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The Feasibility Study of
Padma Bridge in
The People's Republic of BANGLADESH

FINAL REPORT

Volume 3

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STRUCTURE OF FINAL REPORT

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The Feasibility Study of Padma Bridge
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Appendix-1 Economic Feature of Bangladesh

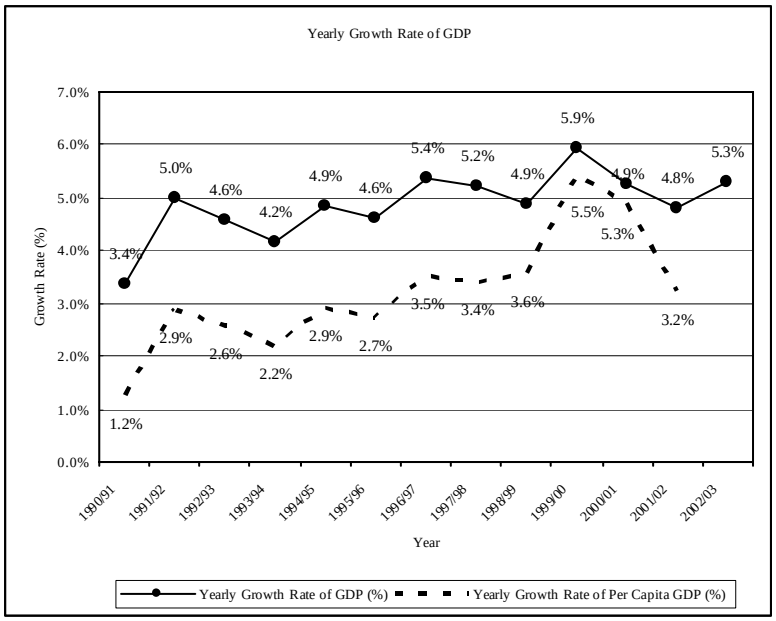
(Macro Economic Performance)

1.1 INTRODUCTION

In the past decade, Bangladesh implemented two national development plans, i.e., Fourth (1989/90 – 1994/95) and Fifth Five Year Plan (1996/97 – 2001/02), in the circumstance of limited natural and human resources and repeated natural hazards. Despite these constrains Bangladesh has made significant progress although economic fluctuations were observed in some sectors. Overviews of macro economic performance for the past ten years are given below:

1.1.1 Review of Fourth Five Year Plan Period (1990-1995)

Bangladesh's economy has experienced comparatively low growth during the Fourth Five Year Plan period (1990-1995) with 3.4% - 5.0% of annual growth rates (Figure 1.1.1). The annual average growth rate of GDP in this period was 4.15% against the plan target of 5%. A main reason of the low growth was near stagnation of agricultural production. The growth of agriculture sector was only 1.55% compared with the Plan target of 3.42% due to problems associated with fertilizer distribution and inadequate public procurement of food grain at support prices.



Original Source: "Statistical Yearbook 2000", "Statistical Pocket Book 2001" BBS

Figure 1.1.1 Yearly Growth Rate of GDP (at 1995/96 prices)

The industrial sector has grown with an average annual growth rate of 7.45% against the target of 9.02%. The yearly growth rate of GDP of industrial sector increased rapidly from 4.57% in FY 1991 to 9.86% in FY 1995. On the contrary, agriculture sector recorded a minus growth rate of -0.30% in the final year of the Fourth Five Year Plan (Figure 1.1.3).

1.1.2 Review of Fifth Five Year Plan Period (1997-2002)

The Fifth Five Year Plan started in fiscal year 1997 after a plan holiday of two years between 1996 and 1997. The realized annual growth rate during the plan period was at 5.33% against its target of 7%. Although this actual growth rate was below the target rate, it was the first time for the Bangladesh economy to exceed the 5% of growth rate in the past three decades. Every plan up to the Fourth Five Year Plan targeted at an average annual growth rate of above 5% but did not achieve the targets (Table 1.1.1).

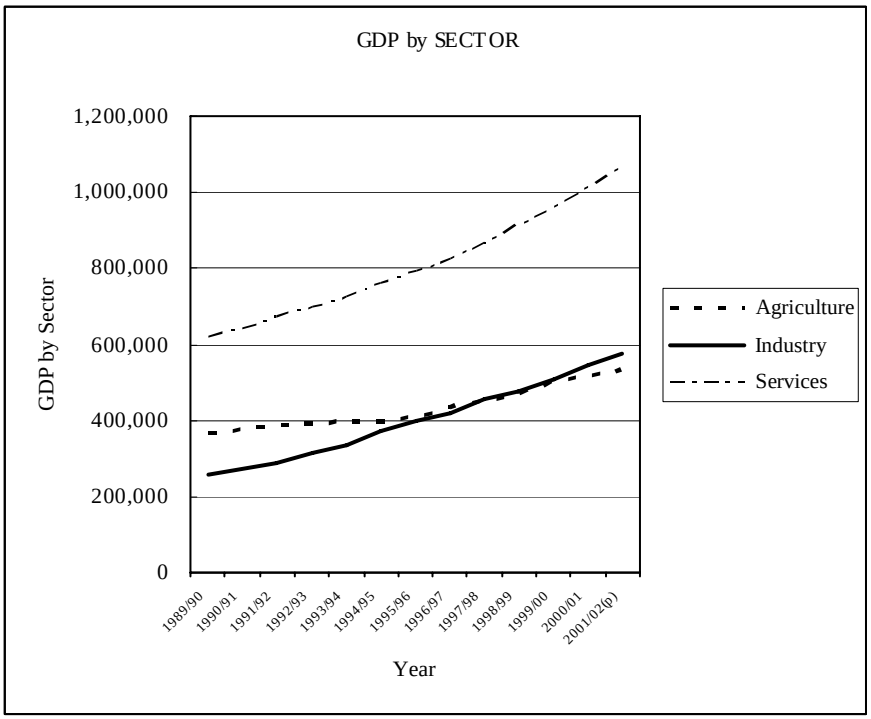
Table 1.1.1 GDP Growth Rate of Past Plans

Plan	Plan Period	Growth Target (%)	Realized Growth (%)
First Five Year Plan	1973 – 1978	5.50	4.00
Two Year Plan	1978 – 1980	5.60	3.50
Second Five Year Plan	1980 – 1985	5.40	3.80
Third Five Year Plan	1985 – 1990	5.40	3.80
Fourth Five Year Plan	1990 – 1995	5.00	4.15
Two Year Plan Holiday	1995 – 1997	-	-
Fifth Five Year Plan	1997 – 2002	7.00	5.33

Source: "The Fifth Five Year Plan 1997 – 2002, March 1998, Planning Commission"
"Statistical Pocketbook 2001, BBS"

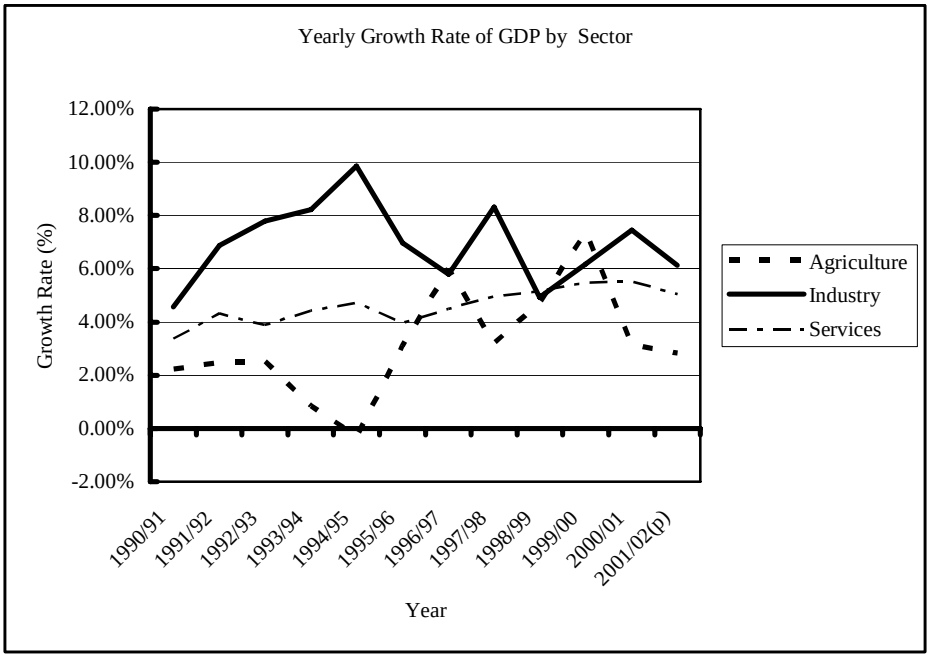
The main reason of such a higher growth rate was attributed to the rebound of agriculture sector and strong growth trend of industrial sector. In the first year of the Fifth Five Year Plan (1997), agriculture sector recorded 6.0% of growth rate. This sector, however, was hit by the flood during September – November of 1998 and the annual growth rate of 1998 went down to 3.2%. The government took prompt actions for implementation of agriculture rehabilitation program after the flood and, as a result, the sector recovered a growth rate of 4.74% in 1999 and 7.39% in 2000 respectively. The rate of 7.39% was the highest in the past decade. The growth pattern of the agriculture sector, however was affected by domestic and external factors. In the last two years of the Fifth Plan (in 2001 and 2002), agriculture sector stagnated again with lower growth rates of 3.14% and 2.83% in 2001 and 2002 respectively.

The industrial sector showed a modest growth path with an average annual growth rate of 6.59% compared with 7.45% of the Fourth Five Year Plan period. However, actual amount of industrial product at 1995/96 constant prices base exceeded the agricultural product for the first time in fiscal year 1998 (Figure 1.1.2). The service sector grew with an average annual growth rate of 5.24% during the plan period and took steady growth path (Figure 1.1.3).



Original Source: "Statistical Yearbook 2000", "Statistical Pocketbook 2001", BBS

Figure 1.1.2 Past Trend of GDP by Sector



Original Source: "Statistical Yearbook 2000", "Statistical Pocketbook 2001", BBS

Figure 1.1.3 Yearly Growth Rate of GDP by Sector

1.1.3 Changes in Economic Structure of the Country

The economic structure of Bangladesh in terms of composition ratios in GDP by sector is shown in Table 1.1.2. The share of agriculture sector declined from 29.5% in FY1990 to 24.6% in FY2002. The share of industry sector went up from 20.8% to 26.5% during the same period. The share of commerce and service sector slightly went down from 49.7% to 48.9%.

Table 1.1.2 Changes in GDP Composition

Sector	1989/90	1995/96	2001/02
Agriculture	29.5%	25.6%	24.6%
Industry	20.8%	24.9%	26.5%
Commerce & Services	49.7%	49.5%	48.9%
Total	100.0%	100.0%	100.0%

Original Source: Statistical Yearbook 2000, Statistical Pocketbook 2001m, BBS

1.2 POPULATION GROWTH

1.2.1 Total Population

The population of Bangladesh has been growing with the high rates of 2.4% per annum in 1970's and 2.1% in 1980's. However, a preliminary result of the Population Census 2001 revealed that the population growth during 1990's was 1.49% per annum compared with the previous census 1991 (Table 1.2.1). The speed of population growth is in declining tendency.

Table 1.2.1 Past Trend of Population Growth

Year	Population (Adjusted) (1,000)	Growth Rate (% p.a.)
1961	54,531	
1974	77,031	2.69%
1981	90,894	2.39%
1991	111,455	2.06%
2001	129,247	1.49%

Source: Population Census, BBS

Although the annual growth rate between 1991 and 2001 was only 1.5%, about 1.8 million people were added every year.

1.2.2 Urban and Rural Population

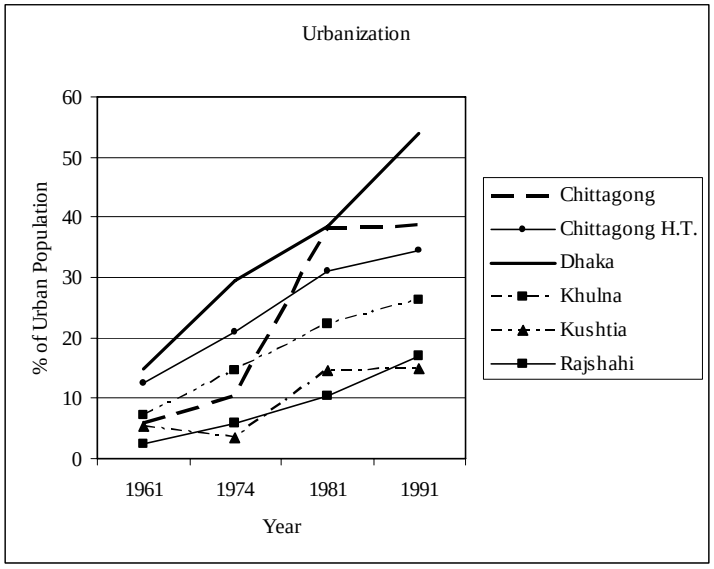
Big waves of urbanization like other developing countries have been observed in Bangladesh in the last decade. The urban population ratio increased to 23.4% in 2001 compared to19.6% in 1991. During the last decade, urban population increased by about 7.9 million while the rural population has increased by 8.9 million. The annual average growth rate of urban population was 3.3% against an only 1.0% of annual growth rate of rural population. These results mean that the urban population increased by 38% during the last decade and rural population increased by only 10% (Table 1.2.2).

Table 1.2.2 Changes in Urban and Rural Population

Locality	Census 1991 (1,000)	(%)	Census 2001 (1,000)	(%)	Incremental Population +Population	Added %	Growth Rate (% p.a.)
Urban	20,872	19.6%	28,808	23.4%	7,936	38.02%	3.30%
Rural	85,443	80.4%	94,343	76.6%	8,900	10.42%	1.00%
Total	106,315	100.0%	123,151	100.0%	16,836	15.84%	1.48%

Source: Population Census 2001, Preliminary Report August 2001, BBS

Figure 1.2.1 indicates the past trend of percentage of urbanization in the six most urbanized districts by the Census year (1996 – 1991).



Original Source: "Statistical Yearbook 2000" BBS

Figure 1.2.1 Urbanization in Six Most Urbanized Former Districts in Census Year

The two mega-cities, Dhaka and Chittagong, largely expanded the urbanization during the past three decades and still growing except for Chittagong and Kushtia.

According to the estimation of the World Bank (WB), urban population of Bangladesh will reach 30 million at this century's end, about nearly 80 million in 2020 ("Bangladesh 2020: A long-Run Perspective Study, 1998 World Bank). As the World Bank pointed out, the "push factor" driving people to urban centers comes from the inexorable growth of rural population and a lack of employment opportunities in rural areas.

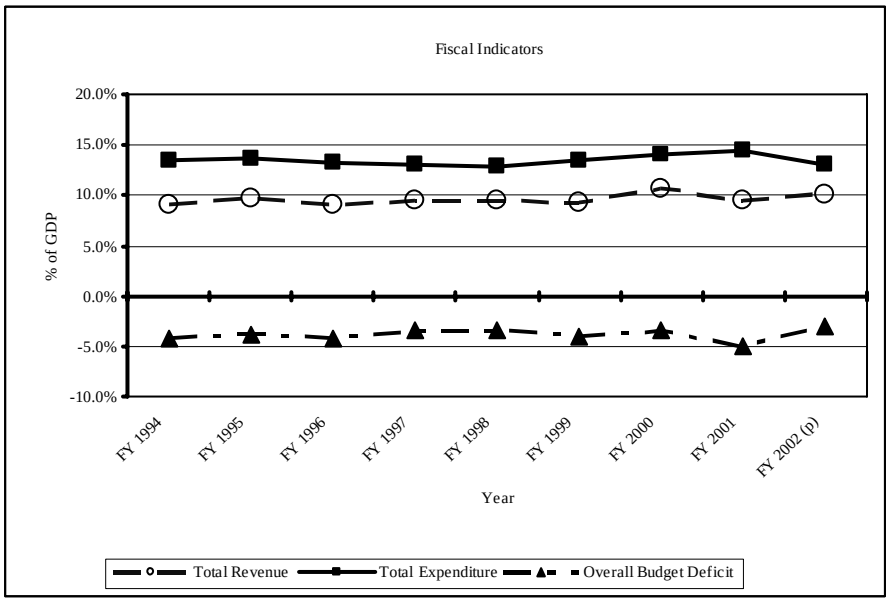
At present, uncontrolled acceleration of population to urban centers is causing sever problems such as congestion, air pollution, waste garbage and adverse effects on urban poverty due to shortage of urban infrastructure and financial constraints of additional investment to supply urban utilities (roads, electricity, water supply, etc.).

In order to mitigate the excess trends of urbanization in the mega-cities, the World Bank referred to the Jamuna Bridge as an example of spill-over benefits providing the robust inter regional network and thereby disperse the urban population to each regional centers.

1.3 FISCAL MANAGEMENT

1.3.1 Trends of Fiscal Condition

The Government's revenue increased with an average annual rate of 9.0% while the expenditure increased at the rate of 7.9% for the period of FY1994 to FY 2002. Although the increase rate of revenue was higher than that of expenditure, fiscal condition of the Government has been in chronic deficits. The ratios of deficits to GDP were in a range of 3.0% - 5.9% for the last decade (Figure 1.3.1). The ratios of fiscal revenue to GDP were around 9% - 10%, one of the lowest among Asian countries (in 2000, the ratio of revenue to GDP was 15.8% in India, 17.2% in Pakistan, and 16.7% in Sri Lanka: "Country Economic Review", December 2001, ADB). The collection of income tax and VAT was weak in performance and coverage of these taxes was not enough to generate sufficient fiscal income.

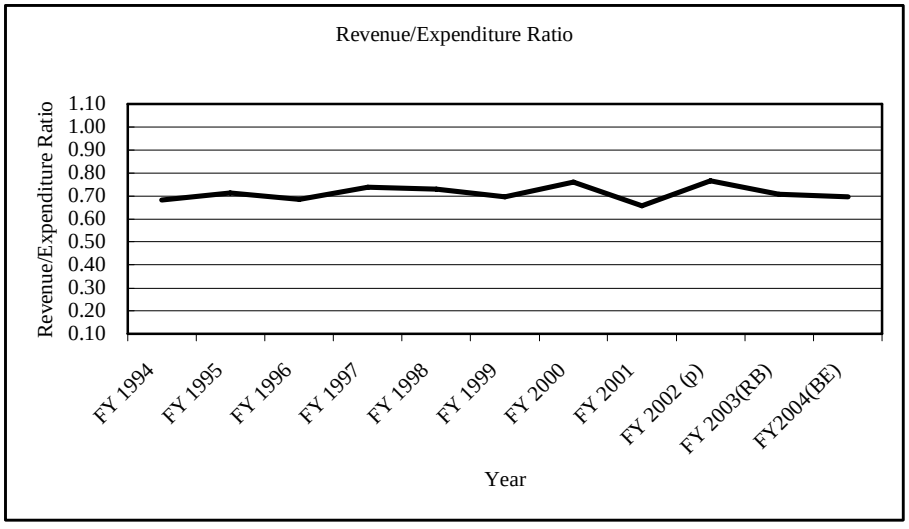


Original Source: "Statistical Yearbook 2000", "Statistical Pocketbook 2001", BBS

Figure 1.3.1 Trend of Fiscal Indicators

Although the VAT network was introduced in Bangladesh in 1991, many exemptions and exclusions are still remained.

In these situations, the fiscal expenditure was covered only 70% by the fiscal revenue (Figure 1.3.2) and rest of 30% was financed by the external sources (such as foreign grants and foreign borrowings) and domestic sources other than tax revenues (borrowing from the banking system, public account transactions and the government bond). It is reported that the manageable/ sustainable level of the fiscal deficit is less than 2.7% of GDP (ADB, -ibid-.).



Original Source: "Statistical Yearbook 2000", "Statistical Pocketbook", BBS

Figure 1.3.2 Fiscal Revenue/ Expenditure Ratio

1.3.2 Fiscal Structure (Budget 2003-04)

The Budget for FY2004, which was effective from 1 July 2003, was passed the Parliament on 30 June. The summary of the Budget for FY2004 is presented in Table 1.3.1 with the

revised Budget for FY2003 and financial sources are shown in Figure 1.3.3.

The budget size of FY2004 (total planned expenditure) increased by 18.3% compared with the revised budget for FY2003. On the other hand, total revenue receipts are estimated to increase by 16.2%, lower rate than the targeted growth rate of total expenditure. As a result the overall deficit would be increase by 23.7%. The estimated amount of fiscal deficit of 158 Billion Taka in FY2004 is the highest in the past decade (Figure 1.3.4).

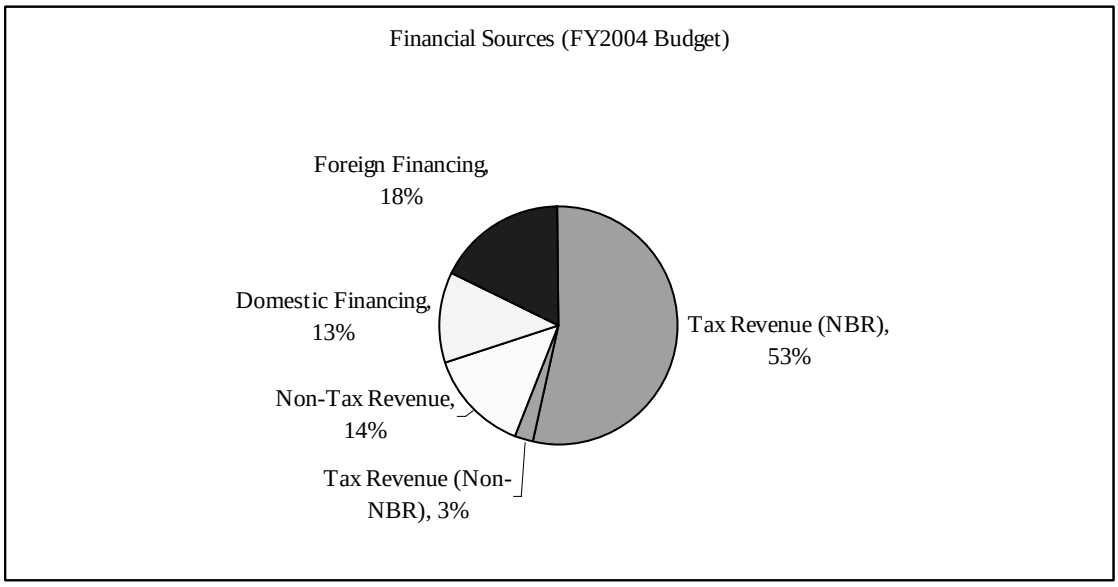
In order to finance the fiscal deficit (amounts to 158 Billion Taka), the Government intends to procure funds from external sources about 59% of the deficit (Grants and Borrowing) and 41% from domestic sources. Any sources except for the grants are required to pay for interest and repayments for principal. Regarding the annual interest payments for the domestic and foreign loans, 64.37 Billion Taka or equivalent to 22.2% of total current expenditure of FY 2004 was reckoned. In addition to these interest payments, repayments for the principal will be necessary and may turn out future issues of an additional burden on the Government fiscal condition.

Table 1.3.1 Budget at a Glance

(Taka in Crore)

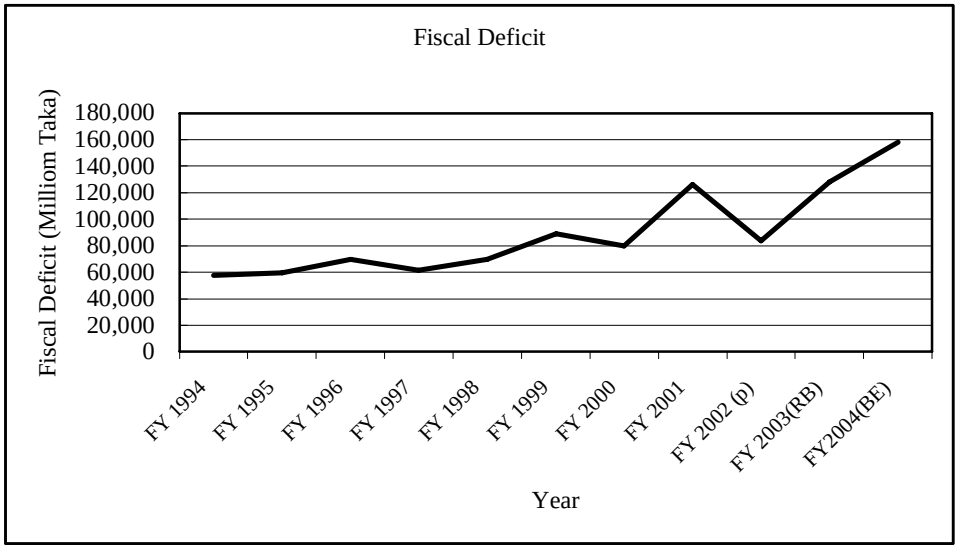
Description	Budget FY 2004	Revised FY 2003	Budget FY 2003
Consolidated Fund – Revenue Receipts			
Tax Revenue	290,71	249,50	255,00
Non-Tax Revenue	71,00	61,70	75,84
Total:	**361,71**	**311,20**	**330,84**
Consolidated Fund – Expenditure			
Non – Development Revenue Expenditure (Current Exp.)	289,69	253,07	238,72
Annual Development Programme (ADP)	203,00	171,00	192,00
Non – ADP Project (Foreign Assistance)	3,90	3,90	3,71
Capital Expenditure	21,55	14,59	9,78
Domestic Loans (Net)	-8,75	-10,29	-5,64
Net Outlay for Food Account Operation	5,19	-76	2,34
Non – ADP Development Expenditure (including FFW)	5,22	7,53	6,63
Total:	**519,80**	**439,04**	**448,54**
Overall Deficit:	**158,09**	**127,84**	**117,70**
Financed By:			
External Sources			
Foreign Grants	25,96	24,47	30,41
Foreign Borrowing	98,05	74,34	61,39
Repayment of Foreign Loan	-30,92	-28,91	-30,07
Total – External Sources	**93,09**	**69,90**	**61,73**
Domestic Sources (Domestic Non – Bank Borrowing)			
Term Debt (Net)	2,37	93	39
Extra Budgetary Resources/ Self Financing	0	2,00	2,00
Departmental Financing (T & T Bond)	2,00	2,00	2,00
Public Account Transactions (Net)	34,60	38,00	38,00
Total – Domestic Non – Bank Sources:	**38,97**	**42,93**	**42,39**
Borrowing from Domestic Banking System:	**26,03**	**15,01**	**13,58**
Total – Financing:	**158,09**	**127,84**	**117,70**

Source: "Annual Budget 2003-04, BUDGET IN BRIEF", Finance Division, Ministry of Finance
Note: 1 Crore=10 million



Original Source: "Annual Budget 200-04 BUDGET IN BREIF", Ministry of Finance

Figure 1.3.3 Financial Sources for the Budget FY2004



Original Source: "Statistical Yearbook 2000", "Statistical Pocketbook 2001", "2003-04 BUDGET IN BREIF Ministry of Finance"

Figure 1.3.4 Trend of Fiscal Deficit

1.4 BALANCE OF PAYMENTS

1.4.1 Overall Situation

(1) Trade and Current Account Balance

The trend of trade balance of Bangladesh is characterized by its chronic deficits. The base of exports of Bangladesh continues to remain narrow, with heavy dependence on the apparel sector. The share in exports of readymade garments, knitwear and hosiery products contributed about 77% of total exports in FY2002. On the other hand, imports exceeded over exports by 30% - 37% in the period of FY1998 to FY2002. Main reasons of chronic excess imports over exports come from the necessity to supplement domestic output due to shortage of natural resources and to use imported commodities as inputs for production of

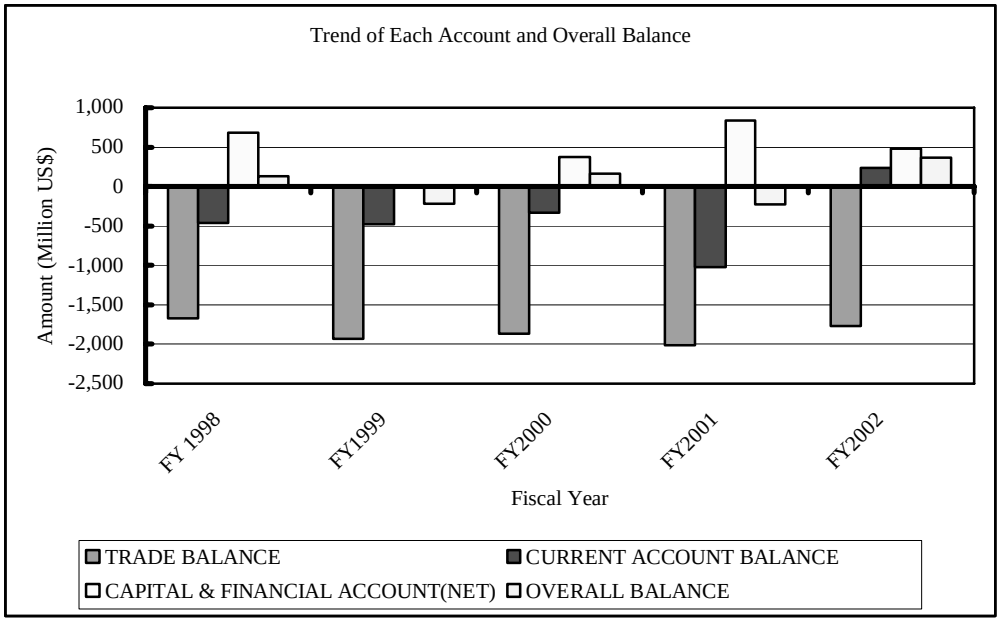
export goods. Import of intermediate goods and industrial inputs comprise about 41% of total imports in FY2002. Especially, the share of capital goods imports (such as machinery and vehicles, etc.) was 34% of total imports in FY2002. A summary of Balance of Payment is shown in Table 1.4.1.

Table 1.4.1 Balance of Payment

(Million US$)

Items/Sector	FY 1998	FY1999	FY2000	FY2001	FY2002
TRADE BALANCE	**-1,669**	**-1,934**	**-1,865**	**-2,011**	**-1,768**
Export f.o.b	5,103	5,283	5,701	6,419	5,929
Import c.i.f	-6,772	-7,217	-7,566	-8,430	-7,697
Service (Net)	-570	-603	-645	-914	-499
Receipts	707	707	849	759	865
Payments	-1,277	-1,310	-1,494	-1,673	-1,364
Income (Net)	-100	-135	-221	-264	-319
Receipts	91	91	97	97	50
Payments	-191	-226	-318	-361	-369
Current Transfers	1,876	2,195	2,394	2,171	2,826
Official	126	220	165	72	69
Private	1,750	1,975	2,229	2,099	2,757
of which worker's remittances	1,525	1,706	1,949	1,882	2,501
CURRENT ACCOUNT BALANCE	**-463**	**-477**	**-337**	**-1,018**	**240**
Capital Account (Net)	445	387	561	432	410
Capital Transfers	445	387	561	432	410
Financial Account	237	-395	-185	407	71
Direct Investment	249	198	194	174	65
Portfolio Investment	3	-6	0	0	-6
Other Investment	-15	-587	-379	233	12
MLT Loans	706	821	806	790	733
MLT Amortization Payments	-308	-341	-396	-416	-421
Other Long Term Loans (Net)	-47	-41	127	-13	-42
Other Short Term Loans (Net)	168	-78	56	86	20
Other Assets	-41	-58	-55	-68	-52
Trade Loans	-522	-829	-641	-260	-253
Commercial Bank	29	-61	-276	114	27
Assets	-19	-31	-161	147	-90
Liabilities	48	-30	-115	-33	117
Errors and Omissions	-88	267	125	-47	-356
OVERALL BALANCE	**131**	**-218**	**164**	**-226**	**365**
Financial Items	-131	218	-164	226	-365
Bangladesh Bank	-131	218	-164	226	-365
Assets	-14	205	-79	302	-276
Liabilities	-117	13	-85	-76	-89

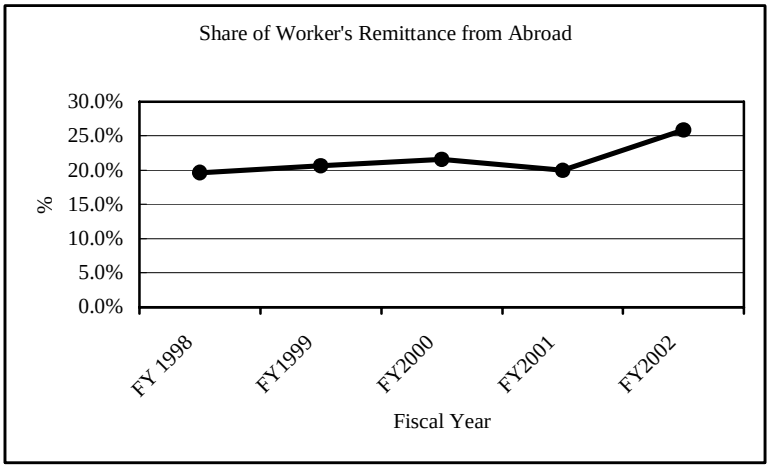
Source: Annual Report 2001-2002, Bangladesh Bank



Original Source: Annual Report 2001-2002, Bangladesh Bank

Figure 1.4.1 Trend of Trade Balance, Each Account and Overall Balance

In addition to the deficit of trade balance, both net service and net income are also in deficit situations. However, the deficit of Current Account Balance are reduced by the current transfers and turned into surplus in FY2002 due to the decline in imports and increase in worker's remittance from abroad.



Original Source: Annual Report 2001-2002, Bangladesh Bank

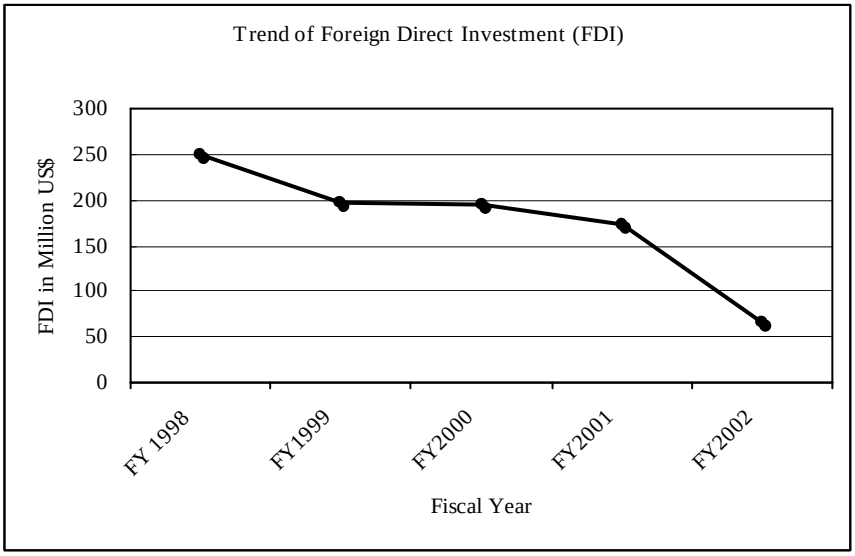
Figure 1.4.2 Share of Remittances from abroad in Total Current Inflow

The remittance from workers abroad grew by 32.9% from US$ 1.88 billion of FY2001 to US$ 2.59 billion in FY2002 and contributed about 20% - 25% of total inflow of the current account (Figure 1.4.2).

(2) Overall Balance

The overall balance combining all accounts of current, capital and financial account were deficit of US$ 0.23 billion in FS2001 due to increase of imports and then surplus of US$0.37 billion in FS2002 due to decrease in import and increase of worker's remittances from abroad.

The Foreign Direct Investment (FDI) in the financial account shows a sharp declining trend from US$ 0.25 billion in FY1998 to US$ 0.065 billion in FY2002 (Figure 1.4.3).



Original Source: Annual Report 2001-2002, Bangladesh Bank

Figure 1.4.3 Trend of Foreign Direct Investment Inflow

1.4.2 Direction of Export and Import by Country

(1) Destinations of Exports

Exports of Bangladesh heavily depend on the markets in North America and Europe as shown in Table 1.4.2; about 41% of FY2000 exports were destined for North America (U.S.A and Canada), followed by EU countries. The exports destined for SAARC (South Asian Association for Regional Co-Operation) group countries remains only 1.8% of total exports. Although India and Pakistan are major export destinations in SAARC group with shares of 63.0% and 31.2% in sub-total of SAARC group respectively, their shares in the total exports are only 1.13% and 0.56%. Total exports to SAARC group countries were also very small with the share of 1.79% in total exports.

Table 1.4.2 Export to Individual Countries by Rank (FY2000)

Rank	Countries	Export (US$ 1,000)	% of total	Major commodities exported
1	U.S.A	2,273,756	39.53%	Woven garments, Knitwear, Shrimps
2	Germany	658,711	11.45%	Woven garments, Knitwear, Shrimps
3	U.K	499,997	8.69%	Woven garments, Knitwear, Shrimps
4	France	367,366	6.39%	Woven garments, Knitwear, Footwear
5	Netherlands	282,772	4.92%	Woven garments, Knitwear, Shrimps
6	Italy	248,283	4.32%	Woven garments, Knitwear, Leather
7	Belgium	225,890	3.93%	Knitwear, Woven garments, Shrimps
8	Canada	110,630	1.92%	Woven garments, Knitwear, Tents
9	Japan	97,637	1.70%	Shrimps, Leather, Footwear
10	Hong Kong	92,977	1.62%	Shark fins & fish maws, Salted & dehydrated fish
11	Spain	88,626	1.54%	Woven garments, Knitwear, Leather
12	Sweden	71,087	1.24%	Woven garments, Knitwear, Specialised textile
	Sub-Total	**5,017,732**	**87.23%**	
13	India	64,863	1.13%	Raw jute, Chemical fertilizer, Jute manufactures
19	Pakistan	32,161	0.56%	Raw jute, Tea in bulk, Pharmaceuticals
41	Sri Lanka	4,766	0.08%	Jute manufactures, Pharmaceuticals, Raw jute
73	Bhutan	779	0.01%	Knitwear, Melamine tableware
88	Nepal	366	0.01%	Pharmaceuticals, Woven garments
140	Maldives	0.08	0.00%	Printed materials
	Total of SAARC	**102,935**	**1.79%**	
78	Myanmar	599	0.01%	Pharmaceuticals, Leather
	Other countries	630,933	10.97%	
	Total of Export	**5,752,199**	**100.00%**	

Source: Export Statistics 1999-2000, Export Promotion Bureau Bangladesh

(2) Origin Countries of Imports

Another source of information on imports in FY2000 is shown in Table 1.4.3. Largest imports were from China, Singapore with the shares of 10.4% and 8.31% in total imports in FY2000 respectively. Imports from India to Bangladesh came in third position with a share of 6.7% of total imports. The import share from SAARC countries were 8.2% in FY2000.

