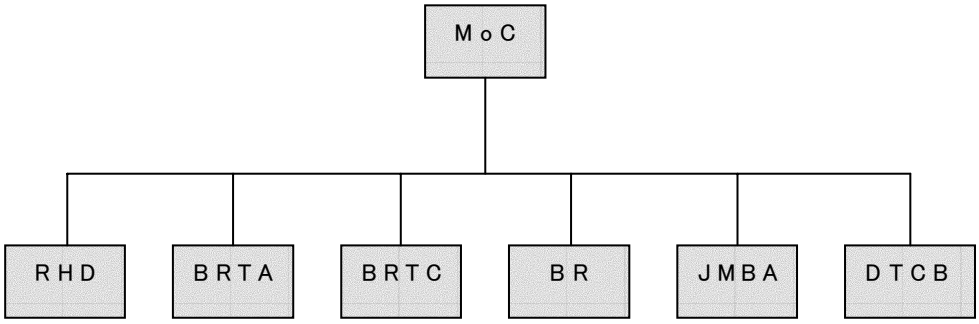
Training of Relevant Staff: Monitoring and picketing of the bank protection works require thorough understanding of the works and skill for handling monitoring devices and maintenance repair, especially for the activities during flood time. Training of the relevant staff is also an important issue.

13.9 ESTABLISHMENT OF ORGANIZATION AND STAFFING

A maintenance organization is necessary to create the conditions and logistical support for the effective implementation of all maintenance activities. The organization should meet the specific requirements and resources of Bangladesh. The system should also accommodate the existing Bangladeshi organizations and budgetary systems for the maintenance of highways. For the Padma Bridge, under each system for maintenance and management, either JMBA supervision or under the BOT consortium, the particular organization for the O&M should be established keeping the relationship with the existing organizations as part of them.

13.9.1 The Existing Relevant Organizations

A large number of Ministries (41 Ministries) are affiliated under the top level frame of the Government of Bangladesh (GoB), and under each Ministry, there are Departments and Autonomous Agencies who are administrative and functional arms of the concerned Ministry. Among the Ministries, the Ministry of Finance (MoF), the Ministry of Law, the Ministry of Planning (MoP) and the Ministry of Foreign Affairs are all decisive authorities. The Ministry of Communications is the higher level institution of the Road and Highway Department (RHD) and Jamuna Multi-purpose Bridge Authority (JMBA).



MOC: Ministry of Communications
RHD: Road & Highway Department
BRTA: Bangladesh Road Transport Authority (License, Registration, etc.)
BRTC: Bangladesh Transport Corporation (Operation Public Transport)
BR: Bangladesh Railway
JMBA: Jamuna Multi-purpose Bridge Authority
DTCB: Dhaka Transport Coordination Board

13.9.2 Implementation of Padma Bridge

After the accomplishment of the Feasibility Study by JICA, project implementation would proceed on the Detailed Design, Bidding Process, and Construction, for which finance would be supported by donors/investors and GoB on a funding share basis. If donors are involved in the project implementation, the External Resource Division (ERD) considers the quantity and quality of foreign aid and formulates plans with heavy reliance on foreign aid financing of plans. The ERD is affiliated under the MOF. At the construction stage of the project of Padma Bridge, the Government of Bangladesh will be the top level and the financial group will have high level involvement.

One case for project implementation suggests that the implementation organization for the Padma Bridge would be not directly under the particular Ministry, but substantially conformed to a Division of a Government Ministry and should cover management of both financing and technical parts, including construction supervision in terms of construction management such as quality, progress, safety and cost control. The other case is that the project implementation will be managed and operated by the BOT investors (privatized group) in collaboration with the Bangladesh Government.

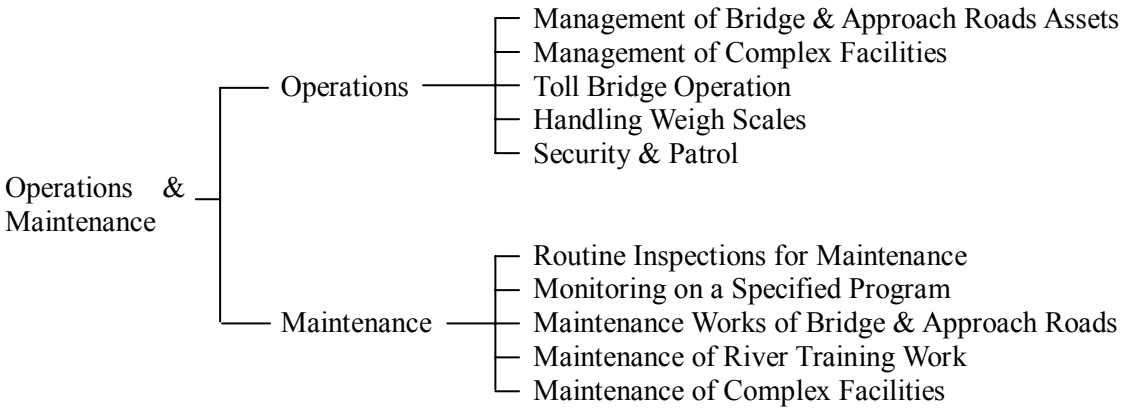
13.9.3 Organization for the O&M of the Padma Bridge

