No.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
JAMUNA MULTIPURPOSE BRIDGE AUTHORITY (JMBA)

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

FINAL REPORT

Volume 2

MAIN REPORT

MARCH, 2005

NIPPON KOEI CO., LTD.
in association with
CONSTRUCTION PROJECT CONSULTANTS, INC.

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05-017

The following foreign exchange rate is applied in this study:

(As of July, 2004)

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PREFACE

In response to a request from the Government of Bangladesh, the Government of Japan decided to conduct the Feasibility Study of Padma Bridge in the People's Republic of Bangladesh, and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Minoru Shibuya of Nippon Koei Co., Ltd. and consists of Nippon Koei Co., Ltd. and Construction Project Consultants, Inc. to the People's Republic of Bangladesh from May 2003 to February 2005.

The team held discussions with the officials concerned of the Government of Bangladesh, and conducted field surveys in the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I am confident that this report will not only contribute to the economic development of Bangladesh, but also to the enhancement of friendly relationship between our two nations.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Bangladesh for their cooperation and friendship extended to the study.

March, 2005

Kazuhisa Matsuoka
Vice President
Japan International Cooperation Agency

March, 2005

Letter of Transmittal

We are pleased to submit herewith the Final Report of the "The Feasibility Study of Padma Bridge in the People's Republic of Bangladesh". This study was entrusted to Nippon Koei Co., Ltd. in association with Construction Project Consultants, Inc., under a contract with Japan International Cooperation Agency (JICA), during the period from May 2003 to March 2005. The Report consists of Executive Summary, Main Report and Appendix.

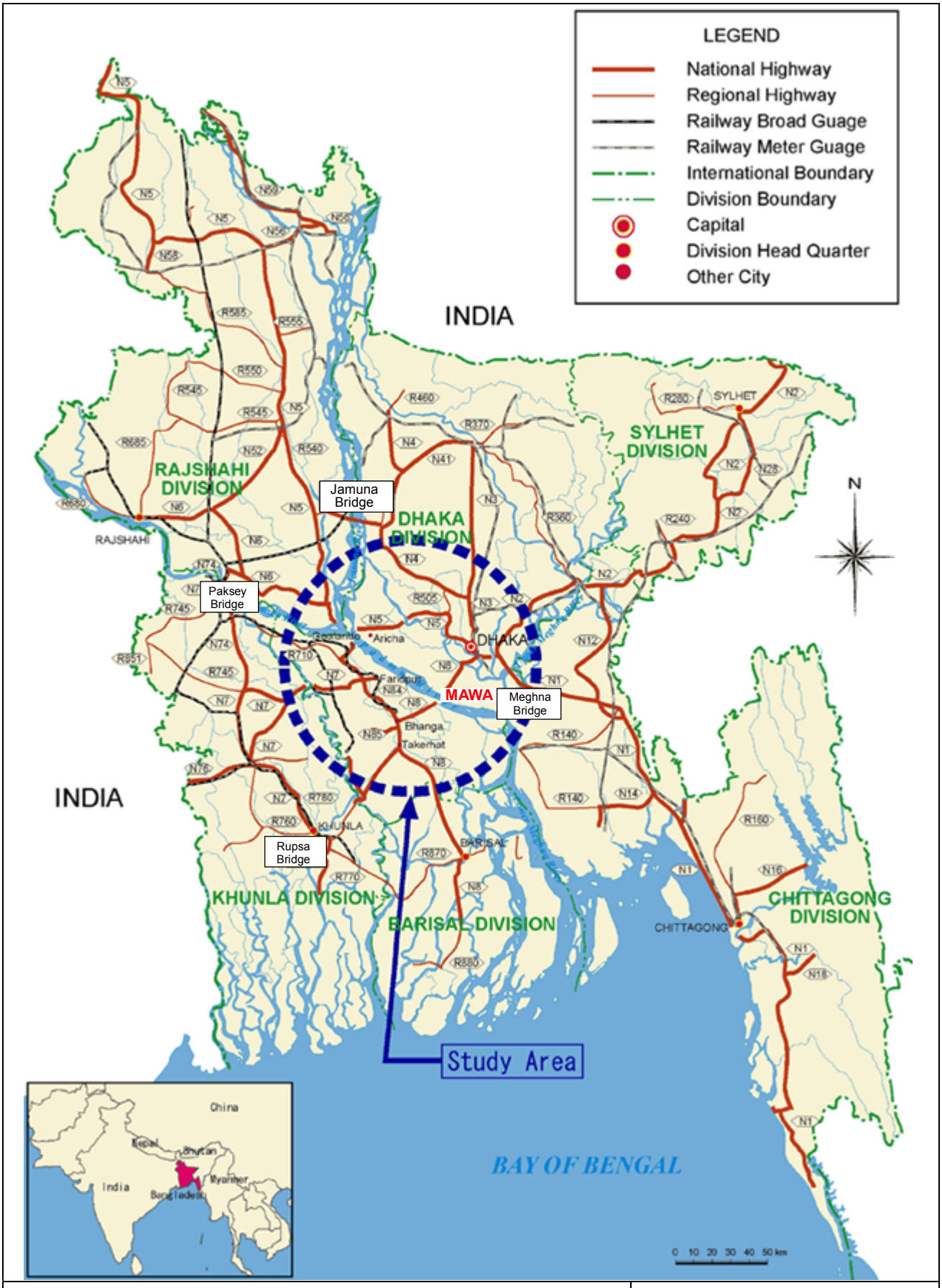
The report contains the advices and suggestions of the concerned authorities of the Government of Japan and your agency as well as the comments made by the concerned authorities of the Government of the People's Republic of Bangladesh and international funding agencies.

We would like to take this occasion to express our sincere gratitude to JICA, Jamuna Multipurpose Bridge Authority and the Ministry of Communications for providing an opportunity to conduct this Study. We are also the most grateful for the cooperation, guidance and assistance of the Steering Committee and the Technical Sub-committee in the Government of Bangladesh, the Embassy of Japan in Bangladesh , the JICA Bangladesh office and the international donors represented in Bangladesh that share the same goal of improving the economic condition of Bangladesh. We have to appreciate the Advisory Committee Members from University of Tokyo, Toyo University, Ministry of Land, Infrastructure and Transportation of the Government of Japan, Japan Highway Public Corporation for extending advices and comments towards the Study. The Final Report is a fruit of excellent collaboration of all stakeholders in this Study.

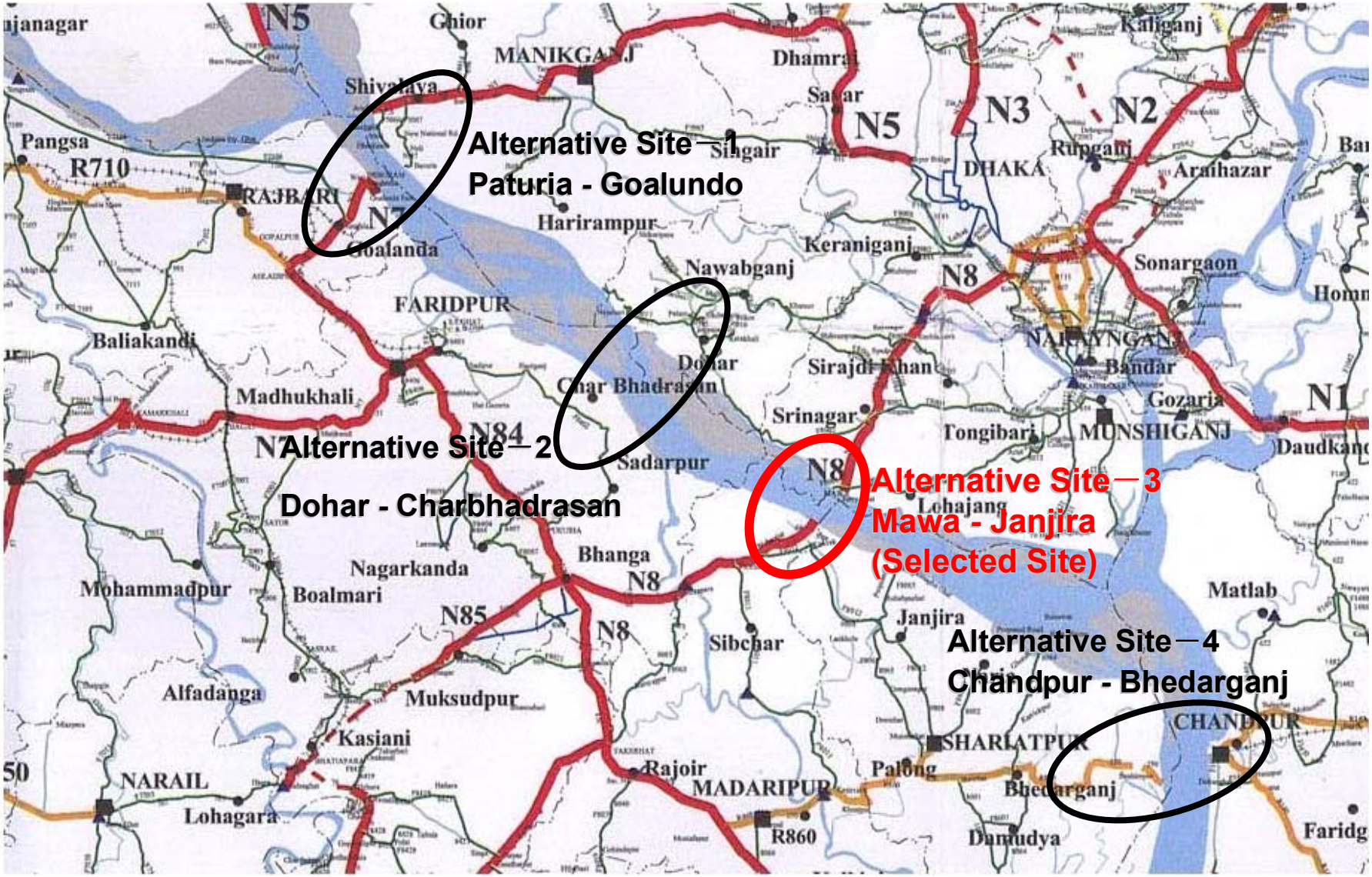
We hope that this report will contribute to improve the economic conditions in the southwest region and all over Bangladesh.

Yours Faithfully,

Minoru SHIBUYA
Team Leader, JICA Study Team for
the Feasibility Study of Padma Bridge
in the People's Republic of Bangladesh



The Feasibility Study of Padma Bridge In the People's Republic of Bangladesh	Location Map（1）



The Feasibility Study of Padma Bridge
In the People's Republic of Bangladesh

Location Map（2）

The Feasibility Study of Padma Bridge In the People's Republic of Bangladesh	Schematic Image（1）

The Feasibility Study of Padma Bridge
In the People's Republic of Bangladesh

Schematic Image（2）

STRUCTURE OF FINAL REPORT

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VOLUME III SOCIO-ECONOMIC AND TRANSPORT STUDIES
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APPENDIX-2: TRANSPORT STUDIES

VOLUME IV TOPOGRAPHIC SURVEY AND GEOTECHNICAL INVESTIGATION
APPENDIX-3: TOPOGRAPHIC AND BATHYMETRIC SURVEYS
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VOLUME V RIVER STUDIES
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APPENDIX-8: BRIDGE ENGINEERING
APPENDIX-9: HIGHWAY ENGINEERING
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VOLUME VII ENVIRONMENTAL AND SOCIAL/RESETTLEMENT STUDIES
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VOLUME IX SUPPORTING STUDIES
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The Feasibility Study of Padma Bridge
Final Report (Vol. 2 Main Report)

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Abbreviations

AASHTO	:	American Association of State Highway and Transport Officials
ADB	:	Asian Development Bank
ADDT	:	Annual Average Daily Traffic
ADP	:	Annual Development Program (of Bangladesh)
AH	:	Asia Highway
AIT	:	Asian Institute of Technology, Bangkok
AP		Affected Person
BBS	:	Bangladesh Bureau of Statistics
BCL	:	Bangladesh Consultants Ltd
BIM	:	Bangladesh Institute of Management
BIWTA	:	Bangladesh Inland Water Transport Authority
BMD	:	Bangladesh Meteorological Department
BOD	:	Bio-chemical Oxygen Demand
BPDB	:	Bangladesh Power Development Board
BR	:	Bangladesh Railway
BTTB	:	Bangladesh Telephone and Telegraph Board
BWDB	:	Bangladesh Water Development Board
CBE	:	Commercial and Business Enterprises
CCTV	:	Closed Circuit Television
CD	:	Chart Datum
CEGIS	:	Center for Environmental and Geographic Information Services
CIDA	:	The Canadian International Development Agency
CO	:	Carbon Mono Oxide
COD	:	Chemical Oxygen Demand
CPR	:	Common Property Resource
DANIDA	:	Danish International Development Agency
DC	:	Deputy Commissioner
DFID	:	The Department for International Development, the UK Government
DF/R / DFR	:	Draft Final Report
DG	:	Director General
DHI	:	Danish Hydraulic Institute
DHWL	:	Design High Water Level
DMSD	:	Design Maximum Scour Depth
DO	:	Dissolved Oxygen
DOE	:	Department of Environment
EA	:	Executing Agency
EC	:	European Communities
ECA	:	Environment Conservation Act
ECR	:	Environmental Conservation Rules
EGIS	:	Environmental and GIS Support Project for Water Planning Sector
EIA	:	Environmental Impact Assessment
EMAP	:	Environmental Management Action Plan
EMMP	:	Environmental Management and Monitoring Plan
EMP	:	Environment Management Plan
EPZ	:	Export Processing Zone

EQS	:	Environmental Quality Standards
ERD	:	Economic Relations Division
EVA	:	Extreme Value Analysis
F&A	:	Finance & Accounts
FAP	:	Flood Action Plan
FDI	:	Foreign Direct Investment
FFWS	:	Flood Forecasting and Warning Services
FFWC	:	Flood Forecasting and Warning Center
FFYP	:	Fifth Five Year Plan
FGD	:	Focus Group Discussions
FY	:	Fiscal year
GB	:	Guide bund
GDP	:	Gross Domestic Product
GIS	:	Geographic Information Services
GJM River	:	Ganges-Jamuna-Meghna River
GOB	:	The Government of Bangladesh
GRDP	:	Gross Regional Domestic Product
GRP	:	Gross Regional Product
GSB	:	Geological Survey of Bangladesh
GTCL	:	Gas Transmission Co., Ltd.
GTZ	:	German Technical Cooperation
GW	:	Ground Water
HH	:	Household
H-Q	:	Stage-Discharge Rating Equation
HWL	:	High Water Level
IDA	:	International Development Association
IDF	:	Intensity, duration, and frequency
IEC	:	Important Environmental Component
IEE	:	Initial Environmental Examination
IRRI	:	International Rice Research Institute
ISA	:	Initial Social Assessment
IUCN	:	International Conservation Union
IWM	:	Institute of Water Modeling
IWT	:	Inland Waterway Transport
JBIC	:	Japan Bank for International Cooperation
JICA	:	Japan International Cooperation Agency
JMBA	:	Jamuna Multipurpose Bridge Authority
JMREMP	:	Jamuna-Meghna River Erosion Mitigation Project
JOMAC	:	Jamuna Operations and Maintenance Advisory Consultants
KFW	:	The German Development Bank
kip	:	1,000 pounds (unit)
LA	:	Land Acquisition
LGED	:	Local Government Engineering Department
LGI	:	Local Government Institutions
LWL	:	Low Water Level
M&E	:	Maintenance of Mechanical and Electronic Equipment
MEPZ	:	Mongla Export Processing Zone
MIKE11	:	A hydraulic model developed by DHI
MJ	:	Mawa - Janjira

MOC	:	Ministry of Communications
MOF	:	Ministry of Finance
MOP	:	Ministry of Planning
MOS	:	Ministry of Shipping
MPA	:	Mongla Port Authority
MWL	:	Mean Water Level
N	:	Newton (unit)
NE	:	Northeast
NEDECO	:	Netherlands Engineering Consultants
NEIP	:	National Flood Insurance Programme
NGO	:	Non Governmental Organization
NMV	:	Non-Motorized Vehicles
NOx	:	Nitrogen Oxides
NS-EGPRSD	:	National Strategy for Economic Growth, Poverty Reduction and Social Development
OECF	:	The Overseas Economic Cooperation Fund, present JBIC
O&M, O/M	:	Operations and Maintenance
OMAC	:	Operations and Maintenance Advisory Consultants
OPEC	:	Organization of Petroleum Exporting Countries
PC	:	Prestressed Concrete
PCU	:	Passenger Car Units
PFR	:	Pre-Feasibility Report
PG	:	Paturia - Goalundo
PGCB	:	Power Grid Company of Bangladesh Ltd.
PRA	:	Participatory Rapid Appraisal
Pre-F/S, Pre-FS	:	Pre-feasibility Study
PWD	:	Public Works Datum
QA	:	Quality Assurance
RAP	:	Resettlement Action Plan
RHD	:	Roads and Highways Department
ROW	:	Right of Way
RPT	:	Rendel Palmer & Tritton
RRI	:	River Research Institute
RRMP-III	:	Third Road Rehabilitation and Maintenance Project
RRP	:	Railway Recovery Program
RTW	:	River Training Works
S.A.	:	Service Area
SAARC	:	South Asian Association for Regional Co-Operation
SDC	:	Swiss Agency for Development and Cooperation
SE	:	Superintending Engineer
SHWL	:	Standard High Water Level
SLWL	:	Standard Low Water Level
SIA	:	Social Impact Assessment
SIDA	:	The Swiss Agency for Development and Cooperation
SOB	:	Survey of Bangladesh
SOx	:	Sulfur Oxides
SPARRSO	:	Bangladesh Space Research and Remote Sensing Organization

SPM	:	Suspended Particular Matter
SRNDP	:	Southwest Road Network Development Project
SW	:	Southwest
SW	:	Surface Water
SWMC	:	Surface Water Modeling Center
T & T Bond	:	Telegraph & Telephone Bond
Tk	:	Taka
TDS	:	Total Dissolved Solid
TYRP	:	Three-Year Rolling Plan
TSS	:	Total Suspended Solid
UN ESCAP	:	United Nations Economic and Social Commission for Asia and the Pacific
UNDP	:	United Nations Development Programme
UP	:	Union *Parishad*
USAID	:	The United States Agency for International Development
VAT	:	Value-Added Tax
WARPO	:	Water Resources Planning Organization
WB	:	The World Bank
WMO	:	World Meteorological Organization

Chapter 1 Introduction

1.1 BACKGROUND OF THE STUDY

1.1.1 Objectives of Padma Bridge Project

The subcontinent's major rivers, the Padma, Jamuna (Brahmaputra), Ganges and Meghna Rivers have geographically and historically divided the People's Republic of Bangladesh (hereinafter referred to as "Bangladesh") since independence in 1971 into four principal areas, viz the North Central (Dhaka Division), East (Chittagong and Sylhet Divisions), Northwest (Rajahahi Division) and Southwest (Khulna and Barisal Divisions) zones.

The road network has been developed and now provides good links between the Northwest, North Central and East zones and encompasses the national capital Dhaka. This development includes five highway bridges that have been constructed over the major rivers except the Padma. Three bridges cross the Meghna and its tributaries (Meghna Bridge, Meghna-Gumti Bridge and Bhairab Bridge); one multipurpose bridge crosses the Jamuna (Bangabandhu Bridge, a combined highway and railway bridge); and one bridge crosses the Ganges (Paksey Bridge).

The Southwest zone is separated from other parts of the country, especially from the North Central zone where the national capital of Dhaka is located, by the Padma River. Although there have been improvements and developments of the road network of the Southwest zone, links with the rest of the country across the Padma River are still via ferries on National Highways No.7 and No.8 and others.

Transport capacity of ferry services is very limited and, even now, waiting time at ferry ghats is about one hour for buses/light vehicles and two hours for trucks. In addition, riverbanks of the Padma River are very unstable and the river width changes frequently and temporally approach ghats have to be changed depending on the seasons. Therefore, expansion of existing ferry terminals is difficult due to these unstable river conditions. Moreover, there is an urgent need to replace existing dangerous ferry/launch operations between Dhaka and the Southwest region by more safety and reliable surface transport system. Overloaded vessels frequently sink in this waterway route passing through near the risky-prone zone of turbulent confluence of the Padma and Meghna rivers.

The social, economic and industrial underdevelopment of the Southwest zone, which encompasses Bangladesh's second major port, Mongla, its third main city, Khulna, and the inland port at Benapole, is in part due to difficult access across the Padma River to the rest of the country.

If a bridge to cross the Padma River is constructed, it will certainly strengthen the linkage between the Southwest and North Central zones. A highway bridge, in particular, will improve and enhance the freight and passenger transportation between Dhaka and major points in the Southwest zone and contribute substantially to the regional development of the Southwest zone as well as to national economic growth. Thus, the primary objective of the Project could be stated as the integration of the Southwest and North Central zones through direct linking of highway networks in both Regions.

Bangladesh will bestride the Asian Highway Route A-1, which is planned under the United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP), to

connect Asia (Tokyo, Japan) to Europe (Kapikule, Turkey) via Pusan, Beijing, Delhi and Istanbul. One section of this corridor is to connect Kolkata in India to Dhaka through Mawa and Bhanga in the area near the Padma River. This section of the National Highway N8 is being improved/rehabilitated as a part of the Southwest Road Network Development Project by the Government of Bangladesh with the assistance of the Asian Development Bank. If the Padma Bridge Project selects the Mawa site as its Padma crossing location, it will complement the missing link of the Asian Highway Route A-1 as well as the National Highway N8.

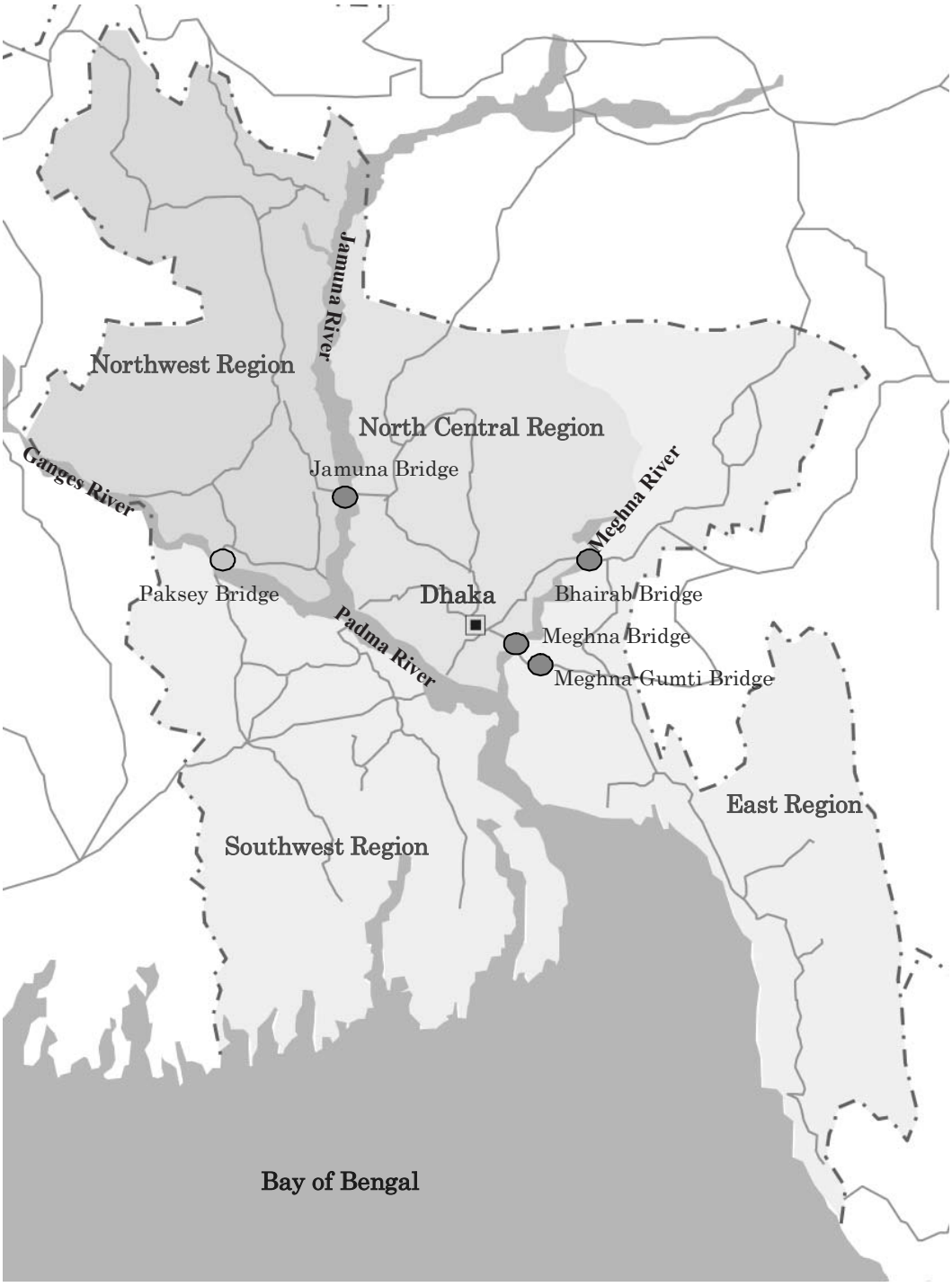


Figure 1.1.1 Four Zones of Bangladesh and Inter-Zonal Bridges

1.1.2 Feasibility Study

A Pre-feasibility Study for the construction of a bridge across the Padma to connect the South West zone to North and East zones was conducted by JMBA contracting with RPT and NEDECO in association with BCL from May1999 to February 2000. In this Pre-feasibility Study, an alternative of ferry improvement was also abandoned due to the same reason explained as above.

Afterwards, the Government of Bangladesh requested the Government of Japan to conduct a Feasibility Study on Construction of the Bridge over the Padma River. In response to the request, the Government of Japan has decided to conduct the Study under the relevant laws and regulations in force in Japan.

The Japan Inte4rnational Cooperation Agency (JICA), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, dispatched the Preparatory Study Team for the Feasibility Study of Padma Bridge, headed by Dr. Yuzo Akatsuka, to Bangladesh from November 22 to December 6, 2001. The Preparatory Study Team had a series of meetings to discuss the Scope of Work for the Study from November 25 to December 4, 2001 with the related agencies, viz. the Economic Relations Division (ERD) of the Ministry of Finance, the Planning Commission, the Ministry of Communications (MOC), Jamuna Multipurpose Bridge Authority (JMBA), Roads and Highways Department (RHD), Bangladesh Railway (BR) and Bangladesh Water Development Board (BWDB). Accordingly, the Scope of Work for Feasibility Study of Padma Bridge in the People's Republic of Bangladesh was established as set out in the Minutes of Meeting dated December 4, 2001 between ERD of the Ministry of Finance and JICA Preparatory Study Team.