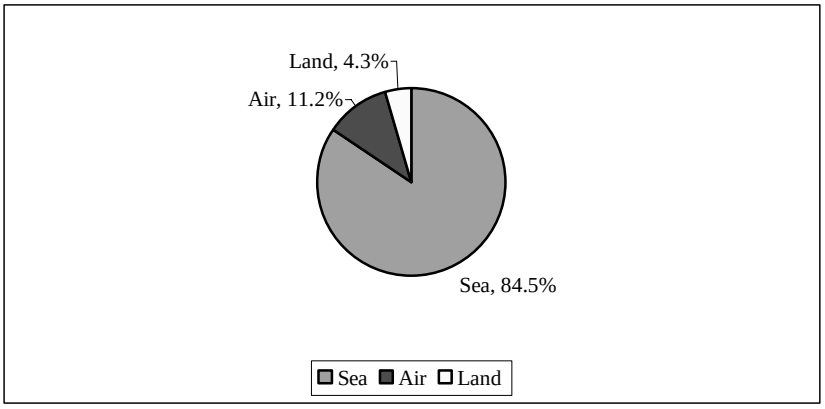
1.4.3 Ports for Import and Exports to/from Bangladesh

Commodities of export and import from/to Bangladesh are usually transported via sea, air and land ports. The percentage shares of sea ports were 84.5% for import value and 98.3% for export value in FY2000. To/from airports, about 11.2% of total import value and 1.7% of export value were transported via airports. The share of land ports was only 4.3% of total import value. There was no record of export via land ports in FY2000 (Figure 1.4.4 and Figure 1.4.5).

Table 1.4.3 Import from Individual Countries (FY2000)

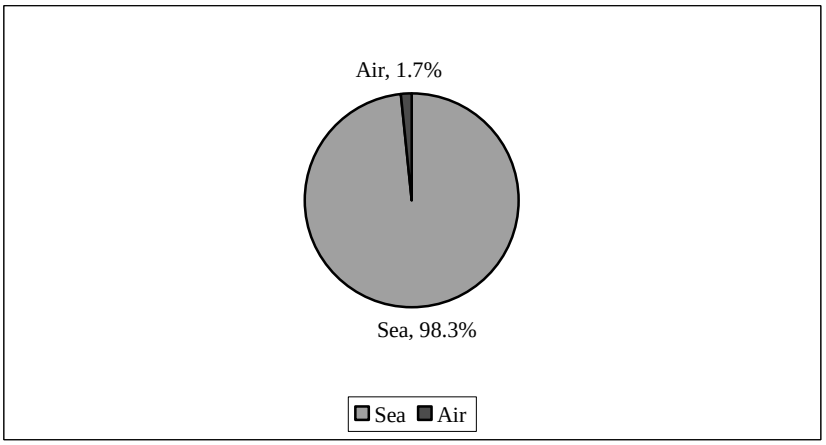
Countries	Import (Million Taka)	% of total
China	38,661	10.39%
Singapore	30,899	8.31%
India	**24,763**	**6.66%**
Taiwan	19,830	5.33%
Hong Kong	19,007	5.11%
Argentina	18,886	5.08%
U.S.A	17,187	4.62%
Indonesia	14,501	3.90%
Australia	10,954	2.94%
Saudi Arabia	10,807	2.90%
Thailand	10,466	2.81%
France	10,262	2.76%
Sub-total(excl. India)	**201,460**	**54.15%**
Pakistan	5,223	1.40%
Sri Lanka	477	0.13%
Bhutan	0	0.00%
Nepal	33	0.01%
Maldives	1	0.00%
Total of SAARC	**30,497**	**8.20%**
Myanmar	1,919	0.52%
Other countries	138,146	37.13%
Total of Import	**372,022**	**100.00%**

Original Source: Statistical Yearbook 2000, BBS



Original Source: Statistical Yearbook 2000, BBS

Figure 1.4.4 Ports for Imports to Bangladesh (FY2000)



Original Source: Statistical Yearbook 2000, BBS

Figure 1.4.5 Ports for Exports from Bangladesh (FY2000)

1.4.4 Foreign Aid, External Debt and Debt Services

Official foreign aid and its repayments (payback of principal and payments of interest for medium and long-term loans) are important factors to investigate the impacts of construction of Padma Bridge on the Balance of Payment of Bangladesh. Interest payments go to the "Investment Income Account" in the "Current Account" of the Balance of Payment as outflows from Bangladesh and repayments of principal go to the "Financial Account" also as outflows.

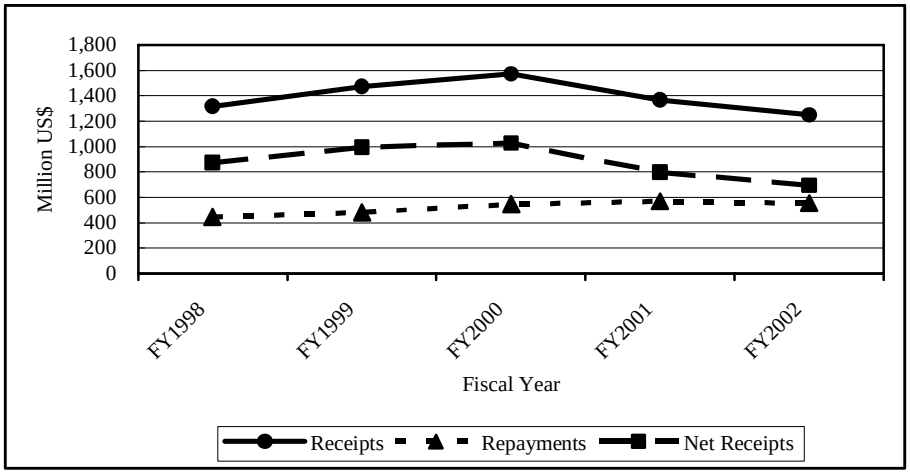
Table 1.4.4 and Figure 1.4.6 show the recent trend of foreign aid receipts and repayments (Debt Services).

Table 1.4.4 Foreign Aid and Debt Repayment

(Million US$)

Particulars	FY1998	FY1999	FY2000	FY2001	FY2002
Receipts (Disbursement)	1,319	1,474	1,575	1,369	1,250
i) Food Aid	99	177	142	51	39
ii) Commodity Aid	187	262	283	184	136
iii) Project Aid	1,033	1,035	1,150	1,134	1,075
Repayments (Debt Services)					
(Medium & long-term)	445	481	548	570	555
i) Principal	308	341	396	416	407
ii) Interest	137	140	152	154	148
Net Receipts	874	993	1,027	799	695
Outstanding External Debt as on 30 June	14,813	15,338	15,791	16,239	16,648
Outstanding Debt as Percentage of GDP	43.70	33.56	33.51	34.60	35.23
External Debt Services as Percentage of Exports	8.60	9.03	9.51	8.80	9.33

Source: Annual Report 1999-2000 and 2001-2002, Bangladesh Bank



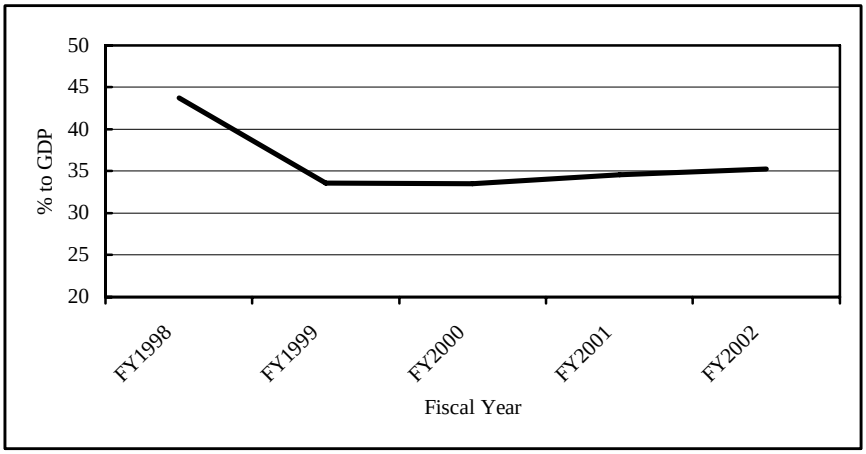
Source: From Table 1.4.4

Figure 1.4.6 Trend of Foreign Aid Receipts and Repayment

Official foreign aid receipts in the past five years increased by 11.8% in FY1999 and 6.9% in FY2000 compared to the preceding years. However, after FY2000, the receipts turned into a decreasing trend with minus rate of -13.5% in FY2001 and -8.7% in FY2002.

About 70% - 86% of the foreign aid receipts are inputs for Project Aid. Total repayments

(debt services) amounted to US$ 570 million in FY2001 and US$ 555 million in FY2002. Although the foreign aid receipts in the past two years are in declining trend, problems are the huge amount of accumulated outstanding debt and its rising trend. The outstanding external debt increased from US$ 14.813 billion in FY1998 to US$ 16.648 billion in FY2002, increased by about US$ 1.835 billion or 12.4% of increased rate for the past four years. The outstanding debt as percentage to GDP was extremely high with a rate of 35.2% in FY2002. This rate was at 43.7% in FY1998 and dropped to 33.6% in FY1999 and to 33.5% in FY2000 and then now steadily increasing. This outstanding external debt will eventually burden to next generations of Bangladesh.



Source: From Table 1.4.4

Figure 1.4.7 Outstanding Debt as Percentage to GDP

1.5 ESTABLISHMENT OF FUTURE SOCIO ECONOMIC FRAMEWORK

1.5.1 Socio Economic Indicators and Traffic Zone System

In order to provide socio economic bases for future traffic demand forecasting on the Padma Bridge, future socio economic indices were forecast for the whole country of Bangladesh and for each traffic zone. The traffic zone system in this study consists of total 75 zones of which 64 zones consist of Districts (Upazilas) in the territory of Bangladesh. Rests of 11 zones are surrounding countries such as India, Nepal, Bhutan and Myanmar. Districts/Upazilas are minimum administrative units in which data of Gross Regional Domestic Product (GRDP) are available.

The forecasted indices are population and GRDP.

1.5.2 National Development Plan after Fifth Five Year Plan

Prior to establishment of future socio economic indices, it is necessary to review the national development plans of the Government of Bangladesh. The Fifth Five Year Plan has already expired after its planning period (FY1997 – FY2002) and, at present, there are no new plans titled “five year plan”. Instead, now the “Three-Year Rolling Plan (TYRP)” is adopted and being implemented covering three fiscal years 2004, 2005 and 2006. The budget for FY2004 explained in the above section 2.3 sets in motion the implementation of TYRP.

TYRP presents a medium term macroeconomic framework up to the fiscal year 2006. A longer term plan beyond FY2006 is also prepared maintaining consistency with TYRP and ADP (Annual Development Program for each year in the plan period). This long term development plan is called “National Strategy for Economic Growth, Poverty Reduction

and Social Development (NS-EGPRSD)" targeting up to the fiscal year 2015.

The ultimate purpose of NS-EGPRSD is to reduce the present poverty rate by half by the end of FY 2015. In order to fulfill this target, NS-EGPRSD sets the concrete required GDP growth rate at 6.5% to be achieved by FY2006 and then 6.5% - 7.0% by the end of FY 2015. The table below indicates the growth targets of NS-EGPRSD.

Table 1.5.1 Macro Targets of NS-EGPRSD

Fiscal Year (FY)	Population Growth (% p.a.)	GDP Growth (% p.a.)
FY2000	1.6	
FY2001	1.5	
FY2002	1.5	4.4
FY2003	1.5	5.2
FY2004	1.5	5.5
FY2005	1.5	6.0
FY2006	1.5	6.5
FY2007	1.4	6.5
FY2008	1.4	6.5
FY2010	1.4	6.5-7.0
FY2015	1.3	6.5-7.0

Source: NS-EGPRSD, Economic Relations Division, Ministry of Finance March 2003

NS-EGPRSD recognizes that the realization of such high sustainable growth is not easy explaining that "attainment of the target of poverty reduction by half will require significant additional efforts given the past growth performance"(NS-EGPRSD, page 26) and possibility depends on "the issue of social choice (or 'social will') as to whether or not a society wants to tread the challenging path of achieving the targets within the shortest possible time by mobilizing all its public, private, NGO, community and individual resources and commitments" (NS-EGPRSD, page 24).

Regarding the targeted GDP growth rate, NS-EGPRSD uses a word of "Required GDP growth to make the present poverty rate into a half level". It is, therefore, different from "the most likely growth rate". ADB has pointed out that if Bangladesh is to achieve a GDP growth rate of 6.5% by FY2006, investment, especially private investment needs to be stepped up significantly through eliminating presently dominated many obstacles and constraints (Quarterly Economic Update, June 2003, ADB).

1.5.3 Forecast of Macro Indices (Population and GDP)

(1) Total Population

The long term trend of population growth for the past 40 years shows a clear decreasing tendency in growth rate and this tendency is expected to continue in the future.

The following equation was obtained through a regression analysis of time series data by population Census.

Population (t) = 1891.64 (t) – 3655836 (R=0.999)

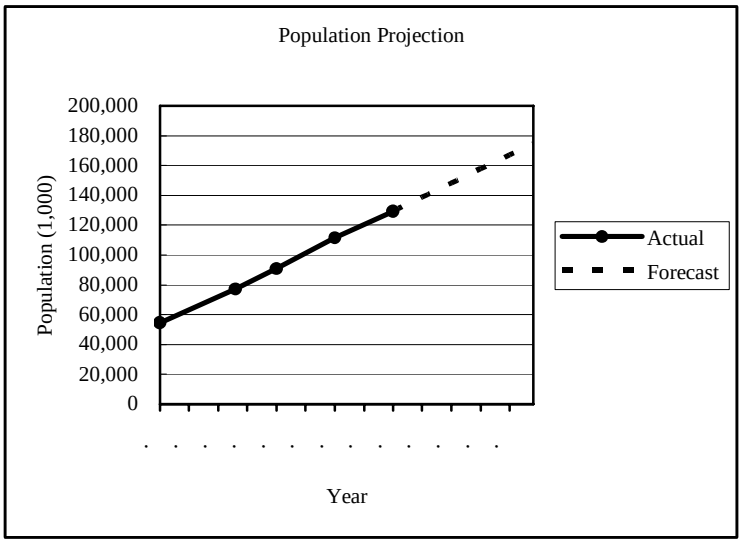
Where, Population (t): Total population in year (t)
t: Year
R: Correlation Coefficient

Results of forecasts of future total population applying the above equation are presented in the Figure below and in Table 1.5.2. The population growth rates will be 1.35% by 2010 and 1.26% by 2015 which are almost the same growth rates of NS-EGPRSD with 1.4% and

1.3% respectively.

(2) Forecast of Population Distribution to Traffic Zones

The total population forecasted above was used as the "Control Total" and distributed to each traffic zone applying, at first, the growth rates of individual zones between the year 1991 and 2001 and then adjusted population of each traffic zone so as to equalize the total of individual zones and the Control Total.



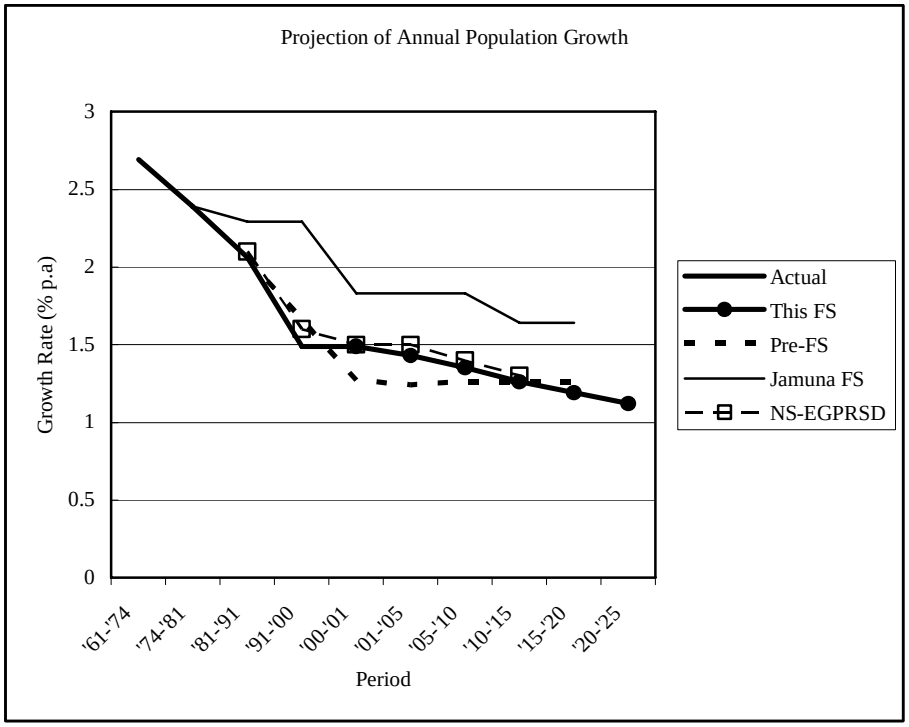
Source: This Study

Figure 1.5.1 Population Projection

Table 1.5.2 Comparison of Population Growth Rates

Year	This Study		1) Padma Bridge Pre-FS		2) Jamuna Bridge FS		3) NS-EGPRSD
	(1,000)	% p.a.	(1,000)	% p.a.	(1,000)	% p.a.	% p.a.
1961	54,531						
1974	77,031	2.69					
1981	90,894	2.39			90,894		
1986					103,178	2.57	
1991	111,455	2.06	111,455				
1996							
2000					139,693	2.19	1.60
2001	129,247	1.49	122,101	1.880			
			129,200	1.420			
			132,500	1.270			
			137,499	1.242	167,412	1.83	
			146,396	1.262			1.50
			155,862	1.261	197,062	1.64	1.40
2002	131,137	1.46	165,932	1.260			1.30
2005	136,809	1.42					
2010	146,261	1.35					
2015	155,713	1.26					
2020	165,165	1.19					
2025	174,617	1.12					

Source: 1) Padma Bridge Study, Pre-feasibility Report, Volume II, ANNEX A, Feb. 2000
2) Jamuna Bridge Project, Draft Feasibility Study, ANNEX H, Feb.1989
3) National Strategy for Economic Growth, Poverty Reduction and Social Development, Economic Relations Division, Ministry of Finance, March 2003



Source: This Study

Figure 1.5.2 Comparison of Population Growth Rates

Future population by traffic zone is presented in Table 1.5.3.

(3) Gross Domestic Product (GDP)

A sector wise forecast of GDP was carried out because the characteristics of past growth trends were different by each sector (Agriculture and Fishery, Industry and Commerce and Services).

The following equations were estimated through the regression analyses of time series data by each sector:

Agriculture & Fishery:	Ln (GDPAgri) = - 662.496 + 88.885 Ln (t)	R=0.999
Industry:	Ln (GDPInd) = - 939.690 + 125.358 Ln (t)	R=0.998
Commerce & Services:	Ln (GDPSer) = - 768.393 + 102.905 Ln (t)	R=0.998

(Note):

Ln:	Natural Logarithm
GDPAgri:	GDP of Agriculture Sector
GDPInd:	GDP of Industrial Sector
GDPSer:	GDP of Commerce & Services Sector
t:	Year
R:	Correlation Coefficient

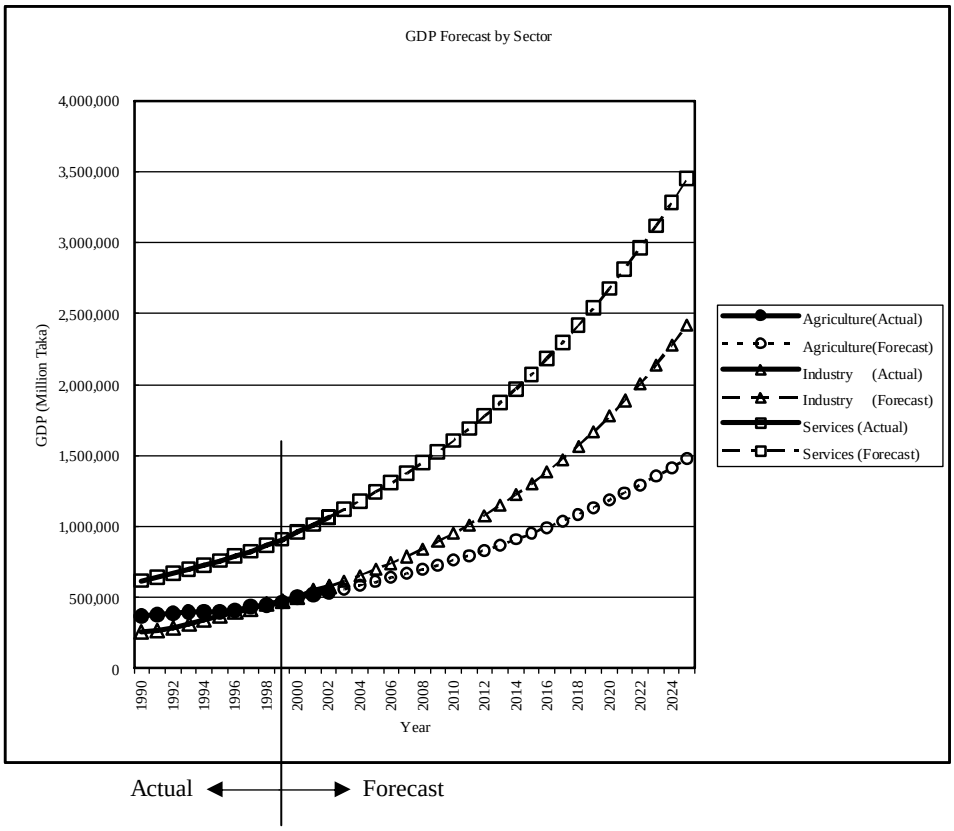
Results of future GDP forecasts based on the above equations are shown in Figure 1.5.3 and Table 1.5.4 below:

Table 1.5.3 Future Population Projection

(Unit: 1000)

Zone No. (Zila)	Division	Year Zila	1991 Census	2001 Census	2010	2015	Growth Rate % p.a. (2001 - '15)	2020	2025	Growth Rate % p.a. (2015 -'25)
1	Dhaka	Dhaka	6,163	9,001	12,475	14,832	3.6%	17,539	20,634	3.4%
2	Dhaka	Manikganj	1,217	1,338	1,437	1,482	0.7%	1,521	1,552	0.5%
3	Dhaka	Munshiganj	1,229	1,358	1,465	1,515	0.8%	1,558	1,594	0.5%
4	Dhaka	Narayanganj	1,819	2,244	2,672	2,919	1.9%	3,173	3,430	1.6%
5	Dhaka	Narshingdi	1,710	1,985	2,237	2,371	1.3%	2,499	2,621	1.0%
6	Dhaka	Gazipur	1,683	2,126	2,587	2,861	2.1%	3,146	3,443	1.9%
7	Dhaka	Tangail	3,108	3,415	3,664	3,779	0.7%	3,876	3,955	0.5%
8	Dhaka	Jamalpur	1,943	2,192	2,409	2,518	1.0%	2,617	2,706	0.7%
9	Dhaka	Sherpur	1,179	1,309	1,417	1,469	0.8%	1,514	1,553	0.6%
10	Dhaka	Mymensingh	4,096	4,659	5,156	5,410	1.1%	5,646	5,862	0.8%
11	Dhaka	Netrakona	1,791	2,034	2,248	2,357	1.1%	2,458	2,550	0.8%
12	Dhaka	Kishoreganj	2,388	2,650	2,869	2,973	0.8%	3,065	3,143	0.6%
13	Dhaka	Rajbari	866	987	1,093	1,148	1.1%	1,199	1,246	0.8%
14	Dhaka	Faridpur	1,558	1,804	2,029	2,148	1.3%	2,262	2,370	1.0%
15	Dhaka	Gopalganj	1,097	1,188	1,258	1,288	0.6%	1,312	1,329	0.3%
16	Dhaka	Madaripur	1,107	1,193	1,258	1,285	0.5%	1,306	1,320	0.3%
17	Dhaka	Shariatpur	986	1,109	1,216	1,269	1.0%	1,317	1,360	0.7%
18	Khulna	Kushtia	1,563	1,798	2,010	2,121	1.2%	2,226	2,324	0.9%
19	Khulna	Magura	752	851	938	982	1.0%	1,022	1,058	0.8%
20	Khulna	Narail	682	723	751	761	0.4%	767	769	0.1%
21	Khulna	Bagerhat	1,489	1,591	1,665	1,693	0.4%	1,712	1,723	0.2%
22	Khulna	Khulna	2,130	2,450	2,738	2,889	1.2%	3,032	3,165	0.9%
23	Khulna	Satkhira	1,660	1,934	2,188	2,324	1.3%	2,454	2,579	1.0%
24	Khulna	Jessore	2,192	2,562	2,906	3,090	1.3%	3,269	3,441	1.1%
25	Khulna	Jhenaidah	1,420	1,632	1,823	1,923	1.2%	2,017	2,105	0.9%
26	Khulna	Chuadanga	844	1,036	1,228	1,338	1.8%	1,451	1,565	1.6%
27	Khulna	Meherpur	511	609	702	754	1.5%	805	856	1.3%
28	Barisal	Pirojpur	1,104	1,183	1,241	1,263	0.5%	1,279	1,289	0.2%
29	Barisal	Barisal	2,299	2,446	2,550	2,588	0.4%	2,612	2,623	0.1%
30	Barisal	Jhalakhati	694	730	754	761	0.3%	764	763	0.0%
31	Barisal	Barguna	805	879	939	965	0.7%	987	1,005	0.4%
32	Barisal	Patuakhali	1,323	1,515	1,688	1,778	1.1%	1,862	1,940	0.9%
33	Barisal	Bhola	1,532	1,760	1,966	2,073	1.2%	2,174	2,268	0.9%
34	Rajshahi	Pabna	2,017	2,261	2,469	2,572	0.9%	2,664	2,746	0.7%
35	Rajshahi	Sirajganj	2,374	2,841	3,292	3,543	1.6%	3,792	4,039	1.3%
36	Rajshahi	Natore	1,455	1,596	1,710	1,763	0.7%	1,806	1,842	0.4%
37	Rajshahi	Bogra	2,799	3,137	3,426	3,569	0.9%	3,697	3,810	0.7%
38	Rajshahi	Rajshahi	1,988	2,374	2,745	2,951	1.6%	3,156	3,357	1.3%
39	Rajshahi	Nawabganj	1,232	1,490	1,743	1,887	1.7%	2,030	2,174	1.4%
40	Rajshahi	Naogaon	2,251	2,495	2,697	2,794	0.8%	2,878	2,949	0.5%
41	Rajshahi	Joypurhat	802	887	957	990	0.8%	1,019	1,043	0.5%
42	Rajshahi	Gaibandha	2,041	2,223	2,366	2,429	0.6%	2,481	2,520	0.4%
43	Rajshahi	Kurigram	1,681	1,870	2,029	2,106	0.9%	2,173	2,232	0.6%
44	Rajshahi	Rangpur	2,270	2,659	3,023	3,219	1.4%	3,409	3,593	1.1%
45	Rajshahi	Dinajpur	2,371	2,748	3,093	3,275	1.3%	3,450	3,616	1.0%
46	Rajshahi	Lalmanirhat	999	1,143	1,272	1,338	1.1%	1,401	1,458	0.9%
47	Rajshahi	Nilphamari	1,416	1,628	1,819	1,919	1.2%	2,013	2,101	0.9%
48	Rajshahi	Panchagarh	746	870	985	1,046	1.3%	1,106	1,163	1.1%
49	Rajshahi	Thakurgaon	1,060	1,255	1,441	1,542	1.5%	1,642	1,740	1.2%
50	Chittagong	Brahmanbaria	2,268	2,483	2,656	2,734	0.7%	2,799	2,851	0.4%
51	Chittagong	Comilla	4,264	4,814	5,293	5,533	1.0%	5,753	5,951	0.7%
52	Chittagong	Chandpur	2,150	2,319	2,448	2,501	0.5%	2,542	2,570	0.3%
53	Chittagong	Laksmipur	1,391	1,552	1,689	1,755	0.9%	1,814	1,866	0.6%
54	Chittagong	Noakhali	2,347	2,658	2,931	3,069	1.0%	3,196	3,312	0.8%
55	Chittagong	Feni	1,158	1,255	1,330	1,363	0.6%	1,388	1,407	0.3%
56	Chittagong	Chittagong	5,744	6,869	7,953	8,557	1.6%	9,156	9,748	1.3%
57	Chittagong	Khagrachhari	366	551	785	947	3.9%	1,137	1,359	3.7%
58	Chittagong	Rangamati	430	532	635	695	1.9%	757	820	1.7%
59	Chittagong	Bandarban	246	308	371	408	2.0%	446	485	1.8%
60	Chittagong	Cox's Bazar	1,502	1,844	2,186	2,383	1.8%	2,584	2,787	1.6%
61	Sylhet	Habiganj	1,611	1,844	2,053	2,160	1.1%	2,262	2,356	0.9%
62	Sylhet	Sunamganj	1,802	2,066	2,304	2,428	1.2%	2,544	2,652	0.9%
63	Sylhet	Sylhet	2,282	2,697	3,090	3,305	1.5%	3,516	3,722	1.2%
64	Sylhet	Maulavi Bazar	1,454	1,683	1,893	2,004	1.3%	2,110	2,210	1.0%
	Total		111,457	129,245	146,261	155,713	1.3%	165,165	174,617	1.2%

Source: 1991 & 2001: Census data, 2010 – 2025: Study Team.



Source: This Study

Figure 1.5.3 Projection of GDP by Sector

Table 1.5.4 Comparison of GDP Growth Rates

Year	This Study		1) Padma Bridge Pre-FS	2) Jamuna Bridge FS	3) NS-EGPRSD
	Factor Cost at 1995/96 prices (Million Taka)	% p.a.	% p.a.	% p.a.	% p.a.
1997	1,679,529				
1998	1,769,275				
1999	1,857,603				
2000	1,971,585		5.70	4.0	
2001	2,078,231		5.70	4.0	
2002	2,177,566	5.33	5.70	4.0	4.4
2003	2,296,324	5.41	5.00	4.0	5.2-5.5
2005	2,550,425	5.41	5.00	4.0	6.0
2010	3,320,241	5.42	4.70	4.0	6.5
2015	4,324,376	5.43	4.00	4.0	6.5-7.0
2020	5,643,784	5.44	4.00	4.0	
2025	7,345,706	5.45			

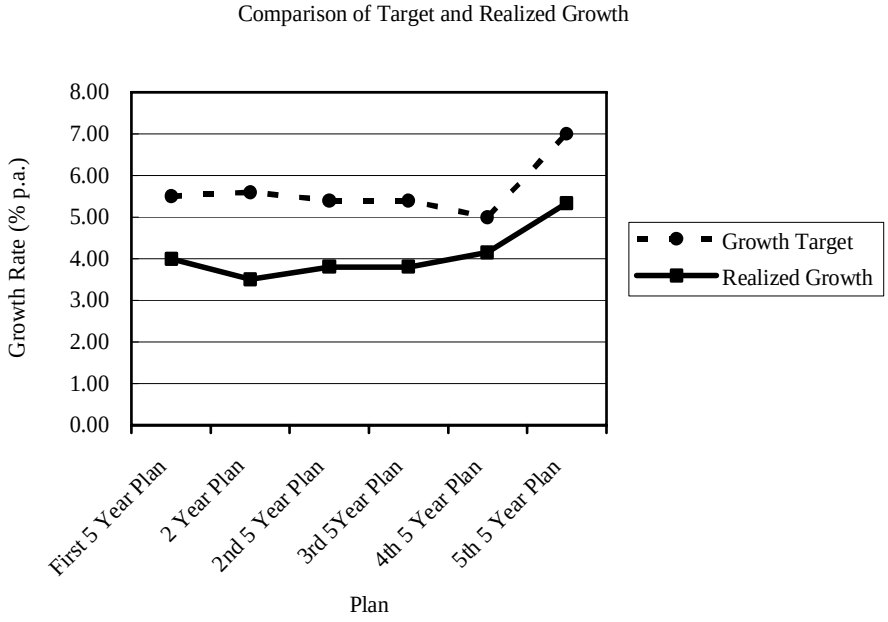
Source: 1) Padma Bridge Study, Pre-feasibility Report, Volume II, ANNEX A, Feb. 2000
2) Jamuna Bridge Project, Draft Feasibility Study, ANNEX H, Feb.1989
3) National Strategy for Economic Growth, Poverty Reduction and Social Development, Economic Relations Division, Ministry of Finance, March 2003.

The targeted GDP growth rates for the period FY2005 – FY2015 by NS-EGPRSD are higher than those of this Study. One of the reasons of these differences comes from the differences in the basic ideas and process for obtaining the targeted growth rates. The targeted GDP growth rates of NS-EGPRSD were the results of counting backward from the goal of poverty reduction as stated, "*Reaching the above targets would not easy. ---- , the calculations show that if the past trends of income inequality persist in the next decade,*

Bangladesh will have to sustain a GDP growth rate of about 7 per cent per year over the next 15 years for reaching the income poverty reduction target"(NS-EGPRSD, page viii).

Therefore, it is understood that the target growth rates by NS-EGPRSD are considered as the "Required growth rates". It should be emphasized here that any reasons can not be found to set a side the NS-EGPRSD's targets as those were based on the scenario prudently formulated by the Government taking into account all necessary measures including the mobilization of all future resources and already started toward the goal.

For the purpose of traffic demand forecasting, however, it is necessary to review the past targeted growth rates and its degree of realization. Figure 1.5.4 indicates the relationships between the targeted growth rates and realized ones for the past three decades from the First Five Year Plan to Fifth Five Year Plan.



Source: From Table 1.1.1

Figure 1.5.4 Comparison of Targeted and Realized Growth Rates

The degree of realization ranges from 63% to 83% for the past plans. If the maximum degree of realization 83% is applied to the target growth rate of 6.5% by the year 2006, the realized growth rate will be 5.4% which is nearly equal to the forecast by this Study as shown in Table 1.5.4. Needless to say, the degree of realization depends on the initiative of the Government, pulling power of private sector and external environment.

(4) Forecast of GRDP by Traffic Zone

Future GRDP by traffic zone was forecast applying the same procedure as the population forecast. Total GDP for the whole country of Bangladesh was used as the "Control Total". At first, future GRDP of each traffic zone was estimated applying the past growth rate between 1996 – 2000 and then future GRDP of each traffic zone was adjusted so as to equalize the total of each zone to the pre-determined GDP. Projected GRDP by traffic zone is shown in Table 1.5.5.

Table 1.5.5 Projection of Future GRDP by Traffic Zone (At 1995/96 constant market prices)

(Unit: Million Taka)

Zone No. (Zila)	Division	Year Zila (District)	1999/00 (Actual)	2010	2015	Growth Rate % p.a ('00 - 2015)	2020	2025	Growh Rate % p.a (2015-'25)
1	Dhaka	Dhaka	309,085	504,659	658,889	5.2%	860,103	1,122,582	5.5%
2	Dhaka	Manikganj	17,612	27,426	35,044	4.7%	44,772	57,190	5.0%
3	Dhaka	Munshiganj	16,492	24,715	31,036	4.3%	38,965	48,913	4.7%
4	Dhaka	Narayanganj	57,499	87,633	110,889	4.5%	140,291	177,460	4.8%
5	Dhaka	Narshingdi	31,440	50,147	64,779	4.9%	83,667	108,045	5.2%
6	Dhaka	Gazipur	60,518	95,832	123,391	4.9%	158,848	204,460	5.2%
7	Dhaka	Tangail	40,343	61,428	77,695	4.5%	98,253	124,231	4.8%
8	Dhaka	Jamalpur	27,074	46,676	62,466	5.7%	83,583	111,821	6.0%
9	Dhaka	Sherpur	15,946	26,452	34,786	5.3%	45,737	60,127	5.6%
10	Dhaka	Mymensingh	63,859	105,054	137,630	5.3%	180,276	236,099	5.5%
11	Dhaka	Netrakona	27,678	42,930	54,758	4.7%	69,831	89,040	5.0%
12	Dhaka	Kishoreganj	32,930	51,048	65,095	4.6%	82,994	105,797	5.0%
13	Dhaka	Rajbari	12,102	19,530	25,364	5.1%	32,934	42,757	5.4%
14	Dhaka	Faridpur	21,312	33,487	42,966	4.8%	55,117	70,693	5.1%
15	Dhaka	Gopalganj	14,510	22,381	28,476	4.6%	36,223	46,071	4.9%
16	Dhaka	Madaripur	13,710	23,081	30,558	5.5%	40,449	53,533	5.8%
17	Dhaka	Shariatpur	12,451	20,283	26,454	5.2%	34,497	44,977	5.5%
18	Khulna	Kushtia	26,233	43,600	57,386	5.4%	75,518	99,364	5.6%
19	Khulna	Magura	11,908	19,596	25,676	5.3%	33,637	44,060	5.5%
20	Khulna	Narail	10,428	15,645	19,656	4.3%	24,691	31,010	4.7%
21	Khulna	Bagerhat	25,048	43,888	59,169	5.9%	79,756	107,489	6.2%
22	Khulna	Khulna	50,672	83,272	109,042	5.2%	142,761	186,878	5.5%
23	Khulna	Satkhira	26,637	46,015	61,639	5.8%	82,552	110,542	6.0%
24	Khulna	Jessore	40,781	64,761	83,492	4.9%	107,622	138,702	5.2%
25	Khulna	Jhenaidah	22,967	36,089	46,305	4.8%	59,402	76,190	5.1%
26	Khulna	Chuadanga	14,202	24,110	32,042	5.6%	42,575	56,561	5.8%
27	Khulna	Meherpur	8,717	14,949	19,958	5.7%	26,641	35,556	5.9%
28	Barisal	Pirojpur	14,724	22,001	27,590	4.3%	34,594	43,367	4.6%
29	Barisal	Barisal	32,626	52,779	68,619	5.1%	89,197	115,928	5.4%
30	Barisal	Jhalakhati	8,909	12,634	15,471	3.7%	18,942	23,188	4.1%
31	Barisal	Barguna	13,922	23,137	30,452	5.4%	40,073	52,725	5.6%
32	Barisal	Patuakhali	24,129	38,874	50,448	5.0%	65,455	84,914	5.3%
33	Barisal	Bhola	24,743	39,179	50,445	4.9%	64,938	83,583	5.2%
34	Rajshahi	Pabna	36,776	62,618	83,328	5.6%	110,869	147,489	5.9%
35	Rajshahi	Sirajganj	35,246	56,951	74,005	5.1%	96,149	124,898	5.4%
36	Rajshahi	Natore	23,724	39,521	52,072	5.4%	68,596	90,350	5.7%
37	Rajshahi	Bogra	40,919	70,741	94,791	5.8%	126,996	170,115	6.0%
38	Rajshahi	Rajshahi	35,369	62,504	84,594	6.0%	114,471	154,876	6.2%
39	Rajshahi	Nawabganj	16,642	28,480	37,986	5.7%	50,657	67,543	5.9%
40	Rajshahi	Naogaon	33,981	58,236	77,726	5.7%	103,720	138,386	5.9%
41	Rajshahi	Joypurhat	12,875	22,141	29,596	5.7%	39,556	52,859	6.0%
42	Rajshahi	Gaibandha	25,279	40,238	51,932	4.9%	67,012	86,457	5.2%
43	Rajshahi	Kurigram	22,941	43,740	61,278	6.8%	85,834	120,209	7.0%
44	Rajshahi	Rangpur	33,947	55,813	73,101	5.2%	95,727	125,335	5.5%
45	Rajshahi	Dinajpur	37,941	63,137	83,148	5.4%	109,481	144,132	5.7%
46	Rajshahi	Lalmanirhat	13,440	24,601	33,832	6.3%	46,518	63,952	6.6%
47	Rajshahi	Nilphamari	18,640	30,523	39,904	5.2%	52,158	68,165	5.5%
48	Rajshahi	Panchagarh	10,638	17,829	23,556	5.4%	31,117	41,098	5.7%
49	Rajshahi	Thakurgaon	18,114	29,506	38,483	5.2%	50,181	65,425	5.5%
50	Chittagong	Brahmanbaria	33,604	48,353	59,606	3.9%	73,464	90,531	4.3%
51	Chittagong	Comilla	56,172	77,339	93,445	3.5%	112,885	136,348	3.9%
52	Chittagong	Chandpur	27,203	45,782	60,603	5.5%	80,208	106,137	5.8%
53	Chittagong	Laksmipur	21,686	33,021	41,767	4.5%	52,820	66,787	4.8%
54	Chittagong	Noakhali	32,706	56,371	75,433	5.7%	100,922	135,002	6.0%
55	Chittagong	Feni	14,695	22,660	28,827	4.6%	36,665	46,627	4.9%
56	Chittagong	Chittagong	162,564	265,725	347,112	5.2%	453,346	591,998	5.5%
57	Chittagong	Khagrachhari	5,425	8,750	11,360	5.1%	14,747	19,141	5.4%
58	Chittagong	Rangamati	8,878	13,839	17,692	4.7%	22,613	28,899	5.0%
59	Chittagong	Bandarban	4,615	6,635	8,176	3.9%	10,074	12,410	4.3%
60	Chittagong	Cox's Bazar	30,081	50,092	65,989	5.4%	86,916	114,461	5.7%
61	Sylhet	Habiganj	23,688	32,927	39,958	3.5%	48,480	58,812	3.9%
62	Sylhet	Sunamganj	23,426	34,936	43,773	4.3%	54,836	68,683	4.6%
63	Sylhet	Sylhet	36,406	63,496	85,425	5.9%	114,906	154,538	6.1%
64	Sylhet	Maulavi Bazar	20,326	30,441	38,213	4.3%	47,962	60,189	4.6%
	Total		2,049,154	3,320,241	4,324,376	5.1%	5,634,784	7,345,706	5.4%

Source: 1999/00: Statistical Yearbook Bangladesh 2000, 2010 – 2025: Study Team.