(1) Operations and Maintenance Organization for the Padma Bridge

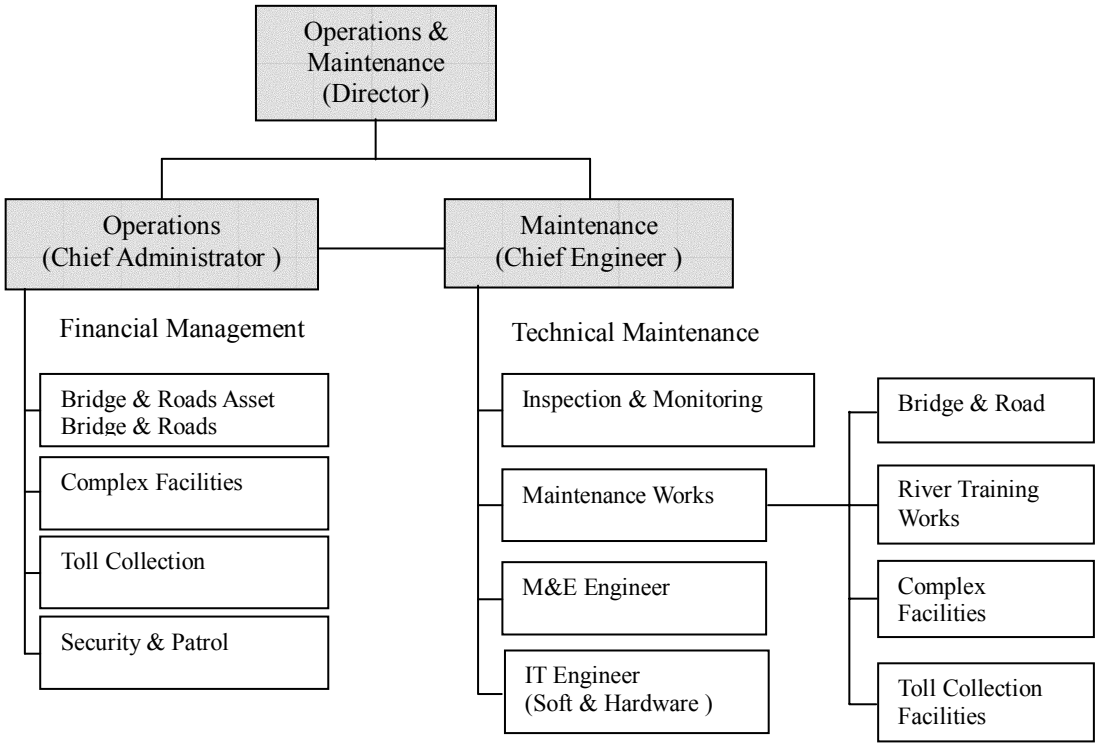
To ensure the further responsibility of the authority who will manage overall bridge and roads assets for the Padma Bridge, complex facilities should be included. It is recommended that professional consultants be engaged on a contract basis for the advantageous reasons of reliable quality, international standards and economizing on the costs. This consultants group, consists of skilled and qualified staff and can be responsible for overall asset management. It will be considered as the Operations and Maintenance Advisory Consultants group (OMAC) for the Padma Bridge. It is recommended that this OMAC be considered even in the case of BOT management.

(2) Functions and Organization of OMAC for the Padma Bridge

The OMAC services will be performed with the function below in the management, administration and supervision of the O&M for the Padma Bridge.



Note: 1) Specialized Inspection and Maintenance, e.g. after earthquake damage, to be carried out by a special group engaged upon occasional requirements.
2) Maintenance of the utilities encroached on/in the bridge are not included in the maintenance tasks of OMAC other than traffic control and security assistance on the bridge and roads.



13.9.4 Staffing for the O&M of the Padma Bridge

In connection with the proposed organization previously introduced the plan of staffing is recommended as follows: one (1) Operations and Maintenance Director who will be responsible for overall management of the O&M services. Under this Director, one (1) Chief Administrator mainly for the operation services, and one (1) Chief Engineer mainly for the maintenance activities from technical inspections to actual maintenance works.