On the basis of the Scope of Work for the Feasibility Study (the Study), JICA is undertaking the Study in close cooperation with the Government of Bangladesh. In May 2003, JICA organized an Advisory Committee headed by Dr. Yozo Fujino, Professor of University of Tokyo. In the meantime, JICA appointed a Study Team, headed by Mr. Minoru Shibuya, consisting of Nippon Koei Co., Ltd. in association with Construction Project Consultants, Inc. (the Study Team) to conduct the Study, and dispatched the Study Team from May 16, 2003.

The Study Team produced and submitted the Inception Report in May 2003. It has been conducting the Study. Study since that time in accordance with the work flow diagram shown in Figure 1.1.2.

In September 2003, the Study Team produced Progress Report-1, which deals with the outcomes of the Study from May to September, 2003. As a result of the Progress Report-1, the Study Team selected 2 prospective bridge sites, Paturia-Goalundo (PG) and Mawa-Janjira (MJ) sites, from 4 conceivable sites that were identified as possible crossings from the viewpoints of engineering and transport at the outset of the Study.

The Study Team has conducted comparative studies between the two prospective bridge sites following the Progress Report-1 so as to select a final bridge site. In February 2004, the Study Team prepared the Interim Report, in which the outcomes and findings from May 2003 to February 2004 were included. As a result of the Interim Report, the Study Team recommended Mawa-Janjira site as the crossing location of the Padma Bridge. A written consent to the Mawa-Janjira site was made by the Government of the Bangladesh on July 17, 2004.

On the basis of the selected Mawa-Janjira site, the Study Team conducted preliminary designs from April to September, 2004 for the various facilities, e.g., Padma Bridge,

approach roads, toll plaza, service areas, minor bridges, underpass, riverbank protection works, public utilities, etc. In September 2004, the Study Team prepared Progress Report-2, which deals with the outcomes of preliminary facility designs.

From October 2004, the Study Team conducted cost estimation, implementation scheduling and economic and financial analyses of the Project. In January 2005, the Study Team prepared the Draft Final Report, which deals with all the outcomes throughout the Study.

This Final Report was prepared incorporating the comments on the Draft Final Report from Bangladesh side, Japan side, and international funding agencies especially ADB and JBIC. Discussions at the seminar conducted on 2nd February, 2005 and written comments dated 12th February, 2005 prepared by Bangladesh side were also reflected.

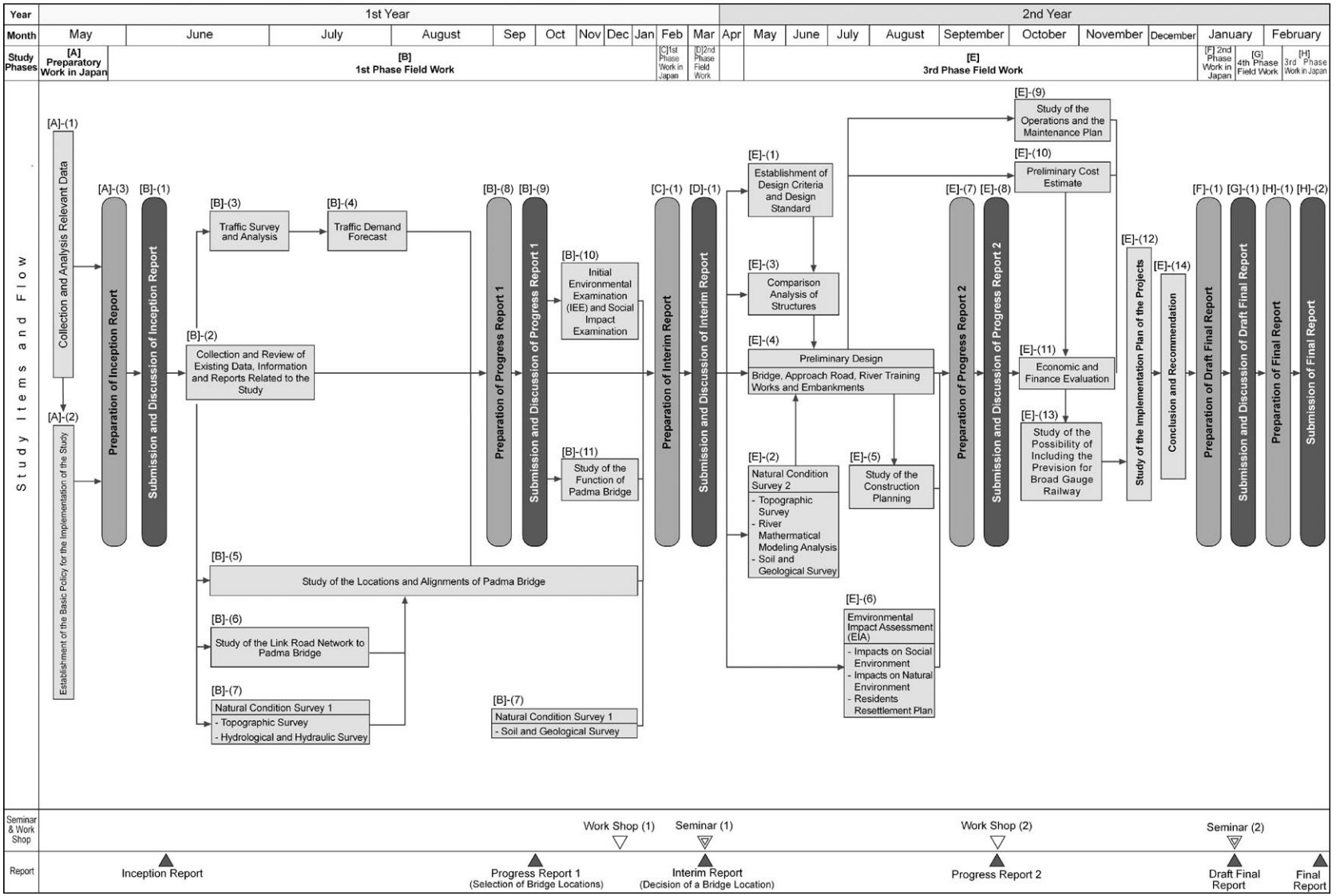


Figure 1.1.2 Work Flow Diagram of the Study

1.2 COMPONENT OF FINAL REPORT

This Final Report consists of the following 9 volumes:

Volume I	Executive Summary
Volume II	Main Report
Volume III	Appendices of Socio-economic and Transport Studies
Volume IV	Appendices of Topographic Survey and Geotechnical Investigation
Volume V	Appendices of River Studies
Volume VI	Appendices of Highway, Bridge and Other Engineering Studies
Volume VII	Appendices of Environmental and Social/Resettlement Studies
Volume VIII	Drawings of Preliminary Facility Design
Volume IX	Supporting Studies

Volume I Executive Summary describes major outcomes and findings of the Study.

Volume II Main Report consists of 11 chapters: Chapter 1 Background of the Project, Chapter 2 Socio-Economic and Transport, Chapter 3 Bridge Location Study, Chapter 4 Field Investigation for the Selected Site, Chapter 5 Preliminary Facility Design, Chapter 6 Construction Plan and Cost Estimate, Chapter 7 Environmental Studies, Chapter 8 Social Impact and Resettlement Studies, Chapter 9 Economic and Financial Evaluation, Chapter 10 Implementation Program, Chapter 11 Operation and Maintenance Plan, and Chapter 12 Conclusions and Recommendations.

Chapter 1 deals with the background of the Project including the background of the Study, member list and main events of the Study. Chapter 2 deals with socio-economic conditions of Bangladesh, existing transport profile, and overview of the Project area. Chapter 3 describes how the bridge site has been selected and includes the characteristics of the Padma River, identification of four bridge location alternatives and selection of final bridge site (Mawa-Janjira) by comparing two prospective sites (Patoria-Goalundo and Mawa-Janjira). Chapter 4 describes topographic and bathymetric surveys, geotechnical investigations and river morphological survey for the selected bridge site. Chapter 5 deals with the preliminary design of the Padma Bridge for five alternatives, approach road and tollway facilities, river facility and public utilities. Chapter 6 deals with the construction plan and cost estimate including methodology, selection of construction methods and plans, procurement of labor, equipment and materials for the construction works, tentative construction schedule, cost estimate procedures, cost estimate by alternatives, etc. Chapter 7 deals with environmental studies and Chapter 8 social impact/resettlement studies. Chapter 9 describes economic and financial evaluation including methodology and analyses for the economic evaluation, toll system, procurement of finance and analyses for the financial evaluation, and socio-economic impacts studies. Chapter 10 deals with implementation program including time schedule of various proceedings, procurement of engineering services and construction works, etc. Chapter 11 describes operation and maintenance plan, and Chapter 12 discusses the conclusion and recommendations of the Study.

1.3 STUDY ORGANIZATION AND MEMBERS INVOLVED

1.3.1 Study Organization

In order to accomplish the purpose of the Study effectively, the study organization was established as shown in Figure 1.3.1.

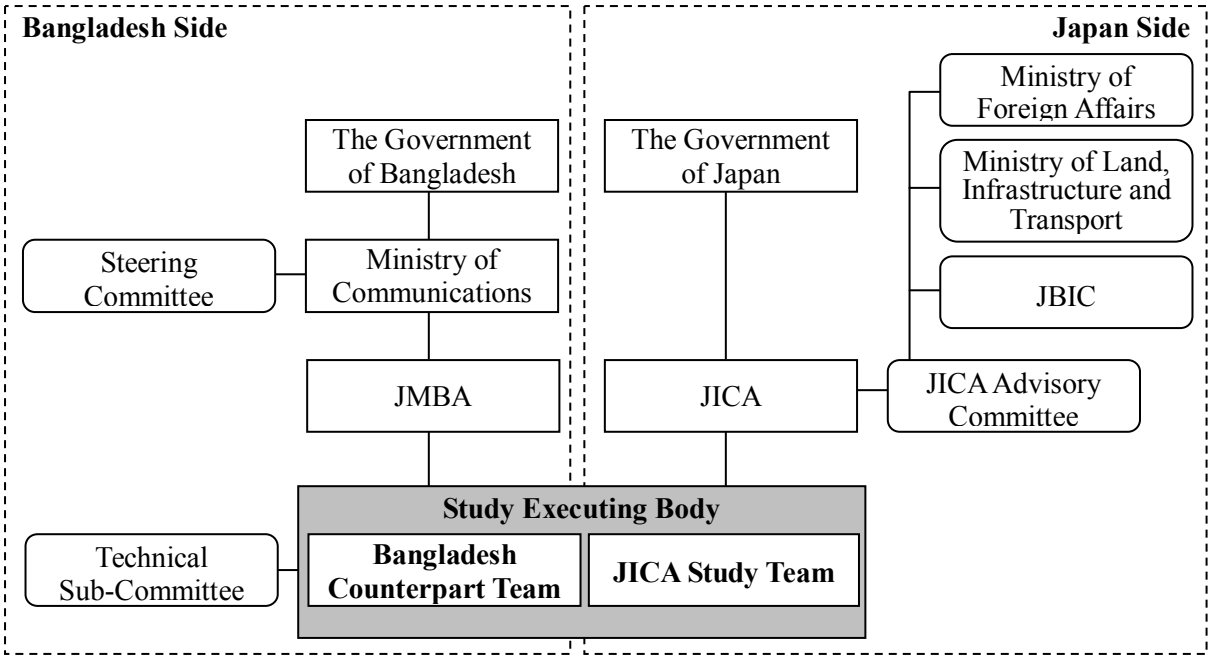


Figure 1.3.1 Study Organization

1.3.2 Main Roles of Each Committee and Counterpart Team

(1) Bangladesh Side

JMBA is the direct counterpart agency of Bangladesh for the Study Team. All necessary arrangements such as setting of important meetings, requesting essential data and information from other agencies concerned, etc. were made through JMBA. They also attended the Technical Sub-committee Meetings. The Study Team has undertaken technical transfer for personnel of JMBA as well.

Steering Committee consists of representatives from related Ministries and chaired by the Secretary of Ministry of Communications. The roles of the committee are to share the common information on the project between ministries and to give high level decisions on the important matters for the project. The Committee also provides comments to the Study Team through discussions in each phase of report submissions. Each discussion was recorded as Minutes of Meeting which was signed by representative of both Bangladesh side and Japan side.

Technical Sub-committee (Counterpart Team) consists of executive engineers/ professionals in the all fields related to the Study from government agencies/ universities and institutes. Deep discussions from the technical point of view were developed and opinions were exchanged between Bangladesh counterpart personnel and the study team. Results of discussions were reflected in the Study as well. The sub-committee meeting was held, in general, on the monthly base.

(2) Japanese Side

JICA Advisory Committee consists of related technical specialists from the universities and governmental agencies in Japan. The committee was established by JICA for the purpose of providing the Study Team with advice, suggestions/ comments on the methodology and results of the Study from the technical point of view. Total 11 times of Advisory Committee Meeting were held at JICA Headquarter in Tokyo. In the meetings, representative of

Japanese governmental agencies including Ministry of Foreign Affairs, Ministry of Land, Infrastructure and Transport, and JBIC (Japan Bank for International Cooperation) also attended to exchange ideas. Members of the committee visited Bangladesh to attend and discuss at Steering Committee meetings and signed on the Minutes of Meeting on the study reports. They also attended Seminars and Workshops for discussion and made special presentations to give advanced ideas related to the study.

1.3.3 Members List of Bangladesh Side

Followings are the members list of Bangladesh side participated in the Study.

(1) Steering Committee Members

Serial No	Officials of Respective Ministry/Department	Designated Position
01.	Secretary, Ministry of Communications.	Convener
02.	Executive Director, Jamuna Multipurpose Bridge Authority (JMBA).	Member
03.	Chief Engineer, Roads and Highways Department.	Member
04.	Joint Secretary (Dev.), Ministry of Communications.	Member
05.	Joint Chief, Ministry of Communications.	Member
06.	Representative from the Ministry of Land (Not below the rank of Joint Secretary).	Member
07.	Representative from the Finance Division (Not below the rank of Joint Secretary).	Member
08.	Representative from the Economic Relation Division (Not below the rank of Joint Secretary/Joint Chief).	Member
09.	Representative from the Ministry of Shipping (Not below the rank of Joint Secretary/Joint Chief).	Member
10.	Representative from the Ministry of Home Affairs (Not below the rank of Joint Secretary).	Member
11.	Representative from the Ministry of Water Resources (Not below the rank of Joint Secretary/Joint Chief).	Member
12.	Representative from the Planning Commission (Not below the rank of Joint Chief)	Member
13.	Representative from the Implementation Monitoring and Evaluation Division (Not below the rank of Director General)	Member
14.	Chief Engineer, JMBA	Member Secretary

(2) Technical Subcommittee (Counterpart Team)

Serial No.	Designated Post	Name, Designation and Organization
01	Convener	Executive Director, JMBA
02	Chief Counterpart Team	Alhaj Md. Abdul Malek, Chief Engineer, Jamuna Multipurpose Bridge Authority (JMBA)
03	Road Engineer	Mr. Kshitish Chandra Majumder, Superintending Engineer (SE), Road Design and Safety Circle, RHD, Dhaka.
04	Bridge Engineer	Mr. Md. Idrish Mia, Additional Chief Engineer, Chittagon Division, RHD
05	Railway Engineer	Mr. Md. Nurul Amin, Joint Director General (Engg,) Bangladesh Railway, Rail Bhaban, Dhaka.
06	River Engineer	Mr. Md. Naushad Ali, Superintending Engineer, Office of the Chief Engineer (Design), BWDB, 72 Green Road, Dhaka-1215.
07	Geo-Technical Engineer	Mr. A. Z. M Nuran Nabi Khan, Superintending Engineer, Design Circle-1, BWDB, 72 Green Road, Dhaka-1215
08	Transport Engineer	Mr. M. A. Khaleque, GMTS, DTCB, Dhaka
09	Social Development Specialist	Mr. Quamrul Ahsan Chowdhury Professor / Chairman, Department of Sociology, Dhaka University
10	Environmental Specialist	Mr. Md. Reazuddin, Director (Technical), Department of Environment, Agargaon, Dhaka.
11	Regional Development Specialist	Dr. M. K. Muniruzzaman, Professor Dept. of URP, BUET, Dhaka
12	Fiscal Specialist	Mr. A.K.M Nurunnabi Chowdhury, Director General, Bangladesh Institute of Management (BIM), Sobhanbagh, Dhaka.
13	Quantity Surveyor	Mr. Md. Helal Uddin, Superintending Engineer, Bridge Planning, RHD, Dhaka

(3) Key Personnel from JMBA Headquarters

Serial No.	Designated Post of JMBA	Name	Period
01	Executive Director	Mr. AKM Shamsuddin Mr. Md. Lutfar Rahman Talukder Mr. Khandaker Md. Ali Hasan Mr. Md. Mohsin Ali Mr. Mustaq Uddin Ahmed Mr. Amiruddin Ahmed	Aug. '04 to date April '04 to July '04 Nov. '03 to April '04 Sep. '03 to Nov. '03 Jul. '03 to Sep. '03 May '03 to Sep. '03
02	Chief Engineer	Alhaj Md. Abdul Malek Mr. Khandaker Azadur Rahman Mr. Moizuddin Ahamed Jaigirdar Mr. Md. Shajahan	Nov'04 to date Aug. '04 to Nov'04 July. '03 to Jun. '04 May '03 to Jun. '03
03	Joint Secretary/Director (F&A)	Mr. Sah Md. Monsurul Haque Mr. Kabir Mr. Md. Serajul Islam	Sep'04 to Date Mar'04 to Sep' 04 May '03 to Dec'03
04	Director (Administration)	Mr. Md. Yousuf Zahangir Sikder	May '03 to date
05	Director (Planning)	Mr. A. K. M. Shamsuzzoha	May '03 to date
06	Director (Finance)	Mr. Fazle Kabir Mr. Fazle Kabir	Aug. '04 to date May '03 to Jul. '04
07	Additional Director (SE)	Mr. Abu Sufian Mr. Md. Zulfiqure Haider	Aug. '04 to date May '03 to Jul. '04
08	Additional Director (Administration)	Mr. Md. Mujibur Rahman	May '03 to date
09	Additional Director (Estate)	Mr. Md. Liaqual Ali	May '03 to date
10	Executive Engineer (RTW)	Mr. Md. Kazi Ferdous	May '03 to date
11	Executive Engineer (Road & Bridge)	Mr. Mohamad Iqbal	May '03 to date
12	Assistant Engineer (RTW)	Mr. Md. Sharful Islam	May '03 to date
13	Assistant Engineer (Road)	Mr. Md. Golam Mortaja	May '03 to date
14	Assistant Engineer (RTW)	Mr. Sayed Rajab Ali	May '03 to date
15	Assistant Engineer (Building)	Mr. Shafiqul Islam	May '03 to date

1.3.4 Members List of Japanese Side

(1) JICA Advisory Committee Members

Serial No	Designated Post	Name, Designation and Organization
01	Leader/ Bridge Planning	Dr. Yozo Fujino Prof., Department of Civil Engineering University of Tokyo
02	Traffic Planning	Dr. Yuzo Akatsuka Professor in Emeritus, Toyo University
03	Road Planning	Mr. Yoshihiro Era Senior Engineer, Information System Div., General Affairs Dept., Japan Highway Public Corporation
04	River Planning	Mr. Osamu Itagaki (Apr. '04 to date) Mr. Atsushi Hattori (May '03 to Mar. '04) Senior Researcher, River Div., National Institute for Land and Infrastructure Management, Ministry of Land, Infrastructure and Transportation
05	Regional Development	Mr. Akira Kaneko Prof., Faculty of Regional Development Studies Toyo University
06	Environment Consideration/ Resettlement	Dr. Masahide Horita Associate Prof., Department of Civil Engineering University of Tokyo
07	Study Planning	Mr. Naofumi Yamamura (Apr. '04 to date) Mr. Tomoyuki Nakazono (May '03 to Mar. '04) 1st Development Study Div., Social Development Study Dept., JICA

(2) JICA Study Team Members

Serial No	Designation	Name
01	Team Leader	Mr. Minoru Shibuya
02	Deputy Team Leader/Traffic Planner	Mr. Masahito Homma
03	Deputy Team Leader/Bridge Planner	Mr. Katsufumi Matsuzawa
04	Highway Planner	Mr. Yuichi Tsujimoto
05	River Planner	Mr. Noboru Jitsuhiro
06	River Morphologist	Mr. Akihiro Matsuda
07	Traffic Survey/Analysis	Mr. Christopher Rose
08	Demand Forecast	Mr. Koichi Arakawa
09	Natural Condition Survey（Hydrological）	Mr. Masayuki Ogino
10	Natural Condition Survey（Geological）	Mr. Masanobu Ishiguro
11	Natural Condition Survey（Topographical）	Mr. Nobuharu Shimizu
12	Environment and Social Impact Assessment	Dr. A. K. M. Nurul Islam
13	Resettlement and Land Acquisition Planner	Dr. Mohammad Zaman
14	Bridge Engineer (Superstructure 1）	Mr. Jiro Koyama
15	Bridge Engineer (Superstructure 2)	Dr. Ahmed S. E. Morgan
16	Bridge Engineer (Substructure 1）	Mr. Paul Wright/ Mr. Nigel Brook*
17	Bridge Engineer (Substructure 2）	Mr. Takeshi Yoshida
18	Highway Engineer	Mr. Hideaki Morita
19	River Facility Planner (1)	Mr. Takuji Kono
20	River Facility Planner (2)	Mr. Daikichi Ogawada
21	Construction Planner/Cost Estimator	Mr. Shinichiro Watanabe / Mr. Naoaki Sonobe**
22	Economic and Financial Analyst (1)	Mr. Katsuyoshi Matsuda
23	Economic and Financial Analyst (2)	Mr. Hajime Onishi
24	Maintenance and Management Planner	Mr. Koji Enomoto
25	Electrical Services and Public Utilities	Mr. Masahiro Iwabuchi / Mr. Akira Shimizu
26	Bridge Engineer (Substructure 3)/Administrator	Mr. Kentaro Okuno
27	Senior Advisor	Dr. Masahiko Oya

Note: * Mr. Nigel Brook was a replacement of Mr. Paul Wright.
**Mr. Naoaki Sonobe was a replacement of Mr. Shinichiro Watanabe from December 2003 to January 2004 when Mr. Watanabe was hospitalized.

1.4 MAIN EVENTS TO DATE

The following are main events from the beginning of the Study in May 2003 to present as of January 2005:

Date (day)	Place	Event
May 18 (Sun), 2003	MOC	Briefing and submission of Inception Report to the Communications Minister
May 20 (Tue)	JMBA	Explanation of Inception Report to JMBA
June 3 (Tue)	MOC	1st Steering Committee Meeting
June 4 (ERD)	ERD	Signing of Minutes of Meeting regarding 1st Steering Committee Meeting
June 9 (Mon)	Padma River	Joint Site Appreciation Survey with JMBA by Helicopter
July 7 (Mon)	JMBA	Technical Subcommittee (Counterparts) Meeting
August 4 (Mon)	Mawa & Paturia Sites	Site Appreciation Visit by JICA Vice President, Representative of JICA Bangladesh Office, etc.
August 6 (Wed)	JMBA	Technical Subcommittee Meeting
August 26 (Tue)	Mawa & Paturia Sites	Joint Site Appreciation Tour with Technical Subcommittee
September 28 (Sun), 2003	JMBA	Submission of Progress Report (1)
October 6 (Mon)	MOC	Steering Committee Meeting chaired by Honorable Minister of Communications
	JMBA	Technical Subcommittee (Counterpart) Meeting
October 7 (Tue)	Mawa Site	Site Appreciation visit by JICA Advisory Committee Signing of Minutes of Meeting regarding
	ERD	Signing of Minutes of Meeting regarding Progress Report (1)
November 20 (Thu)	DFID	Presentation to LCG (Local Consultation Group)
November 24 (Mon)	JMBA	Technical Subcommittee (Counterparts) Meeting
January 10 (Sat), 2004	BRAC Center	Workshop (1)
January 26 (Mon)	MOC	Report to Honorable Minister of Communications
February 28 (Sat)	JMBA	Submission of Interim Report
February 4 (Thu)	JMBA	Technical Subcommittee (Counterparts) Meeting
February 8 (Mon)	MOC	Steering Committee Meeting chaired by Honorable Minister of Communications regarding Interim Report
February 9 (Tue)	ERD	Signing of Minutes of Meeting regarding Interim Report
February 10 (Wed)	Sonargaon Hotel	Seminar (1)
Date (day)	Place	Event
June 1 (Tue)	Mawa-Janjira	Joint Site Visit by JMBA, Technical Subcommittee and JICA Study Team
June 3 (Thu)	JMBA	Technical Subcommittee Meeting
June 27 (Sun)	JMBA	Technical Meeting by JMBA and JICA Study Team
July 8 (Thu) & July 17 (Sat)	ERD	Approval of Site for Padma Bridge by letter from ERD to MOC regarding Mawa-Janjira Site
September 27 (Mon)	MOC	Steering Committee Meeting (scheduled)
September 28 (Tue)	ERD	Signing of Minutes of Meeting regarding Progress Report-2 (scheduled)
September 29 (Wed)	Sonargaon Hotel	Workshop (2)
December 6 (Mon)	JMBA	Technical Discussions on the Questions asked in the Technical Session of Workshop (2)
January 26, 2005 (Wed)	JMBA	Submission of Draft Final Report
February 2 (Wed)	Sonargaon Hotel	Seminar (2)
February 7 (Mon)	MOC	Steering Committee
February 9 (Wed)	ERD	Signing of Minutes of Meeting regarding Draft Final Report
February 12 (Sat)	JMBA	Technical Subcommittee (Counterparts) Meeting

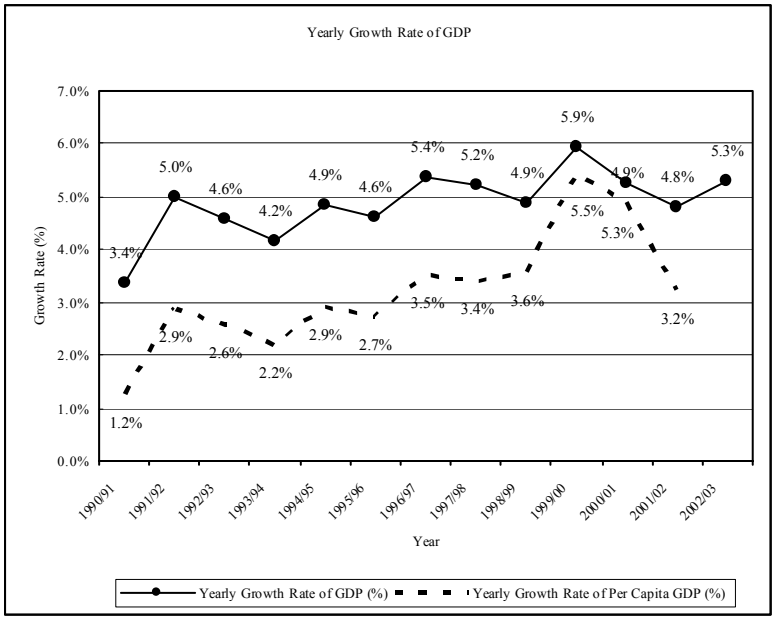
Chapter 2 Economic and Traffic Study

2.1 SOCIO-ECONOMIC CONDITION OF BANGLADESH

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

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

Bangladesh's economy experienced comparatively low growth during the period of the Fourth Five Year Plan (1990-1995), with annual growth rates of 3.4% - 5.0% (Figure 2.1.1). The annual average growth rate of GDP in this period was 4.15% against the Plan target of 5%. A main reason for the low growth was near stagnation of agricultural production. The growth of the agricultural sector was only 1.55% compared with the Plan target of 3.42% due mainly 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 2.1.1 Yearly Growth Rate of GDP (at 1995/96 prices)

The industrial sector has grown at an average annual growth rate of 7.45% against the Plan target of 9.02%. The yearly GDP growth rate of the industrial sector increased rapidly from 4.57% in FY 1991 to 9.86% in FY 1995. Conversely, the agriculture sector recorded a negative growth rate of -0.30% in the final year of the Fourth Five Year Plan (Figure 2.1.3).