Appendix-2 Transport Studies

(Existing Transport Profile of the Project Area and Traffic Demand Forecast)

This Appendix is mainly devoted to present the present characteristics of Padma River crossing traffic and results of traffic survey carried out in this Study. In addition, results of future traffic projection based on the traffic survey are explained as well.

2.1 PADMA RIVER CROSSINGS

The ghats at Padma River are located at Mawa and Paturia. The Padma River crossing can be made by:

- Ferry: This vessel carries vehicles and their passengers. Some buses cross by ferry while others have connecting services at each side of the river. The buses that cross by ferry are loaded with the passengers. These through buses mainly operate at Paturia crossing, and the buses tend to be night coaches, laden with some small commodity, or air-conditioned models with higher paying passengers.
- Launch: this daytime only vessel carries foot passengers who are mainly passengers of buses who are using the connecting bus services. Vehicles do not cross by launch. Bus passengers do not pay crossing charges as the price is included in the bus fare.
- Other: Whilst the BIWTC dominates river crossing services, there are some small private sector boats (speed boats) which provide quick services typically to people who reduce waiting time.

2.1.1 Profile of River Crossing Points

There are two main river crossing points between the Northeast and Southwest regions of Bangladesh. These are Paturia/Goalundo and Mawa/Charjanajat. Other crossing points with minimal crossing traffic that have been identified as potential locations for a bridge are Dohar/Charbhadrasan and Chandpur/Bhedarganj. These are described in more detail as follows.

(1) Paturia – Goalundo

This site is the most northern of the alternatives and is located on the National Highway N5 route from Dhaka connecting to N7 which continues to the Southwest region distributing at Faridpur Junction via the N7 and N84. The Paturia site uses 22 ferries over 24 hours at 5 ghats while the Goalundo site has 3 ghats. The average time of crossing is approximately 40 minutes in the high water level season and 30 minutes in the low water level season.

(2) Dohar - Charbhadrasan

This site does not have an existing ferry service, though there is a scheme to implement one. On the northwest side of the river, road access is from a Feeder Road A, which connects to N8. On the Southwest side, there is currently no road connection to Faridpur Junction.

(3) Mawa - Charjanajat[1]

This site is located on the N8 route from Dhaka to the Southwest region and is the most centrally located site between the Northeast and Southwest regions of Bangladesh. The site utilizes 11 ferries at 4 ghats over 24 hours. The average number of round trips per day for each ferry is 4, and the average crossing time is 2 hours 5 minutes in the high water level season and 2 hours in the low water level season. The Mawa terminal has adequate space capacity for 175 trucks, though there is no terminal on the Charjanajat side and trucks park on the highway. In terms of future development, the government is planning to shift the Charjanajat ghat by approximately 5km to Kathalbari. This would reduce the ferry crossing time.

(4) Chandpur - Bhedarganj

This site is the most southerly and is located on regional highway R140. While the route from Northeast to Southwest via Chandpur is indirect, this site would also attract trips between the southeast and Southwest, thus include the Chittagong area. A launch service operates between Chandpur and Bhedarganj. It is known that trips take place between Chittagong and Dhaka, but the level of traffic between Chittagong and Southwest is likely to be relatively small.

2.1.2 Cross River Movements

Large numbers of people cross Padma River every day. They largely cross as bus passengers either by through bus or a connecting bus service.

In the case of connecting bus, the passengers transfer from bus to launch boat and then get back on a bus on the opposite river bank. Whilst the delay to passengers is greater for this service, this is an efficient method of transport for large numbers, and a high proportion of passengers use this type of service.

Source: This Study, 2003

Launch Transporting Passengers Across Padma River

Through buses involve the transportation of the bus itself across the river by ferry and passengers remain seated in the bus. The picture below shows the long ferry used to transport buses.

[1] Charjanajat is the name maintained by BIWTC and does not reflect the exact location of the ferry ghat. The naming adopted for a possible Padma Bridge to this side of the river from Mawa is Janjira.

Source: This Study, 2003

Ferry Transporting Buses Across Padma River

Approximately 62,500 passengers cross directly from the north-east Dhaka region to the south-west each day at the combined Mawa and Goalundo crossing points. In terms of vehicle numbers, 2,909 vehicles cross Padma River per day comprising 1295 trucks (44%), 700 light vehicles (24%), and 914 (32%). More information on the volume of passenger traffic is provided in the results of the traffic survey.

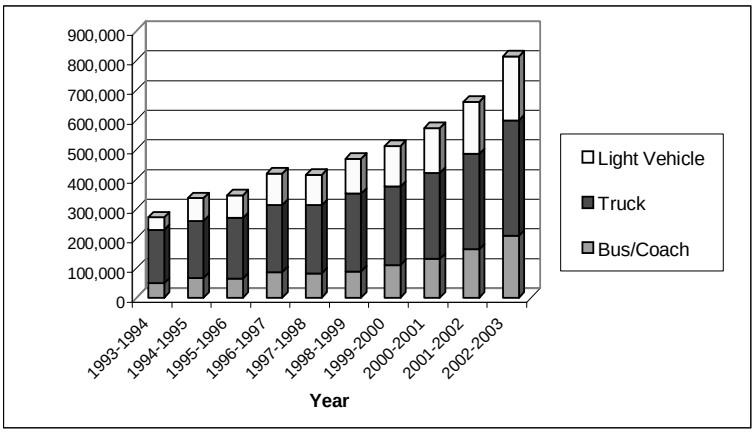
As trucks cross the river by ferry, no loading/unloading of cargo takes place. Trucks tend to have long waiting times. This increases their travel time by hours or even days.

Source: This Study, 2003

Ferry Loaded with Freight Trucks

(1) Volume of Traffic Crossing

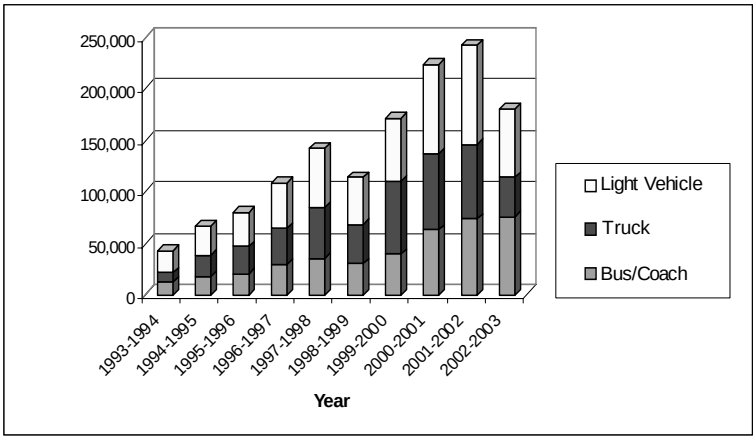
Figure 2.1.1 shows the annual volume of traffic crossing Padma River at the Paturia-Goalundo since 1993. Around 800,000 vehicles cross Padma River at Paturia. This is the heaviest used crossing, particularly by freight traffic. A large increase in traffic is notable in the year 2002/03, mainly caused by re-routing truck traffic, which is avoiding National Highway N8 improvements works on the Mawa route.



Source Data: BITWC

Figure 2.1.1 Volume of Traffic Crossing by Ferry at Paturia-Goalundo

Figure 2.1.2 shows the annual volume of traffic crossing Padma River at Mawa-Charjanajat. Around 175,000 vehicles crossed Padma River at Mawa in 2002/03. The Figure clearly shows a reduction from the previous year, mainly by trucks which have tended to divert to the Paturia crossing to avoid road improvement works on the National Highway N8 between Dhaka and Mawa. In any case, the Mawa crossing carries less traffic than the Paturia crossing at present.

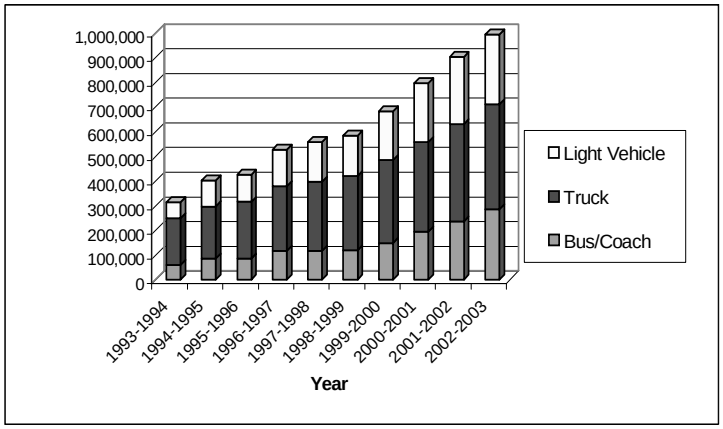


Source Data: BITWC

Figure 2.1.2 Volume of Traffic Crossing by Ferry at Mawa-Charjanajat

Figure 2.1.3 shows the total annual volume of traffic crossing Padma River (i.e. at both Paturia-Goalundo and Mawa-Charjanajat).

Almost 1 million vehicles cross the river by ferry at these two crossings. The annual growth rate is almost 14%, as discussed below. The high proportion and growth of large vehicles, i.e. buses and trucks, characterizes traffic crossing Padma River.



Source Data: BITWC

Figure 2.1.3 Volume of Traffic Crossing Padma River by Ferry

(2) Growth of Ferried Traffic

The growth of traffic since 1993 appears more uniform at the Paturia site. Table 2.1.1 below shows the rate of growth for ferried traffic at both crossing sites over the last 10 years. Overall since 1993, the average annual rate of ferried traffic across Padma River is 13.6%.

Table 2.1.1 Average Annual Growth of Ferried Traffic Across Padma River (1993-2003)

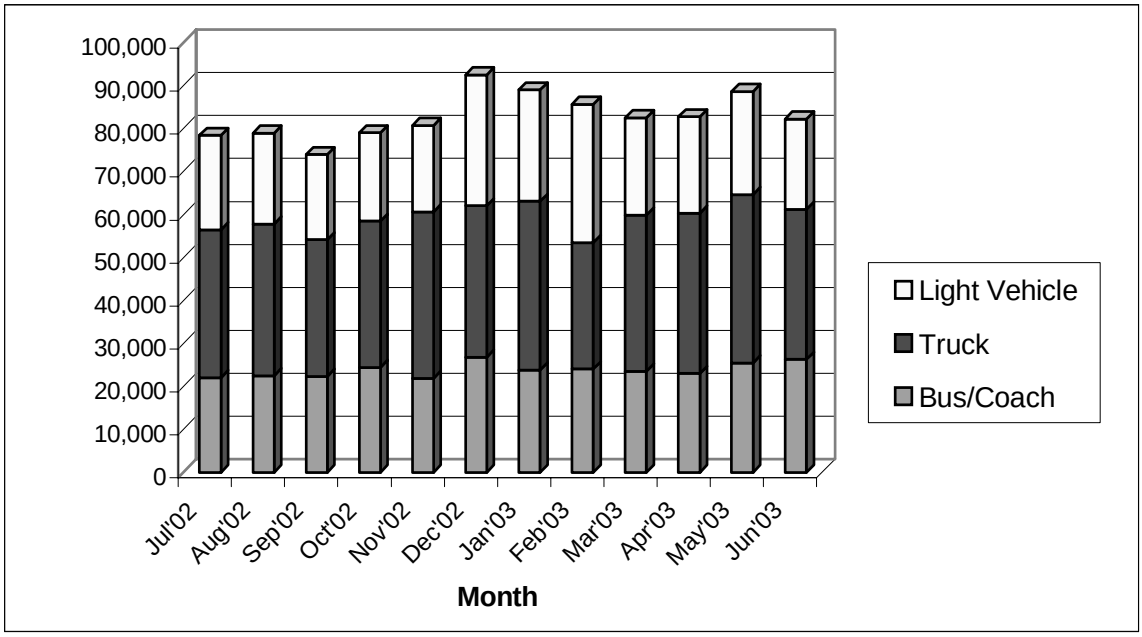
Crossing Site	Bus/Coach	Truck	Light Vehicle	Total
Paturia-Goalundo	17.6%	8.9%	19.9%	13.0%
Mawa-Char Jananjat	22.3%	17.5%	13.0%	17.1%
Combined	18.7%	9.4%	17.9%	13.6%

Source Data: BITWC

Mawa-Charjanajat has recorded the highest growth rate, particularly in bus/coach vehicles. In particular, there has been sustained high annual growth of between 21% and 30% in bus traffic over the last 4 years.

(3) Seasonal Pattern of River Crossing Traffic

Figure 2.1.4 shows the monthly variation of vehicles ferried across Padma River at the combined Paturia and Mawa crossing points.



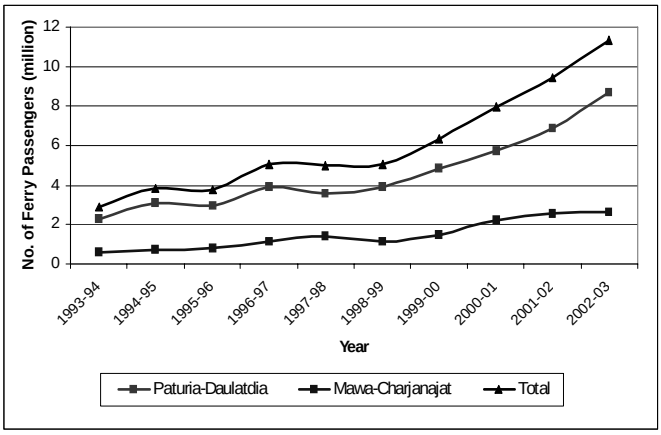
Source Data: BITWC

Figure 2.1.4 Seasonal Variation of Vehicular Traffic Crossing Padma River

The December peak caused by an increase in bus and light vehicles reflects a festival period when city dwellers return to home towns. Surveys for this Feasibility Study were carried out in July which appears to be a typical month, close to the monthly average.

(4) Passenger Trips

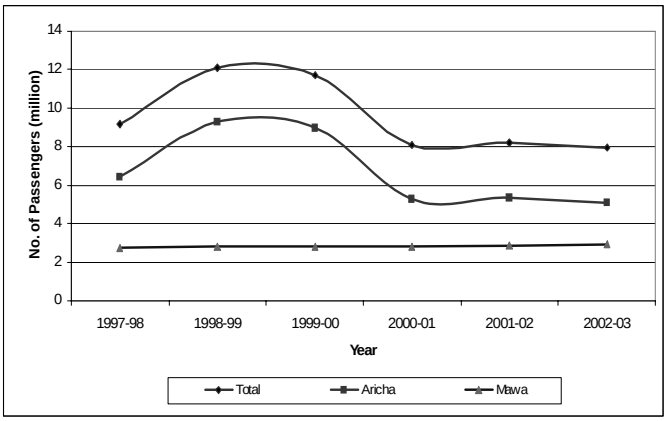
Figure 2.1.5 shows the annual volume of passengers crossing Padma River by ferry at both Paturia-Goalundo and Mawa-Charjanajat crossings. Around 11.3 million ferry passengers crossed the river last year with almost 9 million at the Paturia-Goalundo crossing. This crossing has shown the greatest and most linear growth rate in the past few years, whilst passenger traffic at the Mawa site has remained relatively constant.



Source Data: BITWC

Figure 2.1.5 Annual Ferry Passengers Crossing Padma River

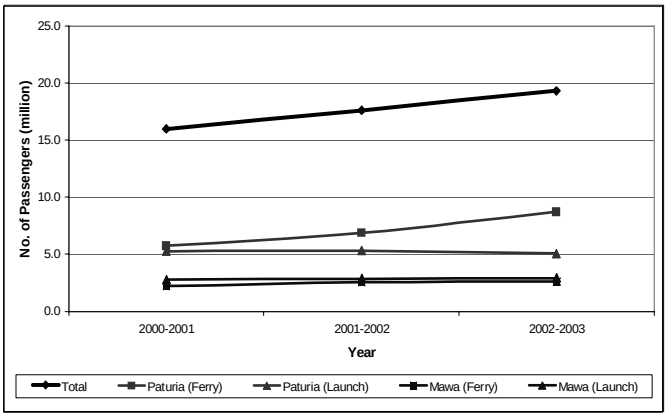
Figure 2.1.6 shows the annual number of passengers who cross Padma River by launch at the Aricha and Mawa ghats. The Aricha site includes services to the north-west and the decrease in passengers during 1999 can be explained by the opening of Jamuna Bridge, whereupon passengers changed mode to road in order to realize time savings. Growth over the past few years has been negligible and around 8 million passengers cross Padma River at the Aricha and Mawa sites.



Source: BIWTA

Figure 2.1.6 Volume of Passengers Crossing Padma River by Launch (1997-2002)

Figure 2.1.7 shows the combined total of ferry and launch passengers over the past 3 years. The majority of these passenger trips can be assumed to be across Padma River between the Northeast and Southwest regions of Bangladesh since launch services to the north-west have largely terminated following construction of Jamuna Bridge. Around 19 million passengers crossed by ferry and launch in 2002. If all were carried by bus, this would equate to some 1,300 large buses per day.



Source: BIWTC and BIWTA

Figure 2.1.7 Volume of Passengers Crossing Padma River by Ferry and Launch (1997-2002)

(5) Comparison of Jamuna Traffic Flows with Padma Flows

In order to gain a perspective of the level of cross river traffic at Padma River, Table 2.1.2 compares the traffic flow at Jamuna Bridge with the ferry traffic at Padma.

Table 2.1.2 Comparison of Jamuna Bridge Traffic Flows with Padma River Flows (1999)

	Traffic Flow (per day)	
	Jamuna Bridge (1999)	Cross Padma River (June 1999)
Light Vehicles	689	412
Buses	783	1322
Trucks	831	853
Total Vehicles	2,303	2,587
Total Passengers	35,313*	55,865*

Source: This Study

Note: * estimated from average vehicle occupancy (bus 40.7, light vehicle 5)

For the selected month of June, after one year of operation the total vehicle level crossing

Jamuna Bridge was very similar to the number of vehicles crossing Padma River by ferry. However, the much higher passenger flow for Padma reflects the greater number of bus passengers at this crossing. Table 2.1.3 again compares for June of the current year.

Table 2.1.3 Comparison of Jamuna Bridge Traffic Flows with Padma River Flows (2003)

	Traffic Flow (per day)	
	Jamuna Bridge (June 2003)	Cross Padma River (June 2003)
Light Vehicles	754	700
Buses	1440	1520
Trucks	1981	1295
Total Vehicles	4,175	3,515
Total Passengers	62,378*	65,364*

Source: This Study
Note:* estimated from average vehicle occupancy (bus 40.7, light vehicle 5)

After 5 years of operation, the traffic flows on Jamuna Bridge have almost doubled and overtaken cross Padma traffic by some 19%. The total volumes of passengers are similar for the two crossing points. The high growth of transport at Jamuna may be explained by traffic inducement.

2.2 TRANSPORT PASSENGER FARES

The level of fare incurred by passengers has a high bearing on choice of mode and choice of route.

2.2.1 Existing Bus Fares

Through bus passengers using the ferries at Paturia and Mawa pay one-time fare for their entire route. Launch passengers at Paturia also pay a single fare that includes the connecting bus services. However, launch passengers at Mawa pay individual fares for each leg of their journey i.e. bus-launch-bus. Table 2.2.1 shows average bus fares for trips between Dhaka and the Southwest region.

Table 2.2.1 Average Bus Fares

From	To	Bus Fare/ passenger (Taka)		Distance (km)	Trip Time (hrs)
		Air-Conditioned	No A/C		
Dhaka	Pirojpur	350	280		9
	Bagerhat	300	280		10
	Barguna	-	340		11-12
	Barisal	300	220	277	6-7
	Bhola	-	290		8-9
	Madaripur	-	150		4-5
	Patuakhali	-	320		10-11
	Khulna	350	260	335	6-7
	Faridpur	-	130	145	3-4
	Jessore	300	230	274	5-6

Source: Bus Companies, 2003

Comparing fares paid to distance traveled, Taka 1.1/km for air-conditioned buses, and Taka 0.8/km for buses without air conditioning.

2.2.2 Other Road & Ferry Charges (Tolls)

Due to the high number of river crossings by ferry and bridge in Bangladesh, there are a number of additional fares or costs that may be incurred by the road traveler. The sum of all

road charges on a route between origin and destination will influence the choice of mode and route. These tolls affect the route cost of vehicles.

Table 2.2.2 Bridge Tolls

Bridge Name	Light Vehicle	MiniBus	Bus	Truck
Megna	50	150	400	400
Megna-Gomti	50	150	400	400
Bhairab	100	150	200	200
Buriganga	19.5	46	132	132
Dhaleshwari1	31	50	50	69
Dhaleshwari2	47	84	84	132
Dhalla	20	47	132	132
Tara	20	20	29	29
Sherpur	20	20	29	29
Gabkhan	18	48	66	66
Gorai	20	38	75	75
Molla Hat	12	29	48	48
Jamuna	400	800	800	1,000

Source: RHD & JMBA

Table 2.2.3 Ferry Charges

Ferry Name	Light Vehicle	MiniBus	Bus	Truck
Mukterpur	20	48	132	132
Varamara-Paksey	33	66	216	216
Gorai	20	48	132	132
Arialkha	33	95	95	132
Rupsa	29	57	132	132
Dapdapia	20	48	95	95
Lebukhali	20	48	95	95
Patuakhali	20	48	95	95
Narail	20	48	75	75
Kazirtek	20	75	104	104
Shekpur	29	57	75	75

Source:RHD

2.2.3 Existing Ferry Fares

Table 2.2.4 shows existing ferry charges at Mawa and Paturia crossings. The Mawa site has slightly higher tariffs, which may contribute to the relative popularity of the Paturia crossing.

Table 2.2.4 Ferry Tariffs by Vehicle Type at Mawa and Paturia River Crossings

Vehicles	Mawa-Charjanajat (Taka)	Paturia-Goalundo (Taka)
Off size Bus/Coach 29'-5" x7'-5" to 34'-5"x8'5" (without passenger)	1155	1155
Trucks above 8 tonnes (loaded or empty)	1265	1090
5 tonne capacity empty Bus/Coach (without passenger)	990	905
3-8 tonne capacity Truck (loaded or empty)	935	770
3 tonne capacity empty minibus/Coaster and <3 tonnes capacity empty Truck	550	440
Microbus/Pick-up/Station Wagon/Land Rover/Scout Type Vehicle/Big Size Jeep (without passenger)	330	305
Car/Jeep/Tampoon (without passenger)/Trailer – separately or with Jeep/Truck	180	155
Baby Taxi/Van/Auto Rickshaw (without passenger)	80	65
Motor Cycle (without rider)	25	25
Bicycle (without rider)	12	12
Passengers		
Deluxe Class	-	33
Upper Class	25	25
Lower Class	8	8

Source: BIWTC
Note: Tariffs as of July 2003

2.2.4 Inland Water Transportation (IWT) Fares

Table 2.2.5 shows IWT passenger fares by class against each for single journey. IWT services of the deck class are cheaper than bus services between Dhaka and Southwest region.

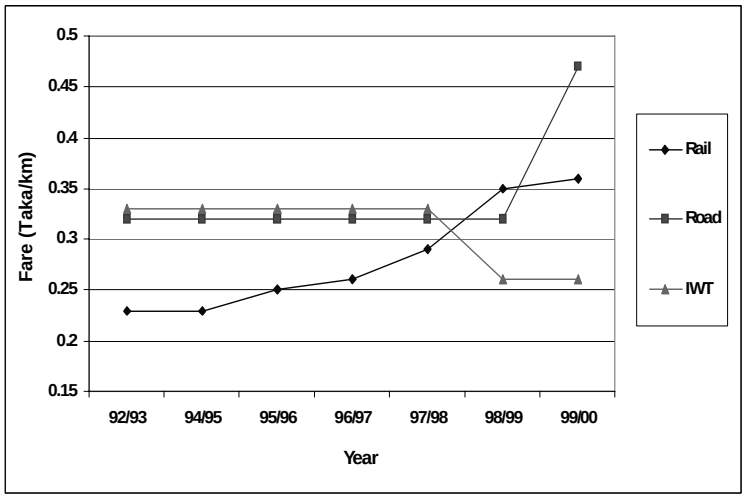
Table 2.2.5 IWT Passenger Fares between Dhaka and Southwest Region

Ferry Station	Deck	Cabin Single	Cabin Double	Trip Time (hrs)
Madaripur	60	300	500	10
Shariatpur	60	300	-	10
Bagerhat	80	350	600	14
Khulna	150	-	1200	16
Pirojpur	60	300	550	14
Barisal	60	350	600	12
Barguna	100	400	600	16
Patuakhali	100	400	600	16
Bhola	80	600	600	14

Source: BIWTA and this Study

2.2.5 Comparison of Fares for Different Modes

Figure 2.2.1 shows a comparison of fare rates per kilometer for different modes of transport. Road and inland waterway fares have been similar until quite recently. In the year 1999/2000, inland water reduced to Taka 0.26/km, whilst road increased to Taka 0.47/km. It is not clear if this reflects genuine changes in fare rates, or if the process of calculation has been reviewed and updated. Also, class of travel is not considered here. Notwithstanding, the possible cost savings of traveling by inland water are highlighted by this chart.

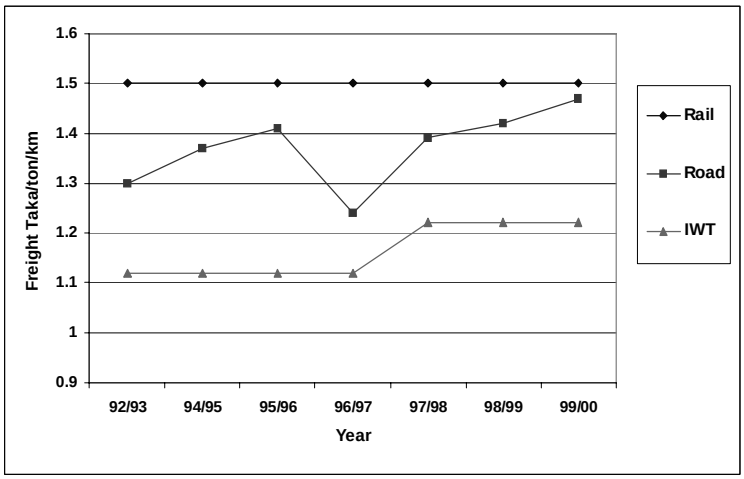


Source: Bangladesh Census 2000

Figure 2.2.1 Fare Rates for Different Transport Modes

2.3 TRANSPORT FREIGHT COSTS

Figure 2.3.1 shows a comparison of freight rates per tonne per kilometer for different modes of transport. In similar to passenger rates, this highlights the lower costs of transport by inland water. Again, it is not clear if the fluctuation in road rates is real or caused by the method of calculation, but the pattern of relative costs is clear. Rail freight costs are highest and have remained constant in the past few years.



Source: Bangladesh Census 2000

Figure 2.3.1 Freight Rates for Different Transport Modes

(1) Transport Mode Costs between Mongla and Khulna2

The Mongla to/from Khulna transport cost by barge from midstream and by truck from the jetty berths compares as follows:

[2] Source: Mongla Port Area Development Project, 1996

Table 2.3.1 Comparison of Mongla-Khulna Transport Mode Costs (Tk/tonne)

	Barge from Midstream	Truck from Jetty Berth
Ship to Jetty	-	40
Loading	40	20
Trip Cost	70	200
Unloading Khulna	20	20
Total	130	280

Source: Mongla Port Area Development Project, 1996

The above comparison clearly shows the preferential use of barge over truck for cost savings in transporting between Mongla and Khulna.

(2) Impact of Container Transport

Expansion of container transport from seaports is taking place and considerable growth in this method of transit is anticipated as developed countries prefer this method of carriage and place pressure on less developed countries to comply. Container transport by road requires a high level of road infrastructure which undeveloped countries cannot provide or maintain. Whilst an inland container depot has been constructed at Dhaka, garments are stuffed into containers at Chittagong after first being transported by truck. This is important if Mongla Port is to start handling garment export in the future, and needs to ensure adequate space and facilities for container handling is provided. Many studies have proven water transport to be the most economical mode for containers. The costs per TEU for IWT and road trucks has been estimated at Tk 6,200 and Tk 11,800 respectively for the Chittagong-Dhaka route[3].

2.4 TRANSPORT MAINTENANCE AND OPERATION

Both roadways and waterways require maintenance to ensure effective and safe transit. Waterways require maintenance to prevent excessive sediments. Dredging is required. The costs of waterway maintenance should be compared to the cost of road maintenance as this comparison may have a significant bearing on modal policy and strategy within the Dhaka-SW transport corridor.

The estimated dredging costs at 1994 price levels are Tk. 50 per cbm.[4] This amounts to about Tk 42 per km. According to a current project at Mongla Port, the average unit rate of dredging is Tk 156 per cbm and Tk 424 million per km. For comparison, the annual maintenance costs of paved roads are about Tk 140 million per km with rehabilitation costs at 1.1 million /km and upgrading at 4.8 million Taka/km. Thus, despite overlooking other costs involved in water transport, this implies that maintaining the inland waterway system is economically beneficial and should be undertaken to as an integral part of the transport network.

The increase in road traffic due to modal transfer from Padma Bridge will inevitably increase road surface degradation. This will place greater burden on the need for maintenance and also on the need for adequate road construction and quality control. A good quality of road surface leads to reduced improved transit of road vehicles and therefore lower vehicle operating costs. The issue of different quality standards between foreign aid projects and domestic funded projects should also be addressed.

[3] Bangladesh Transport Sector Study, 1996 sourced from private ship owners and truck operators.
[4] Bangladesh Transport, 1994

2.5 CONSIDERATION OF LOW INCOME GROUPS

2.5.1 Potential Benefit of Bridge Projects to the Poor

In general terms the poor sector can benefit greatly from: a small amount of land, institutions to provide small amounts of cash, training on new cropping systems, and most importantly a good communication network to market their products. Many of these aspects are established or becoming established in Bangladesh and major bridges linking rural areas with the capital city are effectively the catalyst in realizing economic benefits. Instead of farmers selling their produce at the roadside and then disposing unsold surplus, they can take advantage of links to Dhaka and direct links with buyers, thus reducing the need for middlemen. The economic value of this aspect will be considered in other areas of this Study.

The direct benefits of a bridge to poor sector travelers is easier to assess but has less contribution to poverty alleviation. For example, it is known that once the project benefits of Jamuna Bridge were distributed among the income classes, it was found that the majority (72.5%) go to the non-poor, while the poor and very poor receive relatively few direct benefits at 9.6% and 17.9% respectively. It is considered that the reasons are as follows:

- The poor and very poor do not own vehicles that are permitted to cross Jamuna Bridge i.e. non-motorized traffic is prohibited;
- Though the poor and very poor make up over 62% of the population of the Northwest, they do not own light vehicles and account for only 16.4% of bus passengers;

The second finding above seems to suggest that the poor and very poor comprise a small proportion of travelers. So if they are not traveling by road then they will not realize direct benefits. They only benefit indirectly because the wealthy are able to engage in wider economic activities, which enhances employment prospects for the former. Therefore, direct benefits to the poor and very poor can only be gained appreciably by inducing this sector to travel by road. Further, the impact of a bridge on inland water transport services should be carefully considered to ensure there is not an adverse effect on the low income groups e.g. by reduced service.

2.5.2 Modal Choice of Low Income Travelers

There are several reasons for modal choice (i.e. the choice between inland water transport and road), though fare cost is clearly an important consideration particularly for low income travelers. Table 2.5.1 below compares the income of travelers by both road (river crossing) and inland water.

Table 2.5.1 Average Income of River Crossing Passengers (Taka/Month)

Passenger Type	Paturia-Goalundo	Mawa-Charjanajat	Inland Water
Light Vehicle Driver/ Passenger	11,422	15,681	-
Ferry Bus Passenger	11,286	8,074	-
Launch Passenger	4,892	5,376	5,565

Source: This Study
Note: Bus Drivers and Truck Drivers excluded.

The above table suggests that the average income of inland water travelers is similar to road bus passengers. The proportion of bus passengers traveling for business is around 45% (2003 survey). A similar proportion was recorded for inland water travelers from Dhaka (1999 survey), though from Narayanganj it was only 30%. These results are inconclusive, but it may be assumed that road users requiring faster journeys are more likely to have business reasons.

2.5.3 Methods of Increasing Benefits to the Poor

The approach of how to provide greater benefit to the poor and very poor is difficult as such income groups may not be traveling by road (e.g. only 16% of bus passengers in the Jamuna Survey were poor), and they may either prefer alternatives such as inland water, or simply not travel.

Travelers who continue to use river ferry/launch after completion of the bridge, for reasons of origin/destination or cost, will gain time savings from the lower utilization. However, these benefits are likely to be relatively small and it is not proposed to quantify them in this study. The primary benefit to the poor of lower road user cost savings is in the form of better prices for their goods and the general economic growth impact caused by the bridge. This is not reflected in the estimates of direct benefits.

2.6 REVIEW OF PADMA BRIDGE PRE-FEASIBILITY SURVEY RESULTS

This Study (2003-05) follows on from a Pre-Feasibility Study that was carried out in 1999. That study provided a basis for further investigation and identified important areas that require further study or updated information. Therefore, a brief summary of the pre-feasibility study results is first provided here. Where differences or conflicts in results are evident between the two studies, attempts to explain them are made throughout this chapter.

2.6.1 Summary of Surveys Undertaken

The Pre-Feasibility Report (PFR) included an assessment of traffic currently crossing Padma River, and a forecast of traffic that would utilize a bridge, if constructed. This study included traffic surveys carried out around June 1999. A summary of surveys and results is provided here. Surveys were carried out at the following crossing points: Mawa-Charjanajat; Aricha-Goalundo; Aricha-Nagarbari; and Paksey-Bharamara.

The survey was conducted over 5 days for 24 hours. The type of data collected was (i) Count: Ferry and vehicle count for both directions (i.e. the time of each departing ghat and a count of vehicles by type); (ii) Origin & Destination: O-D of commodity, bus, minibus, light vehicles, large bus passenger, minibus passenger, light vehicle passenger; (iii) Waiting Time: Crossing time by vehicle type; Waiting time by vehicle type; (iv) Freight Weight: Weight of commodity (average for each crossing).

The PFR also surveyed the following river ports: Dhaka; Narayanganj; Barisal; Khulna; Mongla.

2.6.2 Summary of Results

The survey concluded the following important points:

- *Existing Volume of Traffic at River Crossing*. 62,500 passengers cross directly from the north-east to south-west area each day at the combined Mawa and Goalundo crossing points.
- *Goalundo is the Most Popular Ferry Crossing*. Of the 62,500 total river crossing passengers, almost 62% use the more northerly Goalundo crossing and 38% use Mawa.
- *Modal split of Existing Cross River Traffic*. The existing traffic (1999) crossing Padma River at both Mawa and Goalundo amounts to some 2,587 vehicles per day comprising 853 trucks (33%), 412 light vehicles (16%), and 1322 (51%) i.e. 343 through buses and 979 feeder buses – estimated from launch passenger counts.
- *Crossing Time*. The crossing time (including waiting time) at Goalundo is less than that

for Mawa except for trucks. Launch passengers at Goalundo cross the Padma in 82 minutes compared to 110 minutes for Mawa. Buses at Goalundo cross in 155 minutes compared to 200 minutes at Mawa, while light vehicles cross in 130 minutes but 200 minutes at Mawa. Trucks take the longest time to cross with 355 minutes at Goalundo and 280 minutes at Mawa.

- *Journey Purpose*. The journey purpose for river crossing passenger is approximately 60% social and 40% business (not including truck drivers).
- *Trip Origin and Destination*. Most passengers either begin or end their journeys in Dhaka, but the trip-ends in the SW are dispersed. The most popular destination is Madaripur with 16% of trips per day. 29% of trips from the NE end in the northern section of the SW area.
- *Passenger Incomes*. Incomes were modest with launch and bus passenger incomes around 12,000 to 14,000 taka per month. The smaller sample of light vehicles revealed higher incomes ranging from an average of 18,000 taka at Mawa and 35,000 taka at Goalundo.
- *Freight Traffic*. Freight traffic amounts to 855 trucks per day with approximately 2.5mn tonnes per year. 60% of truck movements is Dhaka based with dispersed trip-ends in the SW.
- *Traffic Growth.* While national traffic growth was estimated at 7-9% p.a., Padma ferry traffic has grown very fast, averaging over 13% over the last two decades. In particular, growth of light vehicles was 22.5% between 1992 and 1998.

2.7 PADMA RIVER CROSSING TRAFFIC SURVEY IN THIS STUDY

2.7.1 Introduction

A traffic survey was carried out in July 2003. The survey was important to:

- provide up-to-date transport information in the study area;
- provide data for demand forecasting;
- clarify previous conclusions; and
- ascertain recent traffic growth.