	Director	Manager/Engineer	Number of Staff
a)	Operations & Maintenance	1-O&M Director	
b)	Operations	1-Chief Administrator	
		1-Finance Manager	5
		1-Camp Manager	5
		1-Toll Manager	15
		1-Traffic & Security Manager	40
	Sub-total	5 Managers/Engineers	65 staff
c)	Maintenance	1-Maintenance Specialist	-
		1-Maintenance Work Manager	25
		・1-Bridge Engineer	-
		・1-Road Engineer	10
		1-River Engineer	25
		1-River Surveyor	10
		1-Architect/Utility Engineer	5
		1-Mechanical/Electrical Engineer	
		1-IT System Engineer	
	Sub-total	10 Managers/Engineers	75 staff
Total:	1 Director	15 Managers/Engineers	140 staff

13.10 COST ESTIMATE FOR THE OPERATIONS AND MAINTENANCE OF THE PADMA BRIDGE

To estimate the maintenance costs, it is effective to refer to the actual experience on the expenditure for bridge and road maintenance in Bangladesh and the other countries. The O&M cost could be estimated based on the proposed organization and staffing, and necessary management systems and equipment. However, the costs for the necessary rehabilitation during the operation are not included in the O&M cost for the case that the O&M is conducted under the O&M group under contract with the Government (JMBA). Meanwhile, the rehabilitation costs should be included as management expenditure to be covered by a privatized group under the BOT scheme, but it also should not be defined as an O&M cost.

13.10.1 Maintenance Expenditure in Other Countries

According to the OCED (Organization for Economic Co-operation and Development), based on the review of several countries experience, at least 0.5 percent of the replacement value of the bridges should be devoted yearly to maintenance expenditure to achieve a satisfactory standard. In New York City, there was a 1.8% ratio of annual maintenance to construction cost obtained during the period 1905-1912, and a similar ratio has been reported by other toll collection agencies world wide, e.g. Tokyo Metropolitan Transportation and the Honshuu-Shikoku Bridge Authority in Japan.

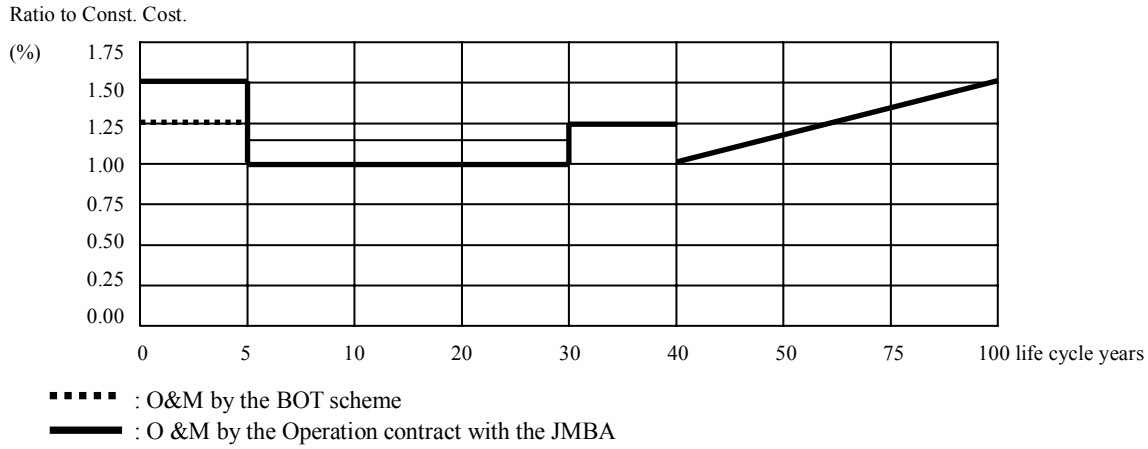
13.10.2 Jamuna Bridge and Bhairab Bridge Cases

Referring to the contract with JOMAC (July 1998) for the Jamuna Bridge, which was composed of a Lump Sum Management Fee and other Additional Costs on a reimbursable basis, the O&M cost ratio to the construction cost is 1.69 % of the construction cost of the bridge and road for the first five years, but only 1.03 % of the construction cost, if the construction cost includes the river training works. In the case of the Bhairab Bridge, the maintenance cost ratio to the construction cost is 1.27% for the first five years.

13.10.3 O&M Cost

For the Operations and Maintenance of bridges and roads from an economic point of view,

it should be discussed in terms of life cycle span as an asset management.