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

The Fifth Five Year Plan started in fiscal year 1997 after a hiatus of two years from 1996

and 1997. The realized annual growth rate during the Plan period was 5.33% against a target of 7%. Although this actual growth rate was below target, it was the first time the Bangladesh economy had exceeded a 5% growth rate in the past three decades. Every plan up to the Fourth Five Year Plan targeted an average annual growth rate of above 5% but did not achieve this level (Table 2.1.1).

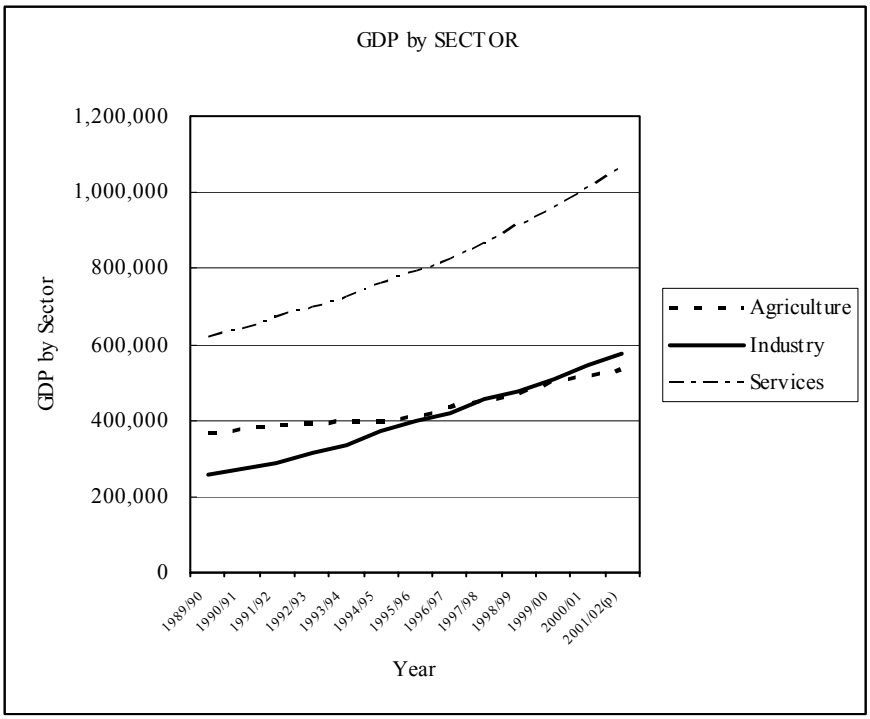
Table 2.1.1 GDP Growth Rate of Past Plans

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"

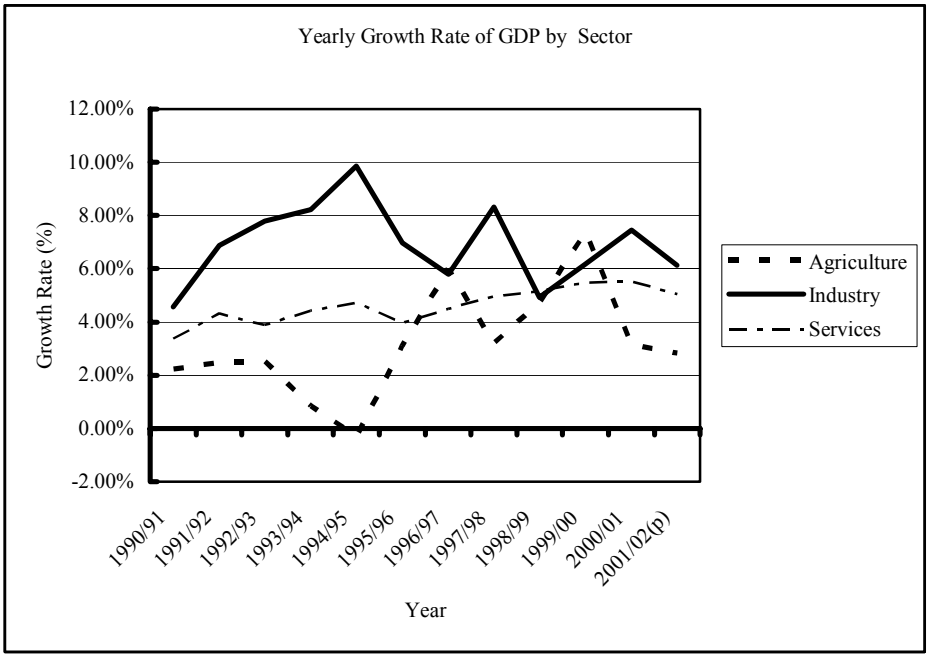
The main reason for such a higher growth rate was attributed to the rebound of the agriculture sector and strong growth trends in the industrial sector. In the first year of the Fifth Five Year Plan (1997), the agriculture sector recorded a 6.0% growth rate. This sector, however, was hit by a flood during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

The industrial sector showed modest growth with an average annual growth rate of 6.59% compared with 7.45% of the Fourth Five Year Plan period. However, actual industrial production at a 1995/96 constant price base exceeded agricultural production for the first time in fiscal year 1998 (Figure 2.1.2). The service sector grew at an average annual growth rate of 5.24% during the plan period, showing steady growth (Figure 2.1.3).



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

Figure 2.1.2 Past Trend of GDP by Sector



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

Figure 2.1.3 Yearly Growth Rate of GDP by Sector

2.1.3 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 2.1.2. The share of the agriculture sector declined from 29.5% in FY1990 to 24.6% in FY2002. The share of the industry sector went up from 20.8% to 26.5% during the same period. The share of the commerce and service sector reduced slightly from 49.7% to 48.9%.

Table 2.1.2 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

2.1.4 Population Growth

(1) Total Population

The population of Bangladesh grew at high rates of 2.4% per annum in the 1970's and 2.1% in the 1980's. However, a preliminary result of the Population Census 2001 revealed that the population growth during the 1990's was 1.49% per annum compared with the previous census 1991 (Table 2.1.3). The speed of population growth is declining.

Table 2.1.3 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%, the population increased by about 1.8 million people every year.

(2) Urban and Rural Population

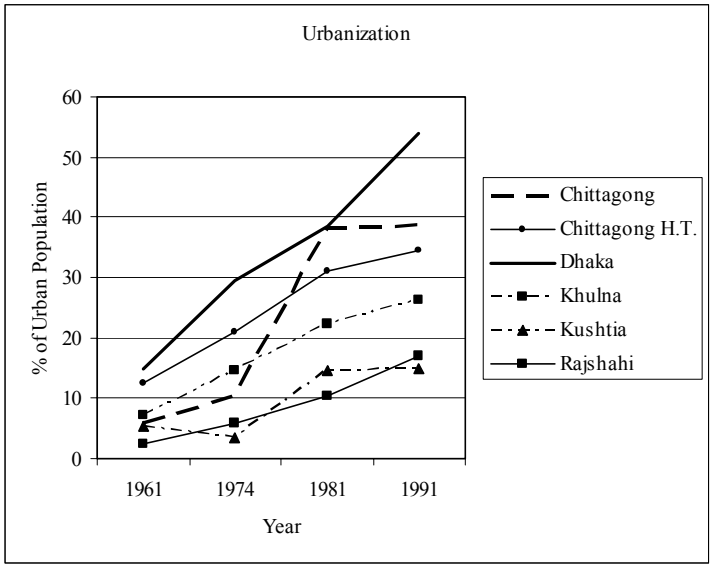
Big waves of urbanization as in other developing countries have been observed in Bangladesh in the last decade. The urban population ratio increased to 23.4% in 2001 compared to19.6% in 1991. During the last decade, the urban population increased by about 7.9 million while the rural population increased by 8.9 million. The annual average growth rate of the urban population was 3.3% compared to a 1.0% annual growth rate of the rural population. These results mean that the urban population increased by 38% during the last decade while rural population increased by only 10% (Table 2.1.4).

Table 2.1.4 Changes in Urban and Rural Population

Locality	Census 1991 (1,000)	(%)	Census 2001 (1,000)	(%)	Incremental Population		Growth Rate (% p.a.)
					+Population	Added %	
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 2.1.4 indicates the past trend of percentage of urbanization in the six most urbanized districts during the Census Year (1996 – 1991).



Original Source: "Statistical Yearbook 2000" BBS

Figure 2.1.4 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 are still growing except for Chittagong and Kushtia.

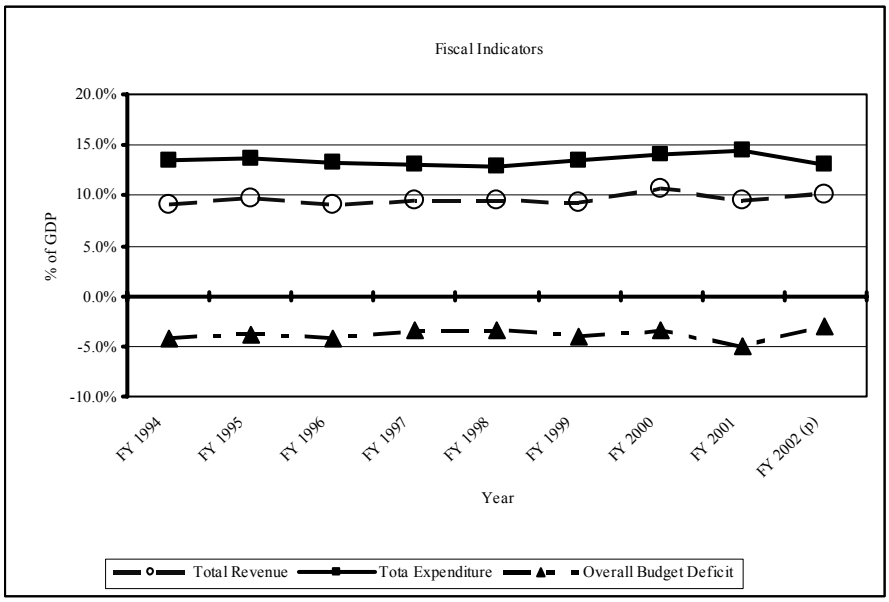
According to the estimation of the World Bank (WB), the urban population of Bangladesh would 30 million at the end of the 20th century and, nearly 80 million by 2020 ("Bangladesh 2020: A Long-Run Perspective Study, 1998 World Bank). As the World Bank pointed out, the "push factor" driving people to urban centers comes from the inexorable growth of the rural population and a lack of employment opportunities in rural areas.

At present, uncontrolled acceleration of population to urban centers is causing severe 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.).

2.1.5 Fiscal Management

(1) Trends of Fiscal Condition

The Government's revenue increased at an average annual rate of 9.0% while the expenditure increased at a rate of 7.9% for the period FY1994 to FY 2002. Although the increased rate of revenue was higher than that of expenditure, the fiscal condition of the Government has been one of chronic deficits. The ratios of deficits to GDP were in a range of 3.0% - 5.9% for the last decade (Figure 2.1.5). 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.

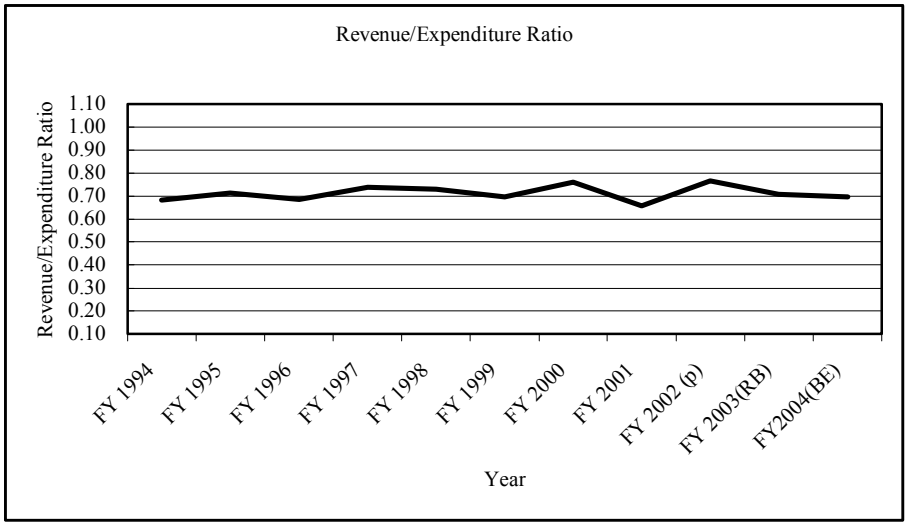


Original Source: "Statistical Yearbook 2000", "Statistical Pocketbook 2001", BBS

Figure 2.1.5 Trend of Fiscal Indicators

Although the VAT network was introduced in Bangladesh in 1991, many exemptions and exclusions remain.

In these situations, only 70% of the fiscal expenditure was covered by fiscal revenue (Figure 2.1.6); the remainder was financed by 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 government bonds). 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 2.1.6 Fiscal Revenue/ Expenditure Ratio

(2) Fiscal Structure (Budget 2003-04)

The summary of the Budget for FY2004 is presented in Table 2.1.5 with revised Budget for FY2003 and financial sources shown in Figure 2.1.7.

The budget 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%, a lower rate than the targeted growth rate of total expenditure. As a result the overall deficit would increase by 23.7%. The estimated fiscal deficit of 158 Billion Taka in FY2004 is the highest in the past decade (Figure 2.1.8).

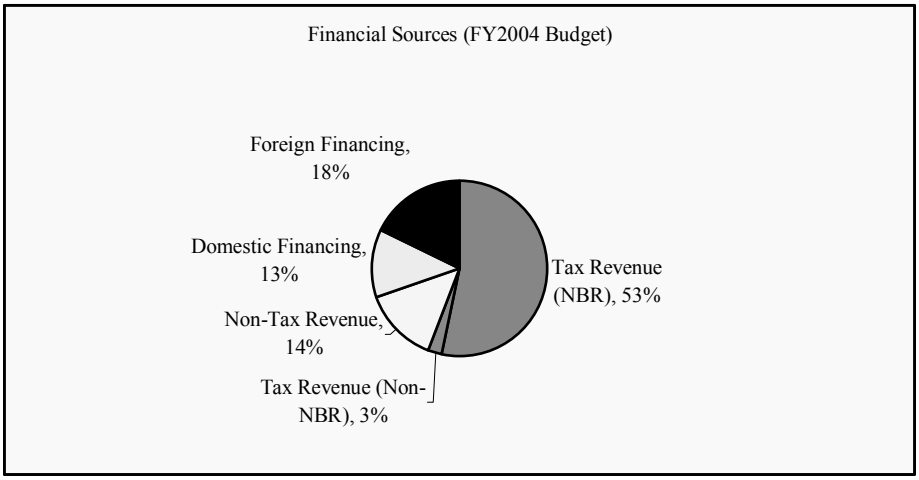
In order to finance the fiscal deficit (amounts to 158 Billion Taka), the Government intends to procure funds from external sources, about 59% of the deficit (Grants and Borrowing) and 41% from domestic sources. Regarding the annual interest payments for the domestic and foreign loans, 64.37 Billion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

Table 2.1.5 Budget at a Glance

(Taka in Crore)

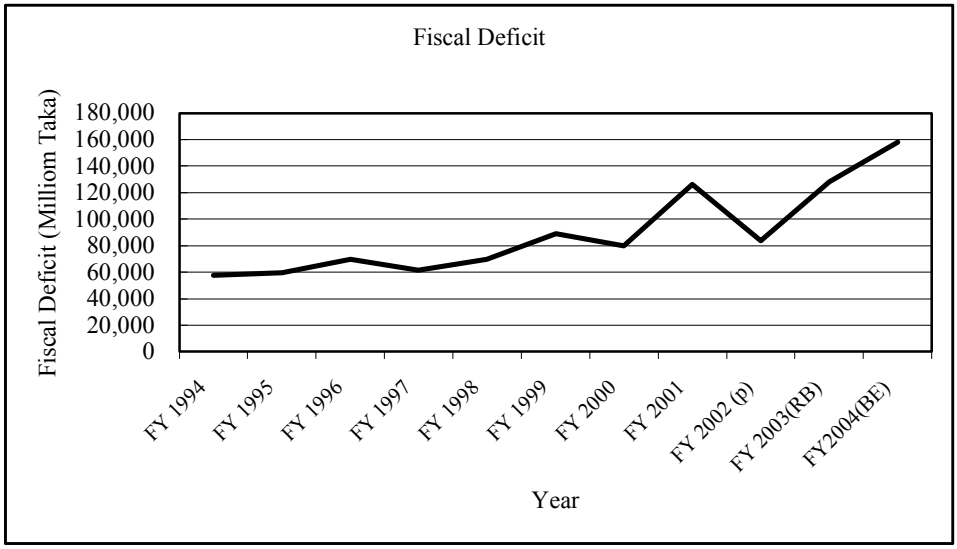
Description	Budget FY 2004	Revised FY 2003	Budget FY 2003
Consolidated Fund – Revenue Receipts			
Tax Revenue	290,71	249,50	255,00
Non-Tax Revenue	71,00	61,70	75,84
Total:	**361,71**	**311,20**	**330,84**
Consolidated Fund – Expenditure			
Non – Development Revenue Expenditure (Current Exp.)	289,69	253,07	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 2.1.7 Financial Sources for the Budget FY2004



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

Figure 2.1.8 Trend of Fiscal Deficit

2.1.6 Balance of Payments

(1) Overall Situation

(a) Trade and Current Account Balance

The trade balance trend of Bangladesh is characterized by chronic deficits. The export base 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 exports by 30% - 37% in the period FY1998 to FY2002. Main reasons for the chronic excess of imports over exports is due to the necessity to supplement domestic output due to shortages of natural resources and to use imported commodities as inputs for production of export goods. Import of intermediate goods and industrial inputs comprised about 41% of total imports in FY2002. In particular, the share of capital goods imports (such as machinery and vehicles, etc.) was 34% of total imports in FY2002. A summary of Balance of Payments is shown in

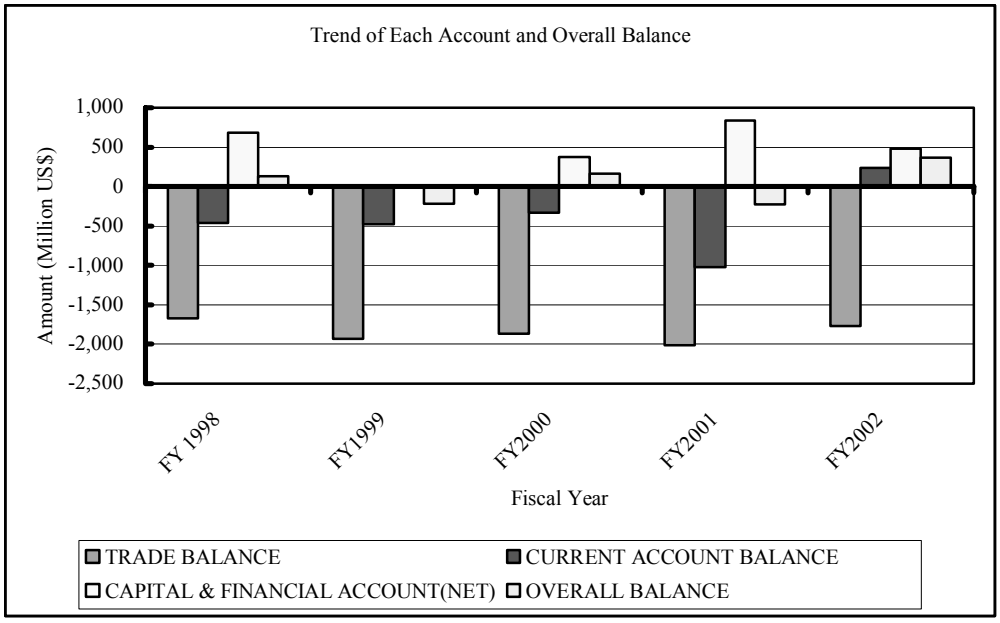
Table 2.1.6 and Figure 2.1.8.

Table 2.1.6 Balance of Payments

(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

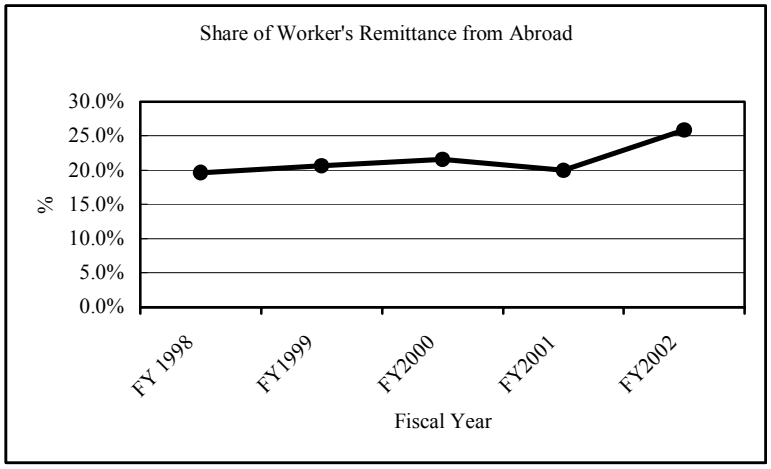
Source: Annual Report 2001-2002, Bangladesh Bank



Original Source: Annual Report 2001-2002, Bangladesh Bank

Figure 2.1.9 Trend of Trade Balance, Each Account and Overall Balance

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



Original Source: Annual Report 2001-2002, Bangladesh Bank

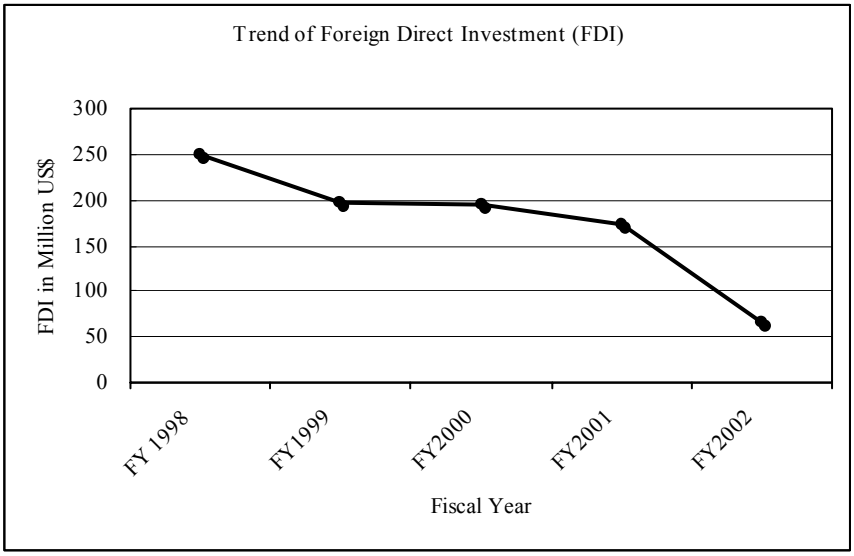
Figure 2.1.10 Share of Remittances from Abroad in Total Current Inflow

The remittances from workers abroad grew by 32.9% from US$ 1.88 billion in FY2001 to US$ 2.59 billion in FY2002 and contributed about 20% - 25% of total inflow of the current account (Figure 2.1.10).

(b) Overall Balance

The overall balance combining all accounts of current, capital and financial accounts indicated a deficit of US$ 0.23 billion in FS2001 due to increased imports and then a surplus of US$0.37 billion in FS2002 due to decreased imports and increased worker's remittances from abroad.

The Foreign Direct Investment (FDI) in the financial account showed a sharp declining trend from US$ 0.25 billion in FY1998 to US$ 0.065 billion in FY2002 (Figure 2.1.11).



Original Source: Annual Report 2001-2002, Bangladesh Bank

Figure 2.1.11 Trend of Foreign Direct Investment Inflow

2.1.7 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 when investigating the impacts of construction of Padma Bridge on the Balance of Payments of Bangladesh. Interest payments go to the "Investment Income Account" in the "Current Account" of the Balance of Payments as outflows from Bangladesh and repayments of principal go to the "Financial Account", also as outflows.