The schedule of the survey is summarized below:

Table 2.7.1 Traffic Survey Program

Task	Date (2003)	Weekday
Recruitment and Training of Enumerators	6th July	Sunday
Mobilization at Site (Paturia)	7th July	Monday
Paturia – Goalundo Survey[1]	8th July to 10th July	Tuesday to Thursday
Shift to Mawa Site	11th July	Friday
Mawa – Charjanajat Survey	12th July to 14th July	Saturday to Monday
Shift to Takerhat & Faridpur Site	15th July	Tuesday
Takerhat & Faridpur Survey	16th July to 18th July	Wednesday to Friday
Shift to Dhaka Port site	19th July	Saturday
Sadarghat Survey	20th July to 22nd July	Sunday to Tuesday
Jamuna Bridge Survey	18th August	Monday

Source: This Study

[1] Includes Ferry Survey 8th July to 10th July (3 days), and Launch Passenger O&D Survey 8th July to 9th July (2 days), and truck waiting time log survey 10th July (1 day)

(Note): The schedule for the traffic survey above was planned to avoid Friday survey, the weekend in Bangladesh as far as possible. The most important survey sites at Mawa-Charjanajat and Patria-Goaludo were surveyed on weekdays. However, out of 3-day counting survey at Takerhat & Faridpur, only one Friday was included. Even if surveys were carried out on weekdays, adjustments of weekly traffic variations and monthly (seasonal) traffic variations to obtain AADT are necessary applying other traffic data sources. This work is done in the traffic demand projection.

2.7.2 Description and Objectives of Surveys

The survey sought to provide detailed information on the volume and characteristics of traffic crossing Padma River, and on waterway transport between the Northeast and Southwest region. The following data was derived.

Padma River Crossing Traffic

- Traffic Counts
- Passenger Counts
- Origin and Destination
- River Crossing and Waiting Time
- Route Choice
- Income
- Purpose of Trip
- Freight Characteristics
- Passenger Fare

Traffic at National Highway Intersections

- Classified Traffic Counts by Direction

Inland Waterway Transport Traffic

- Traffic Counts
- Passenger Counts
- Origin and Destination
- Travel Time
- Income
- Freight Type and Weight
- Fare

Jamuna Bridge

- Origin and Destination
- Freight Characteristics

Whilst the traffic survey, provided detailed up-to-date information, it could not cover all data required for a complete assessment of the existing transport profile, and for later demand forecasting regarding the feasibility of Padma Bridge. Thus, additional information was collected using available resources. Table 2.7.2 (River Crossing) and Table 2.7.3 (Inland Water) summarize the items of desired traffic data and specifies whether it was covered within the survey. Where survey coverage was absent the alternative method of collection is described.

Table 2.7.2 Method of Padma River Crossing Transport Data collection

Desired Criteria	Method of Data Collection
Area Coverage:	
All crossing points on Padma River screenline between Northeast and Southwest region of Bangladesh	Surveys were carried out at Mawa and Paturia crossing points only. An informal crossing point exists at Dohar but does not connect to road routes and is considered negligible. A crossing point exists at Chandpur in the SE region but has relatively low flows. BIWTC maintains statistics of this ferry traffic, and is included in analysis.
Traffic and Passenger Counts:	
No. of categorized road vehicles approaching or departing from ferry ghats.	Vehicle count survey at entrance road to ferry ghats.
No. of Ferries (vessels)	From BIWTC records
No. of Launches (vessels)	Data not collected.
No. of Ferry Passengers	From BIWTC monthly records.
No. of Launch Passengers	By passenger count, i.e. number of persons entering launch area.
No. of Informal Crossing Passengers	Not Surveyed. Informal crossings are difficult to identify, but are most likely localized trips and only a small proportion of overall traffic.
No. of Vehicles Crossing River (categorized)	From BIWTC daily records.
Origin & Destination:	
Ferry Passengers	By Questionnaire Survey of passengers (sample)
Launch Passengers	By Questionnaire Survey of passengers (sample)
Categorized Vehicles	By Questionnaire Survey which records vehicle type (sample)
Time Delay:	
Crossing Time (Ferry and Launch)	From BIWTC records
Waiting Time - Launch Passenger	Not Surveyed. A notional value will be assumed.
Ferry Vehicle Waiting Time	By Passenger Questionnaire (sample)
Passenger Income:	
Ferry Passengers	By Passenger Questionnaire (sample)
Launch Passengers	By Passenger Questionnaire (sample)
Freight Characteristics	
Commodity	From Questionnaire Survey (sample)
Weight	From Questionnaire Survey (sample)
River Crossing Charges (Sample)	
Passenger Fare	From Questionnaire Survey (sample)
Freight Charges	From Questionnaire Survey (sample)
Route/Mode Choice (Sample)	
Ferry Passenger	By Questionnaire Survey (sample)
Launch Passenger	Not Surveyed. Due to the high number of launch passengers, the launch survey focussed on maximizing a high sample rate for the origin/destination survey. Ferry passengers provided some information on route and modal choice.

Source: This Study

Table 2.7.3 Method of Inland Water Transport Data Collection

Desired Criteria	Method of Data Collection
Area Coverage:	
All ports on Northeast to Southwest corridor of Bangladesh	Due to the high number of ports in Bangladesh, only Dhaka Port (Sadarghat) was surveyed. This is the main port for movement between the Northeast and Southwest regions of Bangladesh. Data on other ports was obtained from published BIWTA records.
Counts:	
No. of Launch Passengers	By passenger count, supplemented by published BIWTA data. Launch passenger counts were most likely affected by a recent launch accident and were therefore not considered to be a reliable reflection of the existing situation.
No. of Launches	From BIWTA launch schedule
Origin & Destination:	
Destination of Departing Launch Passengers	Passenger origins and destinations are fixed by the vessel route.
Trip Time:	
Trip Time	Derived from BIWTA schedule.
Passenger Income:	
Launch Passenger	From passenger interview (sample)
Freight:	
Waterway Charges:	
Launch Passenger Fare	By passenger interview, supplemented by contacting shipping companies.

Source: This Study

Table 2.7.3 above highlights the complexity of movements on inland water. Unlike Padma River crossing, there are many types of vessel on waterways and nearly all are privately owned. This necessitated data collection and combination from a variety of sources. In particular, passenger numbers on the numerous routes are not formally recorded by any organized body, so only estimates can be made. Freight moved by cargo boats is formally recorded by BIWTA, though annual reports are not kept up to date.

2.7.3 Survey Results

(1) Padma River Crossing Survey

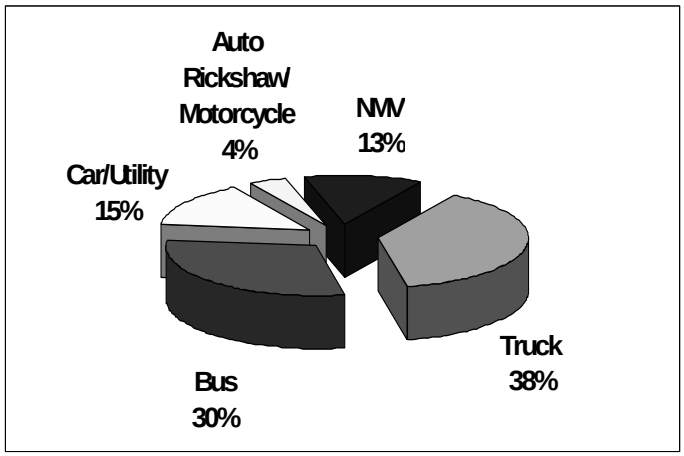
The Padma River screenline survey included the river crossing locations of Mawa-Charjanajat and Paturia-Goalundo. The following items summarize the results of this survey.

(a) Road Traffic Volume Accessing Ghats

The total volume of traffic approaching and departing from the ferry ghats was recorded. This was undertaken by physically counting vehicles on the approach roads. This volume of traffic will be greater than the volume actually crossing the river due to drop-down/pick-up traffic as well as local trade trips. The vehicles actually crossing the river was later recorded from BIWTC who collect the ticket office receipts. This traffic volume is described later.

Paturia-Goalundo River Crossing:

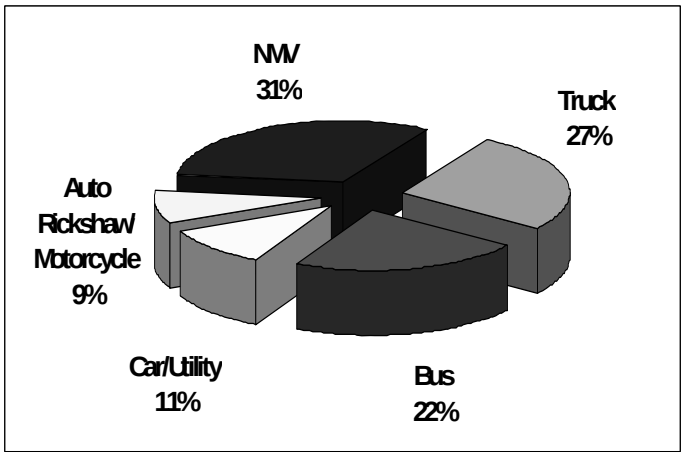
Figure 2.7.1 shows the relative proportions of traffic arriving or departing from Paturia Ferry Terminal on the east (Dhaka) side of Padma River. Around 2,190 recorded vehicles/day approach the river crossing site, and a similar number departs. 87% of this traffic is motorized and 13% non-motorized. A high level of truck traffic is apparent, and most, if not all, will be crossing the river. A high percentage of buses is also notable, though only some will physically cross the river as through traffic. The others act as a feeder service.



Source: This Study, 2003

Figure 2.7.1 Categories of Traffic Approaching Paturia Ferry Terminal (total: 4,275 vehicles/ day)

Figure 2.7.2 shows the relative proportions of traffic arriving or departing from Goalundo Ferry Terminal on the west side of the river. Around 3,000 vehicles/day approach the river crossing site each day, and a similar volume departs, making a total of 6,075 recorded vehicles/day. Approximately 70% of this traffic is motorized. Despite non-motorized traffic not crossing the river, its role as a feeder service is noteworthy in its contribution to nearly a third of all vehicles. This may account for the higher volume of total traffic on the western river bank compared to Paturia on the eastern side.



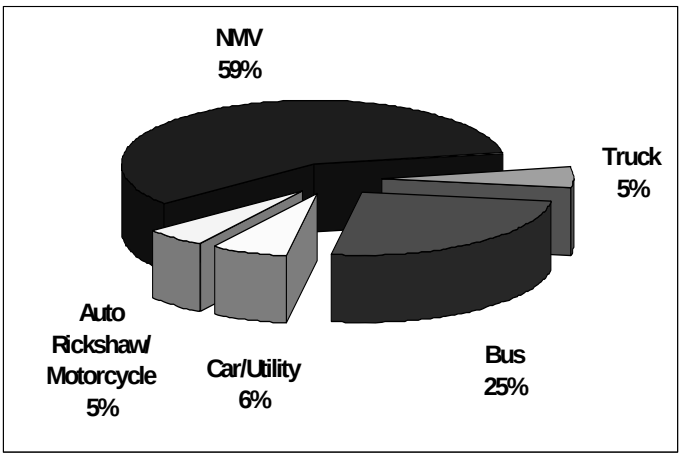
Source: This Study, 2003

Figure 2.7.2 Categories of Traffic Approaching Goalundo Ferry Terminal (total: 6,075 vehicles/ day)

Comparison of the above figures reveals that the volume of 'motorized' traffic arriving and departing is similar at both terminals. However, a much higher level of NMV feeder activity is recorded as taking place at the Goalundo terminal. This is due to the proximity of villages such as Goalundo, which acts as a business center and provides services and local trade to the Goalundo terminal. Also, Goalundo does not have a bus service, so non-motorized traffic is used as a feeder service.

Mawa-Charjanajat River Crossing:

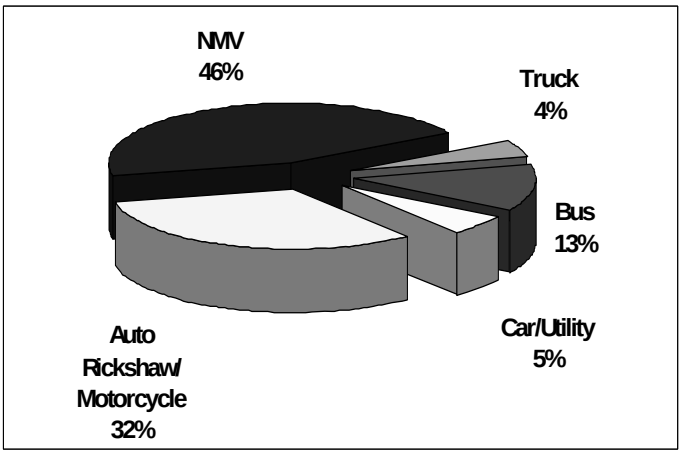
Figure 2.7.3 shows the relative proportions of traffic arriving at or departing from Mawa Ferry Terminal on the east (Dhaka) side of the river. Around 1,670 vehicles/day approach, while 1,900 depart, giving a total recorded volume of 3,576 vehicles/day. The high proportion of NMVs is apparent, though auto rickshaws and motorcycles only contribute 5%. Trucks also only make up 5%. A higher number of medium-sized buses were recorded at Mawa than Charjanajat thus providing the 25% buses.



Source: This Study, 2003

Figure 2.7.3 Categories of Traffic Approaching Mawa Ferry Terminal (total: 3,576 vehicles)

Figure 2.7.4 shows the relative proportions of traffic arriving at or departing from Charjanajat Ferry Terminal on the west side of the river. Around 1,750 vehicles/day approach and a similar number departs, giving a total recorded volume of 3,468 vehicles/day. The high proportion of NMVs and auto rickshaws/motorcycles is notable, and in combination contributes 80% of all vehicles. The low level of trucks at only 4% is evident when comparing with the Goalundo ghat which gave 27%.



Source: This Study, 2003

Figure 2.7.4 Categories of Traffic Approaching Charjanajat Ferry Terminal (total: 3,468 vehicles/day)

Comparing the Paturia-Goalundo and Mawa-Charjanajat traffic approaching and departing from the river ghats, the following conclusions can be made:

- Paturia-Goalundo attracts a higher number of total vehicles than Mawa-Charjanajat;
- Non-motorized vehicles comprise a particularly high proportion of vehicles at the Mawa-Charjanajat crossing, as well as at Goalundo;
- Trucks prefer to use the Paturia-Goalundo crossing;
- Relatively few buses on the Charjanajat side imply a high volume of very localized trip-ends that do not require bus services.

(b) Cross River Traffic Volume

Traffic crossing Padma River comprises ferry traffic, such as buses, trucks, and light

vehicles with their associated passengers, and launch passenger traffic, who usually have connecting bus services on each side of the river. The volume of vehicles crossing the river by ferry was derived from BIWTC, who keeps daily records of such traffic. The volume of launch passengers crossing the river was derived from manual counts over 3 days. Table 2.7.4 shows the average volume of daily traffic for the three days in July 2003.

Table 2.7.4 Traffic Volumes Across Padma River (both ways 2003)

	Paturia-Goalundo		Mawa-Charjanajat		Cross-Padma Total	
	No. of Vehicles	No. of passengers	No. of Vehicles	No. of passengers	No. of Vehicles	No. of passengers
FERRY		-		-		-
Bus/Coach	687	(26,600)[1]	227	(7,000)	914	33,600
Light Vehicle	572	(incl. above)	128	(incl. above)	700	(incl. above)
Truck	1217	-	78	-	1295	-
Total	2,476	26,600	433	7,000	2,909	33,600
LAUNCH						
Passengers[2]		15,559		9,126		24,685
Total	2,476	42,159	433	16,126	2,909	58,285

Source: BIWTC (Data from average over 3 days in July 2003) and Traffic Survey, July 2003

Note: Mawa-Charjanajat traffic volume includes nearby Mawa-Kathal Bari crossing data. The above figures do not include the southerly Chandpur-Shariatpur ferry crossing. Averaged over the same three days as the Paturia survey, around 50 vehicles/day use the Chandpur crossing comprising 13 buses, 21 trucks, and 16 light vehicles.

[1] Estimated from BIWTC passenger total for June 2003

[2] From launch count (average over 3 day survey)

(c) Origin and Destination of Ferry Traffic

Ferry crossing traffic comprises passenger motor vehicles (buses and light vehicles), freight vehicles (trucks), and passengers (i.e. passengers of passenger vehicles). The origin and destination of traffic crossing the Padma River screenline was sampled. This was undertaken by an interview questionnaire while on-board the vessel during the river crossing. Vehicle drivers on ferries were asked their origins and destinations. This task was also repeated for launch vessels, described later. [5]

Table 2.7.5 below shows trip generation by way of the main origins and destinations of all vehicles crossing Padma River at both Paturia-Goalundo and Mawa-Charjanajat for comparison. The table indicates which locations in Bangladesh generate the most trips that cross the river.

[5] The questionnaire used on the ferry was much more detailed than the one used on passenger launches. This was partly due to manning restraints and the fact that ferries carry a larger variety of passenger and cargo, as well as vehicles. The launch interview only requested the origin and destination of passengers and was conducted before the launch departed. The ferry interview was carried out during crossing as more time was necessary.

Table 2.7.5 Comparison of Vehicle Trip Generation at Paturia and Mawa

Zone No.	Zone (Zila)	----------Paturia-Goalundo----------			----------Mawa-Charjanajat----------		
		Passenger	Trucks	All Vehs.	Passenger	Trucks	All Vehs.
	Northeastern Region						
1	Dhaka	93 %	60 %	74 %	98 %	67 %	93 %
6	Gazipur	1 %	7 %	4 %	-	-	-
4	Narayanganj	1 %	4 %	3 %	1 %	15 %	3 %
2	Manikganj	-	4 %	2 %	-	-	-
7	Tangail	-	3 %	2 %	-	-	-
10	Others	1%	2%	1 %	1 %	6 %	2 %
	Eastern Region						
50-60	Chittagong	5%	15 %	11 %	-	12 %	2 %
61-64	Syhet	-	3 %	2 %	-		
		100 %	100 %	100 %	100 %	100 %	100 %
	Southern Region						
22	Khulna	21 %	13 %	16 %	17 %	16 %	17 %
24	Jessore	9 %	19 %	15 %	-	1 %	-
18	Kushtia	12 %	13 %	13 %	-	-	-
65	India (west Bengal)	7%	11 %	10 %	-	-	-
14	Faridpur	9 %	7 %	8 %	6 %	10 %	7 %
26	Chuadanga	6 %	9 %	8 %	-	1 %	-
29	Barisal	11 %	3 %	7 %	8 %	27 %	11 %
25	Jhenaidah	2 %	8 %	5 %	-	-	-
13	Rajbari	4 %	4 %	4 %	-	-	-
23	Satkhira	6 %	3 %	4 %	-	-	-
15	Gopalganj	2 %	1 %	2 %	6 %	7 %	6 %
19	Magura	1 %	2 %	2 %	-	1 %	1 %
16	Madaripur	-	1 %	1 %	9 %	10 %	10 %
20	Narail	2 %	-	1 %	-	-	-
21	Bagerhat	2 %	-	1 %	14 %	9 %	13 %
27	Meherpur	1 %	1%	1 %	-	-	-
28	Pirojpur	2 %	-	1 %	8 %	6 %	8 %
17	Shariatpur	-	-	0 %	21 %	6 %	18 %
30	Jhalakhati	-	-	-	-	3 %	-
31	Barguna	-	-	-	6 %	-	5 %
32	Patuakhali	-	-	-	2 %	-	2 %
33	Bhola	-	-	-	3 %	-	2 %
	Other						
	North Western Region						
34-49		-	1 %	1 %	-	-	-
	Total Southern Region			100 %	100 %		

Source: This study, 2003

Paturia – Goalundo Ferry Crossing

A total of 2476 vehicles/day crossed Padma River at Paturia-Goalundo and 434 vehicle drivers were surveyed representing a 17.5% sample. A further 57 passengers/day were also surveyed. Concerning passenger vehicles, the importance of Dhaka is also highlighted with 93% of all passenger vehicles crossing at Paturia-Goalundo originating or destined for the capital city. Trip-ends in the Southwest are highly dispersed, though the importance of

Khulna for passenger traffic is notable at 21%. Despite Khulna and Barisal being located in the south of the Southwest region, a significant volume of passenger traffic is using the northerly Paturia crossing i.e. 32% combined. Regarding freight vehicles, a total of 1217 trucks crossed Padma River at Paturia, and 246 were interviewed representing a 20% sample. The above table shows a relatively greater spread of trip-ends in the Northeast region for freight traffic through the Paturia crossing. Dhaka is reduced to 60% of all freight trip generation and Chittagong increases to 15%. Interestingly, this Chittagong traffic is making use of the more northerly Paturia crossing rather than Mawa. Jessore is one of the main trip-ends of Chittagong traffic and the higher standard of National Highway N7 is clearly a factor in choosing this route. Overall Jessore generates 19% of freight trips in the Southwest. Also of note is the 11% of trips that are generated by cross border traffic to/from the southern area of West Bengal, India .

Mawa-Charjanajat Ferry Crossing

A total of 433 vehicles crossed the river at Mawa-Charjanajat and 128 were surveyed representing a sample size of 30%. The table above shows 93% of all vehicles in the Northeast have Dhaka as a trip-end. The locations in the Southwest tend to be more southerly with Khulna and Bagerhat featuring more strongly. Jessore and Benapole are barely recorded even for freight. This reflects the low volume of freight traffic using Mawa and the poor standard of route from Charjanajat to the west (i.e. N85, R750, N76). Locations close to the river also feature much more strongly for Mawa crossing traffic, suggesting that Paturia is used more for longer strategic trips.

(d) Origin and Destination of Launch Passengers

The most popular method for passengers to cross the river is by launch vessel with connecting bus services each side of the river. Launches only carry foot passengers and no vehicles so high volumes of people can cross at one time. Cargo is generally not transported by launch, or in negligible quantity. The origins and destinations of launch passengers were sampled by interview questionnaire survey over two days.

Paturia-Goalundo Launch Crossing:

A total of 1184 launch passengers were interviewed over three days at the Paturia and Goalundo launch ghats. This represents a 2.5% sample of the 46,677 total passengers who crossed in those three days. The results again showed the importance of Dhaka with 94% of trips in the Northeast having trip-ends there. Faridpur was the greatest generator with 32%, followed by Khulna (15%), Gopalganj (13%), and Rajbari (13%). Chittagong recorded only 2% reiterating the point that traffic generated by Chittagong and crossing Padma River is mainly freight.

Mawa-Charjanajat Launch Crossing:

A total of 695 launch passengers were interviewed over three days at the Mawa and Charjanajat ghats. This represents a 2.5% sample of the 27,378 total passengers who crossed in those three days.

The most notable conclusion from Mawa launch results is the proportion of trips that begin or end close to Padma River on the south-eastern side. Madaripur recorded 36%, Shariatpur 34%, and Faridpur 11%. Thus 81% of launch trips using Mawa are highly localized.

(e) Origin and Destination of All Padma River Passengers

Table 2.7.6 shows the overall pattern of movements for traffic crossing Padma River. This

combines all classes of vehicle and both ferry and launch traffic.

Table 2.7.6 Total Vehicle Trip Generation Across Padma River

Zone Coding	Zone (Zila)	Vehicle Trips per day (to and from zone)	Proportion of Total Trip Generation (%)
	Northeastern Region		
1	Dhaka	2445	78.2 %
6	Gazipur	105	3.4 %
4	Narayanganj	98	3.1 %
2	Manikganj	68	2.2 %
7	Tangail	37	1.2 %
10	Mymensingh	21	0.7 %
3	Munshiganj	15	0.5 %
5	Narshingdi	12	0.4 %
12	Kishoreganj	6	0.2 %
8	Jamalpur	4	0.1 %
11	Netrakona	4	0.1 %
	Eastern Region		
50-60	Chittagong	269	8.6 %
61-64	Sylhet	41	1.3 %
	Total Northeastern and Eastern Region	3,125	100 %
	Southern Region		
22	Khulna	444	14.2 %
24	Jessore	389	12.4 %
18	Kushtia	341	10.9 %
14	Faridpur	332	10.6 %
65	India (west Bengal)	249	7.9 %
29	Barisal	244	7.8 %
26	Chuadanga	183	5.8 %
13	Rajbari	174	5.5 %
25	Jhenaidah	145	4.6 %
23	Satkhira	122	3.9 %
15	Gopalganj	85	2.7 %
21	Bagerhat	81	2.6 %
28	Pirojpur	63	2.0 %
16	Madaripur	54	1.7 %
17	Shariatpur	53	1.7 %
19	Magura	46	1.5 %
27	Meherpur	34	1.1 %
20	Narail	33	1.1 %
31	Barguna	24	0.8 %
30	Jhalakhati	13	0.4 %
33	Bhola	9	0.3 %
32	Patuakhali	6	0.2 %
	North Western Region		
34-49		13	0.4 %
	Total Southern Region	3,137	100 %

Source: This study, 2003

Note: Number of vehicle trips shown is annual average daily traffic (AADT) in passenger car units (pcu).

The above table shows that 78% of all traffic in the eastern region crossing Padma River is generated by Dhaka City. Chittagong also contributes almost 9%. Sylhet only generates 1% suggesting that traffic from this area is destined for Chittagong. In the western area, Khulna is the greatest generator with 14%. Jessore and Benapole at the India border jointly generate over 20%, which highlights the importance of an east-west route across the Southwest

region. Splitting the Southwest region of Bangladesh into northern and southern sub-sections along the boundary of Faridpur, Narail, and Jessore results in a broad pattern 61% of traffic generated by the north and 39% generated by the south.

Table 2.7.7 Passenger Vehicle Trip Generation Across Padma River

Zone Coding	Zone (Zila)	Vehicle Trips per day (to and from zone)	Proportion of Total Trip Generation (%)
	Northeastern Region		
1	Dhaka	1633	92.3 %
4	Narayanganj	30	1.7 %
6	Gazipur	20	1.1 %
2	Manikganj	18	1.0 %
3	Munshiganj	2	0.1 %
10	Mymensingh	2	0.1 %
12	Kishoreganj	2	0.1 %
	Eastern Region		
50-60	Chittagong	61	3.4 %
61-64	Sylhet	2	0.1 %
	Total Northeastern and Eastern Region	1,770	100.0 %
	Southern Region		
22	Khulna	272	15.4 %
14	Faridpur	229	12.9 %
29	Barisal	186	10.5 %
18	Kushtia	170	9.6 %
24	Jessore	151	8.5 %
13	Rajbari	116	6.6 %
65	India (west Bengal)	89	5.0 %
23	Satkhira	81	4.6 %
26	Chuadanga	68	3.8 %
21	Bagerhat	65	3.7 %
15	Gopalganj	58	3.3 %
28	Pirojpur	54	3.1 %
17	Shariatpur	46	2.6 %
25	Jhenaidah	44	2.5 %
16	Madaripur	32	1.8 %
20	Narail	26	1.5 %
31	Barguna	22	1.2 %
27	Meherpur	19	1.1 %
19	Magura	16	0.9 %
30	Jhalakhati	11	0.6 %
33	Bhola	9	0.5 %
32	Patuakhali	6	0.3 %
	North Western Region		
34-49		0	0 %
	Total Southern Region	1,770	100.0 %

Source: This study, 2003

Note: Number of vehicle trips shown is annual average daily traffic (AADT) in passenger car units (pcu).

The above table shows that over 92% of passenger traffic in the eastern region crossing Padma River is generated by Dhaka City. Chittagong only contributes 3% and Sylhet is negligible. In the Southwestern area, Khulna is the greatest generator with 15%, followed by Faridpur and Barisal.

Table 2.7.8 Truck Generation Across Padma River

Zone Coding	Zone (Zila)	Vehicle Trips per day (to and from zone)	Proportion of Total Trip Generation (%)
	Northeastern Region		
1	Dhaka	812	73.8 %
6	Gazipur	85	6.3 %
4	Narayanganj	68	5.0 %
2	Manikganj	50	3.7 %
7	Tangail	37	2.7 %
10	Mymensingh	19	1.4 %
3	Munshiganj	13	1.0 %
5	Narshingdi	12	0.9 %
8	Jamalpur	4	0.3 %
11	Netrakona	4	0.3 %
12	Kishoreganj	4	0.3 %
	Eastern Region		
50-60	Chittagong	208	15.4 %
61-64	Sylhet	39	2.9 %
	Total Northeastern and Eastern Region	1,355	100.0 %
	Southern Region		
24	Jessore	238	17.4 %
22	Khulna	172	12.6 %
18	Kushtia	171	12.5 %
65	India (west Bengal)	160	11.7 %
26	Chuadanga	115	8.4 %
14	Faridpur	103	7.5 %
25	Jhenaidah	101	7.4 %
13	Rajbari	58	4.2 %
29	Barisal	58	4.2 %
23	Satkhira	41	3.0 %
19	Magura	30	2.2 %
15	Gopalganj	27	2.0 %
16	Madaripur	22	1.6 %
21	Bagerhat	16	1.2 %
27	Meherpur	15	1.1 %
28	Pirojpur	9	0.7 %
17	Shariatpur	7	0.5 %
20	Narail	7	0.5 %
30	Jhalakhati	2	0.1 %
31	Barguna	2	0.1 %
	North Western Region		
34-49		13	1.0 %
	Total Southern Region	1,367	100.0 %

Source: This study, 2003

Note: Number of vehicle trips shown is annual average daily traffic (AADT) in passenger car units (pcu).

The above table shows that around 74% of all truck traffic in the eastern region crossing Padma River is generated by Dhaka City. Chittagong also contributes 15% and Sylhet around 3%. In the western area, Jessore is the greatest generator with over 17%. Jessore and Benapole at the India border jointly generate nearly 30% of truck traffic, which highlights the importance of an east-west route across the Southwest region for trucks in particular.

(f) Crossing and Waiting Time

The magnitude of travel delays will later form an important factor, as time savings produce

substantial economic benefits. Therefore, in order to accurately gain information on waiting time, a survey was carried out. This involved interviewing drivers on the time they took waiting to cross the river at the ghat.

Table 2.7.9 Waiting and Crossing time at Padma River Crossings

(Minutes)

	Paturia-Goalundo			Mawa-Charjanajat		
	Waiting Time	Crossing Time[1]	Total Time	Waiting Time	Crossing Time	Total Time
FERRY						
Bus/Coach	58	35	93	66	122	188
Light Vehicle	48	35	83	67	122	187
Truck	160	35	195	109	122	231
LAUNCH						
Passengers	(20)[2]	35	55	(20)[2]	122	142

Source: This Study, 2003

[1] Crossing Time from BIWTC records (average for high and low water level seasons).

[2] Waiting Time for launch passengers was not surveyed. A notional time of 20 minutes is estimated for embarking and disembarking (including re-boarding buses at the other side).

Trucks have significantly longer waiting times than other vehicles. On average, buses and light vehicles wait around 1 hour before crossing Paturia-Goalundo or Mawa-Charjanajat, whilst trucks wait around 2.5 hours. The two hour crossing time at Mawa is significantly longer than Paturia at 35 minutes and helps to further explain the preferred use of Paturia ghat.

(g) Route Choice

In order to gain a greater understanding of why passengers and truck drivers use a particular route and river crossing or why they prefer road to inland water transport, a question was included in the interview form for ferry river crossing travelers. This simply asked the reason for their travel mode and route. Table 2.7.10 summarizes the results of responses. However, it should be noted that the overall interview survey targeted vehicle drivers rather than their passengers in order to gain the greatest understanding of traffic volume and distribution. In this case, bus drivers may be considered representative of their passengers.

Table 2.7.10 Reasons for Choice of Travel Mode and Route by Ferry Passengers

Reason	Paturia-Goalundo			Mawa-Charjanajat		
	Truck	Passenger Vehicle	All	Truck	Passenger Vehicle	All
Quickest Route/Mode	36 %	32 %	34 %	40 %	31 %	32%
No/Bad Alternative	24 %	29 %	27 %	19 %	29 %	28%
Cost	18 %	8 %	13 %	10 %	5 %	6%
Comfort	9 %	14 %	12 %	1 %	3 %	3%
Proximity to Destination	9 %	9 %	10 %	28 %	32 %	32%
Other	3 %	8 %	5 %	-	-	-
TOTAL (sample size)	659 (100%)	718 (100%)	1377 (100%)	67 (100%)	493 (100%)	560 (100%)

Source: This Study, 2003

In order to maximize the sample size of launch passengers, this question was not included in the launch passenger survey.

For the Paturia-Goalundo crossing, the main reasons for the choice of mode or route were a perceived ‘lack of alternative’ and the ‘quickest way to travel’. Proximity to destination accounted for only 10% of all trip-makers. However, passengers using Mawa-Charjanajat gave ‘proximity to destination’ and ‘quickest route/mode’ as the prime reasons. This fits with the origin/destination results, which show Mawa traffic as having short trip-ends close to the crossing, while Paturia traffic tends to travel farther to/from destinations in the

Southwest. Relatively few passengers specified cost or comfort as being reasons for their chosen travel route or mode.

(h) Purpose of Trip

Information on the purpose of traveling for ferry passengers was derived by interview questionnaire. Categories of trip purpose were set as: work, education, shopping, business, medical, social, tour, commuter, other. The total number of trucks and buses that crossed Padma River over the three surveyed days were 3,885 and 2,742 respectively. The drivers of these vehicles naturally have a work trip purpose. Assuming 40.7 passengers per bus, the number of bus passengers crossing at Paturia was 83,883 and at Mawa 27,717. The trip purpose of these passengers can be estimated from the sample of interviews as set out below. Of an estimated 122,000 bus and light vehicle passengers only 487 were interviewed. However, they give an indication of trip purpose as shown in Table 2.7.11.

The total number of trucks and buses that crossed Mawa-Charjanajat over the three surveyed days was 915. This included 681 buses equating to 27,717 bus passengers.

Table 2.7.11 Purpose of Trip for Bus Passengers Only

	Paturia-Goalundo		Mawa-Charjanajat		Cross Padma Total
	Growthed	Sample	Growthed	Sample	Growthed
Work	36,564	51 (43.6%)	10,975	59 (39.6%)	47,539
Social	27,961	39 (33.3%)	11,533	62 (41.6%)	39,494
Education	9,320	13 (11.1%)	372	2 (1.3%)	9,692
Tour	5,736	8 (6.8%)	1860	10 (6.7%)	7,596
Medical	2,151	3 (2.6%)	0	-	2,151
Business	717	1 (0.9%)	1674	9 (6.0%)	2,391
Commuter	717	1 (0.9%)	0	-	717
Other	717	1 (0.9%)	186	1 (0.7%)	903
Recreation	-	-	1,116	6 (4.0%)	1,116
Shopping	-	-	0	-	-
TOTAL	83,883	117	27,717	149	111,600

Source: This Study (3 day survey in July, 2003)
Note: Launch passengers not surveyed.

In addition, 1,716 light vehicles crossed at Paturia-Goalundo during the three day period and 79 at Mawa-Charjanajat. The average number of passengers was 4 and 7 respectively. An average number of 5 passengers will therefore be assumed for the following calculation.

Table 2.7.12 Purpose of Trip for Light Vehicle Drivers/Passengers

	Paturia-Goalundo		Mawa-Charjanajat		Cross Padma Total
	Growthed	Sample	Growthed	Sample	
Work	5,317	88 (62.0%)	1,118	46 (58.2%)	6,435
Social	1,933	32 (22.5%)	632	26 (32.9%)	2,565
Tour	423	7 (4.9%)	49	2 (2.5%)	472
Medical	423	7 (4.9%)	24	1 (1.3%)	447
Business	242	4 (2.8%)	49	2 (2.5%)	291
Recreation	121	2 (1.4%)	-	-	121
Other	60	1 (0.7%)	49	2 (2.5%)	109
Education	60	1 (0.7%)	-	-	60
Shopping	-	-	-	-	-
Commuter	-	-	-	-	-
TOTAL	8,580	142	1,920	79	10,500

Source: This Study, 2003
Note: Launch passengers not surveyed.

Combining the trip purposes for all trip-makers across Padma River gives the following proportions:

Table 2.7.13 Purpose of Trip for all Trip-Makers

Trip Purpose	Paturia-Goalundo		Mawa-Charjanajat		Cross Padma Total	
	Trip-Makers	%	Trip-Makers	%	Trip-Makers	%
Work	47,593	48 %	13,008	43 %	60,601	47.1 %
Social	29,894	30 %	12,165	40 %	42,059	32.7 %
Education	9,380	10 %	372	1 %	9,752	7.6 %
Tour	6,159	6 %	1,909	6 %	8,068	6.3 %
Business	959	1 %	1,723	6 %	2,682	2.1 %
Medical	2,574	3 %	24	0 %	2,598	2.0 %
Recreation	121	0 %	1,116	4 %	1,237	1.0 %
Other	777	1 %	235	1 %	1,012	0.8 %
Commuter	717	1 %	-	-	717	0.6%
Shopping	-	-	-	-	-	-
TOTAL	98,174	100 %	30,552	100 %	128,726	100 %

Source: This Study, 2003
Note: Launch passengers not surveyed. Work purpose includes bus and truck drivers.

The above analysis shows that work or business accounts for 49.8% of trips across Padma River, while other mainly social reasons account for 50.2%. In summary, from the available survey data, a 50:50 split of work and social trip purposes appears to be a fair approximation.

(i) Passenger Income

Information on the monthly income of passengers was derived by interview questionnaire on both ferries and launches. Due to the high number of bus and truck drivers interviewed the sample size of ferry passengers is relatively small. However, Table 2.7.14 clearly shows the higher income of ferry passengers over launch passengers.

Table 2.7.14 Average Income of River Crossing Passengers (Taka/Month)

Passenger Type	Mawa-Charjanajat	Paturia-Goalundo
Light Vehicle Driver/ Passenger	15,681	11,422
Ferry Bus Passenger	8,074	11,286
Launch Passenger	5,376	4,892

Source: This Study, 2003
Note: Bus Drivers and Truck Drivers excluded.

(j) Freight Characteristics

Information on the characteristics of cargo carried by trucks was derived from interview questionnaire and is summarized in Table 2.7.15.

Table 2.7.15 Trucks Crossing Padma River by Commodity

Commodity	Paturia-Goalundo	Mawa-Charjanajat	Cross Padma Total	
Agricultural Produce	272	8	280	36 %
Others	140	23	163	21 %
Construction Materials (metal)	80	2	82	11 %
Grocery	38	6	44	6 %
Forest Produce	31	7	38	5 %
Consumer Goods	31	2	33	4 %
Fish Produce	27	3	30	4 %
Jute and Jute Goods	21	-	21	3 %
Machinery and Equipment	17	-	17	2 %
Medicine	14	1	15	2 %
Mineral	14	-	14	2 %
Petroleum	10	3	13	2 %
Construction materials (stone)	9	1	10	1 %
Fertilizer	7	-	7	1 %
Animal	4	-	4	0 %
Hide, Skin and Leather	2	1	3	0 %
Empty	3	-	3	0 %
Electronics	2	-	2	0 %
TOTAL	722	57	779	100 %

Source: This Study (O-D Survey)

The above breakdown of commodities, while only representing 20% of the 3,886 trucks that crossed the river over 3 days, shows the importance of road transit for agricultural produce. Few bulk goods are recorded, confirming their preferred transit by inland water. The diversity of cargo is reflected in the 21% of other types of cargo i.e. those not falling into the other main categories. This highlights the importance of road transit for 'general cargo'. The relatively low proportion of consumer goods, which includes garments, shows the low transit of this commodity on the Dhaka-Khulna corridor.