For the first five (5) years, the initial cost of the investment for maintenance works requiring plant, equipment and vehicles will raise the O&M costs up to 1.25 %.

- Between 5 and 30 years, the O&M cost will not require heavy plant, equipment and vehicles for operations and maintenance as those are deemed to be procured during the first five years. So the O&M cost will be reduced to 0.75 %, but still achieve satisfactory quality, and remain constant at 0.75 % until 30 years have elapsed.
- Between 30 and 40 years, the maintenance cost will be raised again due to the replacement of maintenance plant, equipment and vehicles, which become too old to carry out their proper function, and already, at that stage, need frequent repair and consumption of parts. This will make it necessary to raise the O&M cost to 1.00 %.
- After 40 years from the start of maintenance and management, the status of the facilities to be maintained at a satisfactory level will become much more serious, especially with the major part of the project facilities. This causes a gradual increase of the O&M cost from 1.00 % to 1.50 % until reaching 100 years life.
- In the case of the project implementation by the private consortium, the O&M cost could be reduced to 1.00% for the first five years, and followed by the same figures as after five years of the contract-basis with the JMBA.

13.11 FINANCE OF MAINTENANCE FOR ROADS AND BRIDGES

13.11.1 Maintenance of the Road Network under RHD

According to the RHD Hand Book, RHD (Road and Highway Department) and LGED (Local Government Engineering Department) and Municipalities are responsible for both construction and maintenance of roads and bridges within their respective jurisdiction. Based on visual inspection of the bridge and road facilities, annual programs are prepared for routine and temporary maintenance work, and resources/funds are allocated annually.

Due to the small amount for the management of maintenance from the government's budget, there is serious deterioration on the road network. However, recently allocation of funds from domestic resources for maintenance works has been increased, and foreign assistance has been taken into this field as well, especially after 2003, so some loan refunding for development was transferred to the maintenance fund. To improve the budget shortage for road and bridge maintenance, it is recommended that consideration be given to a Road Fund to be collected from road users and vehicle purchases. The amount of fund allocation and its utilization for maintenance of the road network under RHD is tabulated below:

(unit: Mil. Taka)

Financial Year	Fund Allocation for Maintenance	Ratio to the Previous Year
1995-96	2,270	-
1996-97	2,120	0.93
1997-98	2,470	1.16
1998-99	2,700	1.09
1999-2000	2,810	1.04
2000-20001	3,119	1.11
2001-2002	3,310	1.06
2002-2003	3,749	1.13
2003-2004	5,760	1.54

The financial assistance from foreign aid includes reconstruction with widening and improvement as below:

Financial Assistance	Program	Works
World Bank	Road Rehabilitation & Maintenance (RRMP)	Overlay of large portion of network
ADB	Road Improvement & Overlay Project	
ADB & IDA	Road Improvement	Surface treatment, thin layered seal-coat

Recently, in Bangladesh the HDM model for planning and programming the road maintenance activities has been applied to techno-economic evaluation and it enable the selection of priorities to be effectively carried out.

13.11.2 Annual Budget for Maintenance under RHD

The annual budget for Development and Maintenance over the last five years is presented below:

(unit: Mil. Taka)

Year	(1) Development	(2) Maintenance	(3)=(2)/[(1)+(2)]x100%
1996-1997	10,230	2,120	17.2
1997-1998	10,870	2,480	18.0
1998- 1999	13,410	2,600	16.2
1999-2000	14,180	2,700	16.0
2000-2001	18,144	2,900	13.8

The amount of revenue income carried under RHD is increasing every year. The revenue income for the last five years is as below:

(unit: Mil. Taka)

Year	Ferry	Bridge	Others	Total
1995-1996	241	234	78	553
1996-1997	443	273	116	832
1997-1998	315	385	147	847
1998- 1999	264	131	264	659
1999-2000	535	352	125	1,012

13.11.3 Finance and Budget Procedures for O&M for the Padma Bridge

In the case that the O&M was supervised following the JMBA Ordinance 1985, as amended up to November 23, 1998, the JMBA will be authorized to be responsible for the O&M of the Padma Bridge, and be entitled to receive finance. The sums required for the O&M will be estimated for approval by the Finance Department of the MOF. The JMBA will receive the sums for the implementation of the O&M. As for the O&M contract, it will be subject to the decision and the approval by the MOC, the Cabinet Committee on Government Purchase, and endorsement of the Prime Minister as for the cases of JOMAC and Marga

Net One Ltd. for the O&M contract of the Jamuna Bridge with the JMBA.