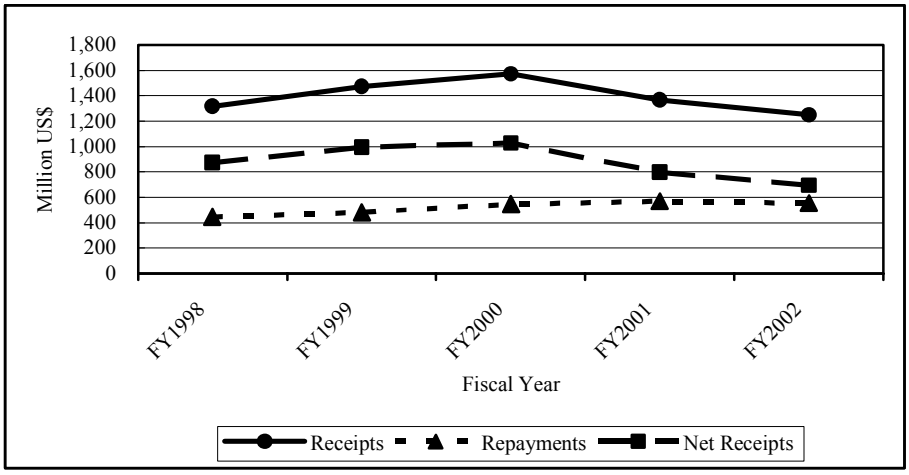
Table 2.1.7 and Figure 2.1.12 show the recent trend of foreign aid receipts and repayments (Debt Services).

Table 2.1.7 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

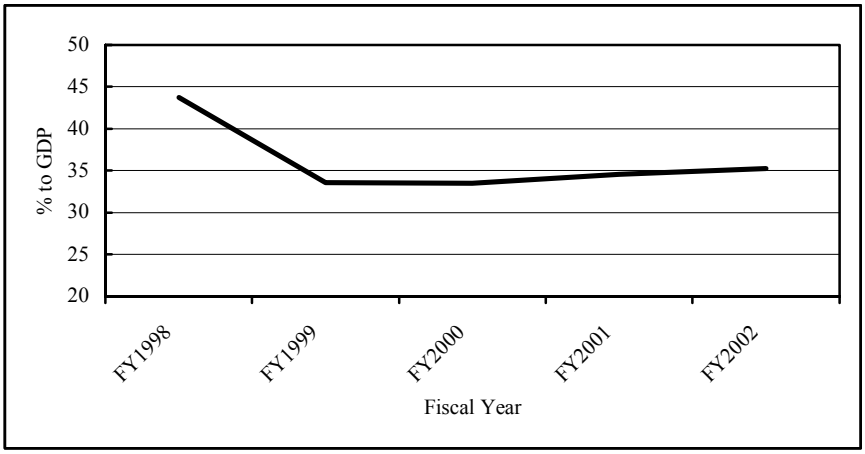


Source: From Table 2.1.7

Figure 2.1.12 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 reverted to a decreasing trend with negative rates 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 declining, 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, an increase of about US$ 1.835 billion or a rate of 12.4% for the past four years. The outstanding debt as a percentage of GDP was extremely high with a rate of 35.2% in FY2002. This rate was at 43.7% in FY1998 but dropped to 33.6% in FY1999 and 33.5% in FY2000 and is now steadily increasing. This outstanding external debt will eventually burden future generations in Bangladesh.



Source: From Table 2.1.7

Figure 2.1.13 Outstanding Debt as Percentage to GDP

2.1.8 Establishment of Future Socio-economic Framework

(1) Socio-economic Indicators and Traffic Zone System

In order to provide socio-economic bases for future traffic demand forecasting of 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 a total of 75 zones of which 64 consist of Districts (Upazilas) in the territory of Bangladesh. The remaining 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 forecast indices are population and GRDP.

(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 entitled "five year plan". Instead, the "Three-Year Rolling Plan (TYRP)" is now adopted and is being implemented to cover three fiscal years 2004, 2005 and 2006. The budget for FY2004 explained in 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)" and targets up to FY 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. Table 2.1.8 below indicates the growth targets of NS-EGPRSD.

Table 2.1.8 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 the phrase "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 the many present dominant obstacles and constraints (Quarterly Economic Update, June 2003, ADB).

(3) Forecast of Macro Indices (Population and GDP)

(a) 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.

$$\text{Population (t)} = 1891.64\,(t) - 3655836 \qquad (R=0.999)$$

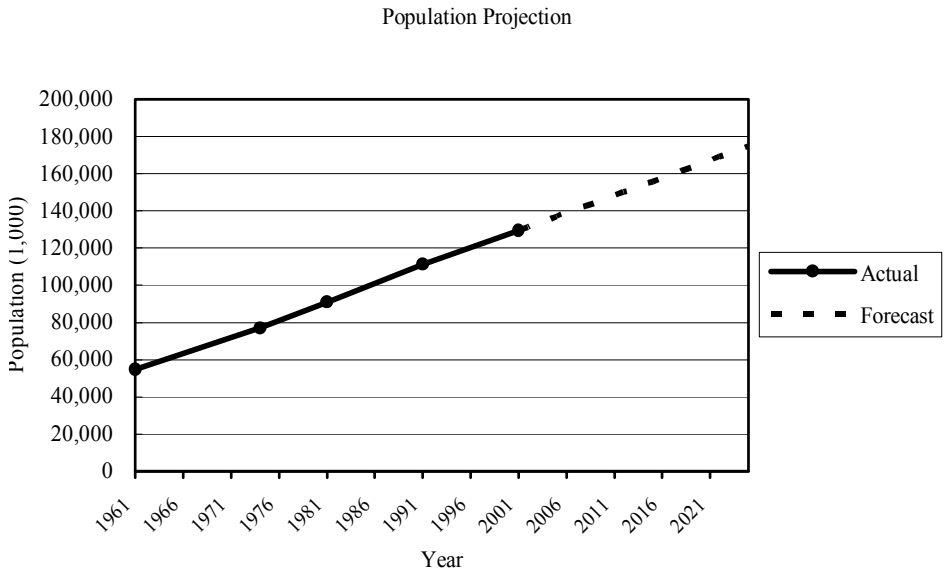
where, Population (t): Total population in year (t)
t: Year
R: Correlation Coefficient

Results of forecasts of future total population applying the above equation are presented in Figure 2.1.14 and Table 2.1.9. The population growth rates will be 1.35% by 2010 and 1.26% by 2015, which are almost the same growth rates of the NS-EGPRSD with 1.4% and 1.3%, respectively.

(b) Forecast of Population Distribution to Traffic Zones

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

Future population by traffic zone is presented in Table 2.1.10.



Source: This Study

Figure 2.1.14 Population Projection

Table 2.1.9 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			122,101	1.880			
2000			129,200	1.420	139,693	2.19	1.60
2001	129,247	1.49					
2002	131,137	1.46	132,500	1.270			
2005	136,809	1.42	137,499	1.242			1.50
2010	146,261	1.35	146,396	1.262	167,412	1.83	1.40
2015	155,713	1.26	155,862	1.261			1.30
2020	165,165	1.19	165,932	1.260	197,062	1.64	
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

Table 2.1.10 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 – 2015: Study Team.

(c) 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).

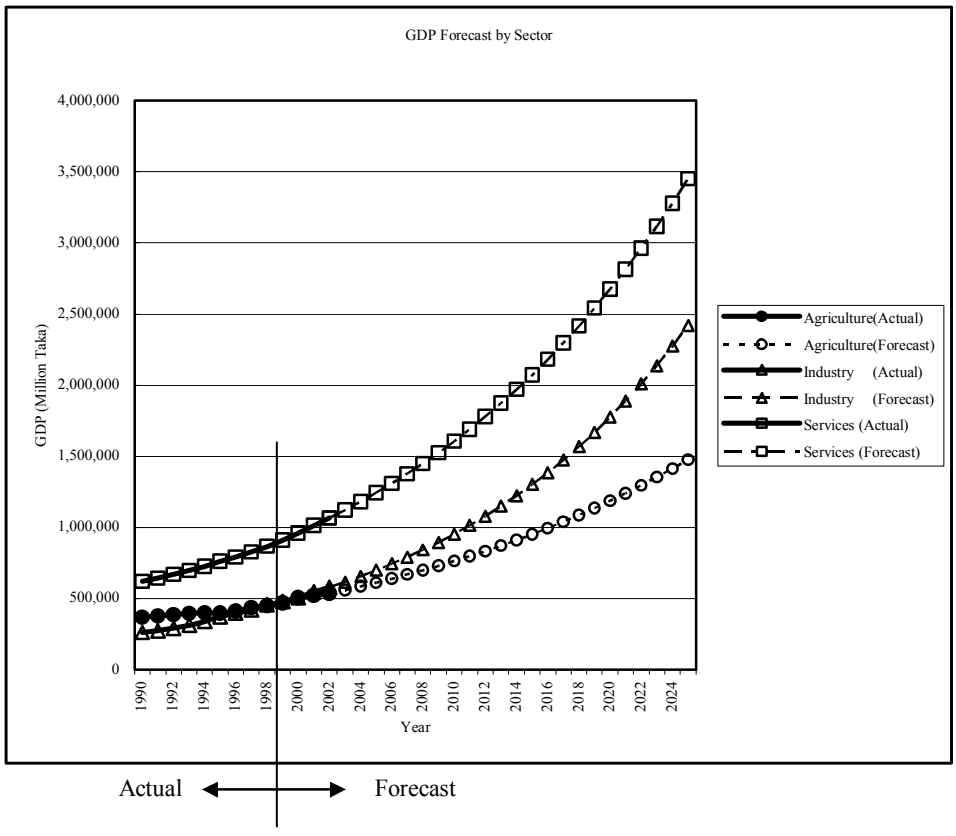
The following equations were estimated through the regression analyses of time series data by each sector:

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 2.1.15 and Table 2.1.11 below:



Source: This Study

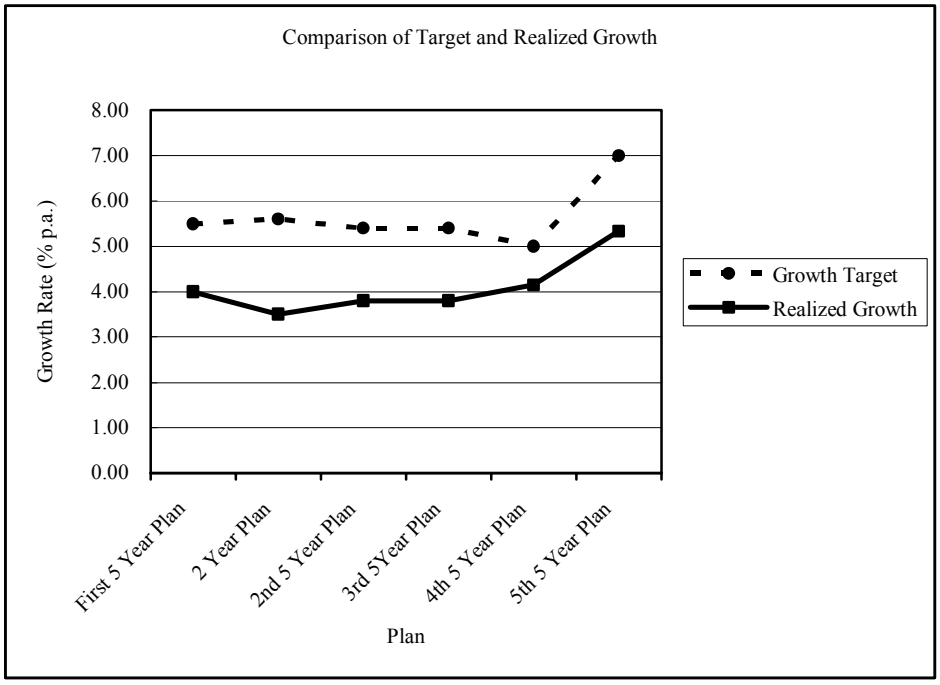
Figure 2.1.15 Projection of GDP by Sector

Table 2.1.11 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

For the purpose of traffic demand forecasting, however, it is necessary to review the past targeted growth rates and their degree of realization. Figure 2.1.16 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 2.1.1

Figure 2.1.16 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 of 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 2.1.11. Needless to say, the degree of realization depends on the initiative of

the Government, pulling power of private sector and external environment.

(c) Forecast of GRDP by Traffic Zone

Future GRDP by traffic zone was forecast applying the same procedure as in 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 future GRDP by traffic zone is shown in Table 2.1.12.

2.2 OVERVIEW OF THE PROJECT AREA

2.2.1 The Project Area

The impacts of Padma Bridge will spread over the whole country of Bangladesh, although the degree of intensity of impacts will differ depending on the location of areas. Among those areas influenced, the Southwest (SW) region will receive the largest benefit from Padma Bridge. Therefore, SW region is the primary project area in this study.

2.2.2 Overview of Natural Conditions

(1) Ganges-Jamuna-Meghna River System

The basin area of the Ganges-Jamuna-Meghna River (GJM River) is 1,740,000 km2 in total, consisting of sub-basins of the Ganges River (1,090,000 km^2), the Jamuna River (570,000 km^2) and the Meghna River (77,000 km^2). Bangladesh is located in the lowest part of the basin.

The Padma River is a stretch of the main stream of the GJM River from the confluence of the Ganges and the Jamuna rivers (Goalundo) to the confluence of the Padma and the Meghna (or the Upper Meghna) rivers (Chandpur). The main stream downstream of the Padma-Meghna confluence is named as the Meghna (or the Lower Meghna) River.

(2) Topography and Geology

The topography of Bangladesh is characterized by its flat and low lands with elevations less than 30m except for the relatively higher land near the international boundaries. The elevation of the Project Area is around 5m.

Most of the land of Bangladesh including the Project Area is on the alluvial plain (Bengal Plain) formed by thick sediment deposited during the Tertiary and Quaternary periods. The thickness of sediment cover in the Project Area is estimated to be 12 to 14 km above basement rock.

Table 2.1.12 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.

(3) Climate and Hydrology

The climate of Bangladesh falls under the tropical monsoon zone, which has distinctive seasonal variations, namely rainy monsoon from July to October, cool winter (11°C to 29°C) from November to February, and hot and dry summer (21°C to 34°C) from March to June.

The amount of annual rainfall varies spatially, and more rainfall is recorded in northeast and eastern coastal regions of Bangladesh. Mean annual rainfall in the Project Area is about 2000 mm of which 70 to 80% is concentrated in the monsoon season.

Mean annual runoff of the Padma River is estimated at about 28,000 m^3/s. The annual runoff is about 11,000 m^3/s in the Ganges River and 19,600 m^3/s in the Jamuna River. Reflecting much rainfall during the monsoon, the high runoff takes place during the period from July to September.

(4) Flood and Inundation

During the monsoon period, river water of the Padma is raised by 5m to 6m due to flood runoff from the huge upper basin. The water level remains high from July to September.

During this period, rainfall and runoff in the Project Area have no means of draining and stagnate in the low-lying lands, creating extensive inundated areas. From the latter portion of the flood season, the Project Area also suffers from periodic cyclones.

(5) Seismicity

Due to its location in an active tectonic region, Bangladesh has experienced large earthquakes in 1869, 1885, 1897, 1918, 1930, and 1934. Among these, the Great Assam Earthquake in 1897 is considered one of the greatest earthquakes with a magnitude of 8.7 in Richter scale.

Structures should be designed taking the intensity of earthquakes into consideration as well as liquefaction of fine sand layers. According to the seismic zoning map of Bangladesh (BWDB), the Padma River is located on the boundary of Zone-1 and Zone-2, which increases severity from Zone 1 to Zone 3.

2.2.3 Socio-economic Profile

(1) Population Distribution

About 30 million people or 23% of the total population of Bangladesh lived in the Southwest region as of 2001. The population density and average growth rate of population of the Southwest region are lower than those of the Northeast region.

Khulna in the Southwest region is the third largest city in Bangladesh, having a Division Headquarters and the important sea port located at Mongla.

(2) Gross Regional Product

Gross regional product of Dhaka Division was about 38% of total GDP of the country and per capita GRP was also the highest in fiscal year (FY) 2000. On the other hand, total GRP of both Khulna Division and Barisal Division was only 17.4% of total GDP. Khulna Division was ranked in third position with US$ 355 per capita GRP and Barisal Division was ranked fourth with US$ 306 per capita GRP in FY2000.

Table 2.2.1 Gross Regional Product (1999/2000, Division Base)

Division	Gross Regional Product (Mill. Taka) (Current Price)	Per Capita GRP (US$) (Current Price)	Growth Rate (FY'96-FY2000) (% p.a.) Constant Price)	Share of GRP of Division (%)	Rank (based on Per Capita GRP)
Barisal	137,247	306	5.2	5.79	4
Chittagong	458,657	360	5.1	19.35	2
Dhaka	894,697	443	5.4	37.74	1
Khulna	274,647	355	5.5	11.58	3
Rajshahi	482,716	302	5.8	20.36	5
Sylhet	122,776	296	5.2	5.18	6
Bangladesh	2,370,740	363	5.4	100.00	

Source: Provisional Estimates of Gross Regional Products 1995-96 to 1999-2000, May 2002, BBS

(3) Regional Economic Structure

(a) Primary Occupation of Households in the Direct Project Area

Table 2.2.2 shows the occupational characteristics of both sides of Padma River at Mawa. Existing data based on a field survey revealed that the primary occupations of residents around the Mawa site are farming/fishing･livestock. However, the situations on the left and right banks of the Padma River are relatively different. Occupations of the households are dominated by commercial activities on the left bank and by farming/fishing･livestock on the right bank.

Table 2.2.2 Primary Occupation of Household at the Mawa Site

Occupation	Left Bank		Right Bank		Total	
	No	%	No	%	No	%
Teacher/Services in Institutions	12	16.00	4	4.60	16	9.87
Commercial	36	48.00	4	4.60	40	24.70
Skilled Worker in Workshop/Industry	3	4.00	-	-	3	1.85
Farming/Livestock	4	5.33	69	79.31	73	45.06
Fishery	1	1.33	3	3.45	4	2.46
Household Work	2	2.67	-	-	2	1.23
Day Laborer	2	2.67	3	3.45	5	3.09
Bus Driver	2	2.67	-	-	2	1.23
Rickshaw puller	7	9.33	4	4.60	11	6.80
Tailoring	1	1.33	-	-	1	0.62
No work	5	6.66	-	-	5	3.09
Total	75	100.0	87	100	162	100.0

Source: PADMA BRIDGE STUDY, Phase I, Pre-Feasibility Report, Volume VI, February 2000

(b) Agriculture and Fisheries in the Southwest Region

Agriculture and fisheries have traditionally been the major sectors in the Southwest region. The share of agriculture and fisheries in GRP was 38% for Barisal Division and 32.7% for Khulna Division, higher than that of the average of 25.5% for Bangladesh in FY2000. The most important agricultural crops are cereals such as rice and wheat followed by jute, sugarcane and tea. Production of rice in the past ten years was increasing although some fluctuations were observed. Particularly, from 1999 to 2000, production of rice increased by 16%. The produced volume of rice in 2000 was 23.1 million tons in the whole country of which about 25% of production came from the Southwest region. The production of wheat in the Southwest region was about 20% of the total in Bangladesh.

Shrimp farming is extensively practiced in Bangladesh, providing employment

opportunities and contributing foreign earnings. The most active shrimp farming center is Khulna Division, particularly in Bagerhat. About 80% of the national shrimp production comes from the Southwest region. Exports of frozen shrimp amounted to US$322.44 million in 2000, which was 90% of total fish exports and 5.6% of total exports from Bangladesh ("Export Statistics 1999-2000, Export Promotion Bureau).

Table 2.2.3 Annual Total Catch of Shrimp Farm (1999-2000)

Division/ District	Area of Shrimp Farms (Hectare)		Shrimp Catch (Metric Ton)			
			1999		2000	
Chittagong (Cox's Bazar)	29,792 (28,909)	21.1% (20.5%)	13,591 (13,302)	21.5% (21.1%)	13,797 (13,500)	21.3% (20.9%)
Khulna Division (Bagerhat)	107,962 (47,710)	76.4% (33.8%)	48,857 (23,378)	77.3% (37.0%)	50,128 (23,617)	77.5% (36.5%)
Barisal Division (Pirojpur)	3,357 (2,294)	2.4% (1.6%)	687 (573)	1.1% (0.9%)	693 (578)	1.1% (0.9%)
Dhaka Division	242	0.1%	29	0.1%	29	0.1%
Total	141,353	100.0%	63,164	100.0%	64,647	100.0%

Source: Statistical Yearbook 2000, BBS

(c) Industry

The main industry in the Southwest region was jute processing. However, this sector has been declining due to a drop of prices in the world markets. The Mongla Export Processing Zone (MEPZ) is partly under operation in the area adjacent to the Mongla Port. The size of export and investment in MEPZ is, at present, small compared to the preceding Chittagong EPZ and Dhaka EPZ.

Table 2.2.4 Present Situation of EPZ (2002)

EPZ	Export (US$ Million)	Investment (US$ Million)
Dhaka	2,520	42.145
Chittagong	4,580	59.136
Mongla	4.60	0.105
Comilla	1.16	1.048

Source: Bangladesh Export Processing Zones Authority

2.2.4 Infrastructure Development

(1) Railway Network in the Southwest Region

The railway network in the Southwest region is a broad gage system while the meter gage system is applied in the Northeast region. The Southwest region is connected with the Northwest region (Rajshahi Division) by the Hardinge railway bridge over the Ganges River. This was constructed in 1915 and connects major cities in the SW region, such as Jessore and Khulna. The cross-border rail services between Bangladesh and India are provided through Benapole and Darsana.

The Barisal Division located in the southeastern area of the SW region is not provided with railway lines due to its geographical constraints with many rivers. At present, the total length of railway network under the Bangladesh Railway (BR) is 2,791 km, of which 448.6 km or only 16% covers the SW region.

The railway lines in the direct project area on the right bank run along the Padma River from Kushtia up to Goalundo, but the section to Faridpur is now closed. There are no railway lines to Char Janajat located on the opposite side of Mawa.

The Bangladesh Railway is implementing the "Railway Recovery Program (RRP)" under ADB assistance. The system of private sector association in the operation of railways was introduced as part of RRP from 1997 and lines departing/arriving from/to the SW region as of 2002 include the following four:

1) Khulna – Chapainawab (Nawabganj district in NW region)
2) Khulna – Goalundo Ghat
3) Khulna – Rajshahi
4) Goalundo Ghat – Rajshahi

(2) Highway Development in Area Associated with Padma Project

The Study Team selected the Faridpur, Barisal, Jessore and Khulna Circles in the Southwest Region and some parts of the Dhaka Circle in the North Central Region as the area associated with the prospective Padma crossing, based on the recognition that the Project is supposed to directly influence the regional linkage between the Southwest and North Central Regions.

The present RHD road network in the region around this associated area is shown in Figure 2.2.1. Also, the current condition of the RHD road network in the associated area, expressed by road surface types, is summarized in Figure 2.2.2 and Table 2.2.5. These clearly show that development of the highways and roads in the Southwest Region is far below the national average, while that in the Dhaka Circle considerably exceeds it.

On the contrary, development of the local roads under LGED such as the Upazila, Union and Village roads has been advanced somewhat more in the associated area than the national average. But there is no distinctive difference in the development achievement between the Southwest Region and the Dhaka Circle, as shown in Table 2.2.6 and Figure 2.2.3.

This indicates that development of local roads as a whole still remains at quite a low level while that of arterial highways, though still insufficient in overall quantity, has been relatively advanced but with considerable regional biases, typical as shown between the Southwest Region and the Dhaka Circle. The Project highway is expected to play an important role to rectify this significant regional gap.