Regarding agricultural produce, Dhaka generates 60% of this commodity traffic and most is destined for the city. Jessore generates 22%, while Chuadanga and Jhenaidah generate 15% and 11% respectively. These areas are located in the more northerly part of the Southwest region. The fact that agricultural produce is the most abundant commodity crossing the river is important as this commodity is perishable and most susceptible to damage by handling or by trip delay.

Based on driver interview responses at Paturia, the average weight of trucks was 10.5 tonnes which exceeds the 8 tonne capacity of the popular medium size truck. The average distance traveled by trucks between origin and destination was 350km, and can most likely be interpreted as round trip.

(2) Inland Water Traffic

Large numbers of people use inland water transport for both local and long journeys each day. The actual traffic volume is notoriously difficult to quantify due to inconsistent vessel scheduling and the haphazard movement of people at the ports. The main passenger port is Sadarghat and surveys were carried out there over 3 days.

(a) Inland Water Traffic Passenger Volume

Over 3 days, 141,918 persons were counted as entering the Sadarghat terminal building (i.e. an average of 47,300 per day. While many of these are trip-makers subsequently departing on launch vessels, some are making local trips on small vessels, engaging in trade activities, or meeting/seeing off travelers. A total of 67 vessels per day (average) were surveyed as

departing from Sadarghat and a passenger head count estimated 27,000/day (81,458 passengers over 3 days). According to the BIWTA timetable, around 72 launches operate each day, therefore the sample rate appears to be high.

It is difficult to accurately ascertain the level of passenger traffic on particular routes due a lack of formal record-keeping and difficulties in accurate surveying. However, from interviews with BIWTA representatives, the estimated number of inland water passengers per day on the route between Dhaka and the southwest region in 2003 is 34,200.

(b) Inland Water Passenger Origin and Destination

A survey was carried out on launches departing from Sadarghat. This recorded a head-count in each launch and the destination of each launch. Table 2.7.16 summarizes the destinations and corresponding numbers of these inland water launch passengers, which is similar share of estimated inland water passengers per day between Dhaka and southwest region in 2003 by BIWTA.

Table 2.7.16 Origin and Destination of Surveyed Inland Launches

Ref.	Origin	Destination	No. of Passengers	%
		Northeast Region		
3	Sadarghat	Munshiganj	2924	3.6
1	Sadarghat	Dhaka	784	1.0
9	Sadarghat	Sherpur	245	0.3
		Southwest Region		
29	Sadarghat	Barisal	15747	19.3
32	Sadarghat	Patuakhali	13759	16.9
17	Sadarghat	Shariatpur	10841	13.3
33	Sadarghat	Bhola	6559	8.1
31	Sadarghat	Barguna	4687	5.8
16	Sadarghat	Madaripur	4295	5.3
28	Sadarghat	Pirojpur	2767	3.4
30	Sadarghat	Jhalakhati	1288	1.6
22	Sadarghat	Khulna	382	0.5
		East Region		
52	Sadarghat	Chandpur	15574	19.1
56	Sadarghat	Chittagong	1067	1.3
51	Sadarghat	Comilla	539	0.7
		Total	81,458	100%

Source: This Study (Survey 16th-18th July, 2003)

The above table shows that Barisal, Chandpur, Patuakhali and Shariatpur are the most popular destinations with almost 70% of all passengers having these trip-ends.

(c) Travel Class

The classes of travel for surveyed launch passengers are shown in Table 2.7.17.

Table 2.7.17 Volume of Passengers/Day Departing from Sadarghat Port, Dhaka

1st Class	2nd Class	Deck Class				Total
		1st Floor	2nd Floor	Ground Floor	Roof Top	
2,084	1,889	8,615	2,001	11,683	854	27,126

Source: This study (Survey 16th-18th July, 2003)

The table shows that deck class is the most popular class to travel with 85% of all passengers.

(d) Inland Water Cargo

Although some cargo surveys were carried out at Sadarghat, the overall picture of main cargo transport by inland water is better gained from published statistics within the BIWTA Annual Ports and Traffic Report. The latest published version is 1998-99. Table 2.7.18 is shown origin and destination across Padma River by construction materials and other commodities. However, while this provides information on commodities transported by cargo boat, some cargo is also transported more informally by launch vessel. This cargo tends to be agricultural produce or grocery items and commonly only 1 tonne in weight. A survey of launches revealed cargo weight ranging between 1 and 85 tonnes, with an average of around 5 tonnes.

Table 2.7.18 Origin and Destination of Inland Water Commodities

Unit: ton/year

Origin	Destination	Constuction Materials
Dhaka	Faridpur	2,000
	Khulna	600
	Barisal	15,796
	Patuakhali	464
Bagerhat	Dhaka	146,805
	Narayanganj	15,064
Khulna	Dhaka	2,150
Jessore	Dhaka	5,300
	Kishoreganj	690
	Sylhet	350
Chittagong	Faridpur	600
	Khulna	2,470
	Jessore	5,410
	Barisal	4,723
	Jhalakhati	230
	Patuakhali	150
Sylhet	Madaripur	176
	Bagerhat	3,595
	Khulna	16,669
	Jessore	71,016
	Pirojpur	3,347
	Barisal	13,634
	Jhalakhati	680
	Barguna	180
	Patuakhali	2,120
Total		314,219

Origin	Destination	Others Commodity
Bagerhat	Dhaka	53,738
	Munshiganj	2,300
	Narayanganj	27,746
	Kishoreganj	1,800
	Chandpur	3,040
Barisal	Dhaka	600
Chandpur	Barisal	300
Chittagong	Faridpur	250
	Jessore	17,180
	Pirojpur	1,050
	Barisal	118,647
	Jhalakhati	56,170
	Patuakhali	440
	Khulna	579,889
Cox's Bazar	Jessore	1,060
	Barisal	250
	Jhalakhati	1,255
	Khulna	1,424
Dhaka	Pirojpur	217
	Barisal	780
	Bagerhat	1,265
Jessore	Dhaka	17,746
	Munshiganj	220
	Narayanganj	1,381
	Kishoreganj	805
Jhalakhati	Dhaka	440

Unit: ton/year

Origin	Destination	Others Commodity
Khulna	Dhaka	200
	Narsingdi	525
Kishoreganj	Madaripur	1,900
	Kushtia	2,350
	Jessore	29,335
	Pirojpur	72
	Barisal	10,737
	Jhalakhati	1,180
	Barguna	600
	Patuakhali	2,200
	Bagerhat	952
	Khulna	1,220
Madaripur	Dhaka	448
	Narsingdi	447
Narayanganj	Bagerhat	30,628
	Khulna	1,965
Narsingdi	Bagerhat	3,311
	Khulna	200
Sylhet	Jessore	1,652
Total		979,475

Source: Annual Ports & Traffic Report 1998-1999, BIWTA

(e) Passenger Income

The average income of surveyed launch passengers was Taka 5,565. This is similar to the income of river crossing launch passengers and less than river crossing ferry passengers.

(f) Inland Water Travel Costs

Comparison of distance traveled by launch with fares paid by passengers, the average cost of travel is Taka 1.2/km.

(3) Jamuna Bridge

In order to more accurately assess the magnitude of traffic that could divert from Jamuna

Bridge to a Padma Bridge, origin and destination survey was carried out by driver interview for one day. This involved interviewing drivers while they stopped to pay the bridge toll. Only details on the location of origin and destination and class of vehicle were determined. A total of 1,589 vehicles were interviewed over 12 hours comprising 492 trucks, 836 buses, and 261 light vehicles. The results are summarized in Table 2.7.19, which show the origins and destinations of all vehicles.

According to traffic records, 125,251 vehicles crossed Jamuna Bridge in June 2003, equating to approximately 4,175 per day. The O&D survey in July recorded 1,589 vehicles, thus a sample size of around 38% can be assumed.

Table 2.7.19 Total Vehicle Trip Generation at Jamuna Bridge

Zone (Zila)	Vehicle Trips per day (to and from zone)	Proportion of Total Trip Generation (%)
Northeastern Region		
Dhaka	3504	83.9 %
Mymensingh	158	3.8 %
Tangail	142	3.4 %
Jamalpur	68	1.6 %
Gazipur	66	1.6 %
Other	66	1.6 %
Eastern Region		
Chittagong	153	3.7 %
Sylhet	18	0.4 %
Total Northeastern and Eastern Region	4175	100 %
Southern Region		
Kushtia	24	0.6 %
Other	11	0.3 %
North Western Region		
Bogra	867	20.8 %
Sirajganj	614	14.7 %
Pabna	558	13.4 %
Rajshahi	424	10.2 %
Rangpur	329	7.9 %
Dinajpur	219	5.2 %
Nawabganj	216	5.2 %
Naogaon	176	4.2 %
Natore	145	3.5 %
Gaibandha	145	3.5 %
Joypurhat	132	3.2 %
Kurigram	76	1.8 %
Thakurgaon	76	1.8 %
Nilphamari	61	1.5 %
Panchagarh	61	1.5 %
Lalmanirhat	42	1.0 %
Total North-West and Southern Region	4175	100 %

Source: This Study, 2003

In terms of movements across Padma Bridge that could compete with a Padma Bridge route, vehicles between Kushtia and Dhaka are most likely, though this number is quite few. Traffic with trip-ends in Pabna, Natore, and Rajshahi, amounting to around 1,100 vehicles/day could select a route via a Padma Bridge, though this requires demand forecasting calculations based on vehicle user benefits to assess the likelihood of diversion.

(4) Road Traffic Counts

Classified traffic counts were undertaken at Takerhat Junction and Brahmkanda Junction. The results are tabulated below and summarized in the Figures that follow.

Takerhat Junction

Table 2.7.20 Takerhat Junction N8 Toward Faridpur

	Truck		Bus		Light Veh		NMV		Total
	North	South	North	South	North	South	North	South	
	431	452	478	505	417	413	509	565	3770
Both ways		883		983		830		1074	3770

Source: This Study, 2003

An average total of 3,770 vehicles/day were recorded as approaching or departing from Takerhat junction in the direction of Faridpur which lies to the north in the direction of Goalundo ghat. A high number of light vehicles were recorded, which includes auto-rickshaws and motorcycles. A particularly high number of non-motorized vehicles was also recorded. No peak hours are evident for truck movements, which were spread fairly evenly during 24 hours, reducing slightly overnight. Buses reduced after around 6pm, and NMVs reduced in evening hours.

Table 2.7.21 Takerhat Junction N8 Toward Madaripur

	Truck		Bus		Light Veh		NMV		Total
	South	North	South	North	South	North	South	North	
	242	279	304	358	658	694	2478	2324	7337
Both ways		521		662		1352		4802	7337

Source: This Study, 2003

An average total of 7,337 vehicles/day were recorded as approaching or departing from Takerhat junction in the direction of Madaripur, which lies to the south in the direction of Barisal, but also Shariatpur to the east. A very large proportion (65%) of NMVs were recorded suggesting much local activity.

Table 2.7.22 Takerhat Junction N8 Toward Gopalganj

	Truck		Bus		Light Veh		NMV		Total
	South	North	South	North	South	North	South	North	
	109	105	169	170	223	208	1439	1402	3825
Both ways		214		339		431		2841	3825

Source: This Study, 2003

An average total of 3,825 vehicles/day were recorded as approaching or departing from Takerhat junction in the direction of Gopalganj, which lies to the south in the direction of Mongla. A very large proportion (74%) of NMVs were recorded suggesting much local activity.

Brahmkanda Junction

Table 2.7.23 Brahmkanda Junction Toward Goalundo

	Truck		Bus		Light Veh		NMV		Total
	North	South	North	South	North	South	North	South	
	838	838	633	646	1169	1120	1768	1545	8557
Both ways		1676		1279		2289			8557

Source: This Study, 2003

An average total of 8,557 vehicles/day were recorded as approaching or departing from Brahmkanda junction in the direction of Goalundo river crossing to the north.

Table 2.7.24 Brahmkanda Junction Toward Faridpur

	Truck		Bus		Light Veh		NMV		Total
			South	North					
	573	569	540	538	2028	1970	4094	4025	14337
Both ways		1142		1078		3998		8119	

Source: This Study, 2003

An average total of 14,337 vehicles/day were recorded as approaching or departing from Brahmkanda junction in the direction of Faridpur, which lies to the south.

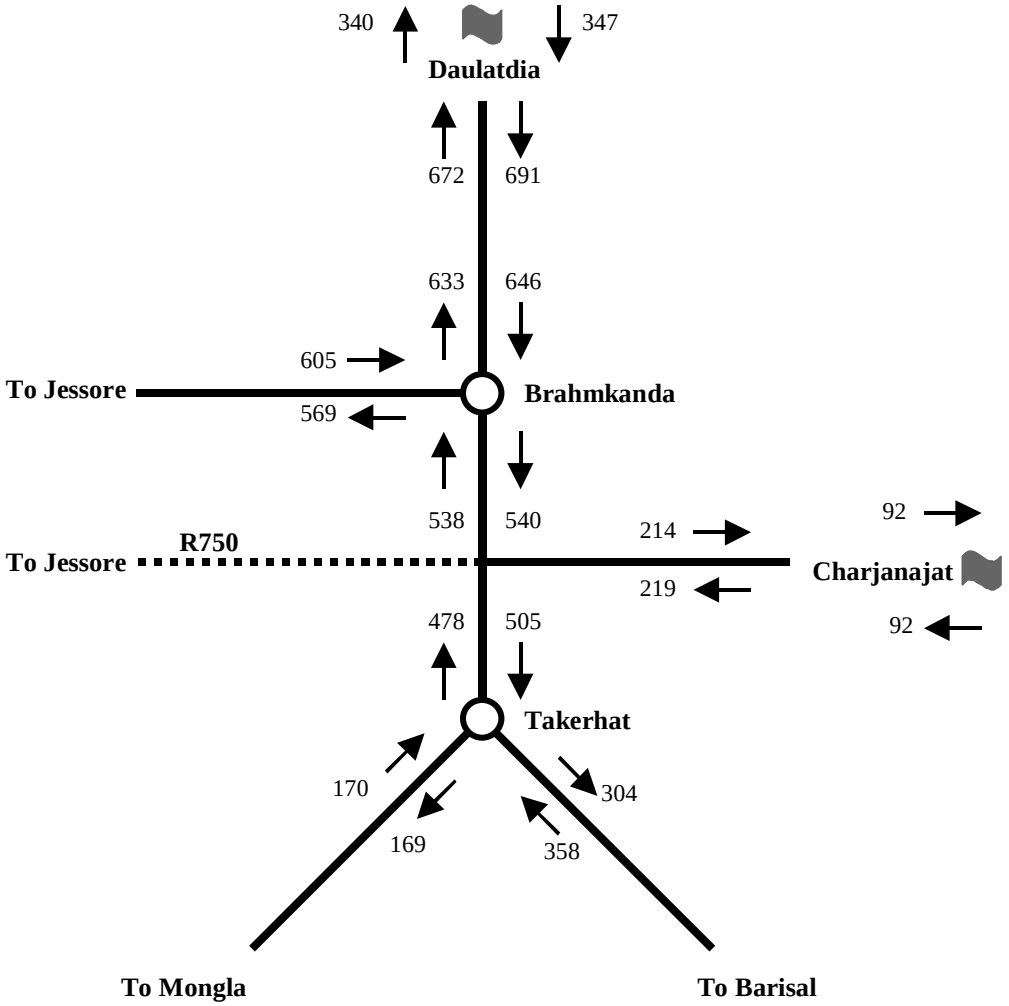
Table 2.7.25 Brahmkanda Junction Toward Magura

	Truck		Bus		Light Veh		NMV		Total
	West	East	West	East	West	East	West	East	
	811	865	569	605	943	984	1549	1689	8015
Both ways		1676		1174				3238	

Source: This Study, 2003

An average total of 8,015 vehicles/day were recorded as approaching or departing from Brahmkanda junction in the direction of Magura, which lies to the west in the direction of Jessore.

Figures 2.7.5 and 2.7.6 show a summary of traffic movements in the south-east region, by combining the several surveys that were conducted. Only bus and truck movements are described here as the high number of other motorized and non-motorized traffic making local trips effectively ‘contaminates’ the pattern of longer distance vehicle movement. These figures are constructed from simple traffic counts and not origin/destination data, therefore they may contain both local and long distance trips.

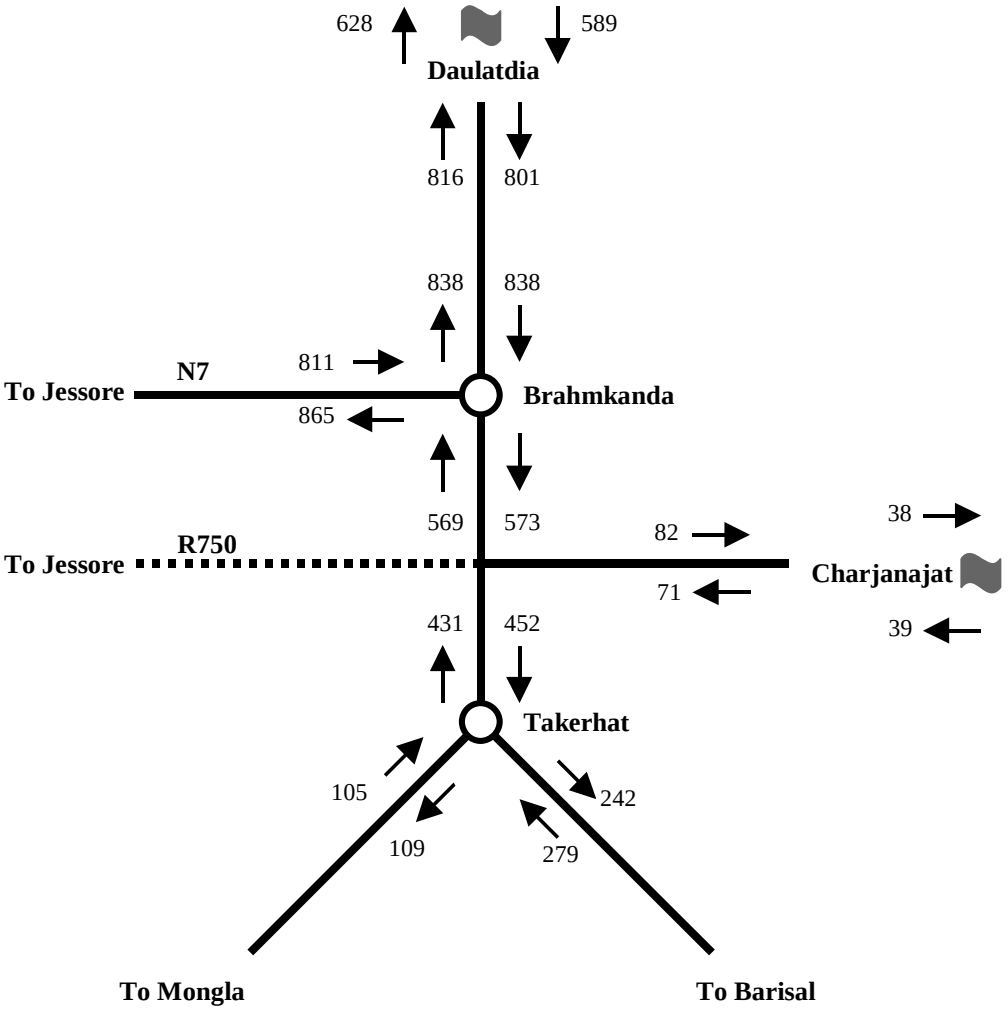


Source: This Study, 2003

Figure 2.7.5 Bus Movements in South-East Region

From Figure 6.7.5 above, the following points can be derived:

- The preferred use of Goalundo ghat to Charjanajat ghat is evident, with around 3 times more bus movements generated.
- A similar proportion of buses appear to physically cross the river at Goalundo and Charjanajat i.e. around 50% compared to 43%. The remainder are performing a pick-up/set-down role.
- The relatively high number of buses on National Highway N7 indicates the preferred use of this route compared to the N85/R750 road.
- A higher number of buses are generated on the Barisal route than the Khulna/Mongla route confirming its attraction as a passenger destination.



Source: This Study, 2003

Figure 2.7.6 Truck Movements in South-East Region

From Figure 2.7.6 above, the following points can be derived:

- The preferred use of Goalundo ghat to Charjanajat ghat is evident, with around 10 times more truck movements generated. However, the impact of road improvements to National Highway N8 is considered to be causing some re-routing.
- The difference in truck numbers arriving/departing at the ferry ghat and actually crossing implies that some trucks do not cross the river, or cross on a later day.
- The relatively high number of trucks on N7 road indicates the preferred use of this route compared to the N85/R750 road.

2.7.4 Survey Irregularities

There were three main aspects of the survey, which are likely to cause some irregularity or consistency in the results:

(1) National Highway Improvement Works

National Highway N8 on the route between Dhaka and Mawa is currently being improved. At the time of the survey, the road surface was being reconstructed and the 'rough' surface is considered to be unattractive to truck drivers in particular, and therefore cause some re-routing to the Paturia crossing point. It is considered that for this reason, traffic flows at

Mawa were 'unusually' low and high at Paturia.

(2) Seasonal Factors

The survey was conducted during the monsoon season, and it is known that traffic flows tend to be lower during rainy weather. However, weather conditions during the surveyed days were generally good.

(3) Inland Waterway Vessel Accidents

A major inland water launch accident occurred on July 8th, two weeks prior to the Dhaka Port survey, which is likely to deter passengers from traveling. In previous years, the number of passengers in the long routes fell by about 30 per cent following the death of some 500 people in two separate launch accidents, according to sources concerned. Notably, a free day launch service between Dhaka and Barisal offered by BIWTC from 20th July 2003, only 35 passengers made the trip to Barisal and 62 on the return leg. The boat has a capacity of 400. The service was offered for a limited period to encourage daytime trips, which are safer.

2.8 TRAFFIC DEMAND FORECAST

2.8.1 Approach and Methodology

Based on the future socio-economic framework, the existing transport profile and the traffic survey analysis, future traffic demand of the Padma Bridge was forecasted. The target year is set at the year 2025. The year 2015 is also considered as the intermediate target year.

2.8.2 Traffic Type

In order to forecast future demand, traffic types are classified as normal traffic, diverted traffic, induced traffic and development traffic. Normal traffic is the traffic which currently uses the existing Paturia – Goalundo and Mawa – Charjanajat ferry services to cross the Padma River, and would be expected to grow regardless of whether the Padma Bridge is constructed or not. Diverted traffic is the traffic which currently travels by other modes or via other routes, and would be diverted to use the Padma Bridge. It is expected that some passengers and freight traffic would be diverted from inland water transportation, depending on travel or transport time, cost and commodity type. And some road traffic may be diverted to the Padma Bridge from the Jamuna Bridge, depending on the bridge location, which is determined by the traffic assignment procedure. Induced traffic is defined as the traffic which will be newly generated due to shorter travel time and greater convenience resulting from the construction of the Padma Bridge and on-going and future projects nearby the Padma River such as Southwest Road Network Development Project and so on. Induced traffic is expected to be generated local and long-distance passenger and freight traffic. Developed traffic generates by increase of activities of regional development or people movements due to effect of the infrastructure investment. In this Study, developed traffic has been defined to be included in induced traffic which is estimated by the change of accessibility.

2.8.3 Vehicle Type

In this Study, the vehicle types are categorized as follows:

- Light Vehicle
- Bus

- Truck

The light vehicles and the buses are considered as passenger transport vehicles, and the trucks are commodity transport vehicles. The light vehicles consist of car, utility, and microbus. Buses consist of mini bus and large bus. Trucks are small truck, medium truck and articulated truck. Each vehicle type is categorized by RHD. Auto rickshaws and non-motorized vehicles are not included in vehicle type in this Study, because they are only used to access and egress to launch ghats, and their ratio are observed very low in all vehicles across the Padma River.

2.8.4 Zoning

For the purposes of traffic demand forecasts, the study area has been divided into 75 traffic zones in Bangladesh and neighboring countries. Each district of Bangladesh is considered as one zone. The traffic zones are shown in Figure 2.8.1 and Table 2.8.1.

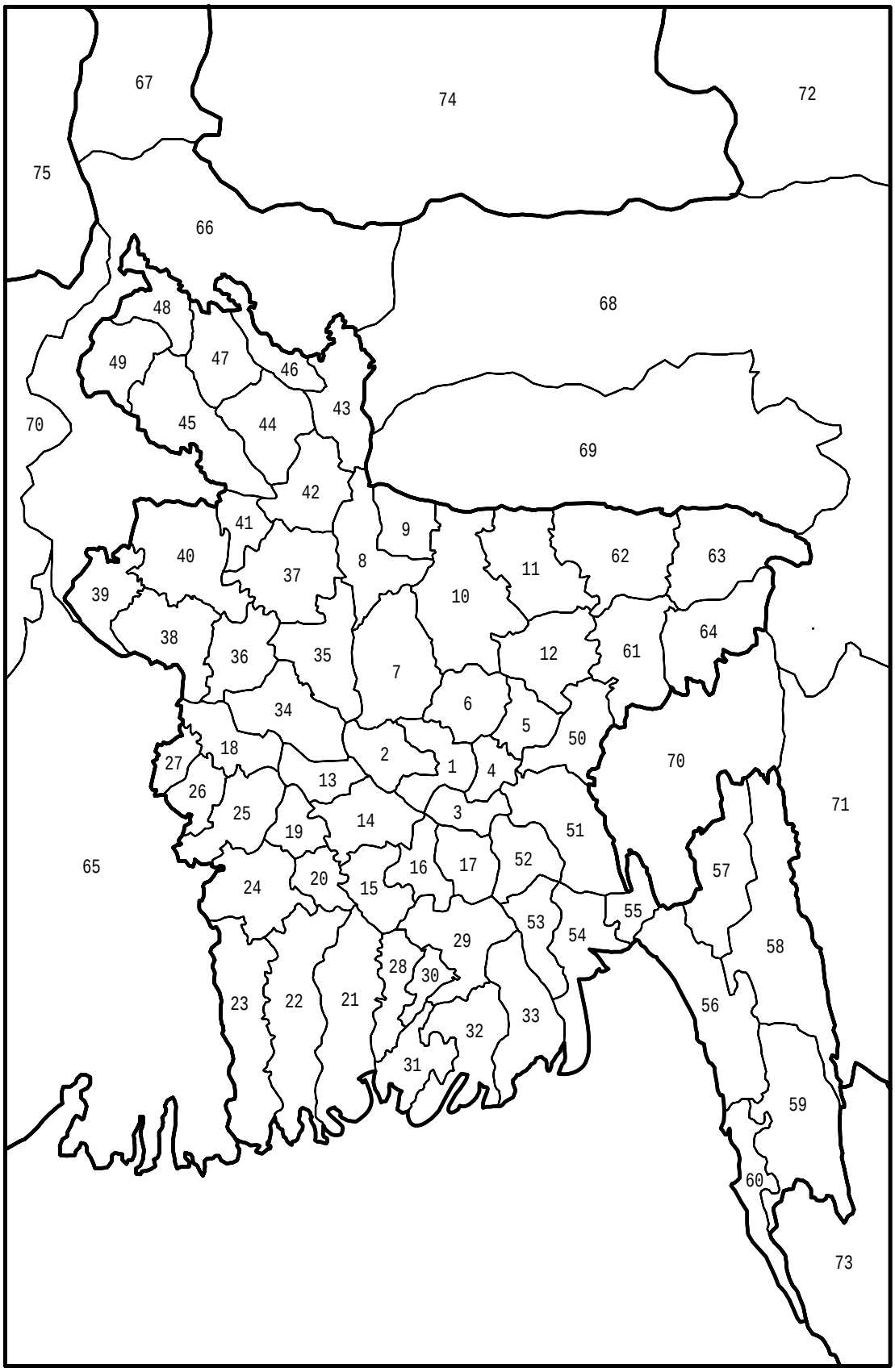


Figure 2.8.1 Zoning Map

Table 2.8.1 (1) Traffic Zones

Zone	Country	Division	Zila (District)	Region
1	Bangladesh	Dhaka	Dhaka	North East Region
2	Bangladesh	Dhaka	Manikganj	
3	Bangladesh	Dhaka	Munshiganj	
4	Bangladesh	Dhaka	Narayanganj	
5	Bangladesh	Dhaka	Narsingdi	
6	Bangladesh	Dhaka	Gazipur	
7	Bangladesh	Dhaka	Tangail	
8	Bangladesh	Dhaka	Jamalpur	
9	Bangladesh	Dhaka	Sherpur	
10	Bangladesh	Dhaka	Mymensingh	
11	Bangladesh	Dhaka	Netrokona	
12	Bangladesh	Dhaka	Kishoreganj	
13	Bangladesh	Dhaka	Rajbari	South West Region
14	Bangladesh	Dhaka	Faridpur	
15	Bangladesh	Dhaka	Gopalganj	
16	Bangladesh	Dhaka	Madaripur	
17	Bangladesh	Dhaka	Shariatpur	
18	Bangladesh	Khulna	Kushtia	
19	Bangladesh	Khulna	Magura	
20	Bangladesh	Khulna	Narail	
21	Bangladesh	Khulna	Bagerhat	
22	Bangladesh	Khulna	Khulna	
23	Bangladesh	Khulna	Satkhira	
24	Bangladesh	Khulna	Jessore	
25	Bangladesh	Khulna	Jhenaidah	
26	Bangladesh	Khulna	Chuadanga	
27	Bangladesh	Khulna	Meherpur	
28	Bangladesh	Barisal	Pirojpur	
29	Bangladesh	Barisal	Barisal	
30	Bangladesh	Barisal	Jhalakhati	
31	Bangladesh	Barisal	Barguna	
32	Bangladesh	Barisal	Patuakhali	
33	Bangladesh	Barisal	Bhola	
34	Bangladesh	Rajshahi	Pabna	North West Region
35	Bangladesh	Rajshahi	Sirajganj	
36	Bangladesh	Rajshahi	Natore	
37	Bangladesh	Rajshahi	Bogra	
38	Bangladesh	Rajshahi	Rajshahi	
39	Bangladesh	Rajshahi	Nawabganj	
40	Bangladesh	Rajshahi	Naogaon	
41	Bangladesh	Rajshahi	Joypurhat	
42	Bangladesh	Rajshahi	Gaibandha	
43	Bangladesh	Rajshahi	Kurigram	
44	Bangladesh	Rajshahi	Rangpur	
45	Bangladesh	Rajshahi	Dinajpur	
46	Bangladesh	Rajshahi	Lalmanirhat	
47	Bangladesh	Rajshahi	Nilphamari	
48	Bangladesh	Rajshahi	Panchagarh	
49	Bangladesh	Rajshahi	Thakurgaon	

Table 2.8.1 (2) Traffic Zones

Zone	Country	Division	Zila (District)	Region
50	Bangladesh	Chittagong	Brahmanbaria	East Region
51	Bangladesh	Chittagong	Comilla	
52	Bangladesh	Chittagong	Chandpur	
53	Bangladesh	Chittagong	Laksmipur	
54	Bangladesh	Chittagong	Noakhali	
55	Bangladesh	Chittagong	Feni	
56	Bangladesh	Chittagong	Chittagong	
57	Bangladesh	Chittagong	Khagrachhari	
58	Bangladesh	Chittagong	Rangamati	
59	Bangladesh	Chittagong	Bandarban	
60	Bangladesh	Chittagong	Cox's Bazar	
61	Bangladesh	Sylhet	Habiganj	
62	Bangladesh	Sylhet	Sunamganj	
63	Bangladesh	Sylhet	Sylhet	
64	Bangladesh	Sylhet	Maulavi Bazar	
65	India	West Bengal (South Area)		Outside Bangladesh
66	India	West Bengal (North Area)		
67	India	Sikkim		
68	India	Assam		
69	India	Meghalaya		
70	India	Tripura		
71	India	Mizoram		
72	India	Other Divisions		
73	Myanmar			
74	Bhutan			
75	Nepal			

2.8.5 Procedure of Traffic Demand Forecast

Future traffic volume crossing the Padma Bridge was forecasted by dividing the all traffic into normal traffic, diverted traffic, and induced traffic respectively. The procedure for the traffic demand forecast is illustrated in Figure 2.8.2 and summarized as below:

- Normal traffic in 2003 was prepared in the form of origin-destination (OD) matrices by vehicle type, using results of traffic survey and existing data,
- Normal traffic demand was forecasted through conventional method, namely, trip production, trip generation/attraction, and trip distribution, based on the past trends of traffic volumes across the Padma River and the Jamuna River, GDP and the future GRDP growth rates by each zone and by vehicle type,
- Diverted traffic from inland water transportation is forecasted by applying modal split models for passenger traffic and freight traffic, respectively,
- Induced traffic is forecasted by applying a gravity model which can reflect the change of accessibility between cases with and without on-going and future projects and the Padma Bridge in the future. Induced traffic is estimated without steps of estimation of trip production, trip generation/attraction applying the future OD matrices of normal traffic forecasted in the above step
- Future OD matrices by vehicle type were prepared by summing normal traffic, induced traffic, and diverted traffic, and
- Future traffic volumes across the Padma Bridge are forecasted by assigning the OD matrices by vehicle type to the future network reflecting future road and bridge construction and improvement plans. The future traffic volumes are estimated by each bridge crossing sites (Paturia-Goalundo (Site-1), Dohar-Charbhadrasan (Site-2), Mawa-Janjira (Site-3), and Chandpur-Bhedarganj (Site-4)).

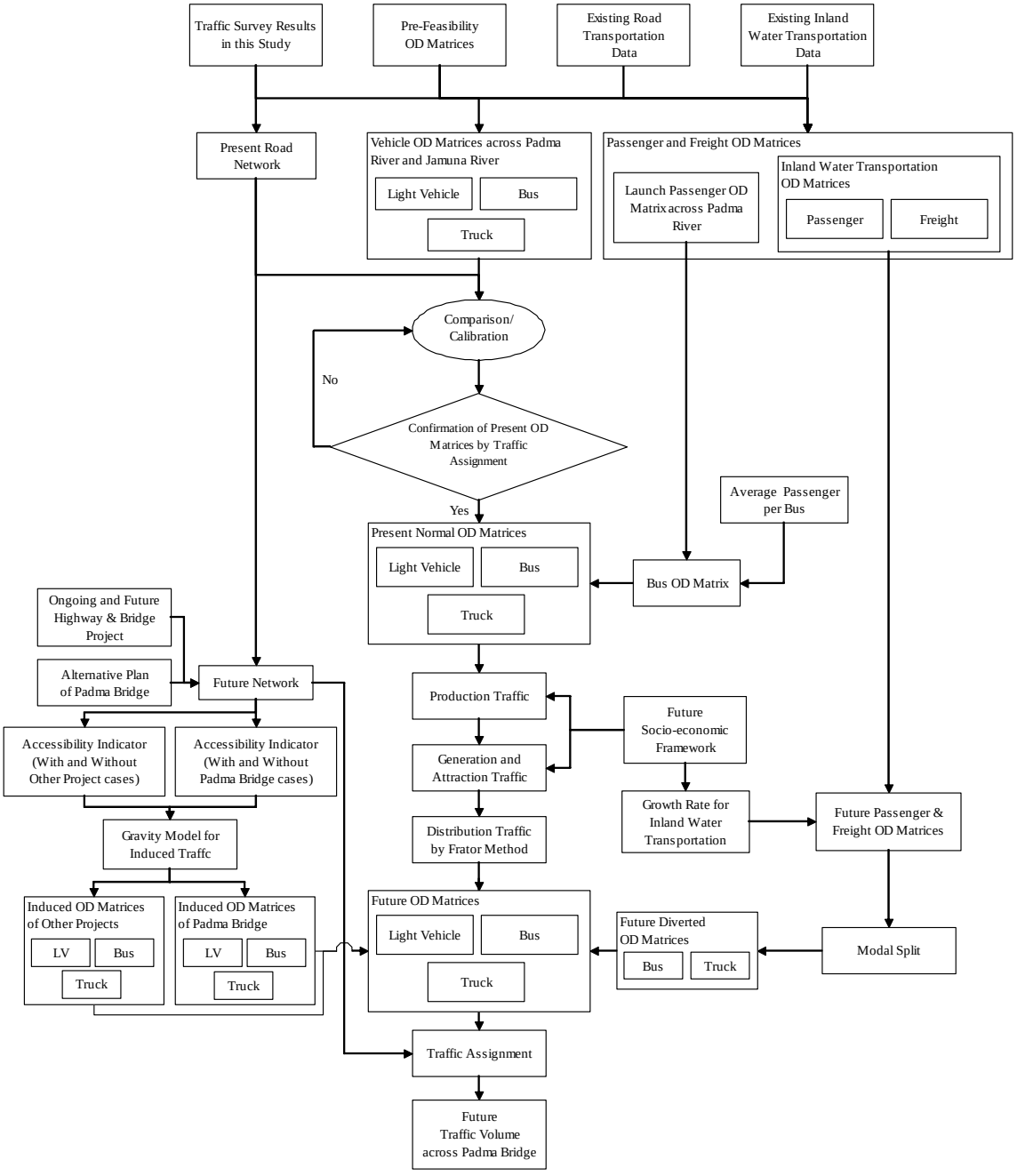


Figure 2.8.2 Procedure for the Traffic Demand Forecast

2.8.6 Estimation of AADT, OD Matrix and Road Network Model in 2003

(1) Annual Average Daily Traffic in 2003

Annual average daily traffic (AADT) crossing the Padma River and Jamuna River has been estimated based on the results of the traffic survey and weekly and monthly traffic records by BIWTC and JOMAC. Weekly and monthly conversion factors to calculate AADT are estimated at each station and survey location, generally. However, traffic volume across the Padma River and the Jamuna River fluctuates depending on the locations of ferry terminals due to diversion of traffic from Paturia-Protappur ferry to Jamuna Bridge and detoured traffic from Mawa-Charjanajat ferry to Paturia-Daulatdia ferry because of on-going improvement works of National Highway N8 on the route between Dhaka and Mawa. Therefore, the conversion factors to grasp neutral fluctuations are estimated by each river, as shown in Table 2.8.2 and Table 2.8.3.

Table 2.8.2 Weekly Factors by Vehicle Type

Month	Padma River Crossing			Jamuna River Crossing		
	Light Vehicle	Bus	Truck	Light Vehicle	Bus	Truck
Mon	0.93	0.95	0.85	1.13	1.00	0.91
Tue	1.07	1.01	0.97	1.05	1.03	0.98
Wed	1.11	1.04	0.88	1.09	1.01	0.92
Thu	0.88	1.00	0.98	0.92	0.94	1.00
Fri	0.97	0.98	1.01	0.83	0.99	1.05
Sat	0.99	1.02	1.46	1.01	1.01	1.23
Sun	1.11	1.01	1.04	1.04	1.03	0.98

Source: JICA Study Team

Note: Above factor was estimated based on BIWTC and JOMAC data.

Table 2.8.3 Monthly Factors by Vehicle Type

Month	Padma River Crossing			Jamuna River Crossing		
	Light Vehicle	Bus	Truck	Light Vehicle	Bus	Truck
Jan	0.93	1.02	0.92	0.95	1.04	0.92
Feb	0.67	0.91	1.11	0.81	0.89	1.17
Mar	1.06	1.03	0.99	0.99	0.98	0.98
Apr	1.03	1.02	0.94	1.07	1.03	0.94
May	1.00	0.96	0.92	0.95	0.98	0.93
Jun	1.10	0.89	1.00	0.95	0.98	0.94
Jul	1.09	1.10	1.05	1.04	1.10	1.08
Aug	1.14	1.08	1.02	1.07	1.05	1.11
Sep	1.17	1.05	1.10	1.18	1.08	1.06
Oct	1.16	0.99	1.06	1.06	1.03	0.90
Nov	1.15	1.07	0.90	1.28	1.15	0.97
Dec	0.79	0.91	1.02	0.83	0.80	1.07

Source: JICA Study Team

Note: Above factor was estimated based on BIWTC and JOMAC data.