On the other hand, a negotiation on the subsidization for revenues with the Government will be necessary for the BOT management, if toll collection revenue is not able to cover entirely the maintenance and management costs.

13.11.4 Study on Insurance Application in case of Natural Disasters

(1) Advantages of Insurance

Natural disasters could be characterized that their occurrence is disastrous for a large area, low frequency, uncertainty, and claim heavy costs for recovering normal conditions. The advantages of insurance coverage are:

- Profit to the managing authority by saving cost in processing maintenance, especially avoiding unexpectedly high maintenance costs.
- Avoid additional involvement of personnel and staff by the managing authority in the maintenance process.
- Reduce extra cost for repair from the taxpayer.

(2) Potential Damage of the Project Facilities

Potential damage of the project facilities, after completion and in the maintenance stage, mainly caused by natural disasters and accidents due to human errors are:

- Riverbank erosion and damage of riverbank and riverbed protection facilities caused by floods
- Concrete cracks and/or settlement on the bridge structures and damage on the bearing function caused by earthquake
- Damage on the bridge pier and foundations by vessel collision in the navigable channel under the bridge girders
- Damage of the bridge and road surface caused by fire due to vehicle collision on the bridge deck or the asphalt concrete pavement
- Damage to the maintenance equipment and vehicles caused by errors in operations.

If damage and risk are over and above the degree or control from the normal preparation of maintenance work and budgetary allotment, it is risky to accommodate urgently required mitigation to maintain the condition originally built. Therefore, insured mitigation should be studied against the potential damages and risks for the project facilities.

(3) Insurance Coverage

Natural insurance coverage will be classified into two types: one is related to personal life and property and another is public property such as highway and bridge facilities. In application to natural insurance, there are difficulties because of uncertain definition and standard in judgement on damage. Therefore, it often requires controversial clarification between damage and coverage in the court. However, application and coverage for personal life and property have advanced. Coverage of insurance for natural disasters in several countries in Europe is limited to the case of personal life and property, and there are no coverage cases in Japan. In the USA coverage is also limited to personal life and property.

(4) Circumstances of the Relevant Insurance

(a) National Flood Insurance Program (NEIP) in USA

The NEIP is a pre-disaster flood mitigation insurance protection program designed to reduce the exalting cost of disaster. Flood insurance is available to any property owner located in a community of all flood areas. Flood insurance claims are not paid by the taxpayer, but through premiums collected for insurance policies. The program has borrowing authority from the US Treasury and these loans are paid back with interest. The standard coverage by this Flood Insurance is basically limited to such as family structures and condominium buildings, along or on the riverbank in the flood prone areas.

(b) Problem Cases of Flood Insurance

There has been an example of conflict on compensation by an insurance contract for house damage on the riverbank. The conflict was whether damage was able to be covered by the insurance policy or was excluded. In this case, the coverage judgement will face the problem on the policy definition of insurance or identification whether the flood damage was caused by a natural and ordinary phenomenon or extremely different from normal events.

(c) Earthquake Insurance

In the USA, special insurance for earthquake damage is available, which is not covered by a standard insurance policy. But most of the coverage is dwellings and life as it does not cover damage to infrastructure such as highways and bridges being managed by a country. In New Zealand also, there is insurance against natural disaster from earthquake and fire, but it is available only for residential land, etc.

(d) Insurance of Vessel Collision

There are many types of insurance coverage for vessel accident, including vessel collision, but this is to insure the ship-owner against loss or damage of vessels. It seems to be complicated to find a case of insurance coverage for bridge structures like piers which might be damaged by vessel impact.

(e) Insurance for Maintenance Equipment

Insurance coverage is available against the damage or loss of vehicles and equipment due to human errors and fire.

For such a situation, the study on insurance for the project properties during the operations and maintenance period is still at a preliminary stage. However, as from the past indication, especially for compensation due to natural disasters, it is necessary for in-depth inquiries and negotiation with insurance companies.

Chapter 14 Conclusion and Recommendations

14.1 INTRODUCTION

The study was commenced in May, 2003. At the outset, four alternative crossing sites were conceived from river platform considerations. In September 2003, Progress Report-1 was submitted to JMBA, in which two crossing sites, namely Paturia-Goalundo and Mawa-Janjira, were regarded as prospective sites of the Padma Bridge. In March 2004, the Interim Report was submitted to JMBA. In the Interim Report, Mawa-Janjira site was selected as the final site of the Padma Bridge based on a range of studies. In September 2004, Progress Report-2 was submitted to JMBA. In Progress Peport-2, the results of preliminary design of Padma Bridge and various associated facilities were prepared. Following Progress-Report 2、the Study Team has continued to prepare a Draft Final Report, in which the main subject is to conduct preliminary cost estimates, environmental, social impact and resettlement studies, economic and financial evaluations, studies on an alternative with railway provision, socio-economic impacts, implementation plan and to prepare recommendations for the Project.