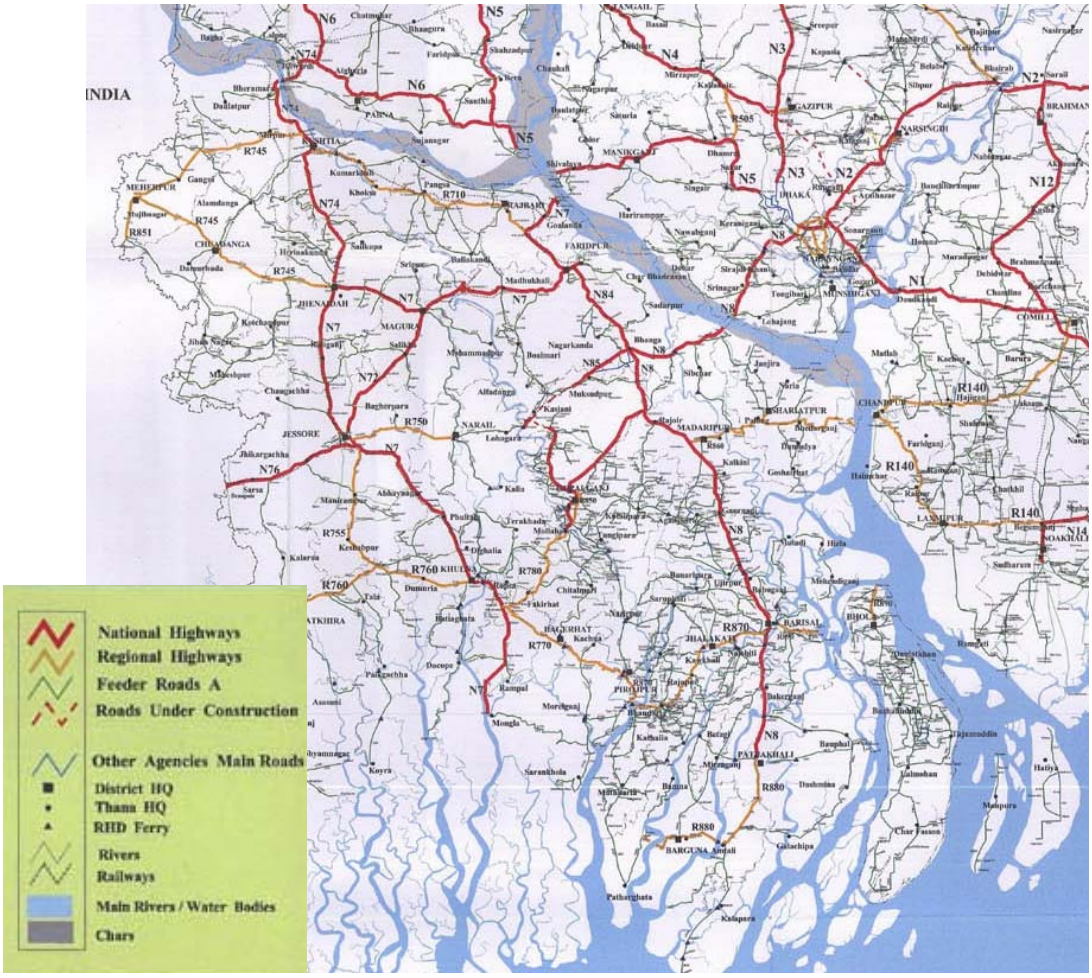


Figure 2.2.1 Present RHD Road Network in the Associated Area

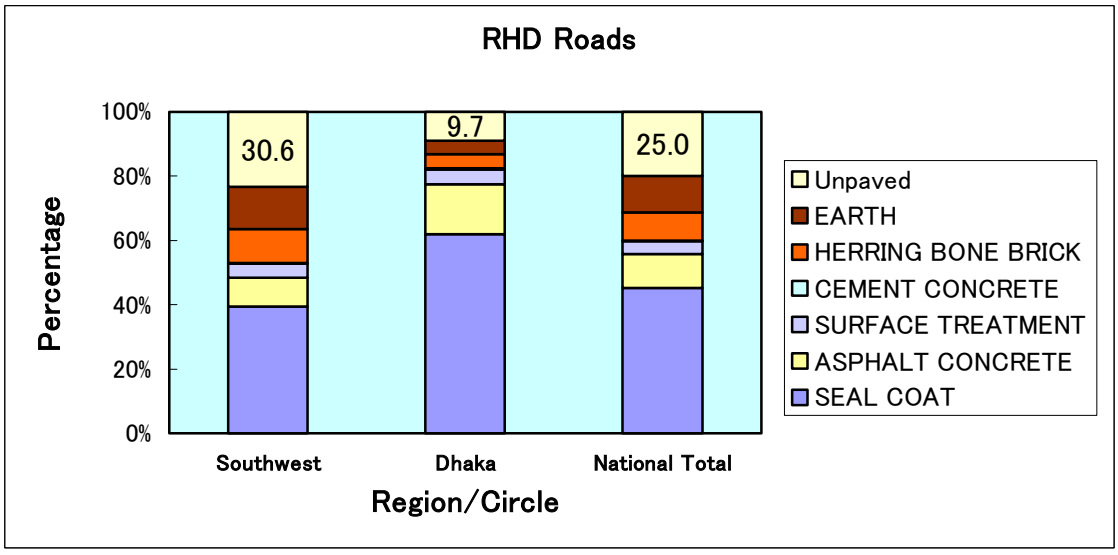


Figure 2.2.2 Road Surface Types of RHD Roads in the Associated Area

Table 2.2.5 Total Length of RHD Roads by Road Surface in the Associated Area, as of 2001

REGION	SOUTHWEST						NORTH CENTRAL		NATIONAL TOTAL	
CIRCLE	FARIDPUR	BARISAL	JESSORE	KHULNA	SUBTOTAL		DHAKA			
	KM	KM	KM	KM	KM	%	KM	%	KM	%
TOTAL PAVED ROAD LENGTH	774	1,050	1,098	462	3,384	69.4	837	90.3	12,481	75.0
SEAL COAT	584	903	741	278	2,506	51.4	630	68.0	9,390	56.5
ASPHALT CONCRETE	128	93	234	129	584	12.0	158	17.0	2,222	13.4
SURFACE TREATMENT	59	45	122	54	280	5.7	45	4.9	808	4.9
CEMENT CONCRETE	3	9	1	1	14	0.3	4	0.4	61	0.4
HERRING BONE BRICK	111	340	177	34	662	13.6	46	5.0	1,800	10.8
EARTH	148	452	96	137	833	17.1	44	4.7	2,350	14.1
TOTAL UNPAVED ROAD LENGTH	259	792	273	171	1,495	30.6	90	9.7	4,150	25.0
TOTAL SURVEYED ROAD LENGTH	1,033	1,842	1,371	633	4,879	100.0	927	100.0	16,631	100.0
TOTAL LENGTH OF ROADS NOT SURVEYED	333	382	142	297	1,154		385		4,168	
TOTAL RHD ROAD LENGTH	1,366	2,224	1,513	930	6,033		1,312		20,799	

Source: ADP Database, RHD

Table 2.2.6 Total Length of LGED Roads by Road Surface in the Associated Area, as of 2003

REGION		SOUTHWEST						NORTH CENTRAL		NATIONAL TOTAL	
CIRCLE		FARIDPUR	BARISAL	JESSORE	KHULNA	SUBTOTAL		DHAKA			
		KM	KM	KM	KM	KM	%	KM	%	KM	%
UPAZILA ROAD	EXISTING DEVELOPED LENGTH	1,369	781	1,663	908	4,721	**70.9**	1,198	**65.1**	15,074	**64.3**
	TOTAL LENGTH TO BE DEVELOPED	182	660	755	339	1,936	29.1	641	34.9	8,360	35.7
	TOTAL LENGTH	1,551	1,441	2,418	1,247	6,657	100.0	1,839	100.0	23,434	100.0
UNION ROAD	EXISTING DEVELOPED LENGTH	938	1,328	1,664	1,190	5,120	**28.1**	1,413	**29.6**	15,942	**23.2**
	TOTAL LENGTH TO BE DEVELOPED	2,306	4,406	3,940	2,477	13,129	71.9	3,353	70.4	52,682	76.8
	TOTAL LENGTH	3,244	5,734	5,604	3,667	18,249	100.0	4,766	100.0	68,624	100.0
VILLAGE ROAD	EXISTING DEVELOPED LENGTH	361	624	417	484	1,886	**5.0**	413	**7.0**	5,504	**4.8**
	TOTAL LENGTH TO BE DEVELOPED	5,880	14,767	8,861	6,316	35,824	95.0	5,513	93.0	108,621	95.2
	TOTAL LENGTH	6,241	15,391	9,278	6,800	37,710	100.0	5,926	100.0	114,125	100.0
TOTAL LGED ROAD	EXISTING DEVELOPED LENGTH	2,668	2,733	3,744	2,582	11,727	**18.7**	3,024	**24.1**	36,520	**17.7**
	TOTAL LENGTH TO BE DEVELOPED	8,368	19,833	13,556	9,132	50,889	81.3	9,507	75.9	169,663	82.3
	TOTAL LENGTH	11,036	22,566	17,300	11,714	62,616	100.0	12,531	100.0	206,183	100.0

Source: LGED Documents, August 2003

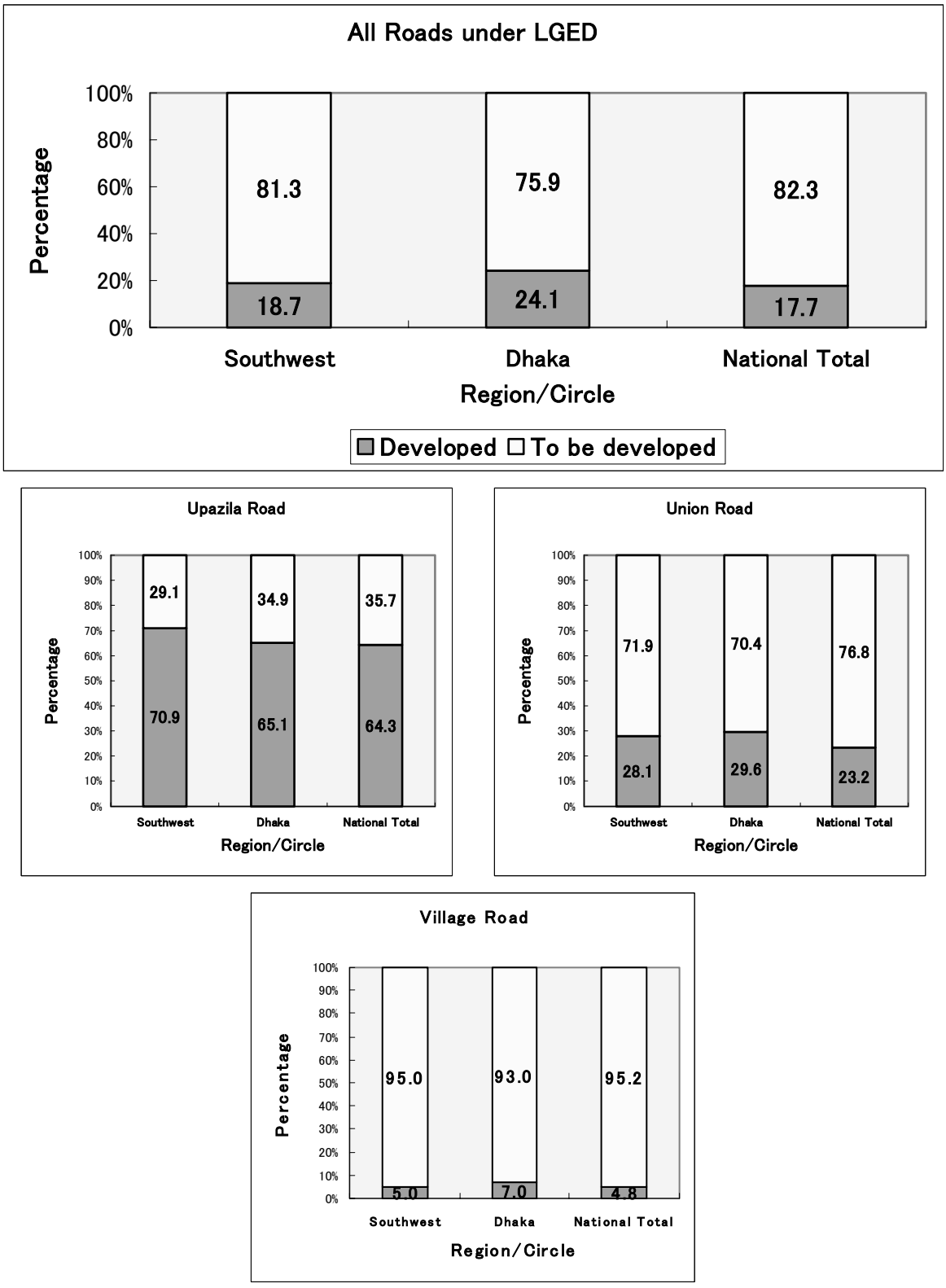


Figure 2.2.3 Roads under LGED by Development Status in the Associated Area

RHD is implementing a variety of road development projects including construction, improvement, rehabilitation and maintenance of roads and bridges all over the country. Table 2.2.7 is the list of such on-going projects in the associated area, though some are not particularly relevant to this area but are nationwide projects.

Furthermore, a number of additional road development projects to be funded by foreign aid are under consideration by the Government of Bangladesh, as listed in Table 2.2.8. Some of those on-going and future projects, as described below, will have direct or indirect influence in the planning of transportation, highway and bridge for the Padma crossing Project.

It should be noted firstly that the South-West Road Network Development Project (No. 88 in Table 2.2.7), now in progress by RHD with ADB financial aid to improve and rehabilitate the National Highway N8 between Dhaka and Noapara, will readily provide the Padma Project highway with a National Highway and currently attainable grade connecting roads at both ends (provided the Mawa-Janjira is selected as the Padma crossing site).

There is another project closely related to the Padma Project in the area within the Road Network Improvement and Maintenance Project under ADB Technical Assistance in 2001. This is the arterial highway rehabilitation project on National Highway N76, Regional Highway R760 and some Zila roads between Benapole and Bhatiapara (No. A-1 in Table 2.2.8).

The latter is extremely important. The prospective road network improvement project between Benapole and Bhatiapara will compose a direct east-west corridor in the central part of the Southwest Region together with the above-mentioned N8. This will complement the missing arterial link between Narail and Bhatiapara and advantageously bear the major traffic between Dhaka and the Southwest Region if the Padma Bridge is located at the Mawa-Janjira location. This project is also noteworthy from the aspect of international freight movement between India and Bangladesh. It will complete the direct link between the capital, Dhaka, and a major land port at the border, Benapole, as well as forming an important section of the Asian Highway A1.

Both on-going and planned projects, jointly displayed on Figure 2.2.4, will interact significantly with each other as well as with the Padma Bridge.

Table 2.2.7 On going RHD Road Projects in the Associated Area, as of July 2003

Ref. No.	PROJECT NAME	PROJECT PERIOD	TOTAL COST in Mil. Taka	PROJECT TYPE	REMARKS	FUNDING
23	Improvement of Kashinathpur – Kazirhat Road & Natakhola Ferry Approach Road	01/07/96-30/06/05	306.3	Impr./Rehab., Road	Road Length: 16.75 km	GOB only
50	Rehabilitation of Major Roads in Patuakhali and Barguna District	01/07/00-30/06/06	1,127.1	Impr./Rehab., Road	Road Length: 116.00 km	Aided by Denmark
76	Feeder Road at Sariatpur – Gonganagar – Mongol Majhirghat	01/07/98-30/06/04	2,865.9	Impr./Rehab., Road	Road Length: 28.00 km	GOB only
83	Upgradation of Kushita – Meherpur Road to Regional Highway	01/07/99-30/06/04	384.8	Impr./Rehab., Road	Road Length: 58.00 km	GOB only
84	Upgradation of Jessore – Magra Road	01/07/99-30/06/05	264.0	Impr./Rehab., Road		GOB only
88	Development of South-West Road Network	01/03/00-31/12/04*	10,861.5	Impr./Rehab., Road	Road Length: 162.39 km including 1,760 m in total length of 40 bridges	Aided by ADB
7	Thana Connecting Road Project	01/07/00-30/06/15	109,776.1	Impr./Rehab., Road		GOB only
13	Public Priority Road & Bridge Project	01/07/94-30/06/06	15,403.2	Impr./Rehab., Road		GOB only
36	3rd Road Rehabilitation & Maintenance Project	01/07/98-30/06/04	25,313.7	Impr./Rehab., Road		Aided by IDA
121	Road Maintenance & Improvement Project	01/04/01-31/03/05	2,227.5	Impr./Rehab., Road		Aided by ADB
8	Pakshi Bridge over Padma River	01/07/97-30/06/05	10,326.9	Construction, New Bridge	Road Length: 16.00 km Bridge Length: 1786.00 m	Aided by Japan
94	Rupsa Bridge and Khulna City Bypass Road with Link to Rupsa Bridge	01/07/00-30/06/05	7,671.7	Construction, New Bridge	Road Length: 8.555 km Total Length of 3 Bridges: 1,480 m	Aided by DRGA/Japan
157	Bekutia Bridge over Kocha River on Barisal – Jhalokati – Pirojupur – Bagerhat – Khulna Highway	01/07/02-30/06/06	823.0	Construction, New Bridge	Bridge Length: 1500.00 m	GOB only
178	Muniganj Bridge at Dhaka – Mawa – Mollahat – Chitolmari – Bagerhat Link Road in Bagerhat	01/07/01-30/06/05	382.0	Construction, New Bridge	Bridge Length: 433.64 m	GOB only

Source: ADP Database, RHD * updated

Table 2.2.8 Future Road Development Projects by THD with Foreign Aid in the Associated Area , As of December 2004

No.	PROJECT NAME	TOTAL COST		PROJECT TYPE	REMARKS
		Million Taka	Million USD		
2	Improvement of Barisal – Jhalakathi – Bhandaria – Charkhali – Pirojpur – Khulna Highway	1,000.00	20.62	Impr./Rehab., Road	Road Length: 118.5 km Total Bridge Length: 650 m, 22 nos.
10	Construction of Second Sitalakhya, Third Burigonga and Muktapur Bridges	2,500.00	51.54	Costruction, New Bridge	
11	Construction of Dopdapia Bridge on Barisal – Patuakhali Highway	1,000.00	20.62	Costruction, New Bridge	Bridge Length: 850 m
15	Improvement of Faridpur – Barisal (N-84)	2,940.30	57.90	Impr./Rehab., Road	Road Length: 154.0 km
18	Feasibility Study and Upgrading Jessore – Benapole Road including Construction of Diversion Road near Benapole Land Port	1,844.00	36.30	Impr./Rehab., Road	Road Length: 42.4 km
21	Construction of Paturia – Dauladia Bridge over the River Padma straight to Uthili-Baruaria	24,000.00	446.10	Costruction, New Bridge	Bridge Length: 3,000 m
28	Improvement of Khulna – Satkhira – Betkhari Roads	1,008.00	18.74	Impr./Rehab., Road	Road Length: 126.0 km Implementation Period: 4 years
A-1	Improvement of Bhatiapara – Narail – Jessore – Benapole Highway	4,481.10	73.46	Impr./Rehab., Road	Road Network Improvement and Maintenance Project II (RNIMP-II), ADB Road Length: 79.5 km Bridge Length: 500 m
A-2	Improvement of Hemayetpur – Hazratpur – Konakhola, Zinzira – Rubitpur – Dohar – Srinagar – Khakladi – Mushiganj, Fatulla – Moktarpur Ferry, Moktarpur – Tongibari – Louhjang – Mawa and Tongi – Ghorashal Road	7,055.11	115.66	Impr./Rehab., Road	Road Network Improvement and Maintenance Project II (RNIMP-II), ADB Road Length: 194.5 km

Source: RHD Handbook, Dec. 2000 and F/S Report of RNIMP-II, 2003, ADB

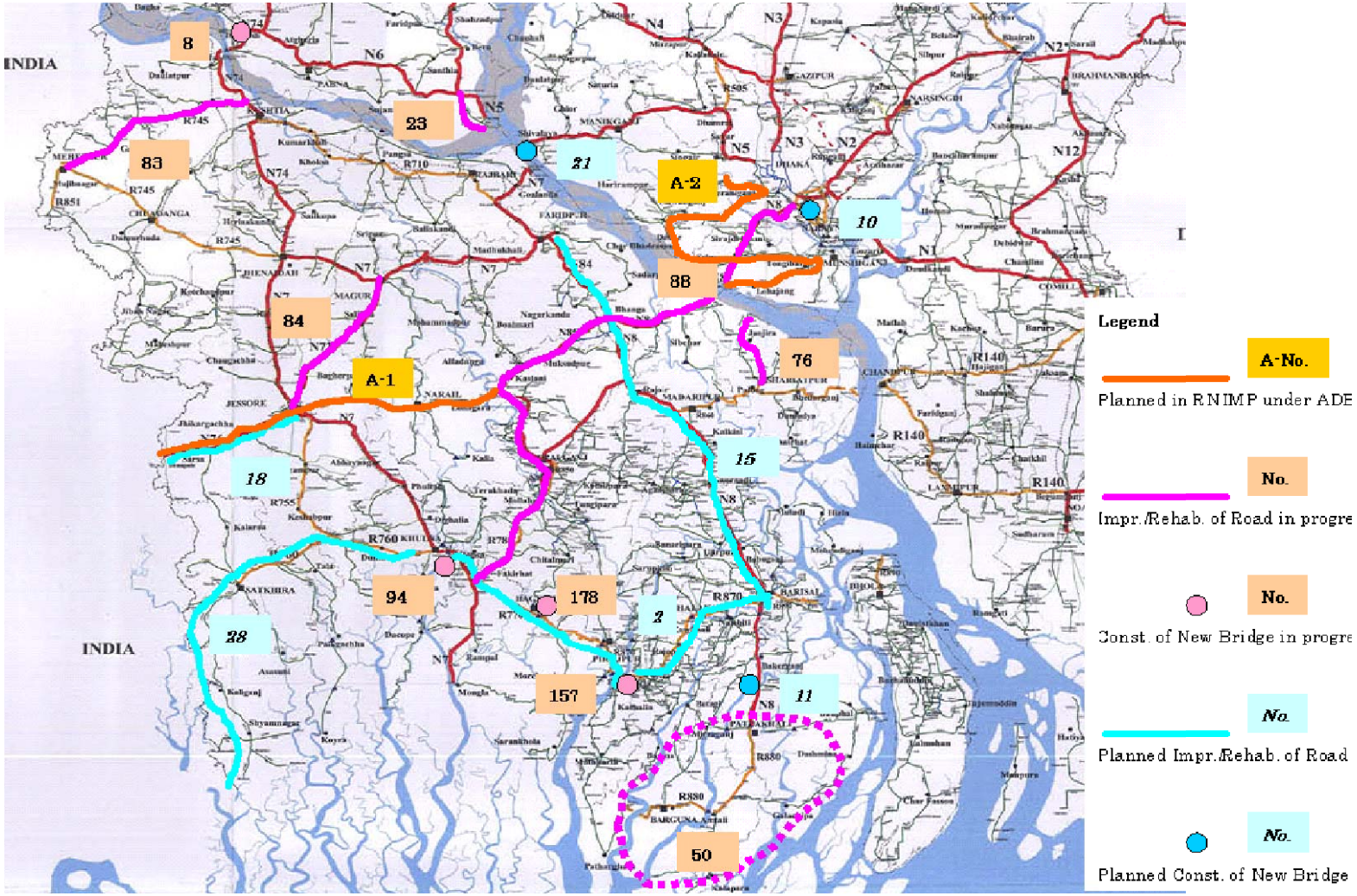


Figure 2.2.4 On-going and Planned RHD Road Projects in the Associated Area

(3) Inland Waterways

The Southwest region is characterized by vast inland waterways utilizing many rivers and their tributaries. At present, there are no direct links by roads and passenger transport between Dhaka and the SW region relies heavily on inland waterways.

There are 48 ghats in Barisal Port, 40 ghats in Khulna Port and 39 ghats in Patuakhali Port.

2.2.5 Environmental Characteristics

The Padma is a braided river with its width varying from 5 to 15 km. The general topography of the area in the vicinity of Padma River is flat. The soil of the Project area consists mainly of recent Holocene alluvial deposits. With sediment materials primarily transported by the river. The Project area is located in a sub-tropical monsoon-fed region and the vegetation comprises mostly secondary forest and cultivated crops. Overall, the landscape features along the Padma River watershed are monotonous.

In general, the Padma River has a high current and velocity during the monsoon season and becomes extremely ferocious and wild. Riverbank erosion and accretion are common in the Padma River watershed. From the main river stream, a number of tributaries, channels and canals have developed. Arial khan is one of the biggest distributaries on the right bank of the Padma River at Shibchar thana in Madaripur District. Seasonal flooding is a common phenomenon in the char lands and floodplains adjacent to the banks of the Padma River. The extent of tidal influence along the Padma River varies from upstream to downstream.

Vegetation along both banks comprises mainly agricultural crops and homestead vegetation, which includes fruit trees, timber, bamboo bush and dhoincha bush. It was found that reforestation or/community plantations have been partially commenced by the Department of Forest and some NGOs in some areas. Major cropping patterns in the char area include paddy, nut, potatoes, jute, chilly, onion, sugarcane, green vegetables, pulse, mustard etc.

A significant number of people live in the area of influence of the Project. The main economic activities are agriculture, fisheries, small trading and day labor. There are many chars within the river and some are inhabited. The economic condition of people on the left bank is more prosperous than those on the right bank of the Padma River. During the field visit it was noted that the Chandpur site is comparatively more wealthy than the other proposed bridge locations.

2.3 EXISTING TRANSPORT PROFILE OF BANGLADESH AND PROJECT AREA

2.3.1 Overview of Existing Transport System

An adequate and efficient transport system is a pre-requisite to economic development. It is recognized that investment to improve transport efficiency is the key to expansion and integration of markets. The transport system in Bangladesh comprises roads, railways, inland waterways, two seaports, maritime shipping and civil aviation.

Transport demand in Bangladesh has grown faster than the GDP growth of the country and doubled between 1974 and 1984 to 35 billion passenger kms (pkms). In 1996, it reached 72 billion pkms. Freight transport has also increased at a similar rate and reached 10 billion ton kms in 1996. However, the share of transport modes has not increased in the same proportion. The road sector carries the majority of passenger traffic, increasing from 54% in 1974 to 73% in 1996, mainly at the expense of rail. In the freight sector, transport by water is more dominant, although its demand has been slightly eroded from 37% in 1974 to 30%

in 1996. In comparison road transport increased to 63% in 1996, again mainly at the expense of rail transport. Thus, the faster expansion of the country's road network as well as the increase in road vehicles has led to the dominance of the road sector, although freight transport by water still remains substantial.

The transport sector in Bangladesh is confronted with numerous problems. Some are common to all sub-sectors while some are sub-sector specific. Major common problems are:

- Physical constraints due to difficult terrain, numerous river crossings, periodic flooding, poor soil condition, siltation and erosion of rivers, river bank sliding etc.;
- Lack of proper maintenance and timely rehabilitation of the transport network, rolling stock and capital assets. The development funds are largely allocated by the Planning Commission while the funds for maintenance are allocated by the Ministry of Finance as part of current expenditure. There is very little co-ordination between these two agencies in determining the level of development and maintenance allocations;
- Unrealistic pricing policy. Although pricing should ideally be based on cost recovery principles, in reality it is not commensurate to the cost of providing services. Fares and rates in all transport sub-sectors are fixed at a level much below the combined cost of transport. This has resulted in perpetual losses in the total transport sector and in turn has put pressure on the total allocation for other sectors of the economy;
- Inherent weaknesses of the institutional and policy framework. These have rendered the transport parastatals as perpetual loss-making concerns;
- Poor liquidity position of most of the transport sector parastatals. Almost all parastatals have accumulated substantial long-term debts. Due to poor financial performance, the debt servicing by the parastatals has also deteriorated. The consequences of this have been a heavy burden on the government budget;
- Waste of resources because of incoherent planning. Allocation to transport sector during planning rarely considers inter-modal priority based on cost effectiveness and optimal modal mix;
- Investment and operation problems due to inadequate co-ordination among the ministries and different parastatals.

Individual sub-sectors also have their own problems. Some of the major sub-sector specific problems are described later.

2.3.2 Transport Policy and Strategy

The transport sector consists of a number of sub-sectors including roads, railways, inland waterways, maritime shipping and civil aviation. The transport sector is managed and developed by four line ministries: Ministry of Communications (MOC) for road and rail; Ministry of Shipping (MOS) for water transport and ports; Ministry of Civil Aviation for air transport; and the Ministry of Local Government, Rural Development and Co-operatives for rural roads. Below the ministry level there are nine parastatals involved in transport operations: Bangladesh Railway, Bangladesh Road Transport Corporation, Bangladesh Inland Water Transport Corporation, Bangladesh Inland Water Transport Authority, Bangladesh Shipping Corporation, Civil Aviation Authority of Bangladesh, Biman Bangladesh, Chittagong Port Authority and Mongla Port Authority. In addition, there is the relatively new Jamuna Bridge Division under MOC (the Jamuna Multipurpose Bridge Authority, established in 1985, was placed under the Jamuna Bridge Division in 1995).

2.3.3 Government Policies and Programs

Until 1995, poor financial performance and weak capital structure of the public sector

parastatals placed a significant financial liability on the government. To address this problem, the Government of Bangladesh (GOB) has been pursuing a two-pronged policy of privatization and restructuring of public sector transport parastatals to achieve improved administrative, management and operational performances. In keeping with the national objective of achieving an average GDP growth rate of 7% per annum, and accommodating the increased volume of domestic traffic (as well future traffic from the Asian Highway and Trans-Asian Railway), the following transport sector objectives, strategies and programs were adopted.