The volumes of AADT across the Padma River and the Jamuna River have been estimated applying the above factors and estimated AADT is in Table 2.8.4. The location of each site is illustrated in Figure 2.8.3.

Table 2.8.4 AADT Across Padma River and Jamuna River

	Padma River Crossing			Jamuna River Crossing		
	Paturia-Daulatdia	Mawa-Charjanajat	Total	Jamuna Bridge	Paturia-Protappur	Total
Light Vehicle	635	152	787	652	22	674
Bus	770	251	1,021	1,560	0	1,560
Truck	1,204	81	1,285	2,275	307	2,582
Total	2,609	484	3,093	4,487	329	4,816

Source: JICA Study Team

Note: BIWTC ferry service crossing the Jamuna River was changed to Paturia-Protappur from Aricha-Nagaribari, recently. Protappur is nearby Nagarbari in Northwest region.

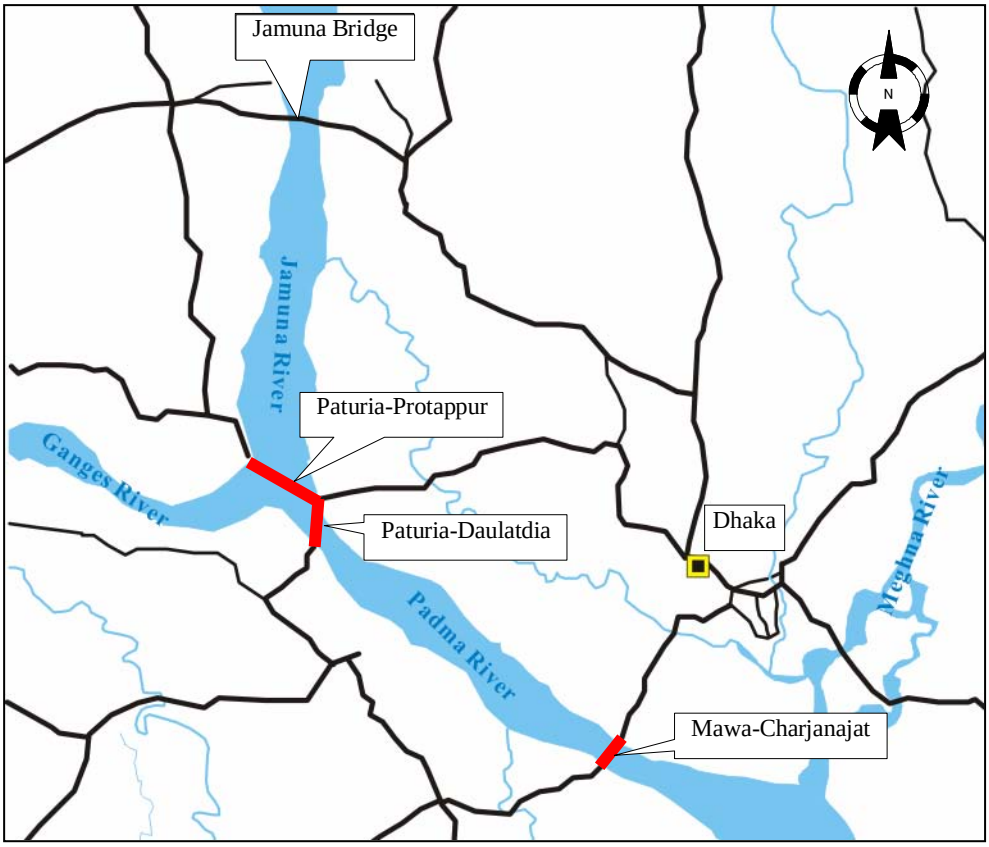


Figure 2.8.3 Locations of AADT Across Padma River and Jamuna River

2.8.7 Present OD Matrices and Network Model

(1) Present OD Matrices

Present OD (Origin/Destination) matrices by vehicle type are established applying the results of traffic survey and AADT described above. Origin and destination patterns of present OD matrices are derived from the results of OD interview surveys at Paturia-Goalundo, Mawa-Charjanajat and Jamuna Bridge. For the Paturia-Protappur OD matrices, those are derived and supplemented by the results of Pre-Feasibility Study (2000). Present OD matrices are expanded by adjusting AADT to total volumes of OD matrices by vehicle type. Present OD matrices for Padma River and Jamuna River are illustrated by the form of desired lines in Figure 2.8.4. It is clear that traffic movements are divided into Dhaka-Southwest at the Padma River and Dhaka-Northwest at Jamuna River. Some traffic movements between Bangladesh and India are observed in the traffic crossing the Padma River.

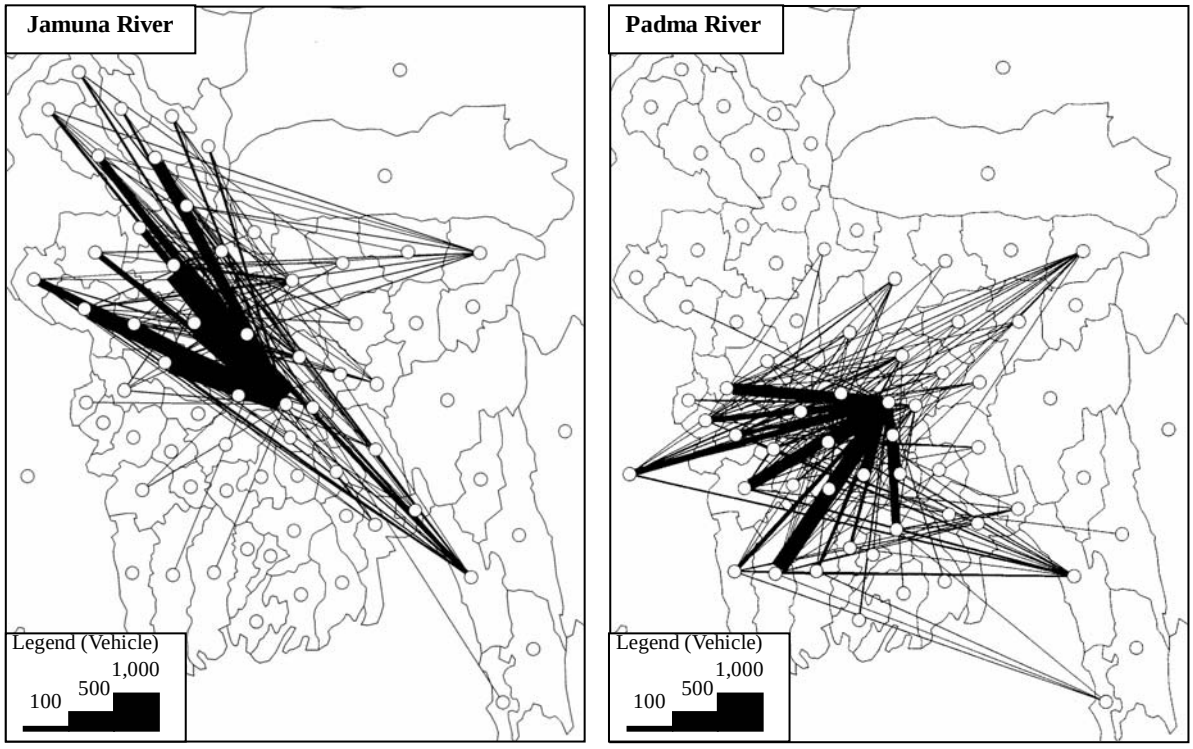


Figure 2.8.4 Present OD at Padma River and Jamuna River

(2) Present Network Model

The present network model was established on the basis of "RHD Road Network Database Annual Report 2002, March 2003" and Pre-feasibility Study. The network model consists of national, regional, and feeder roads as shown in Figure 2.8.5. The feeder roads are taken into account of only for surrounding areas of the Padma River. The link information includes distance between nodes, travel speed and fares as explained below:

- Bridge tolls and ferry fares on national and regional highways in Dhaka and Southwest Region are attached as link information to the present network model,
- RHD ferry crossings are set at 30 minutes including waiting time,
- Waiting times and fares for BIWTC ferries across Paturia-Goalundo and Mawa-Charjanajat are set as the impedance by vehicle type which were obtained from the traffic surveys,
- Link speed is set at speeds of 60 km/h on national highways and 50 km/h on regional highways, based on the free flow speed according to RHD and Pre-Feasibility Study, and assumed as 30 km/h on feeder roads,
- Link distance was taken from RHD Road Network Database and the Pre-Feasibility Study data, and
- Time penalty of 30 minutes was imposed on links through Dhaka City.

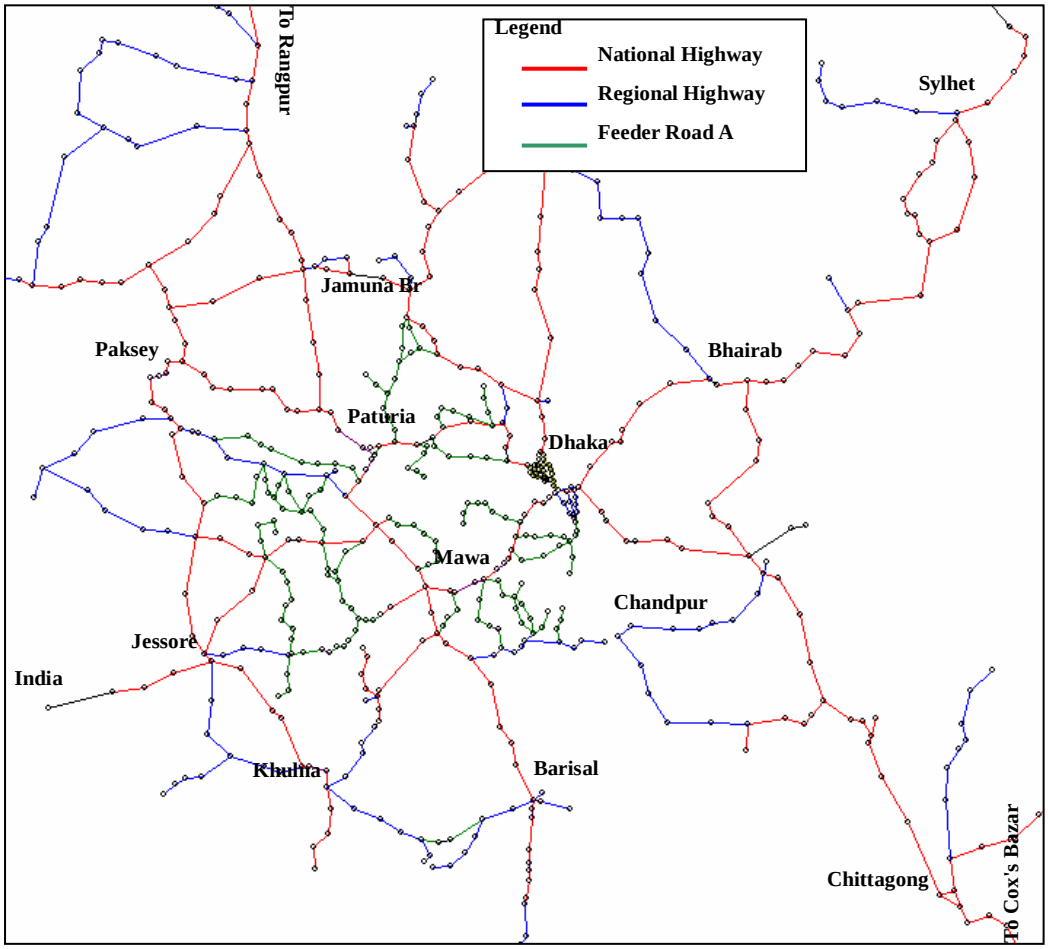


Figure 2.8.5 Present Network Model

2.8.8 Validation of Present OD Matrix and Present Network Model

For the future traffic demand forecast, present OD matrices and network model are basic information. It is important to confirm the consistency between the model results and observed AADT volumes. The present OD matrices and network model are calibrated with iteration of traffic assignment until the simulated traffic volumes approximately match with the AADT volumes across the Padma River and the Jamuna River which were defined as screen line in this Study. Chandpur-Bhedarganj crossing was not considered as the screen line, because of low traffic which is about 50 vehicles per day according to the traffic records by BIWTC. The assigned traffic on the network model is limited only to the traffic which is crossing the Padma River and the Jamuna River. Table 2.8.5 shows a comparison of actual AADT and simulated traffic volumes. As a result, present OD matrices and the network model are confirmed to reproduce the actual AADT, though there are some differences by vehicle type at Mawa-Charjanajat. It is confirmed that the present OD matrices and network model can be applied to forecast future traffic demand.

After above process, launch passengers were converted into bus OD matrix. Launch passengers were estimated as annual average daily passenger traffic by seasonal factor, which were 27,158 passengers. It was converted into 667 buses, using the RHD average occupancy rate of 40.7 passengers per bus. At present, the launch passengers use various modes such as buses, non-motor vehicles, motorcycles and auto rickshaws for access and egress to/from the Paturia-Goalundo and Mawa-Charjanajat launch ghats, according to the results of the traffic survey. However, they would be diverted from present modes to buses as it happened after the opening of the Padma Bridge.

Table 2.8.5 Results of Validation Across Padma River and Jamuna River

Screen Line		Traffic Volumes (vehicle/day)			
		Light Vehicle	Bus	Truck	Total
Paturia-Daulatdia	AADT	635	770	1,204	2,609
	Simulated Traffic	684	784	1,146	2,614
	Ratio	1.08	1.02	0.95	1.00
Mawa-Charjanajat	AADT	152	251	81	484
	Simulated Traffic	109	255	144	508
	Ratio	0.72	1.02	1.78	1.05
Total of Padma River Crossing	AADT	787	1,021	1,285	3,093
	Simulated Traffic	793	1,039	1,290	3,122
	Ratio	1.01	1.02	1.00	1.01
Total of Jamuna River Crossing	AADT	674	1,560	2,582	4,816
	Simulated Traffic	668	1,542	2,577	4,787
	Ratio	0.99	0.99	1.00	0.99

Source JICA Study Team
Note: Above ratio is Simulated Traffic / AADT.

2.8.9 Forecast of Normal Traffic

(1) Produced Traffic

In order to forecast produced traffic which is the control total of OD matrices by vehicle type for normal traffic, regression models were developed to explain the relationship between GDP and annual number of vehicles crossing the Padma River and Jamuna River applying the past five years data. The regression models were shown as below: :

$Pi = \alpha * GDP + \beta$

Where: Pi : Annual number of vehicles across river (Thousand Vehicles)
GDP : GDP at constant prices (Billion Taka)
α and β : Coefficient

		α	β	Correlation Coefficient
Padma River	Light Vehicle	0.287	-364.438	0.983
	Bus	0.389	-609.952	0.997
	Truck	0.285	-228.609	0.999
Jamuna River	Light Vehicle	0.036	135.777	0.694
	Bus	0.502	-641.763	0.993
	Truck	0.464	-294.510	0.958

Note: In terms of light vehicle across Jamuna River, the regression model was developed from Jamuna Bridge records in the past four years only, due to unstable trend in opening year of Jamuna bridge.

The future produced traffic was forecasted by adopting growth rates of the future annual number of vehicles obtained from the above regression models and future GDP established in future socio-economic framework. Table.2.8.6 shows the future traffic growth rates by vehicle type.

Table 2.8.6 Future Traffic Growth across Padma River and Jamuna River

		2003-2015	2015-2025
Padma River	Light Vehicle	9.89%	7.12%
	Bus	11.63%	7.68%
	Truck	7.42%	6.39%
Jamuna River	Light Vehicle	1.79%	3.21%
	Bus	9.65%	7.13%
	Truck	6.97%	6.16%
GDP		5.42%	5.44%

Source: JICA Study Team

(2) Forecast of Generated and Attracted Traffic by Traffic Zone

For the purpose of obtaining future generated and attracted traffic at each zone, the following method was applied:

- Firstly, the tentative future volume of each zone's generated and attracted traffic in 2015 and 2025 were calculated, applying GRDP growth rates to the present volumes of generated and attracted traffic, and
- Secondly, the tentative generated and attracted traffic volumes by each zone calculated above were adjusted proportionally so as to be equal the pre-determined produced traffic because the sum of the generated and attracted traffic should be equal to the number of control total as produced traffic.

Future GRDP growth rates by zone in Bangladesh were calculated from the future economic framework. In addition, 5.64% of average GDP growth rate of India estimated by ADB for 1994-2000, was applied to zones in India. Growth rates for zones in Myanmar, Bhutan and Nepal were not applied because those traffic volumes were not caught in the traffic survey (OD interview survey) and, therefore, not included in the present OD matrices.

(3) Distributed Traffic

Future distributed traffic was obtained based on the present OD pattern and future generated and attracted traffic determined above, using the "present pattern method" through the convergence calculation of Frator method. After that process, OD matrices of normal traffic for the Padma River and the Jamuna River in 2015 and 2025 were added. Future OD movement patterns of normal traffic crossing the Padma and Jamuna Rivers are illustrated by the form of desired lines in Figure 2.8.6.

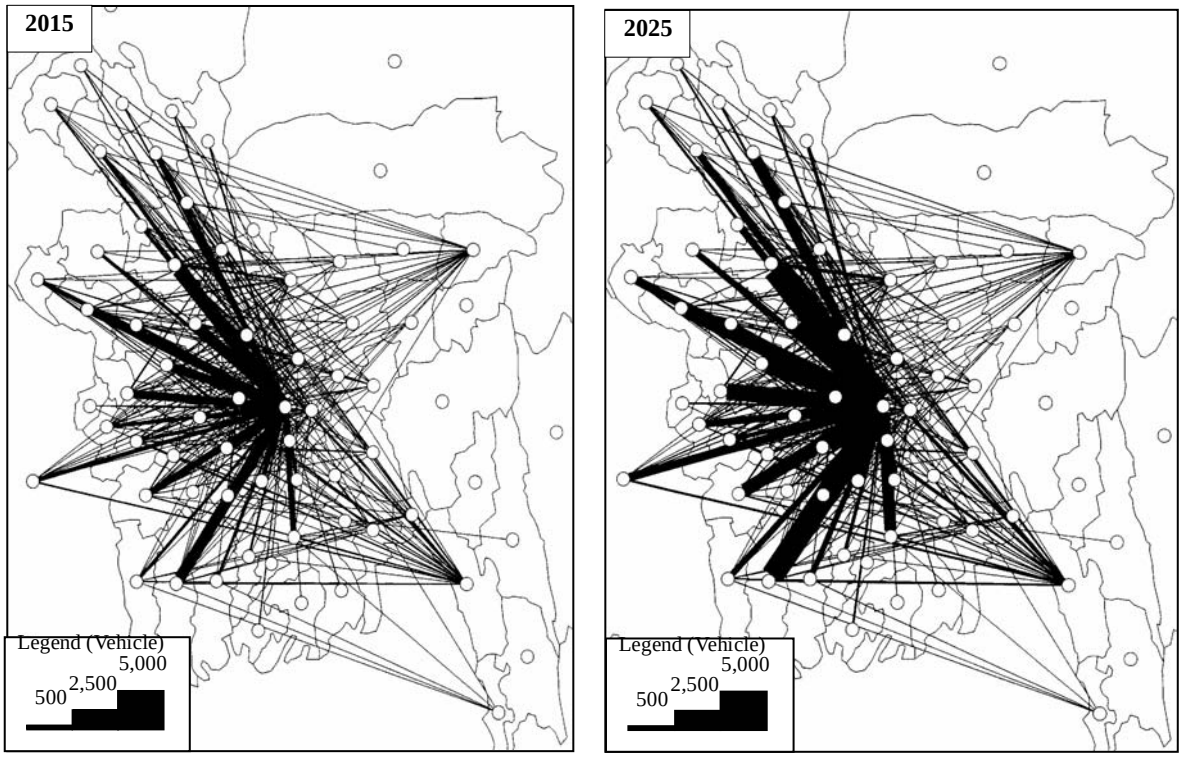


Figure 2.8.6 Desired Line of Normal Traffic in 2015 and 2025

(4) Forecast of Induced Traffic

(a) Definition of Induced Traffic

Induced traffic arises by a trip which becomes more attractive by virtue of a reduction in cost or time as a consequence of development to be brought about by the construction of bridge or road and regional development. Induced traffic is expected to be generated from shops and houses located along roads in short term and commercial centers and EPZ (Export Processing Zone) located in surrounding areas due to a change of land use by regional development plan in long term. In the surrounding areas of the Padma River, there are development projects not only the Padma Bridge project but also on-going and planned other projects.Therefore, induced traffic was estimated the following types:

- Induced Traffic from projects other than Padma Bridge
- Induced Traffic from Padma Bridge

To consider local traffic around the Padma River, there will be traffic affected by the developments such as new markets or improvement of feeder roads planned by LGED. The future developments are classified into “future developments without the Padma Bridge” and “future developments which will be realized by opening of the Padma Bridge”. Rfgarding the “future developments without the Padma Bridge”, the future demand of local traffic is expected to grow regardless of whether or not the Padma Bridge is constructed. Therefore, this type of traffic is included in normal traffic and applied the future GRDP growth rates for forecasting the future generated and attracted traffic because the future GRDP growth is estimated based on past GRDP growth rates which have been achieved with past developments. The future demand of local traffic from “future developments which would be realized by opening of the Padma Bridge” is included in induced traffic which is determined by a reduction ratio of travel time.

(b) Estimation of Induced Traffic

Induced traffic was estimated by a factor of change in accessibility indicator between "with" and "without" project cases. In this Study, the accessibility indicator was defined as travel time of each zone pair and it was obtained by assigning normal traffic to the network model. The bridge tolls and ferry fares were substituted by time and included into the travel time. The following gravity model was applied using the data of population and GRDP by each zone as explanatory variables, and adopted for the estimation of induced traffic:

Gravity Model for Light Vehicle and Bus

$$T_{ij} = \alpha \frac{P_i^{\beta} \times P_j^{\gamma}}{D_{ij}^{\delta}}$$

Where: *Tij* : Theoretical traffic volume between Zone *i* and *j*
Pi : Population of Zone *i*
Pj : Population of Zone *j*
Dij : Travel Time between Zone *i* and *j*
$\alpha,\beta,\gamma,\delta$: Coefficient

		α	β	γ	δ	Multiple Correlation Coefficient
Light Vehicle	Coefficient	0.0144	0.7639	0.6690	0.9284	0.64
	t-value	2.71	5.30	4.63	3.94	
Bus	Coefficient	0.0013	1.6324	1.5270	1.2809	0.76
	t-value	8.31	12.67	11.90	5.48	

Note: The coefficients were estimated from present OD matrices and present network model.

Gravity Model for Truck

$$T_{ij} = \alpha \frac{G_i^{\beta} \times G_j^{\gamma}}{D_{ij}^{\delta}}$$

Where: *Tij* : Theoretical traffic volume between Zone *i* and *j*
Gi : GRDP of Zone *i*
Gj : GRDP of Zone *j*
Dij : Travel Time between Zone *i* and *j*
$\alpha,\beta,\gamma,\delta$: Parameter

		α	β	γ	δ	Multiple Correlation Coefficient
Truck	Coefficient	0.0775	0.7094	0.7707	0.9109	0.70
	t-value	6.00	12.67	13.40	8.23	

Note: The coefficients were estimated from present OD matrices and present network model.

The theoretical traffic volumes are calculated by applying travel time of "with" and "without" project cases to above equations by type of vehicle. Induced traffic is obtained by applying the theoretical traffic volumes to the following equation:

$$T_{ij}^{Induced} = T_{ij}^{Normal} \times \left(\frac{T_{ij}^{with}}{T_{ij}^{without}} - 1 \right)$$

Where: $T_{ij}^{Induced}$: Induced traffic volume between Zone *i* and *j*

T_{ij}^{Normal} : Normal traffic volume between Zone *i* and *j*
T_{ij}^{With} : Theoretical traffic volume between Zone *i* and *j* calculated by gravity model, under "with" project case
$T_{ij}^{Without}$: Theoretical traffic volume between Zone *i* and *j* calculated by gravity model, under "without" project case

In order to estimate induced traffic from other projects and from the Padma Bridge, travel time of each zone pair was calculated from following cases:

Induced Traffic from Other Projects

- "with" project case : Future network model without the Padma Bridge
- "without" project case : Present network model

Induced Traffic from Padma Bridge

- "with" project case : Future network model with the Padma Bridge
- "without" project case : Future network model without the Padma Bridge

Table 2.8.7 Type of Network Model for Induced Traffic

Network Model		Present	Other Projects	Padma Bridge
Induced Traffic from Other Projects	With	O	O	×
	Without	O	×	×
Induced Traffic from Padma Bridge	With	O	O	O
	Without	O	O	×

The future network model without Padma Bridge is includes all on-going and planned projects such as "Southwest Road Network Development Project" together with Arialkhan Bridge on National Highway N8, "Rupsa Bridge Construction Project", "Paksey Bridge Construction Project", "Third Road Rehabilitation and Maintenance Project (RRMP-III)" and "Road Improvement and Maintenance II". Induced traffic from other projects in 2015 and 2025 was estimated as common traffic volume with alternative bridge locations so that it is not affected by alternatives of Padma Bridge location. Induced traffic from Padma Bridge in 2015 and 2025 was estimated as different traffic volume with the alternative bridge locations due to difference in reduced travel time by each bridge location and illustrated by desired lines in Figure 2.8.7. As shown in Figure 2.8.7, induced traffic from Padma Bridge will be largely generated between Dhaka and Faridpur at Site-2, and between Dhaka and all zones in the Southwest Region at Site-3, which shows strong connection between districts divided by the Padma River. Site-1 and Site-4 will have a few traffic compared to other two alternative bridge locations.

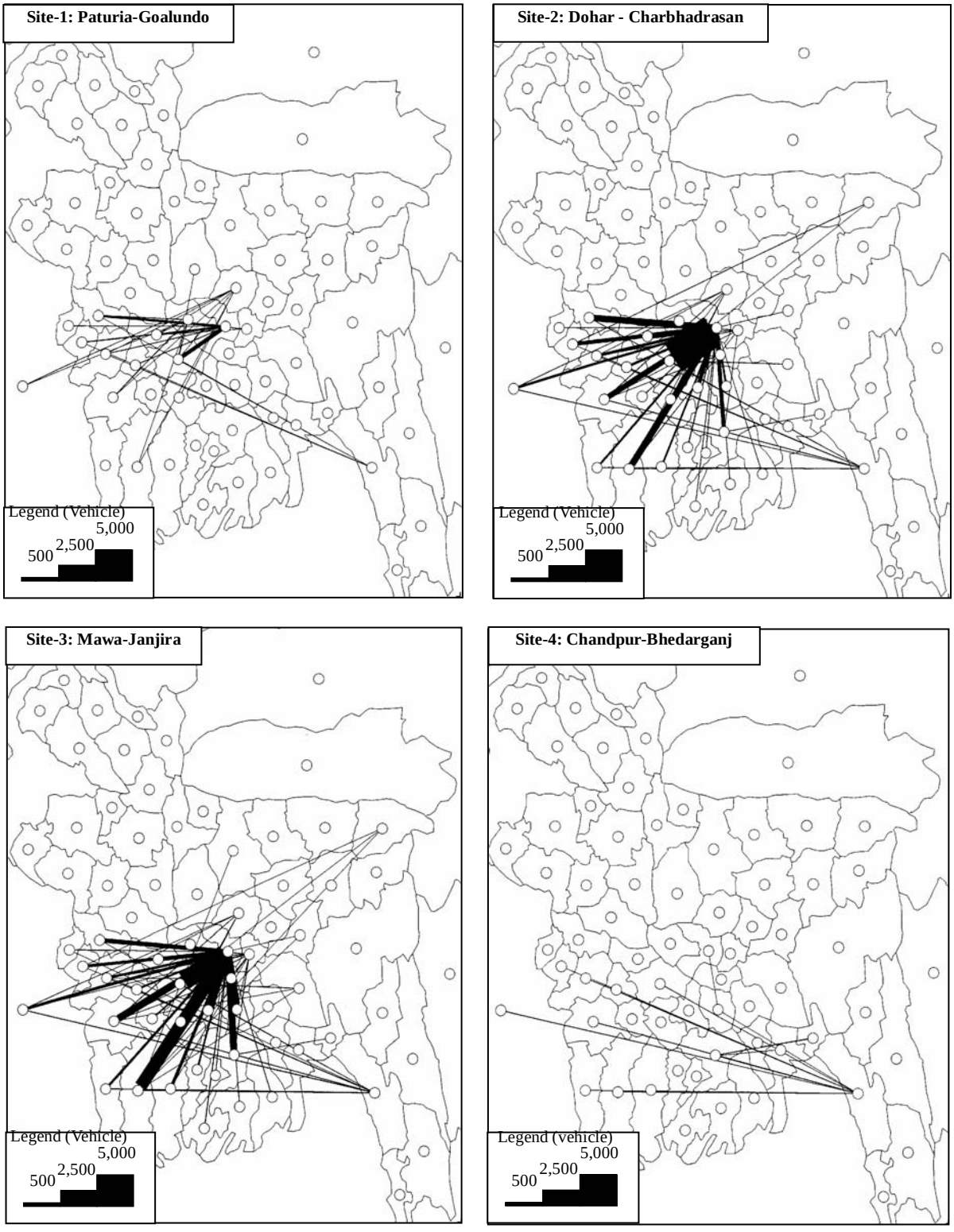


Figure 2.8.7 Induced Traffic from Padma Bridge by Alternative Bridge Location in 2025

(5) Forecast of Diverted Traffic

Traffic presently using the Inland water transportation (IWT) between Dhaka/Sylet/Chittagong divisions and southwest region is likely to change mode from inland water to roads. In this Study, diverted traffic from IWT for passengers and freight is estimated by applying diversion models. Diverted traffic is forecasted passengers between Dhaka and southwest region, and freight between Dhaka/Sylet/Chittagong divisions and the southwest region.

(a) Growth Rates for IWT

The future growth rates of traffic by IWT were forecasted for both passengers and freight of inland water applying future GDP to the regression models developed from the relationships between GDP and the annual number of passengers by motor-launch and steamer, and relationship between GDP and the annual tonnage of cargo by IWT using past traffic data for 1990-1999. The regression models are shown in the following equation:

Inland Water Passenger

$Pi = 109.324*LN(GDP) - 746.269 \quad (R^2 = 0.874)$

Where: Pi : Annual number of passengers by IWT (Million passengers)
GDP : GDP at constant prices (Billion Taka)

Inland Water Freight

$Pi = 5.3564*LN(GDP) - 34.183 \quad (R^2 = 0.867)$

Where: Pi : Annual tonnage of cargo by IWT (Million ton)
GDP : GDP at constant prices (Billion Taka)

The growth rates for passengers and freight traffic by inland water obtained by the above models are shown in Table.2.8.8. In comparison with normal traffic, the growth rates of IWT were estimated at lower level. It can be explained that passengers and freight transfer from IWT to road year by year, due to improvement of road in southwest region.

Table 2.8.8 Growth Rates for IWT

	Passenger	Freight
2003-2015	4.49%	3.24%
2015-2025	2.99%	2.39%

Source: JICA Study Team

(b) Diverted Traffic from IWT

Traffic volumes of passengers and freight per day using IWT are difficult to estimate accurately, because their trips require a few days, in general. According to the results of traffic survey, it was confirmed that all of freight vessels and about 70% of passenger vessels departing from the Sadargat Port usually spent a few days to arrive at their destinations. In order to estimate the volume of passengers and freight using IWT per day, the data of average traffic volume obtained from BIWTA were adopted as present volumes and OD pattern and used in the traffic demand forecast.

Passengers using IWT was assumed to be diverted to buses if they divert to roads. Regarding the freight presently using IWT, their commodity types are classified into “construction material” and “other goods” which are assumed to be diverted to medium

truck if they divert to roads. The methodology for estimating the volume of diverted traffic from inland water to roads was based on modal split models. The equations applied travel cost and travel time for passengers and transport time for freight as explanatory variables. The modal split models calculate different shares by OD pair and each alternative bridge location because of different reductions in time and cost depending on the bridge sites. .

The parameters of the modal split models for passengers and freight using IWT are estimated applying present normal traffic (road traffic) and IWT traffic. Future passengers and freight using IWT can not be directly estimated from the modal split models because different growth rates for normal traffic and for IWT traffic are assumed. Therefore, future diversion rates were assumed as the difference of the theoretical road shares between with and without bridge cases obtained from the modal split models.

Inland Water Passenger

$$P_{ij} = \frac{1}{1+e^{\alpha+\beta(t_{ij}^{Road}-t_{ij}^{IWT})+\gamma(c_{ij}^{Road}-c_{ij}^{IWT})}}$$

$$D_{ij} = P_{ij}^{With} - P_{ij}^{Without}$$

Where:
- P_{ij} : Theoretical road share between zone *i* and *j*
- t_{ij}^{Road} : Road travel time between zone *i* and *j*
- t_{ij}^{IWT} : IWT travel time between zone *i* and *j*
- c_{ij}^{Road} : Road travel cost between zone *i* and *j*
- c_{ij}^{IWT} : IWT travel cost between zone *i* and *j*
- D_{ij} : Diversion rate from passenger using IWT zone *i* and *j*
- P_{ij}^{With} : Theoretical road share between zone *i* and *j*, under "with" bridge case
- $P_{ij}^{Without}$: Theoretical road share between zone *i* and *j*, under "without" bridge case

	α	β	γ	Multiple Correlation Coefficient
Coefficient	3.0581	0.6851	0.02315	0.82
t-value	2.11	2.68	2.83	

Note: The coefficients were estimated from present data.

Inland Water Freight

$$F_{ij} = \frac{1}{1+e^{-8.911+29.11\times\left(t_{ij}^{Road}/t_{ij}^{IWT}\right)}}$$ (Construction Materials)

$$F_{ij} = \frac{1}{1+e^{4.600+0.149\times\left(t_{ij}^{Road}-t_{ij}^{IWT}\right)}}$$ (Other Goods)

$$D_{ij} = F_{ij}^{With} - F_{ij}^{Without}$$

Where:
- F_{ij} : Theoretical road share between zone *i* and *j*
- t_{ij}^{Road} : Road transport time between zone *i* and *j*
- t_{ij}^{IWT} : IWT transport time between zone *i* and *j*
- D_{ij} : Diversion rate from freight using IWT zone *i* and *j*
- $F_{ij}^{With:}$: Theoretical road share between zone *i* and *j*, under "with" project case

$F_{ij}^{Without}$: Theoretical road share between zone *i* and *j*, under "without" project case

		α	β	Multiple Correlation Coefficient
Construction Materials	Coefficient	-8.911	29.112	0.92
	t-value	-4.07	3.27	
Other Goods	Coefficient	4.600	0.149	0.56
	t-value	2.10	2.11	

Note: The coefficients were estimated from present data.

After estimating the diversion rates, diverted passengers and freight were converted into vehicles which are 40.7 passengers per bus and 8 ton per truck and results of forecast of diverted traffic are illustrated with desired lines in Figure 2.8.8.

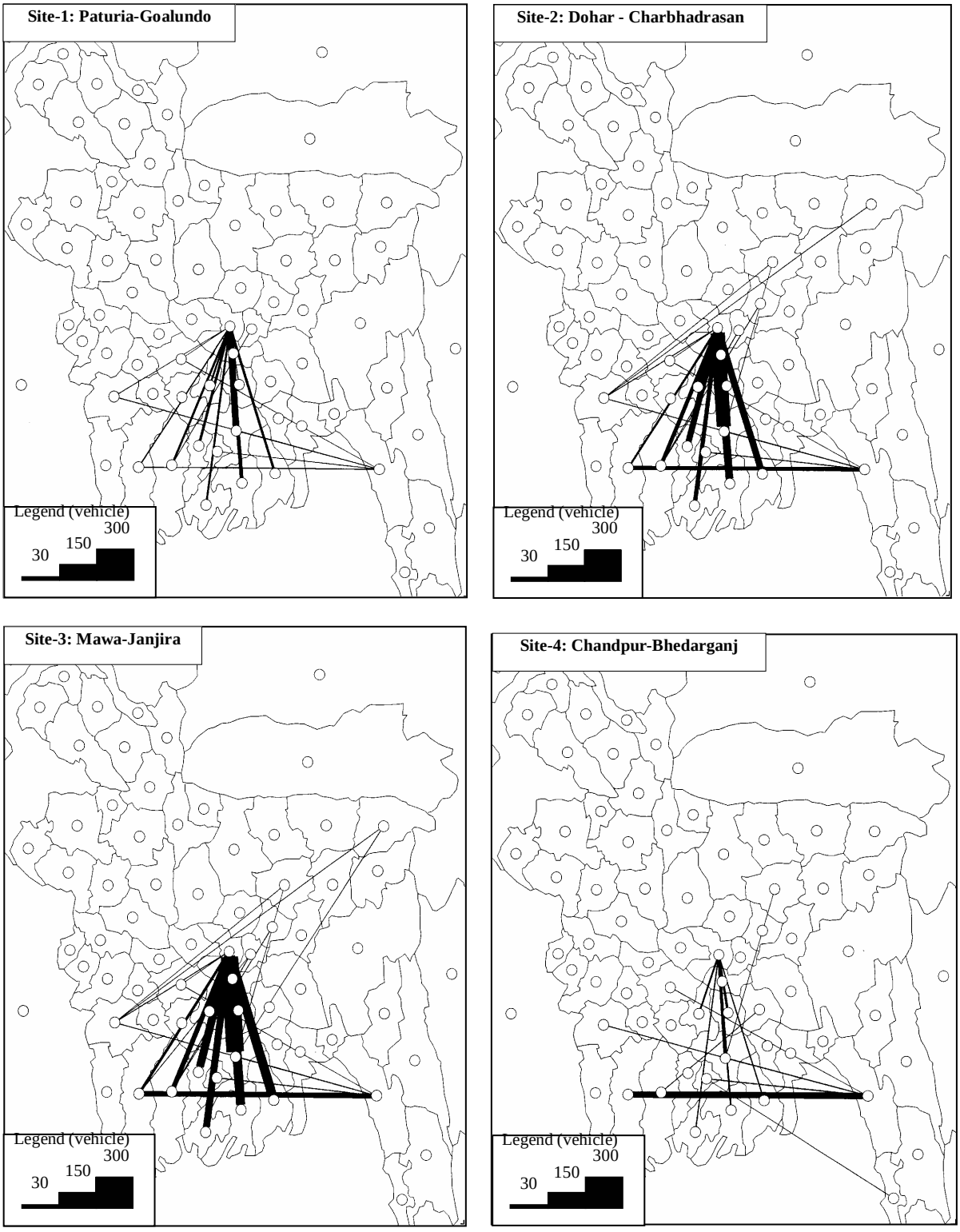


Figure 2.8.8 Diverted Traffic from IWT by Alternative Bridge Location in 2025

(6) Future Traffic Assignment

Future traffic volumes at the alternative bridge locations were determined by traffic assignment methodology, which requires input data consisted of the complete modeling of future network and future OD matrices. Based on the present network model, the future network model was established considering major highway & bridge projects. The future OD matrices are consisted of normal traffic, induced traffic from other projects, induced traffic from the Padma Bridge and diverted traffic by vehicle type (light vehicle, bus and truck). In this Study, "Incremental Assignment Procedure" was adopted using JICA STRADA, which is generally used for traffic assignment on the future network model. Each OD pair was divided by the number of calculation steps and the traffic of each step was assigned on the minimum path considering travel speed of all links. In case a link is levied tolls, it was converted into equivalent travel time using the travel time costs (TTC) and added to the travel time of the tolled link. In this Study, travel time costs for light vehicles and buses were estimated based on the financial travel time costs established by RHD and using average occupancy rates as shown in Table 2.8.9. The travel time cost for trucks were assumed as 533 taka/hr obtained from the average tariff and fare of truck by RHD.