14.2 NECESSITY OF THE PROJECT

The Project, which is to construct the Padma Bridge and associated facilities, is great importance for the development of Bangladesh and is expected to play the following important roles:

1) To integrate central and southwest regions of Bangladesh (reducing to 3-4 hours the driving time from Dhaka to the major cities in southwest region);
2) To contribute to the development of a regional economy in the southwest region of the country by improving transport accessibility to the region and at the same time, through the promotion of regional economic development, contribute to poverty reduction in the region;
3) To support substantial roles for socio-economic development of the northeastern parts of South Asia, encompassing neighboring countries (the Padma Bridge will contribute to the formation of the A-1 route of the Asian Highway and its completion will be expected to improve bilateral trade and increase of tourists between Bangladesh and India).

14.3 FUTURE TRAFFIC

Future traffic volume crossing the Padma Bridge was forecast by dividing normal traffic, diverted traffic, and induced traffic, respectively. The future traffic volume is estimated to be 21,260 vehicle/day in 2015 and 41,550 vehicle/day in 2025.

14.4 CONCLUSION OF TECHNICAL ASPECTS

(1) Bridge

At the outset of the preliminary design, the adoption of steel girders was examined but PC bridge type was concluded to be advantageous.

Three bridge types, such as continuous PC box girder, PC extra-dosed girder and PC cable stayed girder were studied taking into consideration various span lengths from 100m to

240m. As a result, PC extra-dosed girder with a span length of 180m was selected as the most favorable bridge type. The total bridge length is 5,580m.

As for the foundation type, steel tubular driven piles, 3.0m in diameter and 90m in length, were selected to support the PC extra-dosed girder.

Three alternative highway bridges were designed for final selection.

(2) Approach Road

The project has a 12,163 m long approach road. For the embankment a crest width of 27.0 m will be utilized. As the project is operated as a toll road, a simple, single, barrier–type toll gate in each traffic direction is desirable. However, this system will be examined again taking local conditions into consideration. Provision of a service area is recommended near the right bank of the Padma River.

(3) River Facilities

Continuous protection works were designed on both banks so as to protect existing banks and to guide the Padma flow smoothly to the bridge opening.

Left Bank Work: A total length of 6km to protect the bank around bridge structures and a protruding bank upstream from Mawa ghat to strengthen the existing bank.

Right Bank: A total length of 4.0km to secure the stability of the right bank, which is vulnerable to erosion, and to firmly protect the bridge structure.

South Channel Work: A total length of 6.3km downstream from Charjanajat ghat to check the southward shifting of river bank and protect the right approach road.

Revetments were proposed for bank protection to resist estimated design scour depth.

14.5 ENVIRONMENTAL STUDIES

The study of Environmental Impact Assessment was conducted to identify the significant environmental impacts for the bridge site along with mitigation measures. This followed the requirements of the environmental guidelines prepared by JICA, JBIC, GOB and other donor agencies. On this basis a preliminary EMP for the project was prepared. It was found that there are limited negative impacts by the Project on the environment, the scale of which is easily mitigated. A framework of mitigation measures is proposed in this Study, which should be elaborated in the EMP study during detailed design stage.

The key conclusions of the EIA of Padma river bridge project are as follows:

- The impact of the bridge on regional hydrology and flooding pattern will be minimal as the increase in highest water level of the Padma river will be approximately 10 cm after the completion of the bridge.
- Adequate openings on the right bank approach road are planned to alleviate drainage congestion.
- Erosion and sedimentation are limited.
- A total of 327,868 trees will need to be cut for the project. This loss may be compensated by 238,692 trees.
- A total of 58 ponds (area=4.18ha) and 74 ditches (area=2.66ha) will be affected by the project. Fish production loss will be about 11 MT/year which may be compensated by fish culture in new borrow pit ponds.

- The project does not pass through any ecologically protected and sensitive area. However, Padma river is a secondary habitat of two critically endangered species namely, Gangetic Gharial and Dolphin. Their main habitat is the Ganges river upstream of the confluence of the Ganges and Jamuna at Paturia and they are seldom found at the project site at Mawa – Janjira.
- Padma river is also an important migratory route for Hilsa fish. As the river is not constrained and overall flow regime is not changed, impact on Hilsa is expected to be minimal.
- Total income loss is 210 million taka of which agriculture production loss is about Tk. 45 million/ year
- With the proposed mitigation measures, overall impact will be limited.
- The indicative EMP cost is US$ 3 million.