Objectives:

- Achieve a transport sector growth rate of 7.5% per annum.
- Develop a balanced and integrated transport network to accommodate the projected traffic volume.

Strategy:

For the transport network development strategy, an optimal mix of "market integration approach" and "poles of development approach" is adopted. Operational significance of this mixed strategy is that development efforts are concentrated on the five main corridors with special emphasis on Dhaka-Chittagong, Dhaka-Northwest and Khulna-Northwest arterial corridors. This development strategy is reinforced by the rural transport development strategy. The rural transport system is to be developed by integrating the inland water transport sub-sector with the existing road transport system. To this network development strategy, an urban transport sector dimension is added. The elements of the strategy to be pursued are outlined in the Fifth Five Year Plan FFYP (1997-2002) as follows:

- The "Arterial Corridors" will be designated as "Strategic Corridors" and required investment will be made for the development of bridges, ferries and road upgrading works in these corridors to raise them to international standards so they can carry the regional and inter-regional traffic;
- The two sea ports will be further developed and linked to Dhaka, which connects all the major regions of the country;
- Railway links will be established between the east and the west zones of the country;
- The development strategy for rural transport will be reoriented for efficient external access through optimal integration of road and inland water transport and off-road internal access;
- Improvement in resource mobilization will be made through introduction of user charges and fees by the agencies;
- Improvement of management and operation of transport parastatals, including eventual privatization of all or parts of specific transport parastatals;
- Provision of required incentive packages for the private sector for greater participation, not only in transport services, but also for infrastructure building will be made;
- Identification and implementation of preventative, emergency and post-disaster mitigation measures will be made. To minimize road accidents, road safety administration will be adequately administered;
- Broadening the framework of the transport development strategy by incorporating the vital urban transport dimension starting with improvement in transport services of greater Dhaka city will be undertaken;
- Assurance of deficit-free operation of Bangladesh Railway as envisaged in Railway Recovery Program will be fulfilled;
- Improvement of sub-standard ferry operations on major road networks will be made;
- Introduction of necessary institutional reforms to address the operational constraints of the port transit system with special reference to containers and privatization measures

of ports for port transit system will be made;
- Adequate care will be taken while developing transport networks and services so that these do not cause environmental pollution and affect ecological balance; and
- Provision of duty-free and low duty import of engines and spares for mechanization of country boats will be made.

There is no clear preference to a particular mode of transport in Bangladesh at the expense of another. The FFYP (1997-2002) contains strategy objectives of developing a balanced regional transport network that is complimentary rather than contradictory to overall water management policies. It also stresses the necessity of limiting the choice of new projects to economic consideration only.

2.3.4 Priority Investment Programs and Projects

In conformity with the above strategy the following programs were to be undertaken and completed:

- Completion of the Jamuna Bangabandhu Multipurpose Bridge Project along with access roads;
- Construction of Dhaka Eastern by-pass;
- Completion of five major road bridges: two in the Mongla/ Khulna - Northwest corridor, one in Dhaka - Sylhet corridor, one over Dakatia at Chandpur and another on the Laokhali at Patuakhali;
- Completion of the construction of ongoing arterial road projects including their rehabilitation and maintenance;
- Undertaking the rehabilitation and maintenance of a core network of railways, including signaling and telecommunication systems;
- Construction of container terminals at Chittagong sea port, and expansion and modernization of container handling facilities at sea ports;
- Development of new cargo come general container composite port at Dhaka, and inland railway container depots at Dhaka, Tongi and Joydebpur;
- Maintenance of appropriate draft sea ports as well as inland navigational channels through appropriate dredging;
- Development of deep water sea port at Chittagong to cater to domestic as well as regional needs;
- Undertaking programs for development of ferry links to off-shore islands between Shariatpur and Chandpur, and mechanization of country boats;
- Development of M.A. Hannan Airport at Chittagong and Osmani Airport at Sylhet up to international standard; encouraging private sector participation in air transport;
- Initiation of programs for addition of a second runway at the international airport at Dhaka and building another airport at Trishal;
- Development of airports at Barisal, Khulna, Bogra, Rajshahi, Saidpur and Patuakhali;
- Improvement of urban transport system starting in Dhaka city through construction of new infrastructure and development of mass transit system;
- Extension of road network in Chittagong Hill Tracts; and
- Planning road and railway links and ports to the end of regional and sub-regional co-operation.

2.3.5 Financial Outlay of the Transport Sector

The development of an adequate and efficient transport system is seen by the Government of Bangladesh (GOB) as a prerequisite for both initiating and sustaining economic development. GOB is committed to the development of the transport sector, which is evident from the allocation of public sector funding indicated in the FFYP (1997-2002).

The total public sector outlay for the period 1997 to 2002 is estimated to be Taka 859 billion of which Taka 110 billion (13%) is allocated to the transport sector. This is the second largest proportion of the public budget, the largest proportion of Taka 129 billion (15% of the total budget) being for education. The financial outlay for the transport sector in the FFYP is shown in Table 2.3.1.

Table 2.3.1 Public Sector Financial Outlay in the Fifth Five-Year Plan for Transport Sector

Unit: Million Taka

Sub-Sector	Total Allocation	On-Going Projects	New Projects
Road Transport	64,905.50	51,500.00	13,405.50
Bangladesh Railway	24,000.00	17,900.00	6,100.00
Water Transport	13,550.00	9,750.00	3,800.00
Air Transport	7,500.00	6,160.00	1,340.00
Sub-Total	109,955.50	85,310.00	24,645.50
Bangabandhu Bridge	11,800.00	11,800.00	--
Total	121,755.50	97,110.00	24,645.50

Source: Fifth Five-Year Development Plan (1997-2002)

The road sub-sector allocation includes road types up to Zila Road (former feeder road type A), connecting thanas to the arterial roads. It does not include allocation for former feeder road type B and rural roads, which have been considered in the rural development sector.

2.3.6 Mid-Term Review of Five Year Plan

A Mid-Term Review of the FFYP (1997-2002) was published in December 2000. This highlighted a number of problems and issues as follows:

a) In the case of foreign-aid projects, delays in loan negotiation, signing of contracts etc., resulted in cost over-runs. A shortage of experienced personnel at management level, delays in land acquisition and shifting of utility lines from the road site were the main factors affecting implementation.
b) The prolonged flood of 1998 fully submerged around 820km of national highways, 262km of regional highways, and about 9420km of A type feeder roads. Road communication between Dhaka and other parts of the country, except the northern corridor, was totally disrupted. Flood rehabilitation works on the Dhaka-Aricha highway was completed at a cost of US$7 million through project aid from the Danish Government.
c) Dhaka-Eastern Bypass was approved but full implementation could not be undertaken because foreign aid had not been lined up.
d) Generally, lining up of foreign aid was found to be a lengthy process. Matching funds could also not be provided in a timely manner. For these reasons, the utilization of foreign aid slowed down.
e) Though the number of development projects increased considerably during the review period compared to previous years, ADP allocation, and particularly government funds, could not be expanded proportionately. This hindered the implementation of projects on schedule. The inclusion of some new flood rehabilitation projects in the ADP further constrained resources.
f) The Ministry/agency generally took the decision to revise some projects at the end of the project period. In such cases, the project costs increased causing additional pressure on funds to be provided by the government.
g) Cost estimates and specifications of various types of road building works need to be updated and rationalized in order to reduce cost and improve the quality of works.
j) Terminal facilities, mostly under local government bodies and private management, need functional integration with the road network.

i) Generally, construction, management and supervision needed to be improved significantly.

Recently, a draft document on policy and guidelines for construction, maintenance, and management of roads and/or bridges on a Build Operation and Transfer (BOT) basis was prepared by Roads and Railway Division. RHD is initiating policy dialogue between the government and the private sector in areas of financial management, financing, maintenance, and contracting of the road sector. There has also been increased involvement of the private sector in road transportation. Cargo transportation including overland container transport has expanded significantly.

Regarding inland waterway transport, constraints to progress included delays in procurement of container handling equipment at Chittagong Port, and delays in construction of Rupsha Bridge, which links Mongla Port. Further capital investment in dredging rivers approaching both Chittagong and Mongla Ports are also recommended.

As explained in Section 2.1, the Fifth Five Year Plan has already expired after its planning period (FY 1997 – FY2002). A new plan now under implementation is the "Three-Year Rolling Plan (TYRP)" covering the comparatively short/medium term up to FY2006, but keeping consistency with the longer term Plan of NS-EGPRSD.

2.3.7 External Assistance to Transport Sector

Most of the multi-lateral and bi-lateral donors operating in Bangladesh are involved in activities within the transport sector, which consists of a number of sub-sectors. The major donors divide their support to them, although several external donors are involved in more than one sub-sector. The main donors for the transport sector are the World Bank, Asian Development Bank (ADB), JICA, JBIC, DFID, SDC, USAID, CIDA, SIDA, GTZ, DANIDA, IDA, KFW, EC, IFAD, and OPEC. Saudi Arabia and the Netherlands also support the sector.

The World Bank is supporting the inland water transport sub-sector with financial and technical assistance, and assisting the government by setting up a regulatory and legal framework and gradually handing over the provision of services to the private sector. The World Bank, along with ADB and DFID, is also providing support for the development of the road sector under the responsibility of Roads and Highways Division. A key component under the World Bank-funded Second Road Rehabilitation and Maintenance Project is the Institutional Development Component, which is funded by DFID. This component is assisting in capacity-building at the Roads and Highways Division and in improving management and planning capacity. A new dimension of this project is dealing with road safety. The World Bank funded the Third Inland Water Transport Project and a Fourth IWT project is under preparation. The main thrust of the Fourth IWT project is expected to be on re-engineering the sub-sector. The aim is for the GOB to focus on the regulatory and legal framework and gradually hand over the provision of services to the private sector. The external assistance to the development of the road sector under the responsibility of Roads and Highways Division is coming from quite a number of multi- and bilateral donors. The World Bank has traditionally been the lead donor within this sub-sector.

ADB is intervening in the road sub-sector and, with the Third Roads Improvement Project, improving the strategic traffic corridor between Dhaka and Khulna to link up with Mongla Port. This particular traffic corridor has significant importance for the economic development in two priority districts that have been selected for assistance by DANIDA, namely Patuakhali and Barguna Districts. DANIDA has also financed a sector policy and strategy study for IWT and is at the moment providing technical assistance in the area of policy formulation and institutional development to the Ministry of Shipping as well as to

BIWTC. A national shipping policy is considered a prerequisite for future substantial support to the IWT.

A key component under the World Bank-funded Second Road Rehabilitation and Maintenance Project is the Institutional Development Component financed by DFID. This component is assisting in capacity building at RHD and in improving the management and planning capacity. A significant outcome of the component is an annual RHD Road Network Database report. It includes a detailed survey of road inventory and condition, roughness and traffic counts for more than 20,000km and 9,000 bridges of the RHD road network. A third and fourth phase of the project is underway. The institutional development component is expected to continue to play a significant role in the new phases, as capacity building and institutional development are not considered short-term interventions. A new dimension that will be added to this project will deal with road safety, an area where Denmark has a strong resource base, and it may be considered to include this aspect in the transport sector program.

Local Government Engineering Department (LGED) under the Ministry of Local Government, Rural Development and Co-operatives implements rural infrastructure development projects. SIDA is providing support for institutional strengthening of LGED, which is considered one of the most efficient and effective government organizations within the sector by both service users and external donors. Institutional development of the organization is important in order to enhance the momentum that has been built up during recent years. Another important aspect is donor coordination, especially given the high number of donors involved in the sector, in order to avoid duplication and overlap. More than fifteen donors are supporting projects implemented by LGED. Given the high number of donors involved, donor co-ordination is quite difficult, however, still necessary in order to avoid duplication and overlap. SIDA is also providing assistance in the area of institutional support to LGED.

2.3.8 Road Transport

(1) Profile of Highway

The Government's responsibility for roads is divided between the Roads and Highways Department (RHD) who is responsible for planning, construction, and maintenance of national highways, regional highways and Zila Road (former Feeder Road A), and the Local Government Engineering Department (LGED) responsible for Upazila Road, Union Road and Village Road (former Feeder Road B).

Roads in Bangladesh are classified in four main groups namely:

- National Highways,
- Regional Highways,
- Feeder Roads, and
- Local Roads.

National highways connect the national capital with district headquarters, port cities and international highways. Regional highways connect different regions and district headquarters not connected by national highways. Feeder roads are of two types, namely Zila Road (former feeder road type A) and Upazila Road, Union Road and Village Road (former feeder road type B). Zila Road connects the Thana headquarters with Upazila headquarters. Upazila Road connects important growth centres to the main arterial road network. Union Road connects Union headquarters with growth centres or local markets or each other. Village Road connects villages with Union headquarters, local markets, farms and ghats or with each other.

In mid-2003, the total length of road network under RHD was around 21,000 km, of which 12,500 km was paved and 8,500 km was earthen. The lengths of national highway, regional highway and feeder road are 3090 km (15%), 1750 km (8%), and 16,000 km (77%), respectively (Table 2.3.2). At the end of 2000, the total length of different categories of road under LGED stood at 41,179 km (62%) paved and 24,717 km (38%) earthen.

Source: This Study, 2003

Road Improvement Work on National Highway N8 near Mawa

Table 2.3.2 Road System of Bangladesh

DOMAIN	CLASSIFICATION	PRIMARY CONNECTION	LENGTH (km)	
RHD	National Highways	National capital to Divisional headquarters, Sea/Land ports and Asian Highways	3,086	20,799
	Regional Highways	between District headquarters, Main river/land ports, not connected by National Highways	1,751	
	Zila Roads	District headquarters to Upazila headquarters, or between Upazila headquarters, by a single main connection with National/Regional Highway, through shortest distance/route	15,962	
LGED in collaboration with Local Government Institutions(LGI)	Upazila Roads	Upazila headquarters to Growth Center(s), or between Growth Centers by a single main connection, or Growth Center to Higher Road System(National Highways, Regional Highways and Zila Roads), through shortest distance/route	23,434	201,738
	Union Roads	Union headquarters to Upazila headquarters, Growth Centers or Local markets, or	68,624	
	Village Roads	Villages to Union headquarters, Local markets, Farms and Ghats, or between Villages, and within a Village	114,126	
Municipal bodies like City Corporations and Pourashavas	Municipal Roads	within Urban areas	4,300 as of 1997	

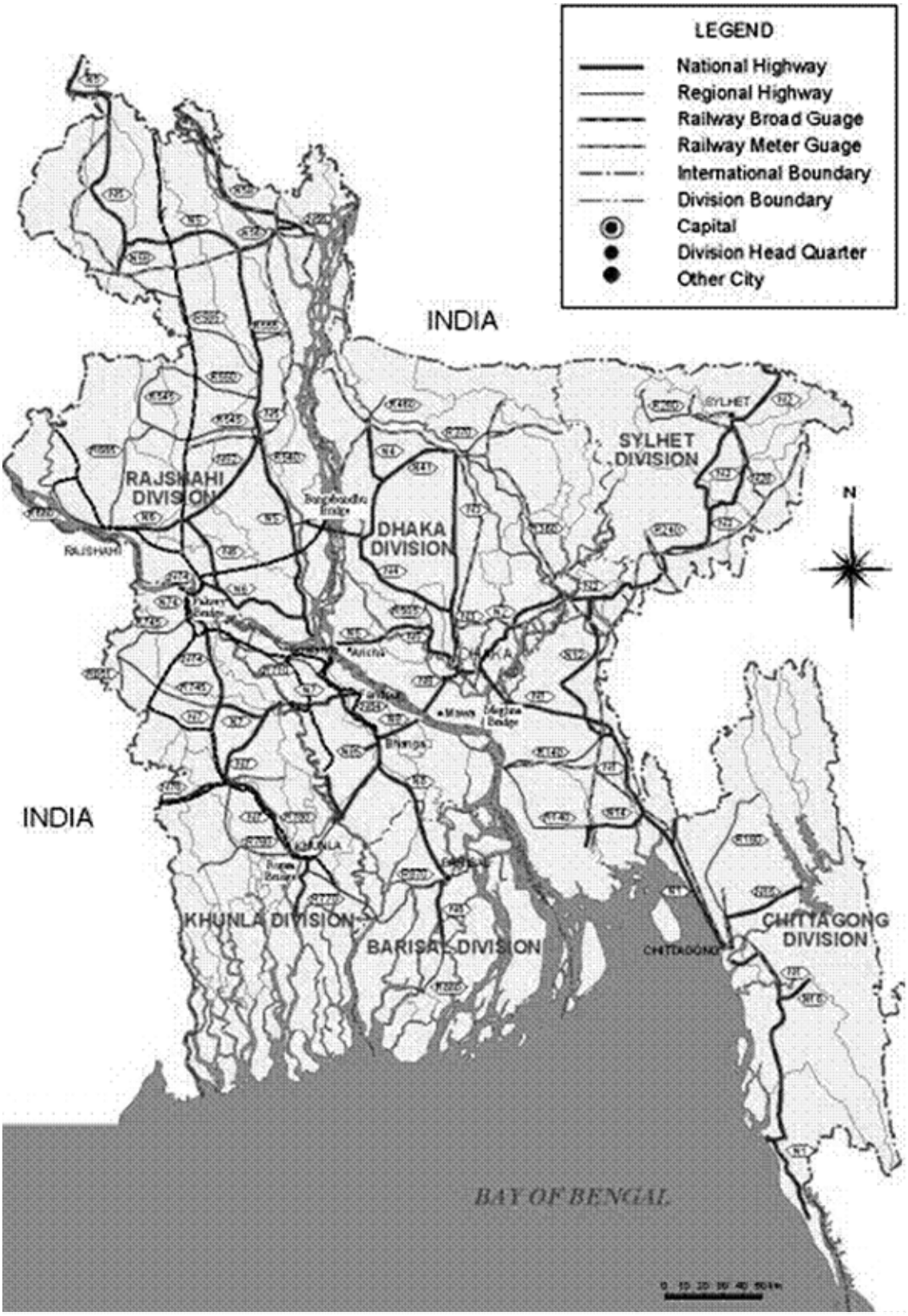


Figure 2.3.1 Highway Network in Bangladesh

(2) Bangladesh Road Vehicle Fleet

The Bangladesh vehicle fleet has a wide variety and age of vehicle types. The country has no vehicle manufacturing plant so all vehicles are imported, with Japanese and Indian manufacturers dominating the market. Table 2.3.3 shows the classification of vehicles in Bangladesh.

Table 2.3.3 RHD Vehicle Categories

RHD Category	Description
Articulated Truck	All articulated trucks and trucks with trailers
Medium Truck	Two or three axle rigid > 3 tonne payload
Small Truck	Two axle rigid < 3 tonne payload
Large Bus	>40 seats and >36 feet chassis
Mini Bus	16 – 39 seats and <36 feet chassis
Microbus	<16 seats
Utility	Four wheel drive jeeps and pick-ups
Car	All saloon cars and taxis
Motorcycle	All two-wheeled motorized vehicles
Auto Rickshaw	Three-wheeled motorized vehicles
Tempo	Large passenger and cargo carrying 3 wheelers
Cycle Rickshaw	Three-wheeled passenger NMV
Rickshaw Van	Three-wheeled cargo NMV
Cart	All animal carts and human drawn/push carts
Bicycle	All two-wheeled non-motorized vehicles

Source: MCC Traffic Guide (RHD), October 2001

Table 2.3.4 shows the number of vehicles registered in Bangladesh over a recent six-year period. Non-motorized vehicles (NMV) are regulated by local authorities, although the actual number of NMVs is unknown. The table below indicates some 594,000 vehicles were registered in 2001 with 46% being motorcycles. However, few motorcycles can be observed in the Dhaka region, and their abundance is mainly in northern areas of the country. Whilst buses and microbuses make up only 5%, their importance is significant in carrying large numbers of passengers over long distances.

Table 2.3.4 Number of Registered Vehicles in Bangladesh

Type	1995	1996	1997	1998	1999	2000	2001	AAGR
Car/Taxi	63,218	74,493	82,861	88,840	94,042	98,682	106,028	9.09%
Jeep/Microbus	29,207	32,015	33,774	36,479	38,748	40,260	43,337	6.81%
Bus	13,406	13,287	13,386	13,762	13,939	14,269	14,859	1.74%
Minibus	10,466	11,052	11,918	12,520	12,999	13,399	14,597	5.72%
Truck	33,210	35,475	36,257	38,990	41,008	43,728	46,203	5.67%
A Rick/Tempo	52,340	62,548	69,094	73,497	75,637	78,767	79,144	7.31%
Motorcycle	178,257	188,669	200,749	215,274	231,785	246,395	271,204	7.25%
Other	8,161	8,685	10,286	11,534	14,151	15,511	18,402	14.65%
Total	388,265	426,224	458,325	490,896	522,309	551,011	593,774	7.34%

Source: BRTA
AAGR= annual average growth rate

(3) Road Transport Problems

The main problems associated with road transport can be summarized as:

- Inadequate allocation of fund for maintenance of roads and vehicles;
- Losses due to operating old, dilapidated, over-aged vehicles;
- Heavy management with excess manpower;

- Poor maintenance and rehabilitation of road infrastructure;
- Poor administration of road safety measures and environmental issues;
- Mixed traffic comprising both motorized and non-motorized traffic;
- Lack of all weather accessibility because of high investment cost due to periodic flooding and consequent height requirement of road embankment;
- Numerous river crossings requiring many bridges and/or ferry links.

(4) Traffic Growth

In 1971 there were around 40,000 motor vehicles, whereas at present there are almost 600,000, representing an average growth of around 10% per year. In the future, as the country grows in prosperity, high growth can be expected in light vehicles. Figure 2.3.2 graphically illustrates traffic growth between 1989 and 1998.

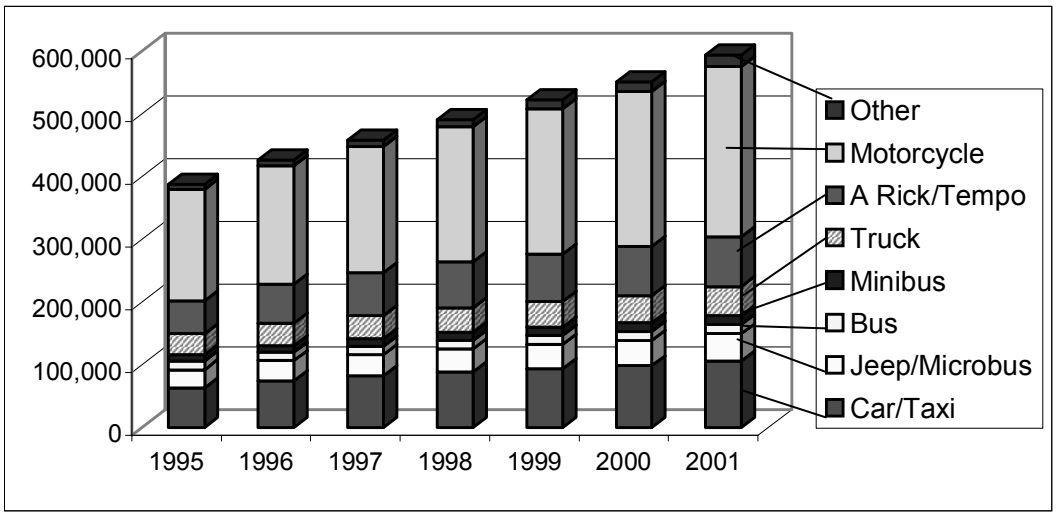


Figure 2.3.2 Motor Vehicle Growth in Bangladesh (1995 to 2001)

Different vehicles have different rates of utilization. For example, in Bangladesh commercial vehicles, and in particular buses, are used intensively. Large buses operating on inter-city routes are utilized for up to 80% of the time available, while most other vehicles average around 60% utilization.

2.3.9 Rail Transport

(1) Overview

Bangladesh railway (BR) is the only organized mode of transport operated by the public sector. The rail transport consists of both broad gauge and metre gauge lines. Broad gauge accounts for 34%, while metre gauge accounts for 66%. Bangladesh railway operates all over the country through 255 stations in the eastern region and 234 stations in the western region. BR provides three types of rail services namely Inter-City, Mail Express and Local Passenger services. In 1994/95 the inter-city trains carried 22%, the express trains 39% and the local trains 39% of the total rail passengers. Railway freight traffic has declined over the years. In 1969 freight traffic carried by rail was about 4.88 million tons, while in 1994 it reduced to 2.7 million tons. Ton-km has also reduced over the years. Net ton-kms in 1994/95 stood at 759 million, while in 1969/70 it was 1265 millions. Railway freight traffic constituted only 7% of the total freight traffic generated in 1996/97. Major commodities carried by rail are food grain, fertilizer, cement, coal, stone and ballast, petroleum products, jute, salt and sugarcane, etc.

A notable improvement in the rail network is provided by Jamuna Multi-Purpose Bridge. In August, 2003 the rail link over Jamuna Bridge from Dhaka to the north-west region was opened, but only offers passenger services.

(2) Railway Problems

The main problems associated with rail transport can be summarized as:

- Financial losses due to diversion of passenger and freight traffic from rail transport to road transport;
- Excess overhead expenditure and lower operating revenue with higher operating cost;
- Losses due to ticket-less traveling, especially in local trains;
- Poor operational efficiency because of inadequate fund allocation for maintenance of tracks and rolling stocks;
- Attitude of railway management not to operate railways on a commercial consideration.

2.3.10 Inland Waterway Transport

(1) Overview

The basic inland waterway transport (IWT) system comprises a triangle of two seaports, Chittagong and Mongla, with the Dhaka-Narayanganj Metropolitan Area. Whilst the total length of waterways is around 14,000km, the length of navigable waterways is 5968km in the rainy season and 3600km in the dry season. There are 23 coastal island ports and 7 ferry ghats located at Paturia, Nagarbari, Daulatdia, Bhuapur, Sirajganj, Mawa, and Char Janajat. In addition there are 233 BIWTA launch ghats and over 1000 more ghats around the country.

More than half of the country's land area and 75% of commercial activities are situated within 10km of a navigable waterway during all seasons. The waterways are developed and maintained by Bangladesh Inland Waterways Transport Authority (BIWTA) and despite problems of siltation and reduced streamflow during the dry season, provide a cost-effective means of transport. The Bangladesh Inland Waterways Transport Corporation (BIWTC) maintains a few inter-city passenger traffic lines and limited IWT cargo traffic. The private sector provides the majority of inland water services. The service providers are organized into a number of associations. The eleven major ports are administered and managed by BIWTA. Contracts are made with the private sector operators to deliver the necessary services.