Table 2.8.9 Financial Travel Cost for 2002-2003 (National Average)

Vehicle Category	Occupancy	TTC per passenger Taka/hr	TTC per vehicle Taka/hr
All Buses	40.7	18.3	745.3
Car/Utility	4.0	32.9	118.6

Source: RHD Road User Cost Annual Report for FY 2002/2003

(7) Traffic Forecast Results for 2015 and 2025

(a) Study Scenarios

In order to forecast future traffic volumes by alternative crossing location, four alternative bridge locations were set as follows including "Without bridge case":

- Case 1: Bridge at Paturia-Goalundo (Site-1)
- Case 2: Bridge at Dohar-Charbhadrasan (Site-2)
- Case 3: Bridge at Mawa-Janjira (Site-3)
- Case 4: Bridge at Chandpur-Bhedarganj (Site-4)
- Case 5: Without bridge

Present ferry services at Paturia-Goalundo and Mawa-Charjanajat across the Padma River are provided to handle the present traffic demand in Without bridge case. If additional ferry improvement plan is not carried out, future traffic demand will exceed ferry capacity and ferry waiting time will increase enormously long in Case 5 (Without bridge case)

The toll rates by vehicle type on the Padma Bridge for case 1 to case 4 are assumed at 400 taka for light vehicle, 800 taka for bus and 1,000 taka for truck, which are the same levels of the Jamuna Bridge. The toll rates of the bus and the truck are lower than that of present ferry charge at Paturia-Goalundo and Mawa-Charjanajat.

(b) Traffic Forecast Results for 2015 and 2025

Future traffic volumes on the Padma Bridge in four cases in 2015 and 2025 were forecasted by assigning the OD matrices by vehicle type (light vehicle, bus, truck) and by traffic type (normal traffic, two induced traffic and diverted traffic), separately, to the future network model. From the results of forecast, following characteristics in future traffic can be stated with and without bridge cases, respectively:

i) With Bridge cases

The assignment results in 2015 and 2025 for "with bridge cases" are summarized in Table 2.8.10 and 2.8.11 and illustrated in Figure 2.8.9 and 2.8.10. Comparisons of normal traffic by each bridge location for the year 2025 are shown in Figure 2.8.11.

Case 1: Bridge at Paturia-Goalundo (Site-1)

Future traffic volumes in the Case 1 will be 10,300 vehicles/day in 2015 and 19,850 vehicles/day in 2025. In this case, 30% of total traffic across the Padma River will use Mawa-Charjanajat ferry on National Highway N8 improved by "Southwest Road Network Development Project".

Case 2: Bridge at Dohar-Charbhadrasan (Site-2)

In the Case 2, the future traffic volumes are forecasted as 18,120 vehicles/day in 2015 and 34,880 vehicles/day in 2025, requiring construction of longer approach roads between National Highway N8 and near Faridpur.

Case 3: Bridge at Mawa-Janjira (Site-3)

The highest future traffic volumes are forecasted in the Case 3 with 21,260 vehicles/day in 2015 and 41,550 vehicles/day in 2025. It is indicated that most of total traffic across the Padma River will pass through the bridge at Mawa-Janjira.

Case 4: Bridge at Chandpur-Bhedarganj (Site-4)

The future traffic volumes will be 2,560 vehicles/day in 2015 and 5,040 vehicles/day in 2025. In this case, movements between Chittagong and the southwest region are significant. However, future traffic volume is forecasted in the lowest in the four cases, because Paturia and Mawa ferries are still attractive for the movements between Dhaka and southwest region.

ii) Without Bridge case

As shown in Figure 2.8.12, in "without bridge case", Paturia ferry will have higher traffic volume than Mawa ferry like the same pattern of present situation. While present shares between Mawa and Paturia ferries are 19% and 81% respectively according to present AADT, it will change to 40% and 60% in 2025 due to improvement of road condition on N8 as noted earlier.

(c) Influence to Jamuna Bridge

In order to grasp the influence of traffic on the Jamuna Bridge in case of the construction of the Padma Bridge, normal traffic volumes on the Jamuna Bridge by each case are shown in Figure 2.8.13. The Padma Bridge at Chandpur-Bhedarganj will not affect the traffic on the Jamuna Bridge, compared to "without bridge case". While if the Padma Bridge is constructed at other locations, the traffic volumes on the Jamuna Bridge will decrease by about 8% due to the traffic diversion from the Jamuna Bridge to the Padma Bridge.

(d) Cross Border Traffic via Padma Bridge

The cross border traffic between Bangladesh and India via Padma Bridge (through Benapole) was also forecasted in future traffic across the Padma River. The cross border traffic should be carefully treated because the conditions at cross borders are changeable in

future not only by improvement of infrastructure projects, but also by political factors. The forecast in this Study did not consider the clearance condition and waiting time at borders.

Table 2.8.10 Traffic Assignment Results by Alternative Bridge Location in 2015

Unit: vehicle/day

		Site-1	Site-2	Site-3	Site-4
Normal Traffic	Light Vehicle	1,990	2,020	2,340	80
	Bus	3,720	5,350	6,300	1,150
	Truck	2,430	2,350	2,580	670
	Total	**8,140**	**9,720**	**11,220**	**1,900**
Induced Traffic from Other Projects	Light Vehicle	200	230	240	10
	Bus	620	1,110	1,210	230
	Truck	340	340	360	110
	Total	**1,160**	**1,680**	**1,810**	**350**
Induced Traffic from Padma Bridge	Light Vehicle	220	1,310	1,270	30
	Bus	420	3,990	5,270	70
	Truck	210	1,030	1,140	120
	Total	**850**	**6,330**	**7,680**	**220**
Diverted Traffic	Bus	120	300	430	30
	Truck	30	90	120	60
	Total	**150**	**390**	**550**	**90**
Total	Light Vehicle	2,410	3,560	3,850	120
	Bus	4,880	10,750	13,210	1,480
	Truck	3,010	3,810	4,200	960
	Total	**10,300**	**18,120**	**21,260**	**2,560**
Vehicle-km of Normal Traffic		5,400,888	5,240,067	5,081,482	5,405,938
Vehicle-hour of Normal Traffic		110,964	100,975	92,664	111,970

Source: JICA Study Team

Note: Site-1:Paturia - Goalundo Site2:Dohar – Charbhadrasan Site3:Mawa - Janjira
Site-4:Chandpur - Bhedarganj

Table 2.8.11 Traffic Assignment Results by Alternative Bridge Location in 2025

Unit: vehicle/day

		Site-1	Site-2	Site-3	Site-4
Normal Traffic	Light Vehicle	3,830	3,790	4,450	160
	Bus	7,650	10,870	12,880	2,430
	Truck	4,350	4,220	4,690	1,320
	Total	**15,830**	**18,880**	**22,020**	**3,910**
Induced Traffic from Other Projects	Light Vehicle	360	430	460	20
	Bus	1,260	2,260	2,470	470
	Truck	580	570	610	160
	Total	**2,200**	**3,260**	**3,540**	**650**
Induced Traffic from Padma Bridge	Light Vehicle	420	2,430	2,430	50
	Bus	850	8,010	10,820	130
	Truck	350	1,780	2,020	200
	Total	**1,620**	**12,220**	**15,270**	**380**
Diverted Traffic	Bus	160	400	580	30
	Truck	40	120	140	70
	Total	**200**	**520**	**720**	**100**
Total	Light Vehicle	4,610	6,650	7,340	230
	Bus	9,920	21,540	26,750	3,060
	Truck	5,320	6,690	7,460	1,750
	Total	**19,850**	**34,880**	**41,550**	**5,040**
Vehicle-km of Normal Traffic		10,451,259	10,192,696	9,830,143	10,484,861
Vehicle-hour of Normal Traffic		220,536	203,077	184,259	223,149

Source: JICA Study Team

Note: Site-1:Paturia - Goalundo Site2:Dohar – Charbhadrasan Site3:Mawa - Janjira
Site-4:Chandpur - Bhedarganj

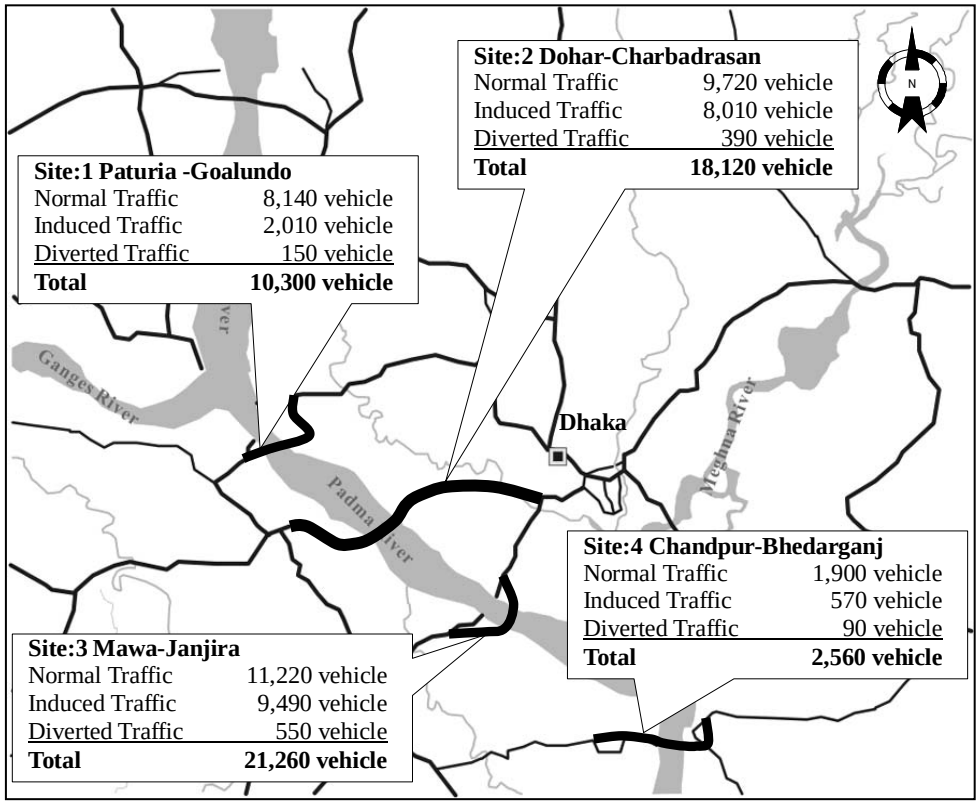


Figure 2.8.9 Traffic Volume by Alternative Bridge Location in 2015

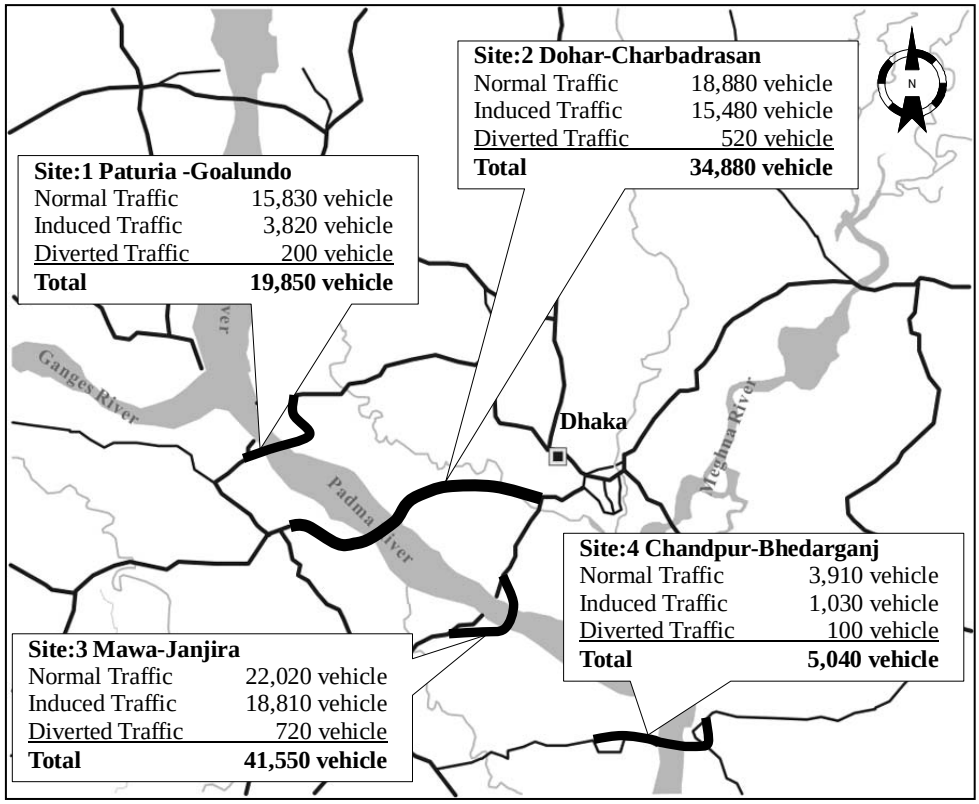


Figure 2.8.10 Traffic Volume by Alternative Bridge Location in 2025

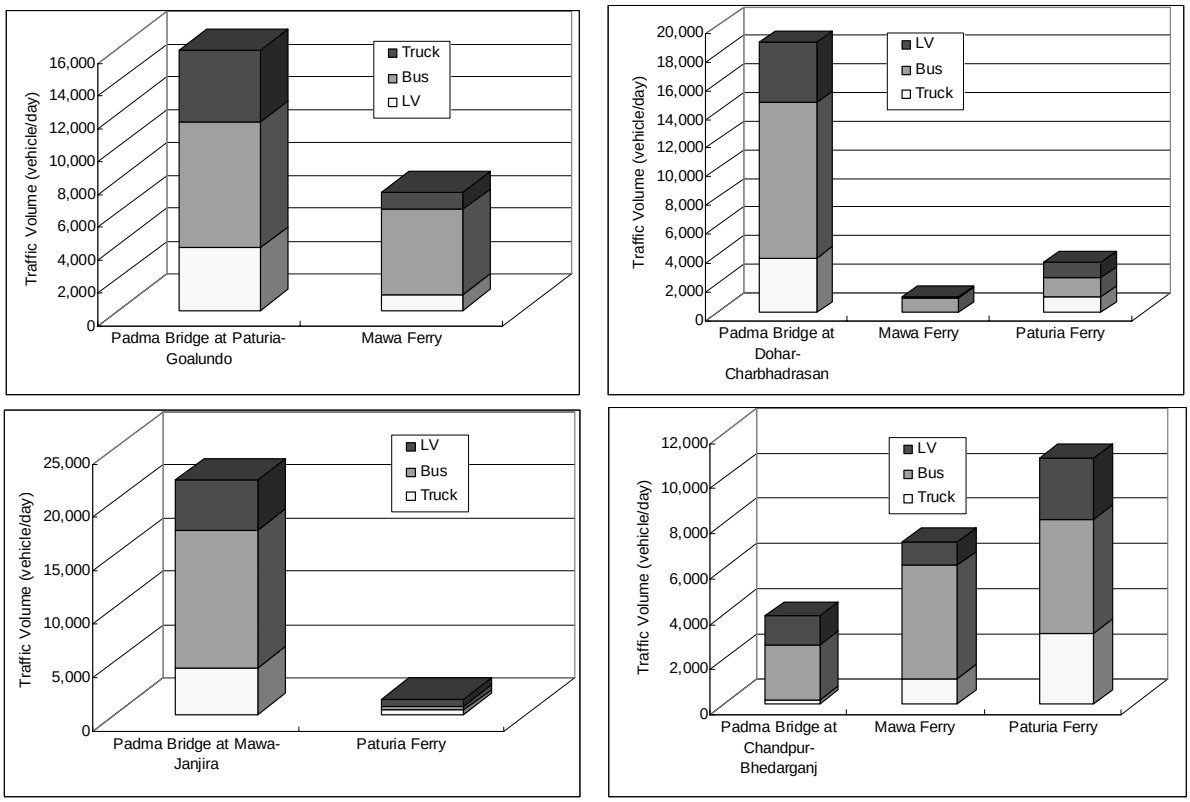


Figure 2.8.11 Normal Traffic Volume at Padma River Crossing by Alternative Bridge Location in 2025

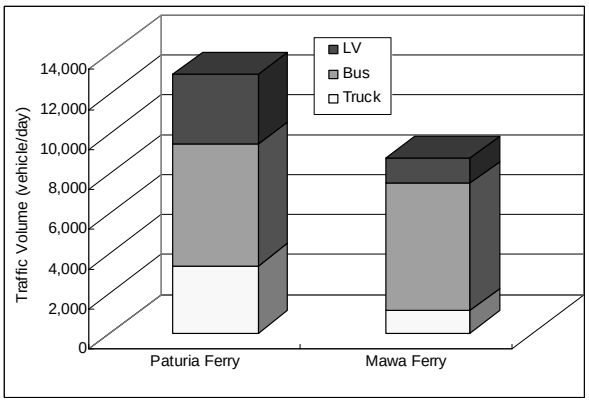


Figure 2.8.12 Normal Traffic Volume at Padma River Crossing of Without Bridge Case in 2025

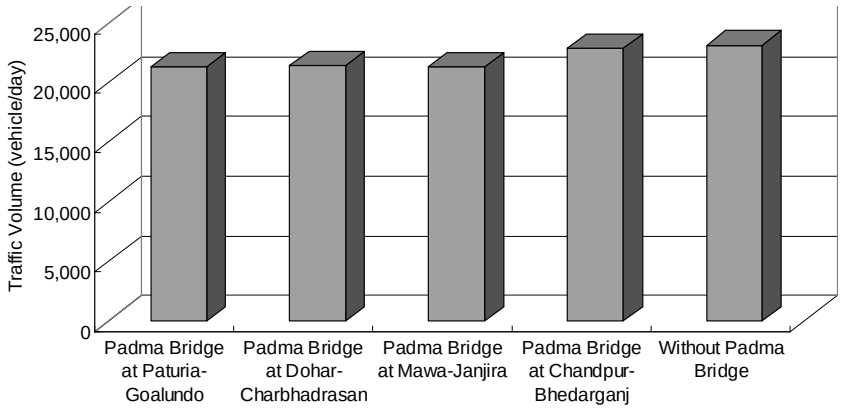


Figure 2.8.13 Normal Traffic Volume on Jamuna Bridge in 2025

2.9 COMPARISONS OF TWO BRIDGE SITES (INDIRECT EFFECT)

In this section, two candidate bridge locations are compared based on the results of traffic demand projection and from the aspects of indirect effects of the Bridge.

(1) Main Factors Taken into Account

The following factors were taken into account for the analysis and comparisons of indirect economic effects.

1) Improvement of Accessibility
2) Formation of International Road Network
3) Contribution to Regional Economic Development
4) Relationship with Regional Development Projects

(2) Improvement of Accessibility

(a) Time Contour Maps from Dhaka to Southwest Region

In order to evaluate the degree of improvement of accessibility by the Padma Bridge, time contour maps from Dhaka to Southwest Region were prepared based on the network simulation. The main conditions for the network model are as follows:

- Free flow speed on National Highway: 60 km/h
- Free flow speed on Regional Highway: 50 km/h
- Free flow speed on Feeder Road: 30 km/h
- Ferry waiting time at Paturia: 58 minutes
- Ferry crossing time at Paturia: 38 minutes
- Ferry waiting time at Mawa: 66 minutes
- Ferry crossing time at Mawa: 122 minutes

Above free flow speed was adjusted depending on traffic volume assigned and slowing down reflecting congestion in the network simulation model.

For the purpose of comparison, three time contour maps were prepared as shown below:

- In the case of "Without Bridge", travel time required from Dhaka to each district in the Southwest Region will be over four hours except for Rajbari District which is located on the opposite side of Paturia. This means that existing crossing of the Padma river is a serious bottleneck lying between North Region and Southwest Region.
- When the Padma Bridge is constructed on Paturia route, the districts of Rajbari and Faridpur will be covered within three hour area and Kushtia, Jhenaidan, Magura, parts of Narail, Gopalganj, Jessore and Madaripur districts will be covered within four hour area. However, other districts in the southern part will remain in the area more than four hours.
- In the case of Mawa route, areas within two hours, three hours and four hours will be expanded extensively. It should be emphasized that the districts located along the Paturia route will also enjoy benefits of improvement of accessibility significantly in case of Mawa route. This is because of the location of the Mawa route which runs into the gate to/from Dhaka which is located at the middle point of entrance of Southwest Region, and then distributes traffic effectively to the northwest, southwest and to the east in the region.

The Padma Bridge at Mawa will reduce the time cost by about 2.5 hours from Dhaka to Mongla Port and to Benapole Land Port.

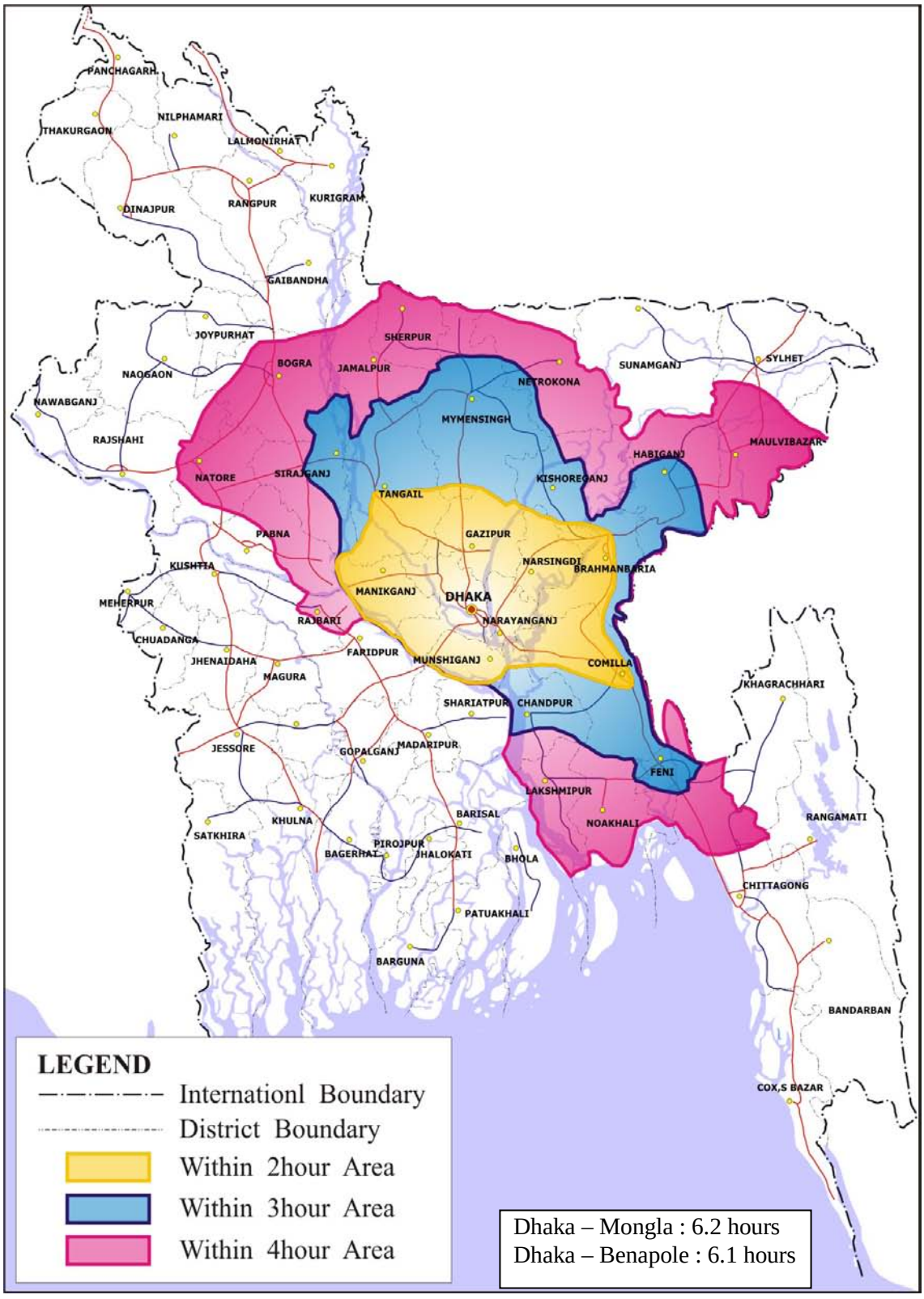


Figure 2.9.1 Time Contour Map (Without Bridge Case)

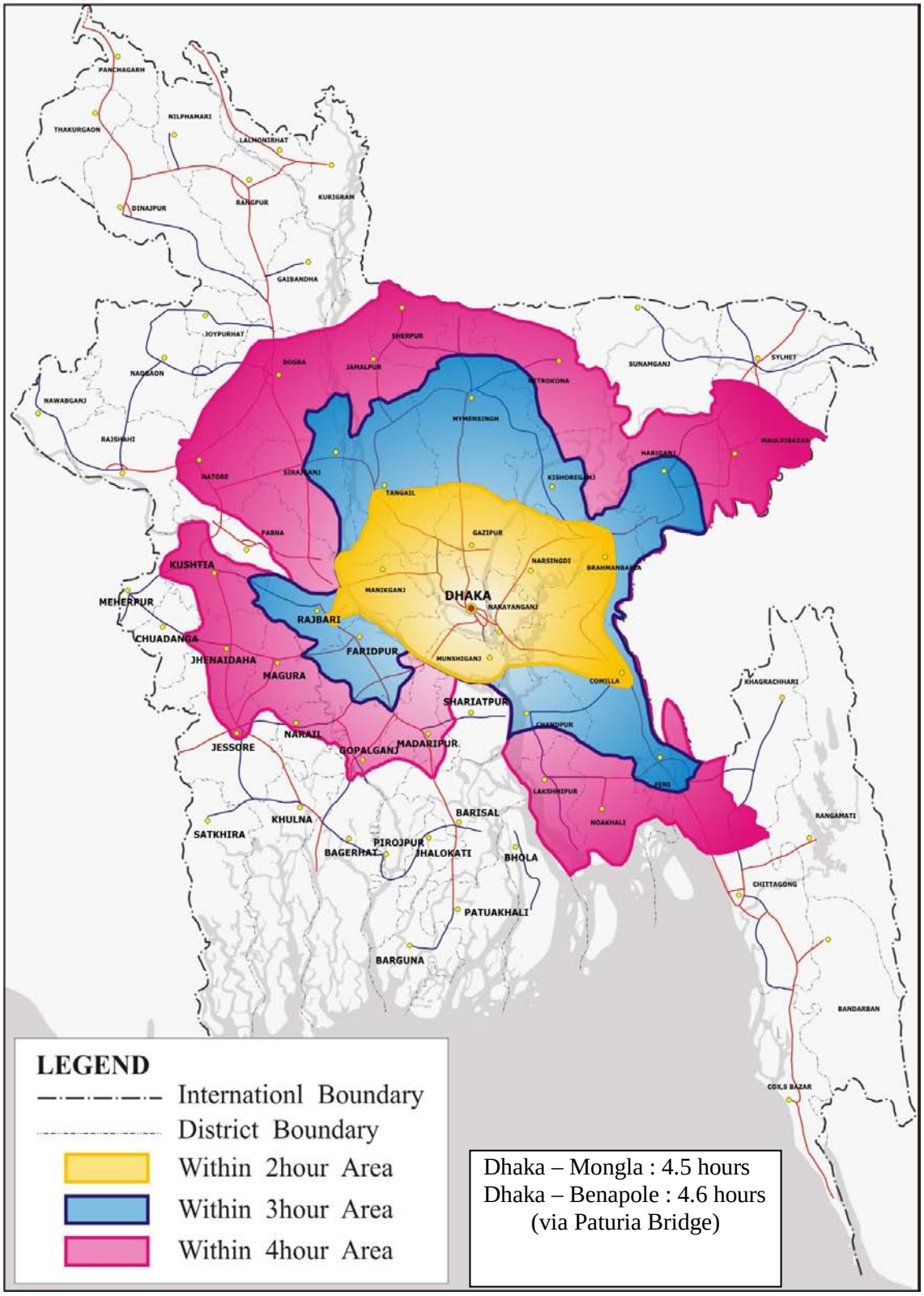


Figure 2.9.2 Time Contour Map (Paturia – Goalund)

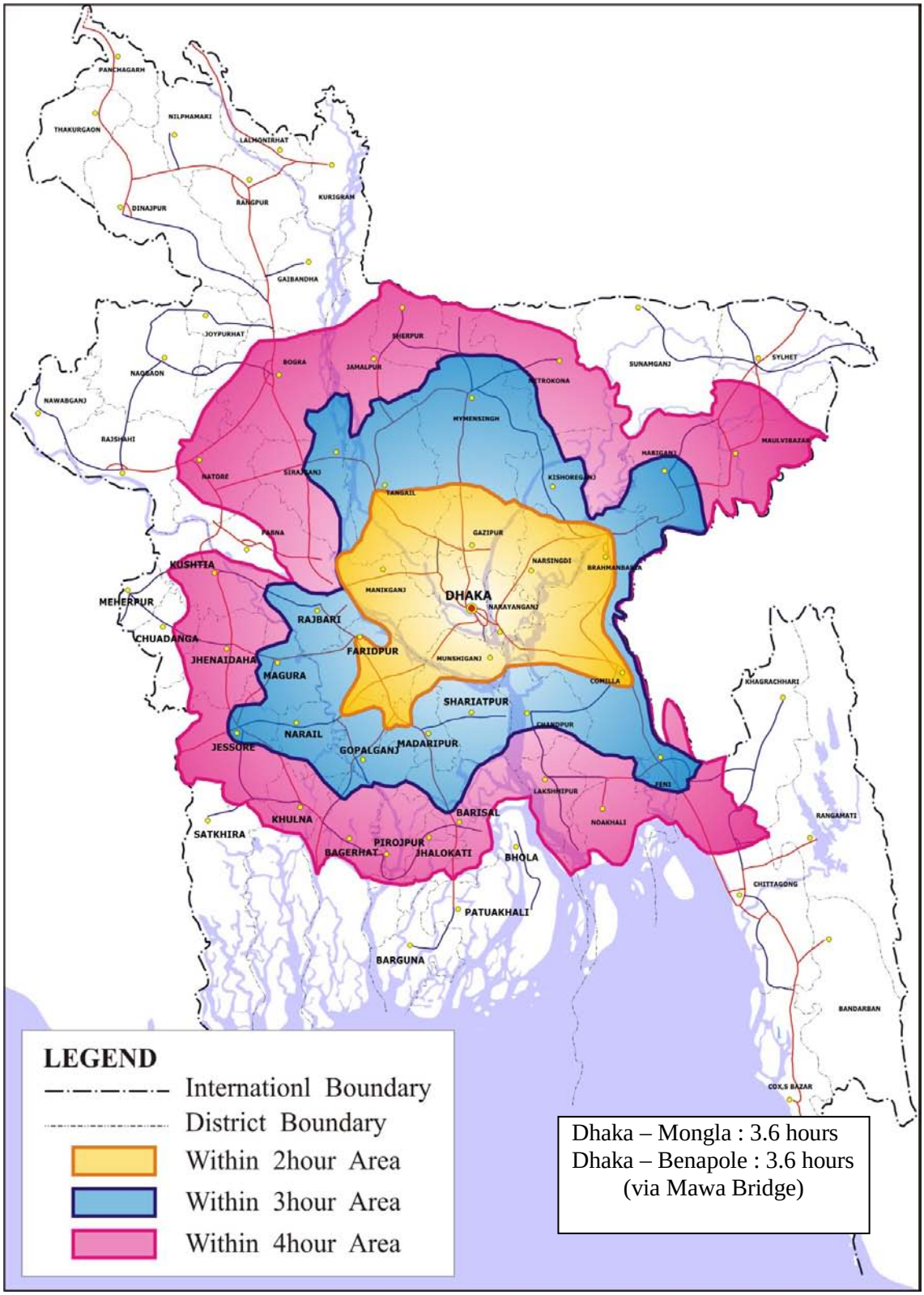


Figure 2.9.3 Time Contour Map (Mawa – Janjira)

(b) Beneficiary Population (Population Cover Rate)

About 30 million people are living in the Southwest Region (2001 Census). Number of population covered by the time bund to/from Dhaka (within three hours, four hours and more than four hours) was estimated by Paturia route and Mawa route.

About 2.8 million people (9% of total population of Southwest Region) will be covered within three hour area if the Padma Bridge is constructed at Paturia. On the other hand, if the bridge is constructed at Mawa route, about 10.4 million people (35%) will be covered within three hour area. Regarding the four hour area, Paturia route will cover 12.7 million people (42%). However, Mawa route will cover 22.2 million people (74%).

Therefore, impact of improvement of accessibility to/from Dhaka will be higher in case of Mawa route.

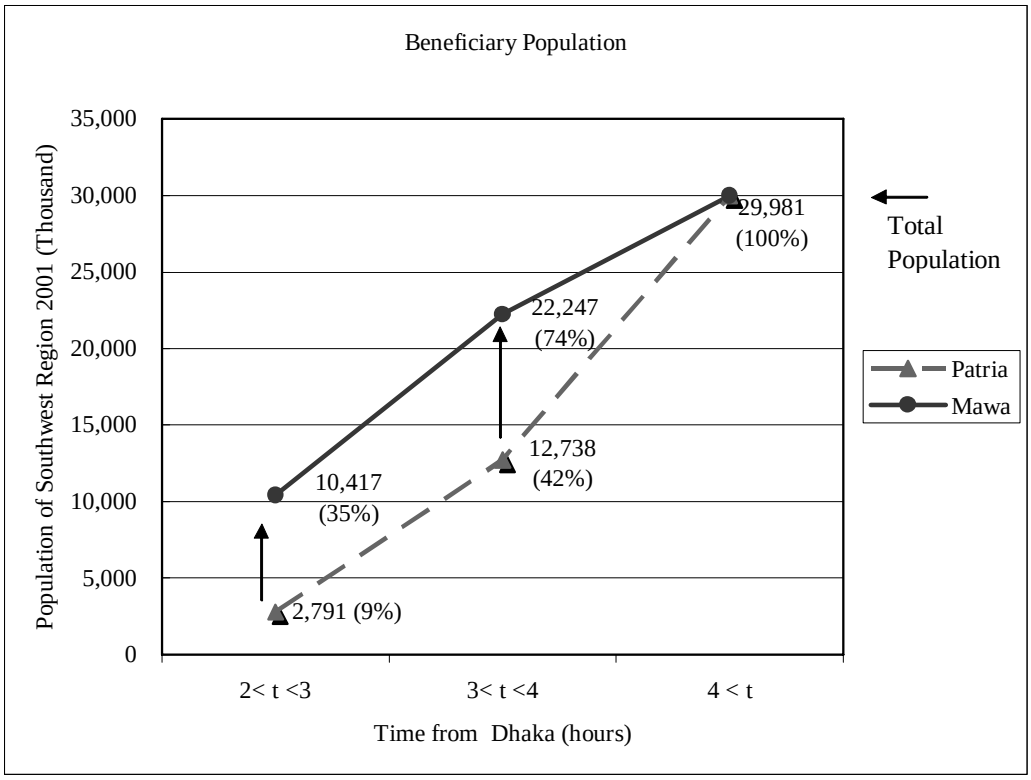


Figure 2.9.4 Beneficiary Population (Population Cover Rate)

(3) Feeder Road Network in the Southwest Region

Impact of the Padma Bridge will be accelerated and that effect will cover whole country of Bangladesh when it is connected well formulated local road network (feeder roads), National and International Highways.

Density of feeder roads under LGED (km/km^2) of all districts is shown in Table 2.9.1 and Figure 2.9.5. As shown in Figure 2.9.5, density of feeder roads is comparatively high along the corridors of trunk roads such as National and Regional Highways. This means that feeder roads play an important role as access to National and Regional Highways connecting many Growth Centers (markets and bazaars) with trunk roads and district headquarters.

Regarding the feeder road network in the Southwest Region, density of feeder road under LGED is high especially in the districts of Barisal, Pirojpur and Jhalakhati with the density of more than 2.0 km/km^2. At the same time, density of feeder roads in the districts around the Rajbari districts is also comparative high although their density is less the 2.0 km/km^2.

Existing condition of feeder road network around the two bridge sites is shown in Figure 2.9.6. There are no big differences of density and network configuration between the two sites.