14.6 SOCIAL IMPACT/RESETTLEMENT STUDIES

The social/resettlement issues will be critical and challenging for the construction of the Padma Bridge. The feasibility study report contains an assessment of the adverse project impacts, including the extent of land acquisition and resettlement of the affected population. The recommended resettlement framework provides measures for mitigation, including restoration of income and livelihoods of the affected people. The RAP, to be prepared during the detailed design period, must consider the framework and prepare a full inventory of affected persons and assets. The institutional aspects, including capacity building for resettlement management and monitoring, should be addressed by the RAP. The timely construction of the bridge project is largely dependent on land acquisition and resettlement management in this project.

14.7 PROJECT COST

The project cost of the three alternatives is estimated to be in the range of US$ 1220 million to US$ 1070 million in July 2004 prices. The anticipated share between foreign and local currency is around 70% and 30%, respectively, based on the cost estimates.

14.8 ECONOMIC AND FINANCIAL EVALUATION

The economic analysis followed the conventional discounted cash flow methodology in determining the EIRR, NPV and B/C ratio. The major economic benefits quantified were the vehicle operation cost saving, travel time cost saving, ferry waiting time saving and ferry operation cost saving. Economic evaluations for three alternatives were conducted and the results are tabulated below. These results indicated that the project is feasible.

Financial evaluation was carried out on the revenue using the current toll rate of Jamuna Bridge and maximum toll rate. The result shows FIRR value of around 10% for all alternatives. However, this value is far below the optimum, but is enough to guarantee that the project can be implemented by private financing methods.

To involve private investment in the construction works is considered difficult, however, there are many areas for private investment to participate. These include fields such as O&M of the Padma Bridge, O&M of public utilities loaded on the Padma Bridge and O&M of the service area.

Project cost	Total Amount (Unit : USD)		
Bridge Alternative	Alternative-H1	Alternative- H2	Alternative- H3
Bridge type	Extra-dosed girder	Extra-dosed plus cable stay girder	Extra-dosed girder
Carriage Purpose of Bridge	Road	Road	Road
Bridge width	21.5m	21.5m	17.1m
Total project cost	1,178,335,900	1,218,510,992	1,069,375,418
(Project cost ratio)	1.00	1.03	0.91
EIRR (%)	15.35	15.01	16.18
B/C Ratio	1.46	1.41	1.61
NPV (Million USD)	206.7	190.5	244.2

14.9 SELECTION OF ALTERNATIVES

Alternative-H3 is the minimum investment case with minimum roadway width. Since this width does not conform to the design criteria of the Asian Highway Standard and EIRR values of other alternatives conforming with this Standard exceed 15%, adoption of alternative-H3 will not be considered.

Alternative-H1 and alternative-H2 were therefore examined further. If the main channel of the Padma is fixed, there will be some tendency to employ larger spans to cross the main channel and to enjoy its aesthetic beauty. However, the main channel of the Padma changes its route every year, as concluded from the aerial photos and satellite images of the past 40 years and the results of mathematical modeling. Under such circumstances, in order to minimize initial investment cost, alternative-H2 (Extra-dosed plus cable stay bridge) will not be recommended.

Alternative-H1 (continuous extra-dosed bridge) some 5.58km in length will definitely provide spectacular scenery to all people visiting the bridge.

Alternative-H1 is recommended as the best alternative for a highway bridge.

14.10 ALTERNATIVE WITH RAILWAY PROVISION

Since a highway bridge on the Padma is judged to be feasible, an alternative with railway was examined as mentioned in the mutually agreed Scope of Work. Preliminary design and cost estimates for the alternative were conducted and economic and financial evaluations examined. Total project cost of Alternative-HR was estimated as US$ 1,256,822,720. Although the alternative represents an increase of about US$ 80 million over the best highway bridge alternative, the EIRR is 14.80% and the project is considered feasible. From the viewpoint of formation of an international transportation corridor, the “Trans-Padma Corridor” with railway must be developed in the future. The alternative-HR with railway provision is considered reasonable and is recommended.

14.11 SOCIO-ECONOMIC IMPACT

The Padma Bridge will generate remarkable impacts for the whole country of Bangladesh and contribute to the economic development of the Southwest Region.

The Padma Bridge is situated at the best location to form an international transport network, Asian Highway A-1. If a railway provision on the Padma Bridge is effectively connected with the existing railway network, the Padma Bridge can contribute to the formation of a multi-modal international transport network for the Eastern Region of the Indian Sub-continent and will possibly provide a transit route for India to its eastern states of seven sisters.