(2) Waterway Problems

The main problems associated with water transport in Bangladesh can be summarized as:

- Siltation of inland waterways and lack of adequate navigation aids.
- Poor operational efficiency of BIWTC fleet. Most of the vessels in its fleet are old and involve higher fuel consumption, maintenance and repair costs.
- Heavy losses due to non-profitable BIWTC passenger services in the coastal routes and inefficient cargo services in other routes.
- Poor cargo capacity of BSC due to lack of container-carrying vessels.
- Huge BIWTC and BSC establishments with excess manpower.
- Poor operational efficiency of Chittagong port due to inadequate arrangement for carriages as well as loading and unloading of containers. Furthermore, the cargo handling equipment and vessels remain inoperative for long periods because inadequate foreign exchange allocation and cumbersome, time-consuming procedures for import of

required spare parts.

- Operational problems because of siltation of channels from anchorage to the port area. Proper dredging cannot be undertaken because of financial constraints of port authorities.
- Operation problem of Mongla port due to siltation of approach channels and lack of multipurpose berths and ancillary equipment.

(3) Inland Water Movements

(a) Passenger Movements

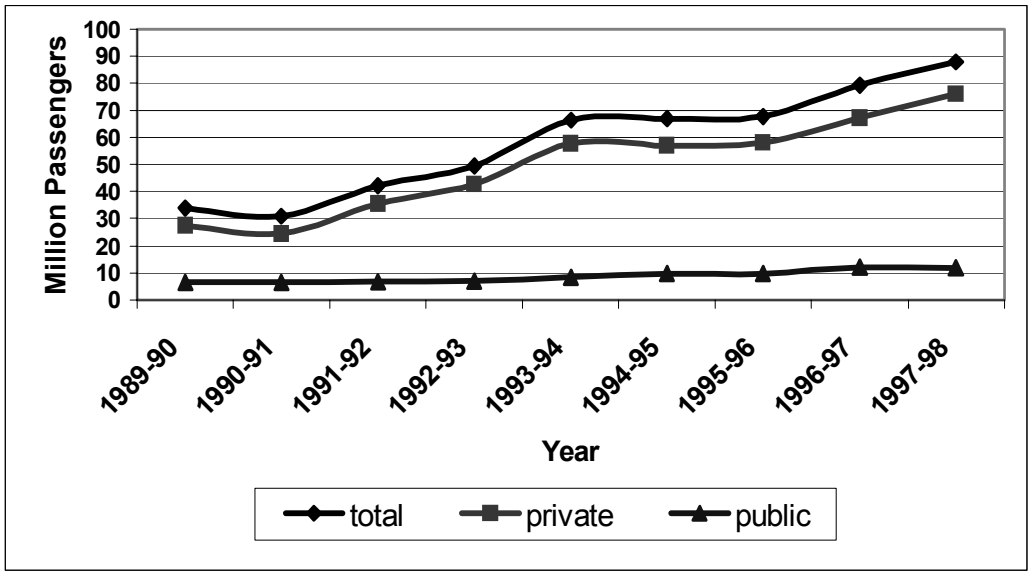
Many passenger trips are made by IWT due to cost, comfort such as sleeping facilities, convenience, and direct access to destination. In 1998 there were a total of 230 passenger vessel routes and 4372 registered mechanized vessels. The majority of passengers travel by motor launch with others by ferry service and steamer. Like road traffic, water traffic also comprises a mix of mechanized and non-mechanized vessels.

Source: This Study, 2003

Passenger Launch at Dhaka Port

Since non-mechanized water transports are unregistered, it is not possible to give accurate statistics of their number and carrying capacity.

Figure 2.3.3 shows that almost 88 million passengers traveled by inland water in 1997-98. The majority of these were by private vessel. From 1989/90 to 1997/98, the average annual rate of growth was 11% until 1997/98.

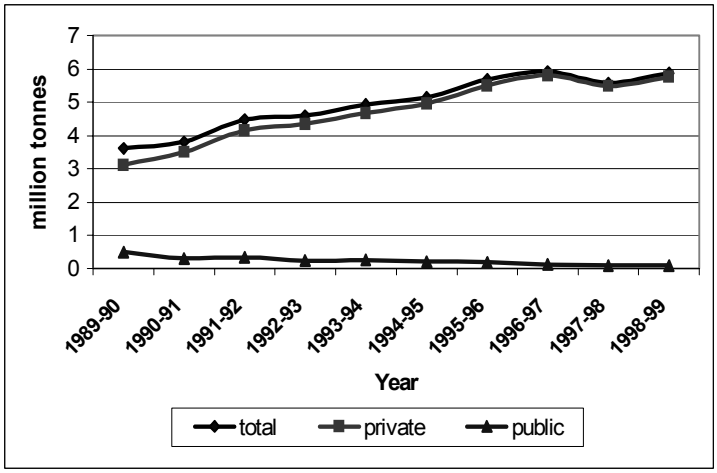


Source Data: Annual Ports and Traffic Report, 1998-99, BIWTA

Figure 2.3.3 Passenger Transport by Inland Water

(b) Freight Movements

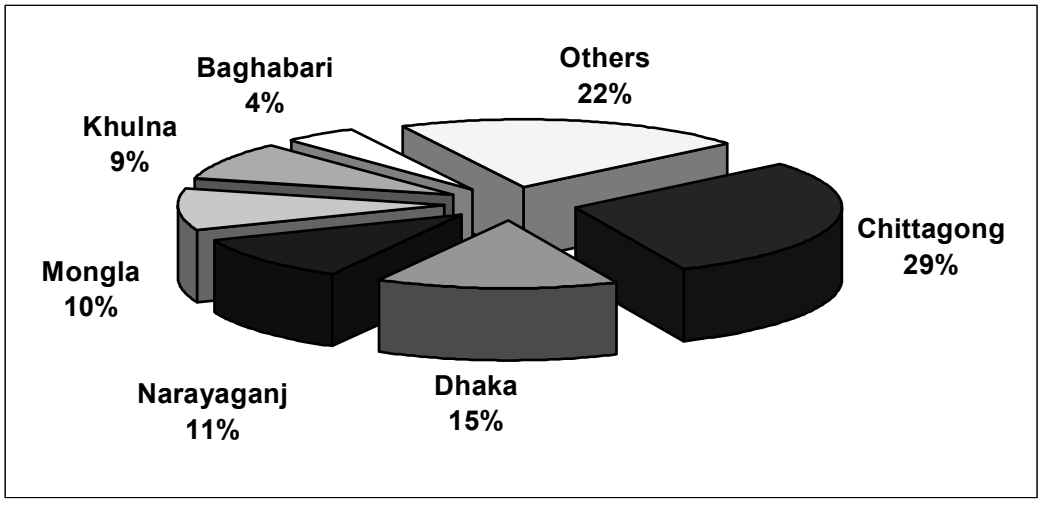
Large volumes of freight are transported by inland water between more than 120 ports. Of all cargo moved by inland water in 1998/99, almost 80% was transported and handled between the two seaports and the inland ports of Dhaka, Narayanganj, and Khulna. Extensive water traffic is also provided by country boats, but these cannot be quantified. Figure 2.3.4 shows that around 6 million tonnes of freight were moved by inland water in 1998/99.



Source Data: Annual Ports and Traffic Report, 1998-99, BIWTA

Figure 2.3.4 Freight Transport by Inland Water

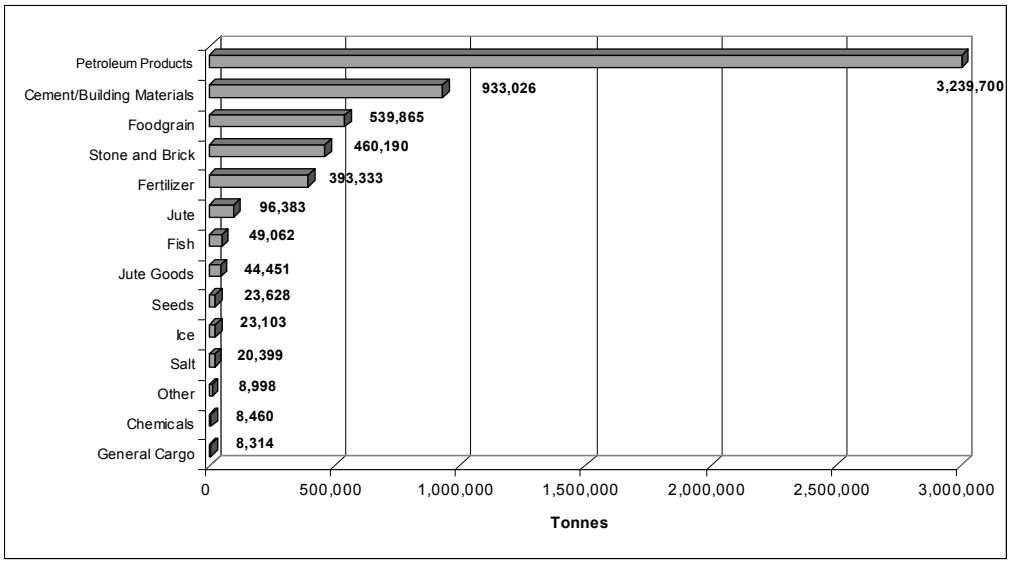
The rate of growth in freight between 1989 and 1998 has been about 5%. Figure 2.3.5 shows the relative proportions of inland water cargo handled by each of the main ports in Bangladesh during 1998-99. Chittagong Port handled 29% of all cargo, with Dhaka Port second at 15%. Mongla and Khulna Ports shared 19%. Chittagong is the main forwarding port whilst Dhaka is the main receiving port.



Source Data: Annual Ports and Traffic Report, 1998-99, BIWTA

Figure 2.3.5 Share of Cargo Handled at Stations

Figure 2.3.6 illustrates the breakdown of total cargo moved by inland water during 1998/99. This clearly shows the importance of the IWT sector for bulk cargoes and indicates its comparative advantage over other modes, such as road.



Source Data: Annual Ports and Traffic Report, 1998-99, BIWTA

Figure 2.3.6 Commodities Moved by Inland Water Transport (1998-99)

Bulk commodities such as petroleum products, building materials, food grain, and fertilizer make up around 83% of total freight traffic. Cargo grouped under 'other' commodities includes firewood, soft drinks, sundries, paper and board, newsprint, machinery, pulp, sugar, and dry fish.

2.4 PADMA RIVER CROSSING TRAFFIC SURVEY

2.4.1 General

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 on each side of the river. The buses that cross by ferry are loaded with passengers. These through buses mainly operate at Paturia crossing, and the buses tend to be night coaches, laden with some small commodities, or air-conditioned models with higher paying passengers.
- Launch: this daytime-only vessel carries foot passengers who are mainly passengers of buses not 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 wish to reduce waiting time.

2.4.2 Profile of River Crossing Points

There are two main potential 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 below.

(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, although 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, although 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 including 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 the Southwest is likely to be relatively small.

2.4.3 Cross River Movements

Large numbers of people cross Padma River every day. They predominantly 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

[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.

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.

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.

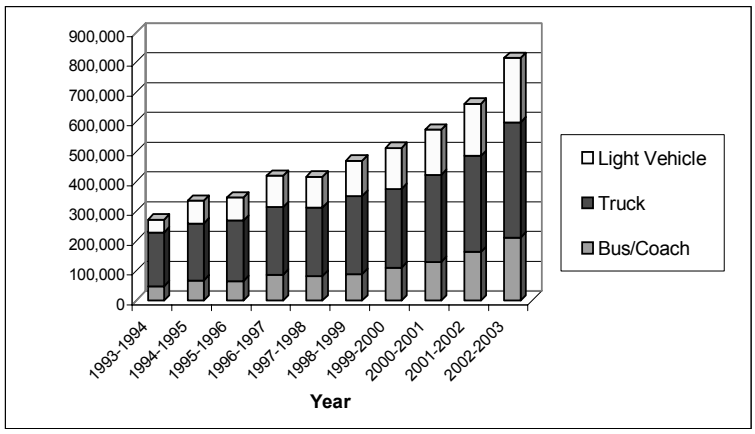
As trucks cross the river by ferry, no loading/unloading of cargo takes place. Trucks tend to have long waiting times. This increases their travel time by hours or even days.

Source: This Study, 2003

Ferry Loaded with Freight Trucks

(1) Volume of Traffic Crossing

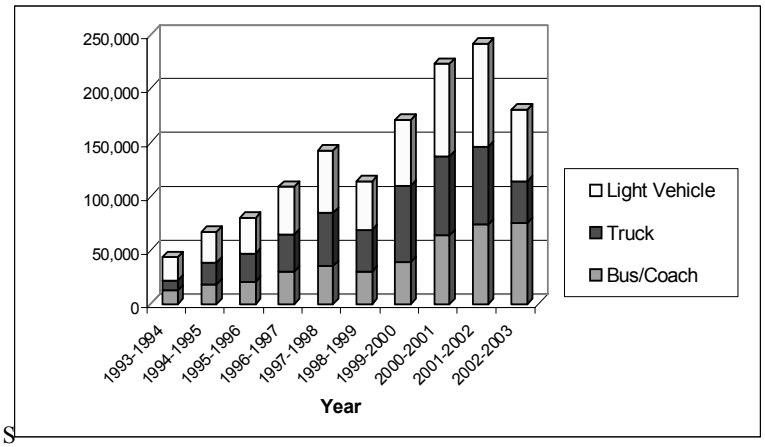
Figure 2.4.1 shows the annual volume of traffic crossing Padma River at Paturia- Goalundo since 1993. Around 800,000 vehicles cross Padma River at Paturia. This is the heaviest used crossing, particularly by freight traffic. A large increase in traffic is notable in the year 2002/03, mainly caused by re-routing truck traffic, which is avoiding National Highway N8 improvements works on the Mawa route.



Source Data: BITWC

Figure 2.4.1 Volume of Traffic Crossing by Ferry at Paturia-Goalundo

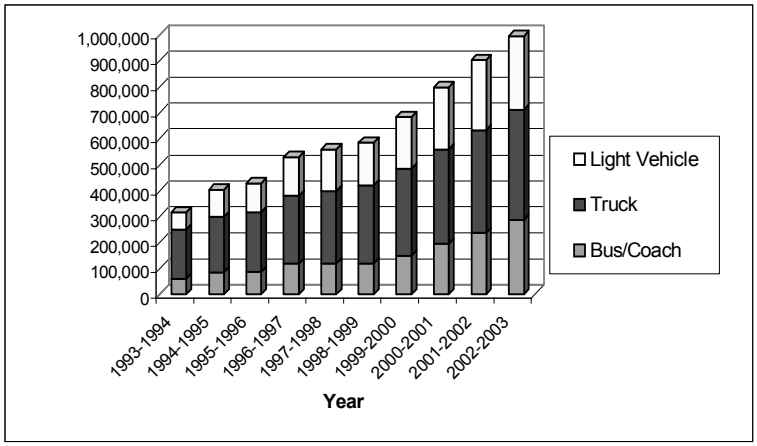
Figure 2.4.2 shows the annual volume of traffic crossing Padma River at Mawa-Charjanajat. Around 175,000 vehicles crossed Padma River at Mawa in 2002/03. The Figure clearly shows a reduction from the previous year, mainly by trucks, which have tended to divert to the Paturia crossing to avoid road improvement works on the National Highway N8 between Dhaka and Mawa. In any case, the Mawa crossing carries less traffic than the Paturia crossing.



Source Data: BITWC

Figure 2.4.2 Volume of Traffic Crossing by Ferry at Mawa-Charjanajat

Figure 2.4.3 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 2.4.3 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 2.4.1 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 2.4.1 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%

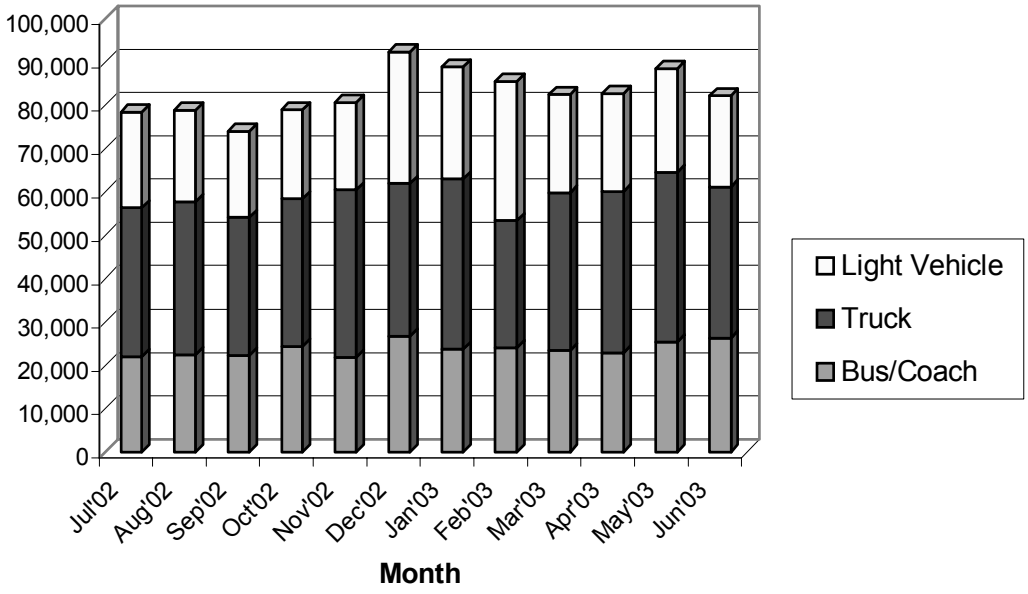
Source Data: BITWC

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

The December peak associated with 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.

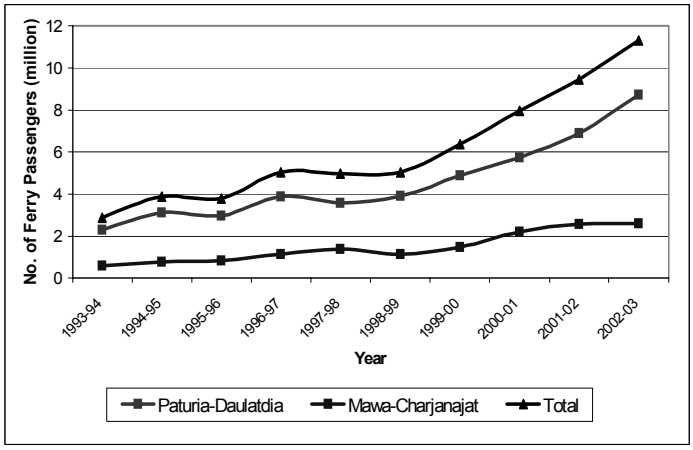


Source Data: BITWC

Figure 2.4.4 Seasonal Variation of Vehicular Traffic Crossing Padma River

(4) Passenger Trips

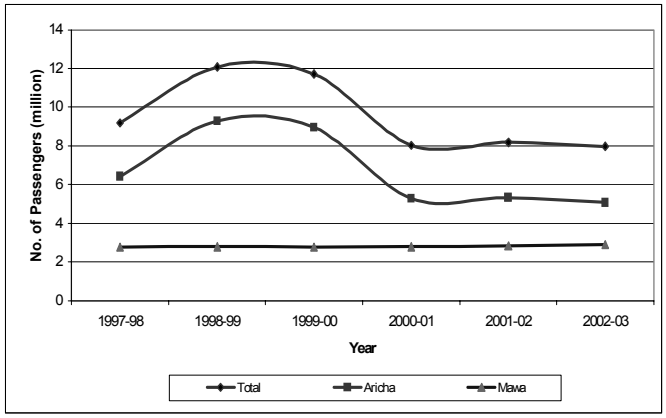
Figure 2.4.5 shows the annual volume of passengers crossing Padma River by ferry at both Paturia-Goalundo and Mawa-Charjanajat crossings. Around 11.3 million ferry passengers crossed the river last year with almost 9 million at the Paturia-Goalundo crossing. This crossing has shown the greatest and most linear growth rate in the past few years, whilst passenger traffic at the Mawa site has remained relatively constant.



Source Data: BITWC

Figure 2.4.5 Annual Ferry Passengers Crossing Padma River

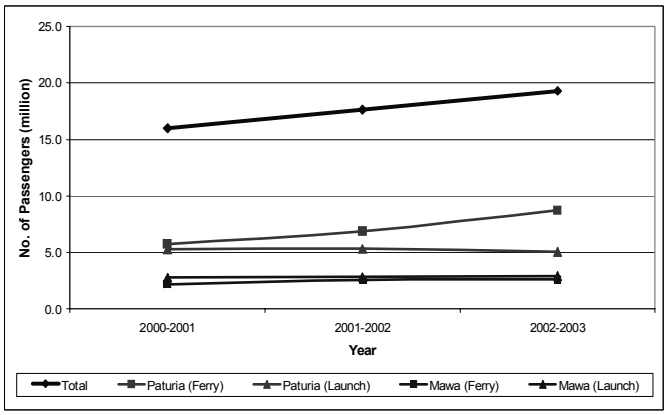
Figure 2.4.6 shows the annual number of passengers who cross Padma River by launch at the Aricha and Mawa ghats. The Aricha site includes services to the north-west and the decrease in passengers during 1999 can be explained by the opening of Jamuna Bridge, whereupon passengers changed mode to road in 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 2.4.6 Volume of Passengers Crossing Padma River by Launch (1997-2002)

Figure 2.4.7 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 2.4.7 Volume of Passengers Crossing Padma River by Ferry and Launch (1997-2002)

2.4.4 Existing Ferry Fares

Table 2.4.2 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 2.4.2 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 passengers)	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

2.4.5 Traffic Survey in This Study

(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 2.4.3 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 surveys, the weekend in Bangladesh, as far as possible. The most important survey sites at Mawa-Charjanajat and Patria-Goalundo were surveyed on weekdays. However, of the 3-day counting survey at Takerhat & Faridpur 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 by applying other traffic data sources. This work is done in the traffic demand projection.

(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 regions. The following data were derived:

(1) 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

(2) Traffic at National Highway Intersections

- Classified Traffic Counts by Direction

(3) Inland Waterway Transport Traffic

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

(4) 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 2.4.4 (River Crossing) and Table 2.4.5 (Inland Water) summarize the items of desired traffic data and specify whether it was covered within the survey. Where survey coverage was absent the alternative method of collection is described.

Table 2.4.4 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 regions 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 recording 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 focused 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 2.4.5 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 2.4.5 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, although annual reports are not kept up to date.

2.4.6 Survey Results

(1) Padma River Crossing Survey

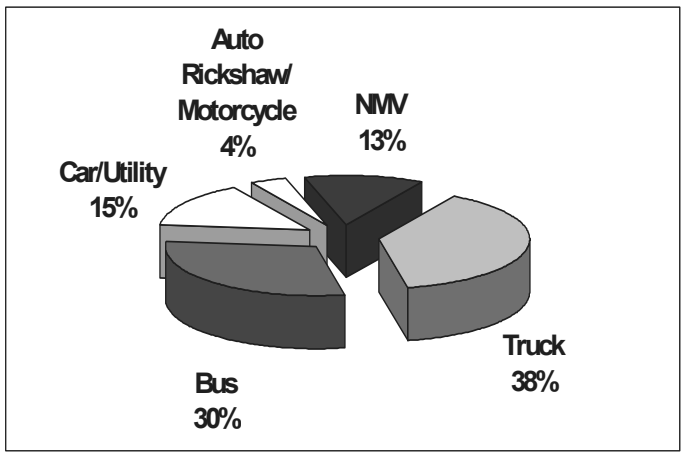
The Padma River screenline survey included the river crossing locations of Mawa-Charjanajat and Paturia-Goalundo. The following items summarize the results of this survey.

(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-off/pick-up traffic as well as local trade trips. The vehicles actually crossing the river were later recorded from BIWTC who collect the ticket office receipts. This traffic volume is described later.

Paturia-Goalundo River Crossing:

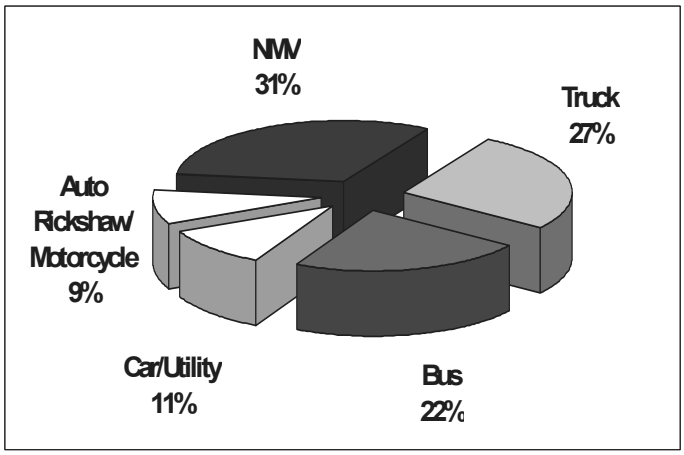
Figure 2.4.8 shows the relative proportions of traffic arriving or departing from Paturia Ferry Terminal on the east (Dhaka) side of Padma River. Around 2,190 recorded vehicles/day approach the river crossing site, and a similar number depart. Some 87% of this traffic is motorized and 13% non-motorized. 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, although only some will physically cross the river as through traffic. The others act as a feeder service.



Source: This Study, 2003

Figure 2.4.8 Categories of Traffic Approaching Paturia Ferry Terminal (total: 4,275 vehicles/ day)

Figure 2.4.9 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 riverbank compared to Paturia on the eastern side.