Table 2.9.1 Inventory of Feeder Roads under LGED

Zone No.	Division	Zila	Area Km2	Upazila Road	Union Road	Village Road	Total (km)	Feeder Road Density (km/km2)
1	Dhaka	Dhaka	1464	311	1272	1409	2992	2.044
2	Dhaka	Manikganj	1379	435	831	946	2212	1.604
3	Dhaka	Munshiganj	955	212	451	759	1422	1.489
4	Dhaka	Narayanganj	759	344	477	829	1650	2.174
5	Dhaka	Narshingdi	1141	271	857	1080	2208	1.935
6	Dhaka	Gazipur	1741	266	878	1916	3060	1.758
7	Dhaka	Tangail	3414	641	2123	2108	4872	1.427
8	Dhaka	Jamalpur	2032	402	1400	1381	3183	1.566
9	Dhaka	Sherpur	1364	262	685	936	1883	1.380
10	Dhaka	Mymensingh	4363	713	2923	3672	7308	1.675
11	Dhaka	Netrakona	2810	502	1387	1694	3583	1.275
12	Dhaka	Kishoreganj	2689	354	1116	2368	3838	1.427
13	Dhaka	Rajbari	1119	269	628	1167	2064	1.845
14	Dhaka	Faridpur	2073	473	742	1728	2943	1.420
15	Dhaka	Gopalganj	1490	371	755	969	2095	1.406
16	Dhaka	Madaripur	1145	173	504	1102	1779	1.554
17	Dhaka	Shariatpur	1181	265	614	1275	2154	1.824
18	Khulna	Kushtia	1621	542	699	1380	2621	1.617
19	Khulna	Magura	1049	281	620	857	1758	1.676
20	Khulna	Narail	990	156	480	1021	1657	1.674
21	Khulna	Bagerhat	3959	354	1256	1890	3500	0.884
22	Khulna	Khulna	4395	551	1126	2040	3717	0.846
23	Khulna	Satkhira	3858	342	1285	2870	4497	1.166
24	Khulna	Jessore	2578	542	1359	2754	4655	1.806
25	Khulna	Jhenaidah	1950	432	1189	1801	3422	1.755
26	Khulna	Chuadanga	1158	308	673	889	1870	1.615
27	Khulna	Meherpur	716	157	584	575	1316	1.838
28	Barisal	Pirojpur	1308	180	993	1808	2981	2.279
29	Barisal	Barisal	2791	361	1286	4899	6546	2.345
30	Barisal	Jhalakhati	758	90	572	955	1617	2.133
31	Barisal	Barguna	1832	209	654	2450	3313	1.808
32	Barisal	Patuakhali	3205	349	1533	3458	5340	1.666
33	Barisal	Bhola	3403	252	697	1821	2770	0.814
34	Rajshahi	Pabna	2371	470	1547	1556	3573	1.507
35	Rajshahi	Sirajganj	2498	407	1435	1798	3640	1.457
36	Rajshahi	Natore	1896	260	1075	1768	3103	1.637
37	Rajshahi	Bogra	2920	696	1935	2112	4743	1.624
38	Rajshahi	Rajshahi	2407	667	1754	1720	4141	1.720
39	Rajshahi	Nawabganj	1702	220	741	1159	2120	1.246
40	Rajshahi	Naogaon	3436	677	1501	2242	4420	1.286
41	Rajshahi	Joypurhat	965	308	559	742	1609	1.667
42	Rajshahi	Gaibandha	2179	386	1020	1526	2932	1.346
43	Rajshahi	Kurigram	2296	358	1053	1284	2695	1.174
44	Rajshahi	Rangpur	2308	787	1496	1737	4020	1.742
45	Rajshahi	Dinajpur	3438	668	2116	2948	5732	1.667
46	Rajshahi	Lalmanirhat	1242	325	1025	982	2332	1.878
47	Rajshahi	Nilphamari	1641	456	1022	1259	2737	1.668
48	Rajshahi	Panchagarh	1405	360	947	1577	2884	2.053
49	Rajshahi	Thakurgaon	1809	406	1049	1602	3057	1.690
50	Chittagong	Brahmanbaria	1927	234	683	1604	2521	1.308
51	Chittagong	Comilla	3085	405	2058	3562	6025	1.953
52	Chittagong	Chandpur	1704	269	1037	1602	2908	1.707
53	Chittagong	Laksmipur	1456	194	602	2021	2817	1.935
54	Chittagong	Noakhali	3601	290	1593	2922	4805	1.334
55	Chittagong	Feni	928	167	455	1447	2069	2.230
56	Chittagong	Chittagong	5283	320	2143	4690	7153	1.354
57	Chittagong	Khagrachhari	2700	197	506	1500	2203	0.816
58	Chittagong	Rangamati	6116	494	1627	1275	3396	0.555
59	Chittagong	Bandarban	4479	174	534	1306	2014	0.450
60	Chittagong	Cox's Bazar	2492	179	588	1676	2443	0.980
61	Sylhet	Habiganj	2637	316	958	1760	3034	1.151
62	Sylhet	Sunamganj	3670	477	964	1561	3002	0.818
63	Sylhet	Sylhet	3490	599	863	2485	3947	1.131
64	Sylhet	Maulavi Bazar	2799	298	1089	1896	3283	1.173

Source: Local Government Engineering Department (LGED)

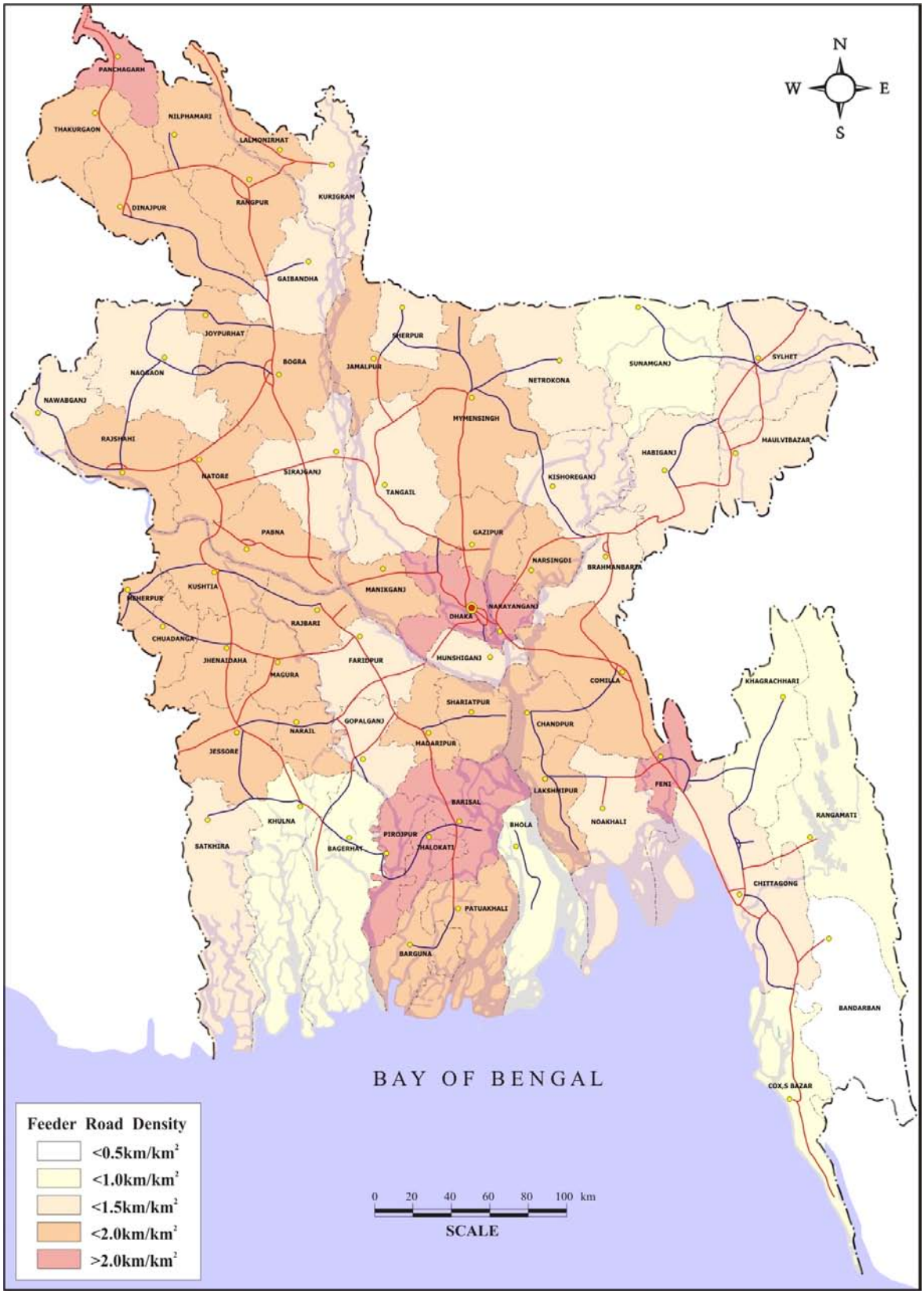


Figure 2.9.5 Density of Feeder Road under LGED (km/km2)

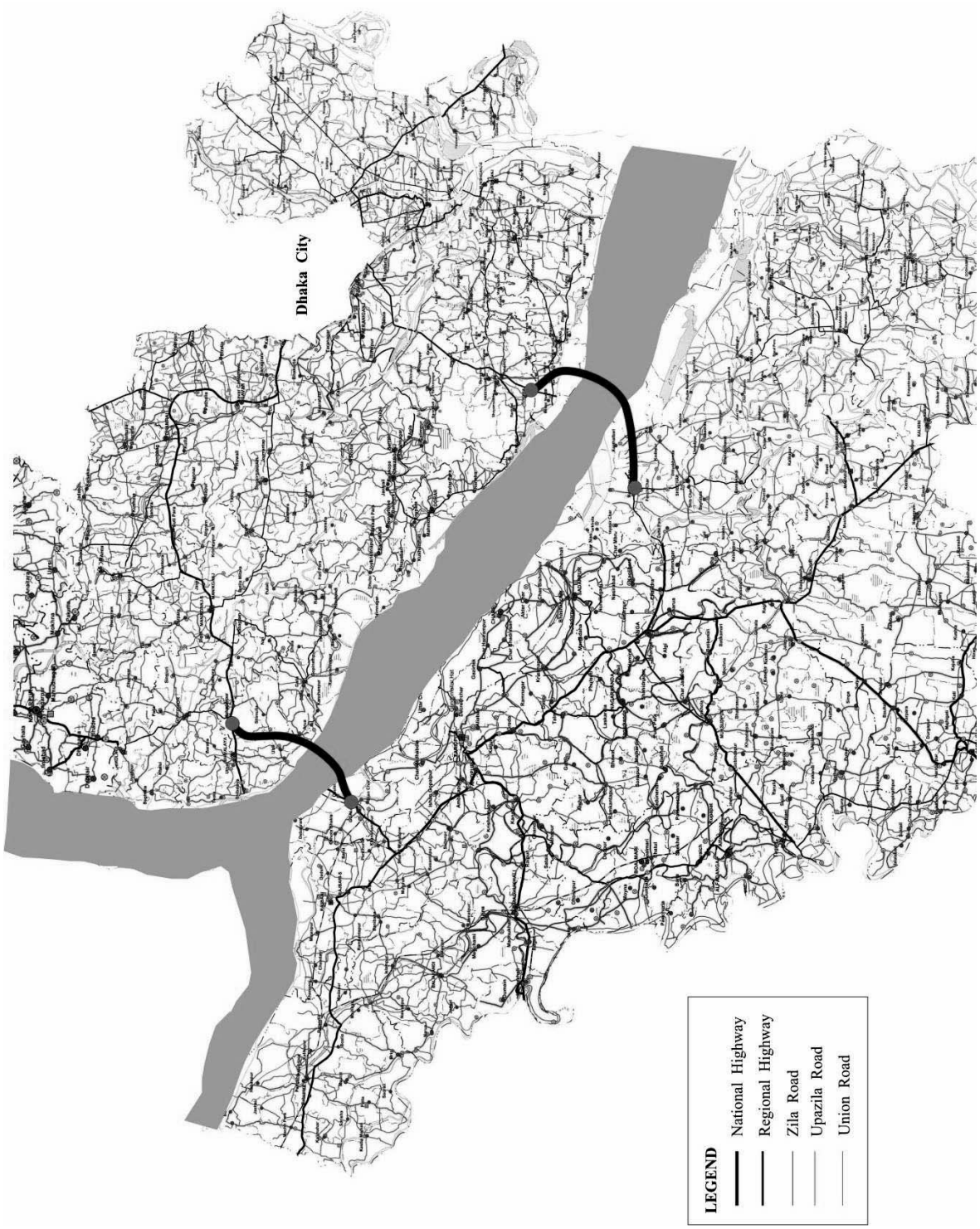


Figure 2.9.6 Feeder Road Network around Padma River

(4) Formation of International Road Network

The Padma Bridge will contribute to the formation of international road network providing a strong road link for a part of the Asian Highway A-1 and international trade between India and Bangladesh will be accelerated to/from Calcutta (West Bengal) and Dhaka through Benapole Land Port, Bhang, Mawa on National Highway No.8. The Asian Highway A-1 is also connecting Southwest Region with Assam in India and Nepal by using Asian Highway A-41 and A-2.

The Padma Bridge on the Mawa route, therefore, is essential for the formation of smooth international road network.

There are 13 land ports in Bangladesh as shown below and in Figure 2.9.7.

Sl No.	Land Port in Bangladesh	Adjacent Land Port in India
1	Benapole (Jessore)	Haridaspur/Petrapol (Bangaon, West-Bengal)
2	Banglabandha (Panchagar)	Siliguri
3	Burimari (Lalmunirhat)	Chenrabandha (Mekhliganj)
4	Kaluaghat (Mymensingh)	Gachoapara
5	Tamabil (Sylhet)	Douki (Silong), Meghaloy
6	Akhaura (Brahamanbaria)	Ramnagar (Agartola)
7	Bibirbazar (Comilla)	Sreemontopur (Agartola, Tripora)
8	Tekhaf (Cox-Bazar)	Mundo (Myanmar)
9	Bhomra (Satkhira)	Gozadanga (Chabbish, Pargona, West-Bengal)
10	Darshana (Cuadangha)	Gede
11	Sona-Masjid (Nawabganj)	Mehedipur, District-Malda
12	Hilly (Dinajpur)	Hilly, District-West Dinajpur
13	Birol (Dinajpur)	Radhikapur

Source: Bangladesh Land Port Authority (BLPA)

In April 2001, the government of Bangladesh created the *Bangladesh Land Port Authority (BLPA)* under the Ministry of Shipping, to develop and oversee 12 major border-crossing points. These 12 points have been selected from the 184 Land Customs Stations currently gazetted, of which only about 30 are regularly staffed by Customs. The mandate of the BLPA is to develop road-oriented border terminals, including storage facilities. The intent is that the terminals will be operated by the private sector.

Among the 13 land ports, Benapole is the busiest in terms of traffic. Currently, there are 400 – 500 trucks moving via Petrapole – Benapole border station. At present, transport vehicles of India and Bangladesh cannot cross over into each other's territory and bilateral trade is conducted through designated trans-shipment points. Off-loading and loading commodities are time consuming works. Transit of both countries to go through each country is not yet agreed. However, in order to increase capacity of Benepole Land Port and to reduce waiting, handling time, BLPA is making a plan to expand the terminals including new 4 stations.

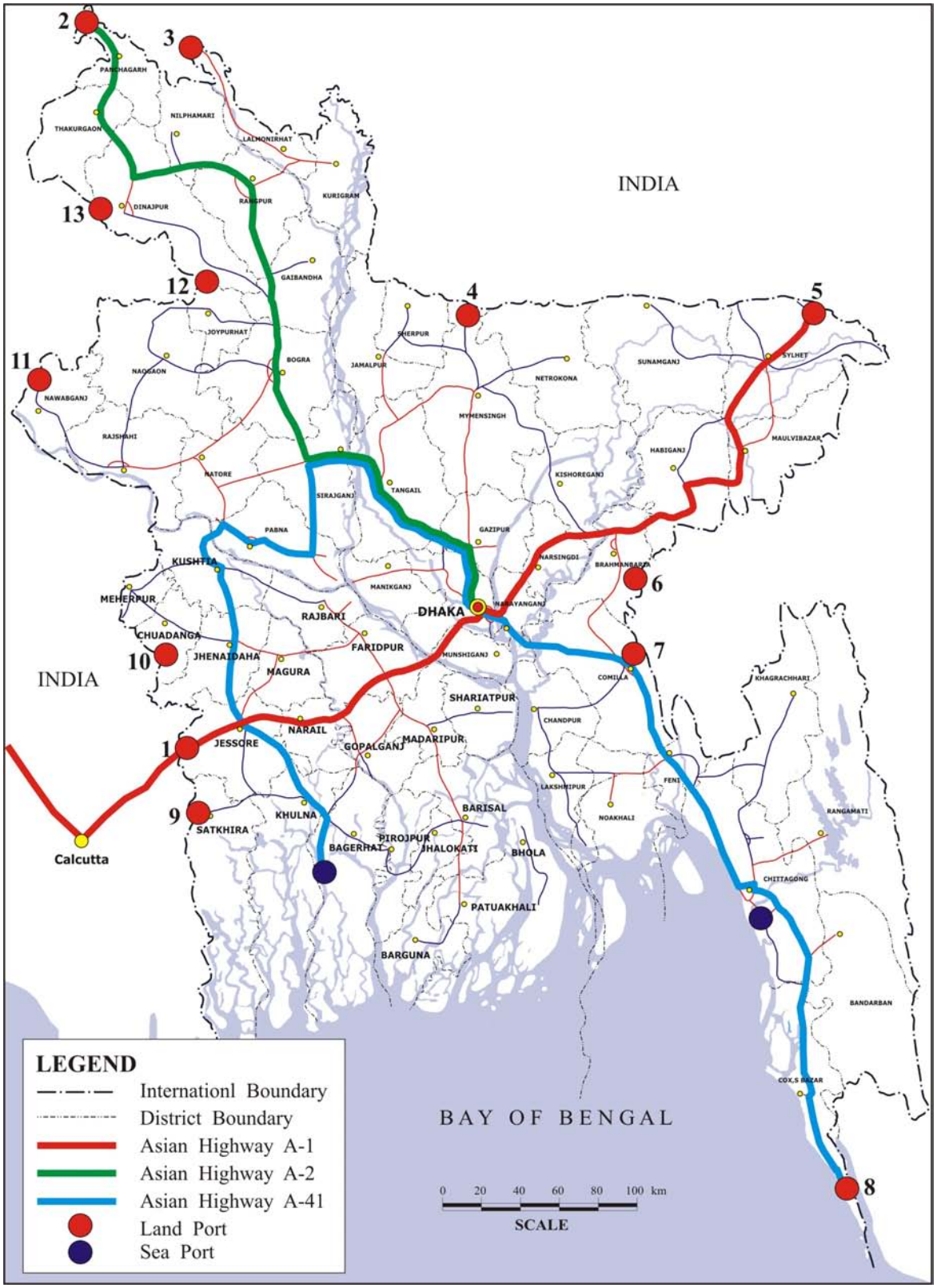


Figure 2.9.7 Locations of Land Ports/Sea Ports and Asian Highways

(5) Contribution to Regional Economic Development

The Padma Bridge will promote the regional economic development through the improvement of accessibility. The relationship between the travel time to/from Dhaka and GRDP (Gross Regional Domestic Product) by district is shown in Figure 2.9.8. GRDP/km^2 is a kind of index of "Productivity of land". In addition to this relationship, it is necessary to take into account one more factor to reflect the condition of regional infrastructure such as feeder roads. Therefore, an equation below was estimated by the regression analysis.

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

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 "With Bridge Case" (density of feeder roads is fixed), impact on the change of GRDP was estimated as shown in Table 2.9.2 and Table 2.9.3.

The results indicate that if the Padma Bridge is constructed at Patria Route, GRDP of the Southwest Region will increase by 18% compared to the "Without Bridge Case. In the case of Mawa route, GRDP will be pushed up by 35%.

	Impact Ratio	
	Paturia Route	Mawa Route
Southwest Region	1.18	1.35
Bangladesh	1.04	1.07

However, these impacts will not be realized in few years after the Bridge is opened. As the impact of this kind requires long term period, 10 to 20 years after opening are necessary to be realized. If the Padma Bridge is fully used in 15 years after opening, impact rates will be 1.2% per year in the case of Paturia route and 2.3% per year in the case of Mawa route.

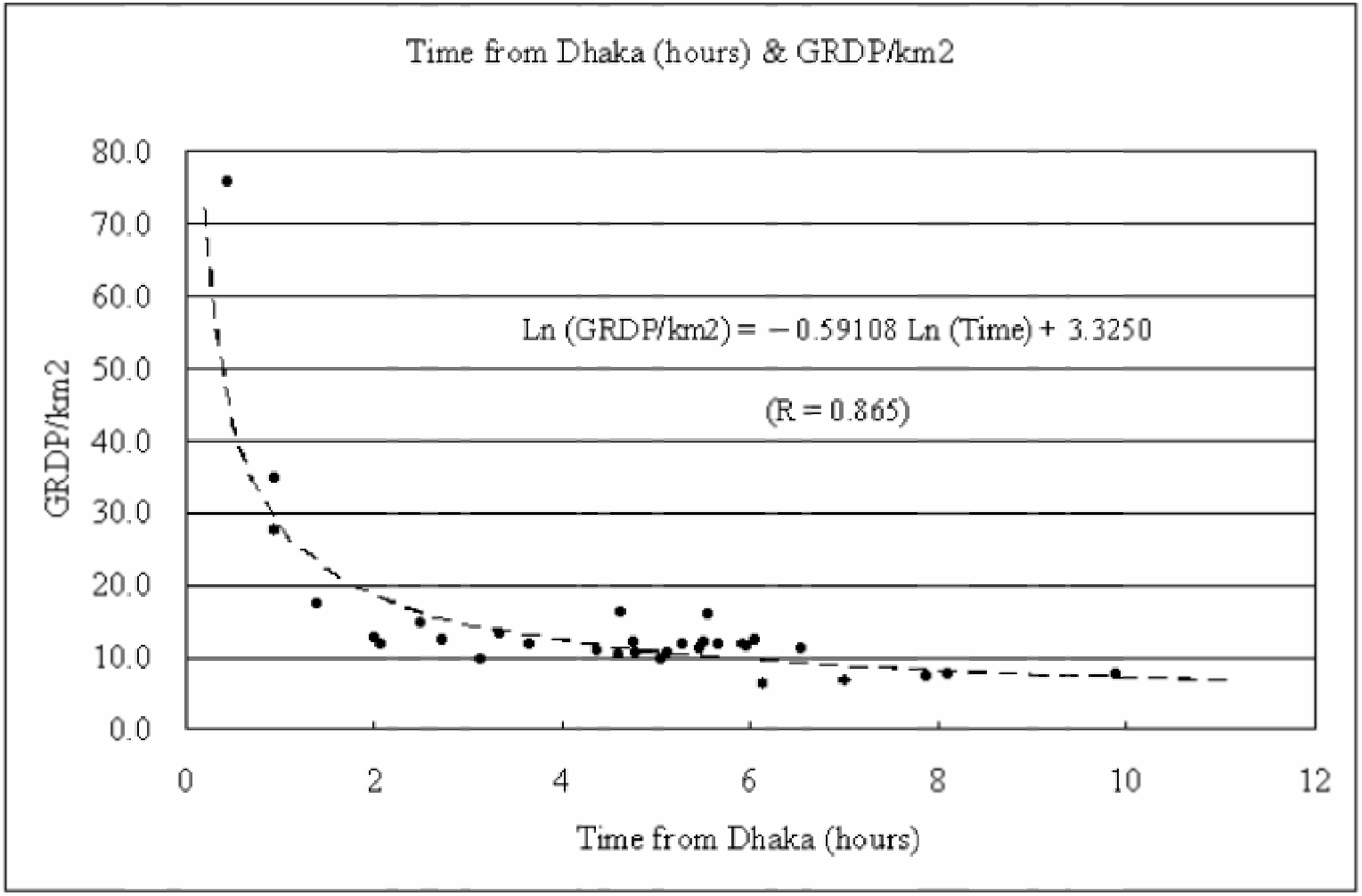


Figure 2.9.8 Relationship Between Travel Time and GRDP

Table 2.9.2 Impact on Regional Economy (Paturia Route)

Impact on Regional Economy (GRDP) : Patria 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 Patria	GRDP With Patria	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	15.9	17808	1.47
Faridpur	14	4.6	1.42	10.3	10.8	0.950	21312	14.8	30585	1.44
Gopalganj	15	5.05	1.41	9.7	10.2	0.952	14510	11.3	16909	1.17
Madaripur	16	4.77	1.55	12.0	11.1	1.080	13710	14.1	16145	1.18
Shariatpur	17	4.78	1.82	10.5	12.0	0.880	12451	11.4	13508	1.08
Kushtia	18	4.63	1.62	16.2	11.5	1.408	26233	19.8	32177	1.23
Magura	19	5.46	1.68	11.4	10.7	1.062	11908	15.1	15852	1.33
Narail	20	5.13	1.67	10.5	11.1	0.953	10428	12.2	12119	1.16
Bagerhat	21	6.14	0.88	6.3	7.3	0.865	25048	7.2	28314	1.13
Khulna	22	5.96	0.85	11.5	7.3	1.585	50672	13.1	57451	1.13
Satkhira	23	7.01	1.17	6.9	7.8	0.886	26637	8.0	30702	1.15
Jessore	24	5.56	1.81	15.8	11.0	1.441	40781	19.1	49119	1.20
Jhenaidah	25	5.28	1.75	11.8	11.1	1.058	22967	14.3	27910	1.22
Chuadanga	26	6.04	1.61	12.3	9.9	1.235	14202	14.5	16771	1.18
Meherpur	27	5.51	1.84	12.2	11.1	1.094	8717	14.1	10063	1.15
Pirojpur	28	6.55	2.28	11.3	11.3	1.000	14724	12.6	16485	1.12
Barisal	29	5.67	2.35	11.7	12.4	0.946	32626	13.4	37306	1.14
Jhalakhati	30	5.93	2.13	11.8	11.5	1.022	8909	13.4	10120	1.14
Barguna	31	9.89	1.81	7.6	8.0	0.949	13922	8.2	14973	1.08
Patuakhali	32	8.11	1.67	7.5	8.6	0.878	24129	8.2	26385	1.09
Bhola	33	7.88	0.81	7.3	6.1	1.187	24743	7.9	26934	1.09

GRDP (W/O Bridge)		GRDP (With Bridge)		Impact Ratio
SW Region	430731	SW Region	507637	1.18
Bangladesh	2049154	Bangladesh	2126060	1.04
Regional Share %	21.0%	Regional Share%	23.9%	1.2% per year

Model

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

(R = 0.902)

Table 2.9.3 Impact on Regional Economy (Mawa Route)

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% per year

Model

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

(R = 0.902)

(6) Poverty Reduction

The Government of Bangladesh has been making great effort to reduce poverty for a long time with assistance from other donors such as Asian Development Bank and World Bank. All infrastructure projects in Bangladesh are required to set the ultimate target on poverty reduction.

The long term plan titled as "National Strategy for Economic Growth, Poverty Reduction and Social Development (NS-EGPRSD)" set the target to reduce present poverty rate by half by the end of FY2015. In order to fulfil this target, NS-EGPRSD set the required GDP growth rate at 6.5% to be achieved by FY2006 and then 6.5% - 7.0% by the end of FY2015. Therefore, economic growth is a necessary precondition for poverty reduction.

The Padma Bridge will provide people in the Southwest Region with opportunities of easy access to Dhaka, the largest market in Bangladesh, and access to growth centres (local markets/ bazaars) through feeder road network.

The Padma Bridge is, therefore, expected to contribute to poverty reduction through the promotion of regional economic development (growth of Gross Regional Domestic Product: GRDP) especially for the Southwest Region as already explained above.

This effect of poverty reduction by the Padma Bridge will spread over whole country of Bangladesh and its effect will be more than that of existing Jamuna Bridge

(7) Relationship with Regional Development Projects

The Padma Bridge is expected to contribute extensively and intensively toward the national and regional development of Bangladesh. These effects will be surely realized and accelerated when the Padma Bridge is combined with and used by on-going and future development projects such as Rural Development Projects by the Local Government Engineering Department (LGED), especially feeder roads/ bridges and Growth Center (GC) development in the Southwest Region.

At present, there are 25 on-going and 9 new projects by LGED as shown in Table 2.9.4. These projects consist of the following components:

1) Development of physical infrastructure including roads (feeder roads, rural roads and bridge/culverts), storage and markets.
2) rrigated agriculture, minor drainage and flood control works.
3) Production and employment program (PEP) for rural poor.
4) Development of Growth Centers (Markets and Bazars).
5) Construction of river ghats.
6) Community participation, providing employment opportunity to rural poor by labor intensive technique.
7) Road maintenance by local community.

These projects are located in almost all districts in the Southwest Region and, therefore, it is not easy to judge which bridge site is superior from the point of view of existing development projects (such as number of projects on each bridge site).

However, a comparison of density of existing growth centres was carried out as shown in Figure 2.9.9.

Number of growth centres within the areas of 30 km and 50 km from the origin and ending points of approach roads of each bridge site were counted. From the comparison between

Goalund and Janjira, number of growth centres within 30 km is almost the same around 10 growth centres. However, number of growth centres around Janjira within 50 km is a little bit higher than Goalund, but difference is not big.

Table 2.9.4 Development Schemes included in ADP During FY2003-04 (On-going under LGED)

SI No.	Title of Development Projects	Duration	Source of Aid	Project Area
	Sector: RD & I (LGD)			
1.	Rural Development Project-16: Infrastructure, Patuakhali and Barguna Districts (2nd Phase)	1999-00 2003-04	DANIDA	Patuakhali & Barguna Districts.
2.	Rural Infrastructure Development Project: Important Roads and Hat Bazar Development. (3rd Phase)	1995-96 2003-04	GOB	All over Bangladesh.
3	Rural Development Project-19: Infrastructure, Greater Barisal District.	1997-98 2003-04	OPEC	Bhola, Barisal, Jhalakathi and Pirojpur Districts.
4	Construction/Reconstruction of Roads, Bridges & Culverts (including flood damaged infrastructure) in Rural areas on priority basis. (Part-II)	1997-98 2003-04	IDB	All over Bangladesh.
5	Construction of Large Bridge/Culvert on important Feeder & Rural Roads.	1997-98 2003-04	DRGA	Dhaka, Munshigonj, Gopalgonj, Faridpur, Madaripur, Shariatpur Districts in Dhaka Division, Kushtia District under Khulna Division, and Barisal, Bhola, Patuakhali, Barguna & Jhalkathi Districts under Barisal Division.
6	Construction of Union Parishad Complex Building and Growth Center Connecting Road Development Project.	1998-99 2005-06	GOB	All over Bangladesh.
7	Rural Development Project-24: Greater Faridpur Infrastructure Development (Rural Infrastructure Development with the help of working facilities and participation).	1998-99 2004-05	JBIC	Faridpur, Madaripur, Gopalgonj, Shariatpur and Rajbari Districts.
8	Greater Jessore District Infrastructure Development Project.	1998-99 2003-04	GOB	Jessore, Jhenaidah, Magura and Narail Districts.
9	Construction of Steel Baily Bridge under DFID Assistance (2nd Phase), (Flood Rehabilitation).	1998-99 2003-04	DFID	Dhaka, Faridpur, Madaripur, Shariatpur, Khulna, Jessore, Kushtia, Barisal, Patuakhali, Jhalakathi Districts.
10	Netherlands Assisted Construction of Portable Steel Bridge under ORET Program.	1998-99 2003-04	Netherlands	All over Bangladesh.
11	Union Parishad Connecting Road Development: Patuakhali and Barguna Districts.	1998-99 2005-06	GOB	Patuakhali and Barguna Districts.
12	JICA Assisted Construction of Multipurpose Cyclone Shelter Project (2nd Phase).	1998-99 2003-04	JICA	Patuakhali and Barguna Districts.

SI No.	Title of Development Projects	Duration	Source of Aid	Project Area
13	Construction of Portable Steel Bridges under Japanese Grant.	1999-00 2003-04	JICA	Dhaka, Manikgonj, Munshigonj, Faridpur Districts.
14	Construction of Low Cost Bridge/Culvert in Rural Areas (2nd Phase).	2000-01 2003-04	GOB	All over Bangladesh.
15	Greater Khulna District Infrastructure Development Project.	2000-01 2003-04	GOB	Khulna, Bagerhat & Satkhira Districts.
16	Rural Development Project: (Road, Bridge/Culvert, Growth Center/Bazar, etc. Development).	2000-01 2004-05	GOB	All over Bangladesh.
17	Construction/Reconstruction of Roads, Bridges & Culverts (including flood damaged infrastructure) in Rural Areas on Priority Basis (Part-III).	2001-02 2003-04	GOB	All over Bangladesh.
18	Construction of Connecting Road of Asrayan Project.	2001-02 2003-04	GOB	Rajbari, Faridpur, Madaripur, Gopalgonj, Manikgonj, Khulna, Narail, Chuadanga, Magura, Jhinaidah, Meherpur, Kushtia, Bagerhat, Barisal and Barguna Districts.
19	Cyclone Rehabilitation Project: Entire Coastal Area (2nd Phase).	2001-02 2005-06	OPEC	Bhola Barguna, Patuakhali, Barisal, Jhalakthi, Pirojpur, Bagerhat, Khulna and Satkhira Districts.
20	Rural Infrastructure Development (Important Rural Road and Hat Bazar Development & Rehabilitation.	2001-02 2010-11	GOB	All over Bangladesh.
21	Rural Infrastructure Development Project (2nd Phase).	2002-03 2005-06	GOB	All over Bangladesh.
22	Greater Kushtia District Infrastructure Development Project.	2002-03 2004-05	GOB	Kushtia, Chuadanga & Meherpur Districts.
23	Greater Dhaka District Infrastructure Development Project.	2002-03 2006-07	GOB	Dhaka, Munshigonj and Manikgonj Districts.
24	Rural Infrastructure Improvement Project: 25 Greater Kushtia, Jessore, Khulna, Barisal & Patuakhali Districts.	2002-03 2008-09	ADB/KfW/ GTZ	Greater Kushtia, Jessore, Khulna, Barisal & Patuakhali Districts.
	Food Assistant Project:			
25	World Food Country Program 2001-05: Feeder Road Rehabilitation and Maintenance. Rural Road Maintenance Project through Destitute Women in Hill District (WFP).	2001-02 2005-06	WFP	All over Bangladesh.

Source: LGED

Three Year Rolling Investment Program During FY2004-05 (New Projects)

SI No.	Title of Development Projects	Duration	Source of Aid	Project Area
26	Food Security and Rural Development Project : Khulna Division.	2002-05	EU	Khulna Division.
27	Construction/Reconstruction of Roads, Bridges/Culverts in Rural Areas on Priority Basis (Part-IV).	2003-05	GOB	All over Bangladesh.
28	Rural Infrastructure Development Project through Partnership.	2002-05	GOB	All over Bangladesh.
29	Integrated Rural Infrastructure, Socio-economic Development and Poverty Reduction Project.	2002-05	GOB	Kushtia, Chuadanga, Meherpur, Faridpur and Rajbari Districts.
30	Rural Infrastructure Development (Important Rural Transportation Infrastructure and Markets Development & Rehabilitation) Project: 2nd Part.	2002-05	GOB	All over Bangladesh.
31	Integrated Rural Infrastructure and Poverty Reduction Project: Dhaka and Manikgonj Districts.	2002-05	SFD	Dhaka and Minikgonj Districts.
32	Construction/Reconstruction of Connecting Roads including Bridge/Culvert in under Development industrial and Agro-based Industrial Areas through Partnership.	2002-05	GOB	All over Bangladesh.
33	Construction/Reconstruction of Connection Roads including Bridges/Culverts in Tea Garden Areas.	2002-05	GOB	All over Bangladesh.
34	Construction of Union Parishad Bhaban & Development of Connecting Roads.	2002-05	GOB	All over Bangladesh.

Source: LGED

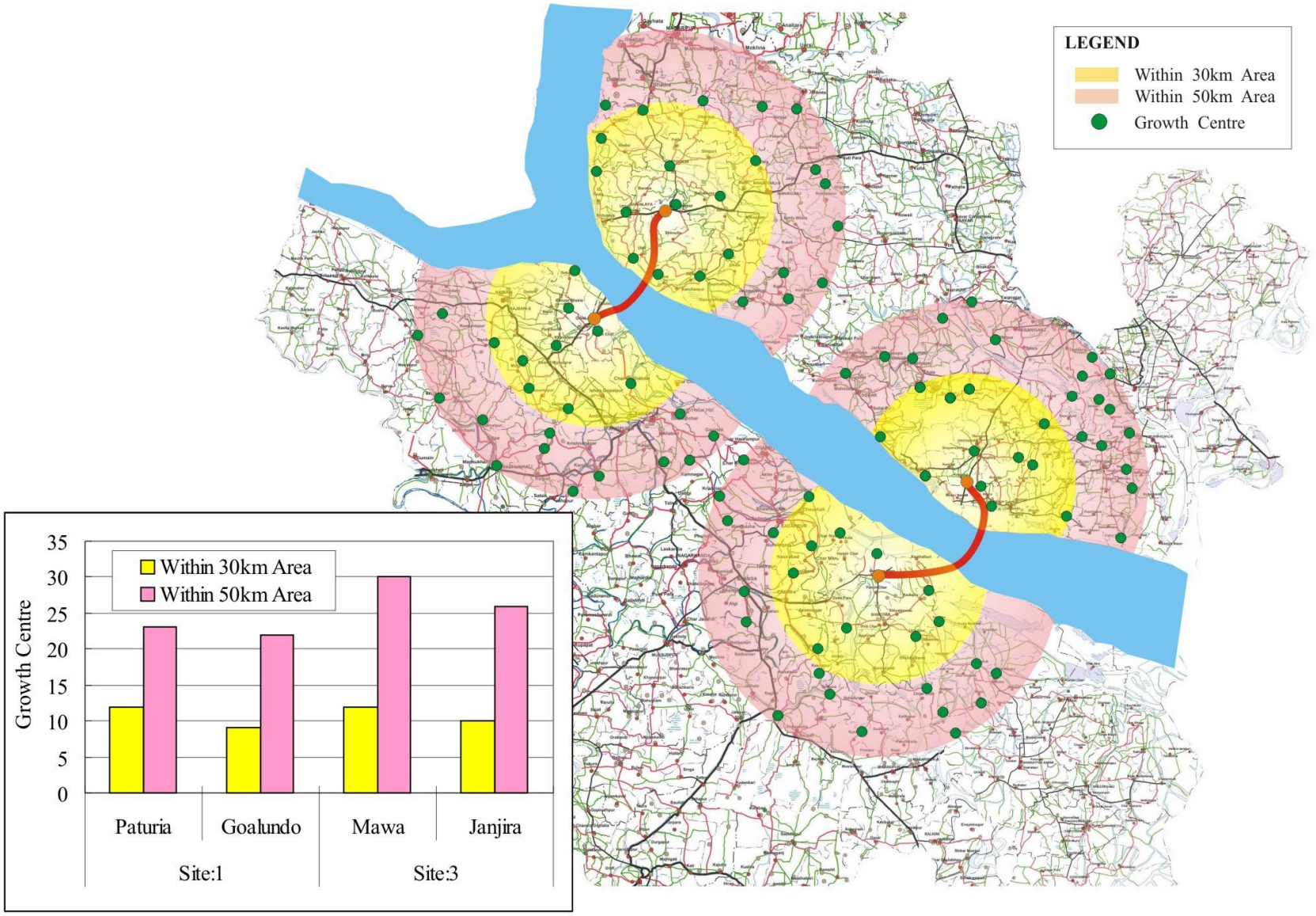


Figure 2.9.9 Growth Centres around Padma River

(8) Summary and Concluding Remarks

Comparisons between two candidate sites were made from various aspects and conclusions are summarized as below:

Item	Paturia Route	Mawa Route
Traffic Demand (2025)	19,850 vehicles/day	41,550 vehicles/day
Economic Feasibility	EIRR = 9.6 %	EIRR = 16.9 %
Financial Project Cost	1,260 Million US$	1,074 Million US$
Improvement of Accessibility	(Travel time) Dhaka – Mongla 4.5 hours Dhaka- Benapole 4.6 hours (Beneficiary Population) Within 3 hours from Dhaka 2,791,000 (9%) Within 4 hours from Dhaka 12,738,000 (42%)	(Travel time) Dhaka – Mongla 3.6 hours Dhaka – Benapole 3.6 hours (Beneficiary Population Within 3 hours from Dhaka 10,417,000 (35%) Within 4 hours from Dhaka 22,247,000 (74%)
Density of Feeder Roads	No big difference	
Formation of International Road Network		Asian Highway A-1 Short distance to Benepole Land Port and Mongla Sea Port
Contribution to Regional Economic Development	GDP of Southwest Region will increase by 18% (1.2% per year)	GDP of Southwest Region will increase by 35% (2.3% per year)
Growth Centers around the bridge sites	No big difference	

Therefore, Mawa route is considered as the most appropriate location for the Padma Bridge from the aspects of traffic demand, economic feasibility and indirect benefits.