Poverty impact analysis of the Padma Bridge shows that the substantial portion of direct benefit will go to the poor and the Poverty Impact Ratio is estimated as between 1.97-4.25. This implies that the project has an "ultra-pro-poor" nature.

Regarding fiscal affordability of the Government for the implementation of the project, it is concluded that the Padma Bridge may have a lower burden on national and ministry budgets than in the case of Jamuna Bridge.

14.12 IMPLEMENTATION PROCEDURE AND PROCUREMENT METHOD

Two different contracting methods were examined for the future implementation. These are: Conventional Contracting and Design-Build. In general the Design-Build is a fast track contracting method but the Project requires longer period for LAP and RAP which results in decreasing the time advantage of the Design-Build. From the stand point of Owner's benefit and to maintain fairness of tenders, merits and demerits of two contracting methods were examined. In order to implement the Project smoothly as well as to obtain high levels of fairness, Conventional Contracting with Overlapping Activities is recommended.

14.13 ADVERSE EFFECTS OF THE PROJECT

Large infrastructure projects like the Padma Bridge Project are planned from their beneficial viewpoints; however, they also carry tremendous adverse social impacts in terms of land acquisition and resettlement. Therefore, a well-deliberated Social Action Plan is required to minimize and mitigate adverse social impacts to the project affected persons.

Also, careful attention should be paid to the probability that the Project may preferentially receive domestic funding from the Government, given that the Project is appointed as a "national priority project" and the Government will prioritize financial assistance for its implementation. This may cause shortage of financial resources for projects in other sectors of the nation.

14.14 RECOMMENDATION

(1) Construction of Padma Bridge is viable from the macro-economic perspective. It will contribute to the development of the regional economy and to a reduction in poverty. At the same time, the contribution of the bridge has great significance in terms of developing the international transport corridor. Therefore, this should be an urgent project to be implemented at the earliest opportunity.

(2) Taking the importance of international transport corridor into consideration, the Padma Bridge shall have four lanes in both directions to meet the Asian Highway Standard and a necessary space along the median for future railway provision. An increase of about US$ 80 million will be required for the provision of the railway, but the EIRR of this project still exceeds 15% and is economically feasible. A further study on the railway provision is urgently required.

(3) Concerning the arrangement of the project cost of US$ 1257 million, the foreign currency portion of US$ 895 million shall be co-financed by international lending agencies or foreign governments, and the local currency portion of US$ 362 million shall be borne by the Government of Bangladesh. This arrangement is considered as the most practical and standard procedure.

(4) Prior to undertaking the next step for more detailed study, JMBA has to receive the approval of a Project Concept Paper, Project Proforma from the Government, and Environmental Clearance from DOE. JMBA should then request the Government to

apply to the international lending agencies for foreign currency funding. JMBA should simultaneously arrange the local currency portion.

(5) Based on a comparison of the Conventional Contracting and Design-Build contracting methods, a Conventional Contracting with Overlapping Activities, which maximizes merits to the project owner, is recommended. Concerning the operation and maintenance of Padma Bridge, it is recommended that an O&M contractor be selected under international competitive bidding, as in the case of Jamuna Bridge.

(6) The success of the Project completely depends on whether smooth and timely land acquisition and relocation of affected people will be implemented. In order to attain this goal, the project execution agency should refer to Chapter 8 of this report and Appendix-12, together with resettlement experience of Jamuna Bridge and other infrastructure projects in Bangladesh, to take appropriate measures during the detailed study and implementation periods. For example, a resettlement action plan (RAP) is critical to safeguard the rights of the affected people, such as replacement value of their assets, resettlement, livelihood restoration, and additional assistance to marginal and vulnerable groups.

(7) The Government shall take the following actions to ensure the maximum contribution of the Padma Bridge to promote the regional economy:
- To expand the capacity of existing NH-8 connecting to Padma Bridge to four lanes before the traffic volume exceeds its capacity.
- To intensify the local road network in the influence area of the Padma Bridge.
- To invite enterprises and factories to locate in the influence area of the Padma Bridge.
- To utilize the service area for the promotion of local working opportunities and local small industry.
- To improve proper entrance and exit routes to and from Dhaka.

(8) The Government shall take the following actions to contribute further to boosting the Sub-Regional Economy encompassing both national borders and the international transport corridor of Padma Bridge:
- To conclude an international treaty to smooth cross-border transport.
- To enact the necessary regulations and laws related to international treaties and to train officials regarding the regulations and laws.
- To complete the necessary facilities of land ports, such as Benapole.
- To introduce a plan to promote domestic forwarders.