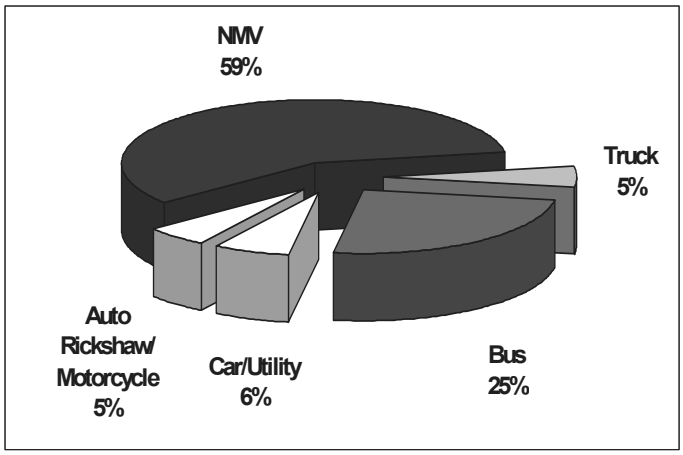
Source: This Study, 2003

Figure 2.4.9 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:

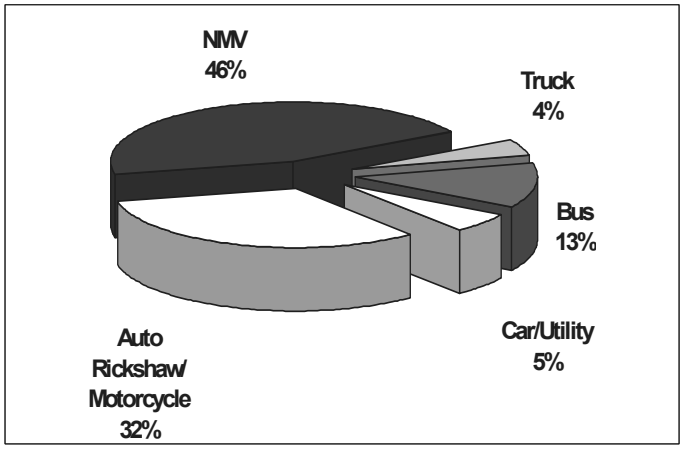
Figure 2.4.10 shows the relative proportions of traffic arriving at or departing from Mawa Ferry Terminal on the east (Dhaka) side of the river. Around 1,670 vehicles/day approach, while 1,900 depart, giving a total recorded volume of 3,576 vehicles/day. The high proportion of NMVs is apparent, although 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% of buses.



Source: This Study, 2003

Figure 2.4.10 Categories of Traffic Approaching Mawa Ferry Terminal (total: 3,576 vehicles)

Figure 2.4.11 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 depart, 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 accounted for 27%.



Source: This Study, 2003

Figure 2.4.11 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, which keeps daily records of such traffic. The volume of launch passengers crossing the river was derived from manual counts over 3 days. Table 2.4.6 shows the average volume of daily traffic for the three days in July 2003.

Table 2.4.6 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 used 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. [2]

Table 2.4.7 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.

[2] 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 2.4.7 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	Sylhet	-	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 Northwestern 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, although 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 2.4.8 shows the overall pattern of movements for traffic crossing Padma River. This combines all classes of vehicle and both ferry and launch traffic.

Table 2.4.8 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 %
	Northwestern 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 Indian 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 with 61% of traffic generated by the north and 39% generated by the south.

Table 2.4.9 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 %
	Northwestern 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 2.4.10 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 %
	Northwestern 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 Indian 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 2.4.11 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) Freight Characteristics

Information on the characteristics of cargo carried by trucks was derived from interview questionnaires and is summarized in Table 2.4.12.

Table 2.4.12 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 %
Groceries	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 2.4.13 summarizes the destinations and corresponding numbers of these inland water launch passengers, which is similar to the share of estimated inland water passengers per day between Dhaka and southwest region in 2003 by BIWTA.

Table 2.4.13 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.

(3) Jamuna Bridge

In order to more accurately assess the magnitude of traffic that could divert from Jamuna Bridge to a Padma Bridge, an 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 2.4.14, 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 2.4.14 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 %
Northwestern 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, although this number is relatively small. Traffic with trip-ends in Pabna, Natore, and Rajshahi, amounting to around 1,100 vehicles/day, could select a route via a Padma Bridge, although this requires demand forecasting calculations based on vehicle user benefits to assess the likelihood of diversion.

Chapter 3 Bridge Location Studies

3.1 IDENTIFICATION OF BRIDGE LOCATION ALTERNATIVES

Main objective of this section is to identify four alternative bridge sites from aspects of river morphology of the Padma River and the transportation and road network in Bangladesh.

3.1.1 Features of Padma River

(1) River and Basin

The territory of Bangladesh lies in the north eastern part of South Asia, between latitude 20°34'N and 26°38'N, and between longitude 88°01'E and 92°41'E. As shown in Figure 3.1.1, the territory is bounded by India on the west to northeast, Myanmar on the southeast and the Bay of Bengal on the south. The area of the territory is 147,570 km^2 mostly covered with the low-lying flood plain of the Ganges-Brahmaputra delta which is the largest delta in the world. The geographic location of the territory is a key factor to characterize the climate and hydrology of Bangladesh, surrounded by the Indian sub-continent to the west, the Himalayas and Tibetan Plateau to the north, and the Bay of Bengal and Indian Ocean to the south.

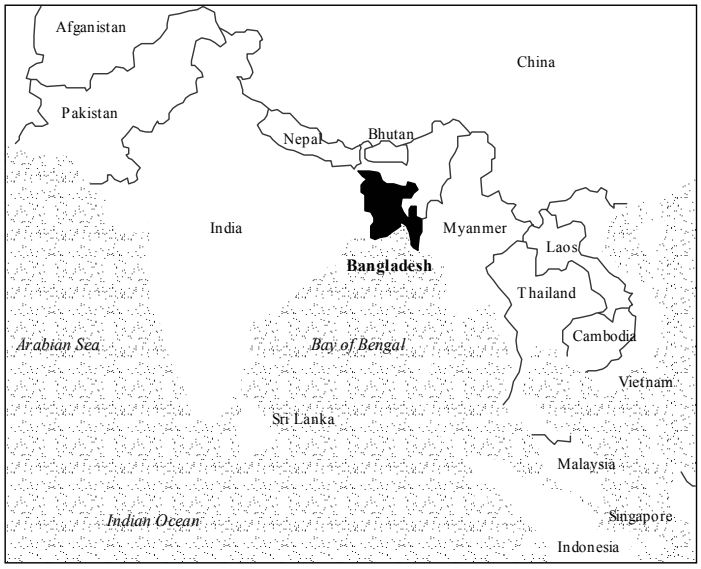


Figure 3.1.1 Location of Bangladesh

The Ganges, the Jamuna and the Meghna rivers constitute the Ganges-Jamuna-Meghna (GJM) river system. Basin area of the GJM River is 1,740,000 km^2 in total. Bangladesh is located in the lowest part of the GJM river basin.

The Ganges River (1,090,000 km^2 basin) and Jamuna River (570,000 km^2 basin) meet each other near Goalundo and flow to the south and join the Meghna River (or the Upper Meghna, 77,000 km^2) at Chandpur. The river stretch from the Ganges-Jamuna confluence to the Meghna River confluence is called the Padma River in the present Study, though the Ganges River is also called the Padma River. The main stream of the GJM river system downstream of the Padma-Meghna confluence is the Meghna River (or the Lower Meghna).

Basin map of the GJM River is shown in Figure 3.1.2. The drainage area in Bangladesh shares only some 5% of the total basin area at Goalundo. Most of the upstream basin is located outside of Bangladesh, and river related interventions in the upstream countries may directly influence the flow conditions in Bangladesh. The Ganges, the Jamuna and the Meghna rivers have different hydrological characteristics due to their different basin sizes, locations and channel profiles.

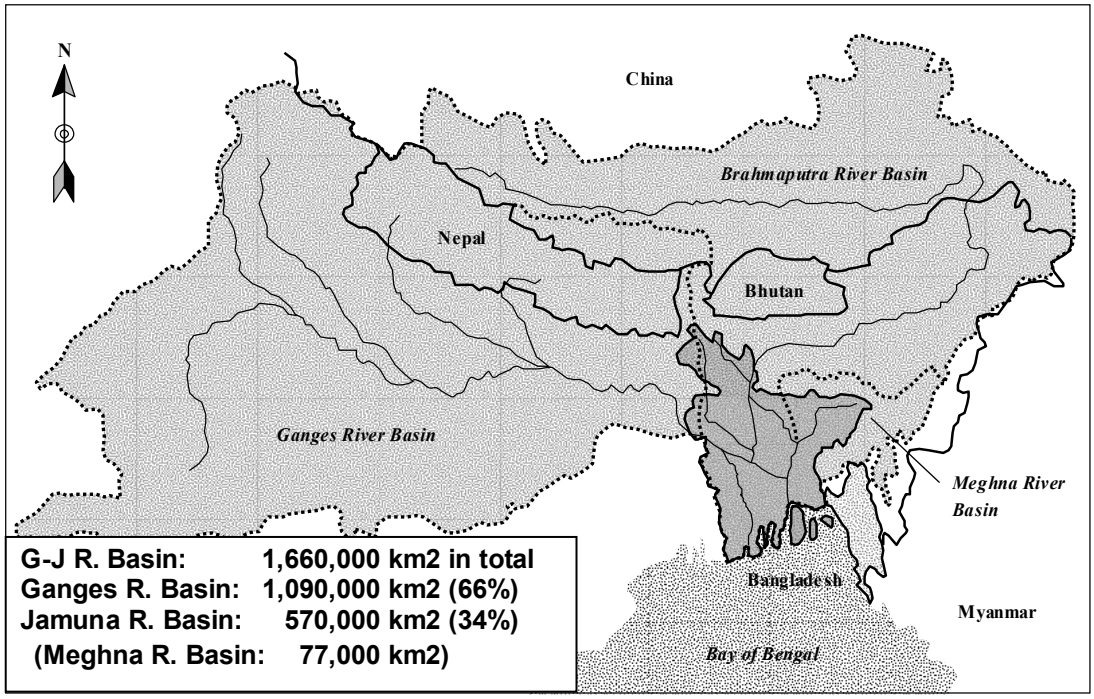


Figure 3.1.2 Ganges-Jamuna-Meghna River System

(2) Padma River and Other Major Rivers in Bangladesh

(a) Ganges River

The Ganges River originates at the Gangotri Glacier at elevation 7,010 m in the Himalayas. Passing through Delhi, it flows in a south southeastern direction, draining the southern slope of the Himalayas in Nepal and Uttar Pradesh of India on the left bank, and the right bank basin in Rajasthan and Bihar in India. The river enters Bangladesh at Godagari.

At the confluence with the Jamuna near Goalundo, the drainage area of the Ganges River is 1,090,000 km^2, of which, 80% lies in India, 13% in Nepal, 4% in Bangladesh and the rest in Tibet. Total river length is about 2,520 km from the source to Goalundo.

(b) Jamuna River

The Jamuna River (Brahmaputra River) originates in the Great Glacier at about 5,150 m in Tibet. Draining snowmelt runoff and rainfall on the northern slope of the Himalayas, it flows eastward. Then the river abruptly turns south to emerge from the foothills of the Himalayas and turns again westward. The river enters Bangladesh at Kurigram and turns to the south. It meets with the Ganges near Goalundo.

The drainage area of the Jamuna River is 570,000 km^2 at the confluence of the Ganges near Goalundo, of which 50% lies in Tibet, 34% in India, 8% in Bhutan and 8% in Bangladesh. Total river length is about 2,820 km from the source to Goalundo.

The Jamuna is a braided river having 4 to 6 channel segments in a cross section.

(c) Padma River

The Padma River drains the combined flows of the Ganges and the Jamuna rivers. The river length is about 102 km from the Ganges-Jamuna confluence to the Padma-Meghna confluence. There is no major inflow from the tributaries until it meets with the Meghna River at Chandpur, but the Arial Khan River branches upstream of Charjanajat Ghat.

River course of the Padma River is straight as a whole extending toward the southeast holding some great chars (islands) within the river sections.

(d) Meghna River

The Meghna River has a total drainage area of about 77,000 km^2 at the confluence with the Padma River near Chandpur, of which 58% lies in Bangladesh and the rest in India. The river length is about 900 km from the source to Chandpur. The river, after joining with the Padma River, flows southwards to the Bay of Bengal.

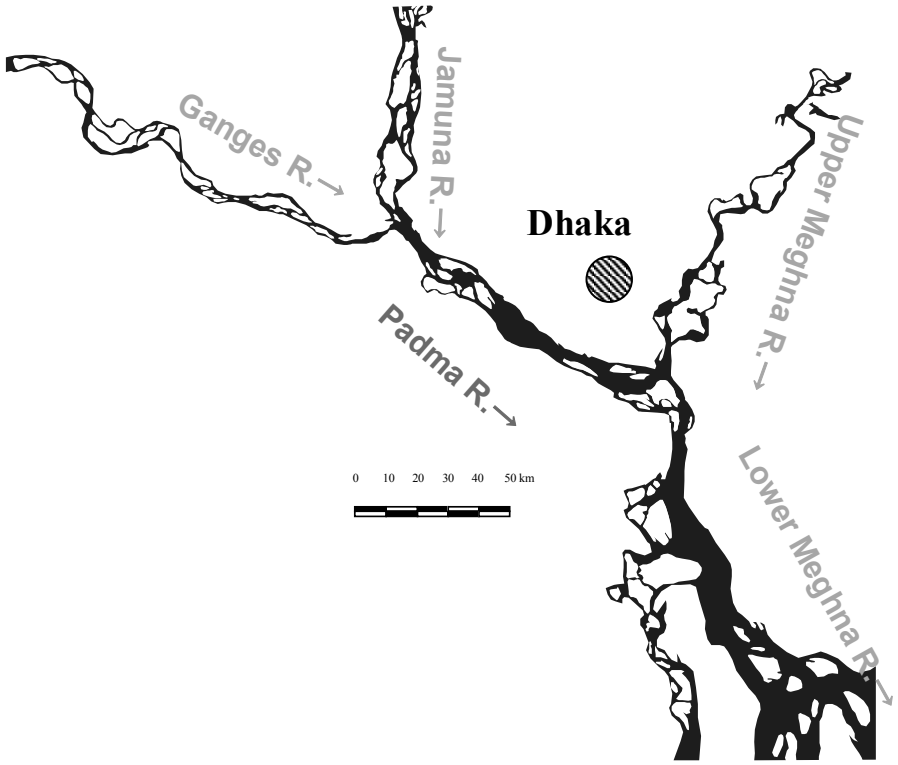


Figure 3.1.3 Padma River and Other Major Rivers in Bangladesh

(3) River Morphology of Padma River

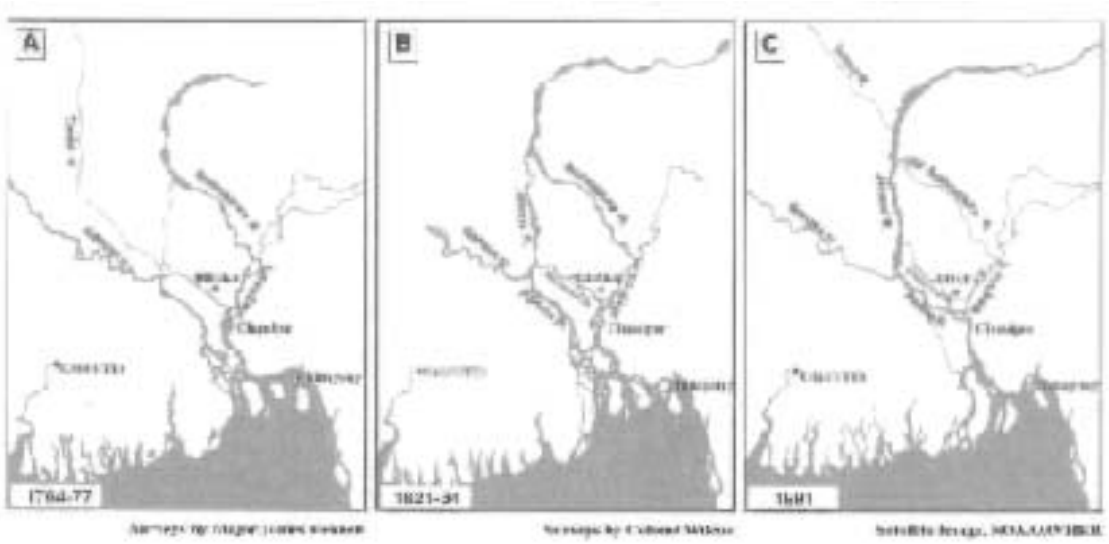
(a) Historical River Course Shifting

The Bengal Basin is tectonically active. The Madhupur and Barind tracts are uplifted Pleistocene alluvial deposits. The Sylhet Basin is subsiding at 1 to 3 mm/year because of over thrusting of the adjacent Shillong block. In most of the Bengal Basin, including the coastal zone and offshore areas, compaction and/or isostatically induced subsidence occurs. In addition to the tectonic activities, the formation of the Bengal Basin is strongly influenced by the huge input of sediments from the Ganges and the Jamuna rivers. These rivers spread huge amounts of sediments brought from the Himalayas over the lowlands in

the Bengal Basin, changing their courses.

The river course shifting in the lower Bengal Basin is illustrated in Figure 3.1.4. Around 1770, the Ganges River took its course almost along the present course of the Arial Khan River and emptied into the Bay of Bengal separately from the Jamuna River. Meanwhile, the main flow of the Jamuna River then flowed along the present course of the old Brahmaputra River in the east of the City of Dhaka or the Madhupur tract and drained into the bay through the Meghna River. There was only a small stream running along the present Jamuna river course.

According to the Wilcox's map in around 1830, the main course of the Jamuna River is found in the present river course and met with the Ganges almost at the present confluence. The joint flow, named the Padma, discharged into the Bay of Bengal. Some time between 1830 and 1860, the Padma River cut through the Chandina Alluvium downstream of Mawa and was connected with the Meghna River at the present confluence. The Padma River gradually shifted to the east and reached the present location. The Padma River is a young river. Especially the Padma River downstream of Mawa is a new river channel formed less than 170 years ago.



(Source: Riverine Chars in Bangladesh; EGIS,2000)

Figure 3.1.4 Historical River Shifting

(b) Trend of Eastward Shifting of Padma River

The eastward shifting of the Padma River has been pointed out by the FAP-19 study. The satellite image shown in Figure 3.1.5 verifies the eastward shifting clearly with the vestiges of old river courses. Numerous old river courses of similar scale of the present river channel are found in the flood plain on the west side bank, which implies that the west flood plain used to be the river course until recent years. On the other hand, the landforms in the east side flood plain show distinctively different features from the west one. No vestiges of recent river courses are found on the east bank and the ground seems to be old and firm compared to the west bank with relatively higher resistance to erosion.

From the above, the trend of eastward shifting of the Padma River could be confirmed. However, the eastward shifting should be regarded as a long-term and gradual trend of yearly riverbank movements.

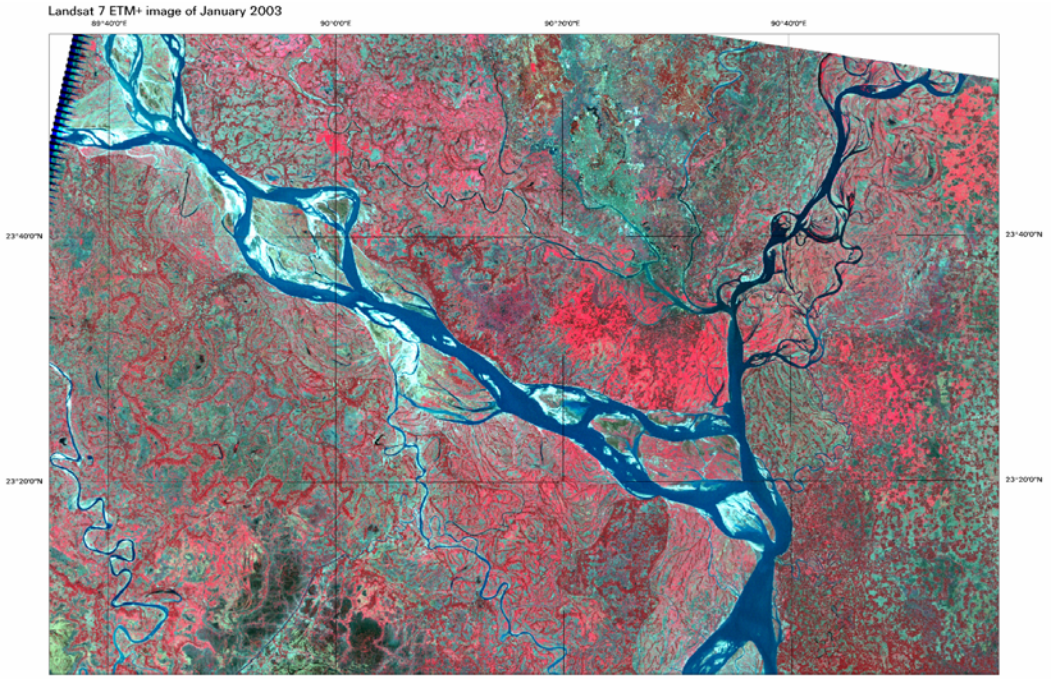


Figure 3.1.5 Landform Patterns on Satellite Image (Jan. 2003)

(c) Recent Changes of Riverbank

In order to get an overview of the changes in the riverbanks in recent years, old topographic maps of scale 1/250,000 (published in 1926, 1965) and LANDSAT satellite images taken in the dry seasons of 1973, 1984, 1993 and 2003 were collected and studied preliminarily. From the riverbank changes during the past 78 years since 1926, the following river morphologic features were found:

1) The Padma River alternated its plan-forms with and without big chars (islands) within the river channel. This alternation influences the changes of riverbank mainly on the right (southwest) bank.
2) The confluence of the Ganges and the Jamuna rivers shifted southwards (toward downstream) by about 6 km during the period from 1926 to 1973.
3) The Lower Meghna River drastically changed its channel features. The left bank is continuously eroded and the river width is gradually narrowed gradually forming a single channel section. These changes were more active in early years up until 1973.
4) As a whole the left (east) riverbank is relatively stable, especially at Paturia-Goalundo and Mawa-Janjira sections. It was also confirmed that these two sites maintained narrow (or nodal) sections at least during the past 78 years.
5) According to the latest satellite image taken in 2003, three big chars (islands) exist in the 102 km long Padma River. These chars, however, are not stable and were formed less than 30 years ago. The chars in the river are alternately formed, disappear and are reformed again.

3.1.2 Bridge Location Alternatives

From the river morphology in the above 3.1.1, four nodal points were identified as conceivable sites of the Padma Bridge in the stretch of the Padma River from the Ganges-Jamuna confluence to the Padma-Meghna confluence. The Pre-feasibility Study in 1999/2000 examined only two crossing sites, Goalundo and Mawa. The Study looked into the Padma River again from the view points of river morphology, transport and road network.

Site-1: Paturia-Goalundo Site
Immediately downstream of the Padma-Jamuna confluence
Site-2: Dohar-Charbhadrasan Site
About 30 km downstream of Site-1
Site-3: Mawa-Janjira Site
About 31 km downstream of Site-2
Site-4: Chandpur-Bhedarganj Site
Immediately downstream of Padma-Meghna confluence

Locations of these four conceivable sites are shown in Figure 3.1.6.

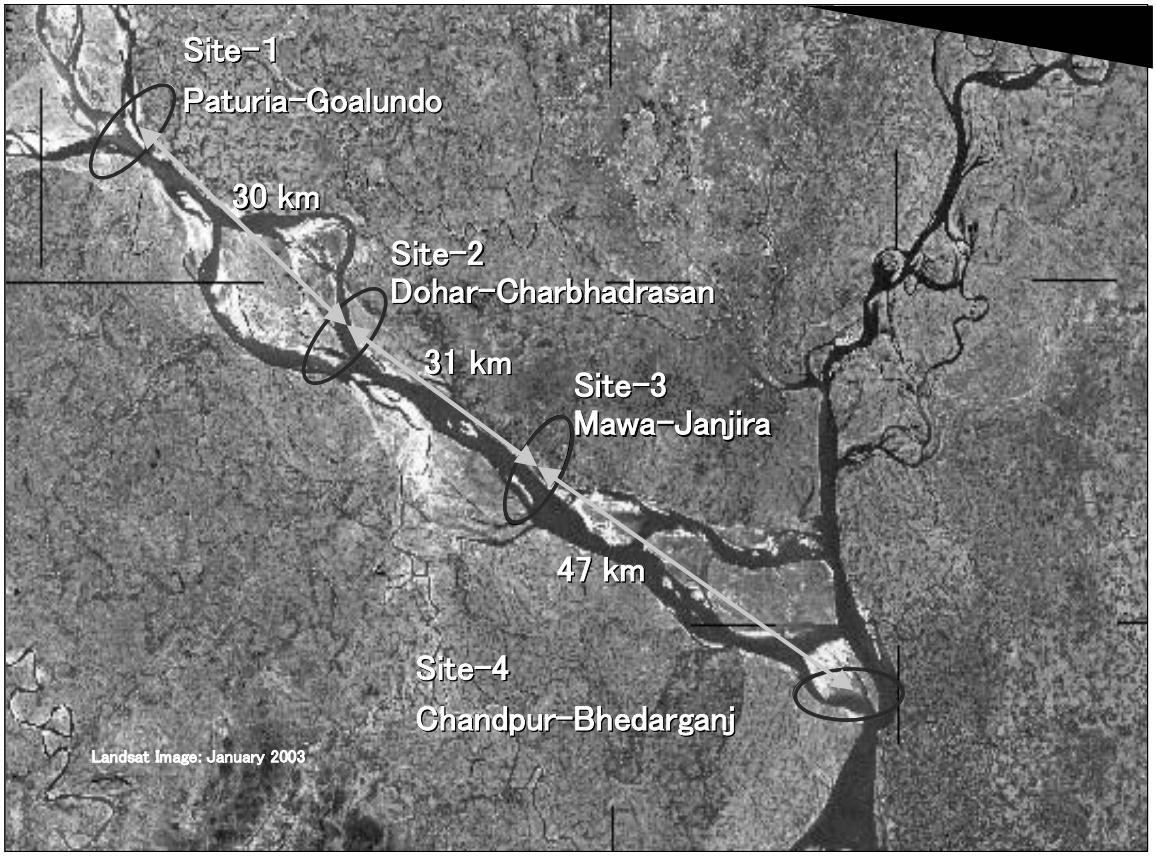


Figure 3.1.6 Conceivable Bridge Location Sites

3.1.3 Alternatives in "Without Project Case"

In without Project case, there may be the following two alternatives to be taken into account:

1) Improvements of existing ferry services such as expansion of ferry ghats (or ferry terminals) and increase of frequencies of ferry operations in order to meet the future traffic demands.
2) Do nothing situation (Business as it is).

However, although the candidate bridge sites were selected because of its more stable river conditions compared to other sites, the Padma River changes its width and plan-forms of riverbanks frequently. River width has changed from minimum 2.44 km to maximum 5.00 km for the past 30 years at the site of Paturia and 2.00 km to 4.92 km at Mawa site. In addition, temporally approach ghats have to be changed depending on the seasons. Due to such unstable conditions of the Padma River, newly construction of large permanent ferry