JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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MINISTRY OF COMMUNICATIONS
THE GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

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THE STUDY
ON
CONSTRUCTION OF THE BRIDGE OVER THE RIVER RUPSA
IN KHULNA
(Phase I)

FINAL REPORT
Vol I: MAIN REPORT

MARCH 1999

PACIFIC CONSULTANTS INTERNATIONAL
JAPAN OVERSEAS CONSULTANTS

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The following foreign exchange rate is applied in the study :

US$1.00 = 48.00 Taka (as of December 1998)

PREFACE

In response to a request from the Government of the People's Republic of Bangladesh, the Government of Japan decided to conduct the Phase I study on the Construction of the Bridge over the River Rupsa and entrusted the study to the Japan International Cooperation Agency.

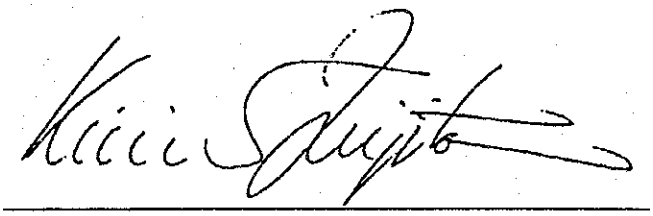
JICA selected and dispatched a study team headed by Mr. Kenji Maruoka of Pacific Consultants International, consisting of Pacific Consultants International and Japan Overseas Consultants to Bangladesh, three times between July 1998 and March 1999. In addition, JICA set up an advisory committee headed by Dr. Yuzo Akatsuka, Professor/Dean of Faculty of Regional Development Studies, Toyo University to examine the study from specialist and technical points of view.

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

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

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

March 1999



Kimio Fujita
President
Japan International Cooperation Agency

March 1999

Mr. Kimio Fujita
President
Japan International Cooperation Agency

Letter of Transmittal

Dear Sir,

We are pleased to submit herewith the Final Report of "The Study on Construction of the Bridge over the River Rupsa in Khulna (Phase I)" in the People's Republic of Bangladesh.

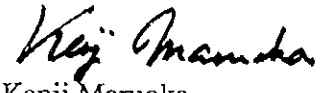
The report contains the results of study which was carried out by Pacific Consultants International in association with Japan Overseas Consultants between July 1998 and March 1999. The report consists of three volumes of Summary, Main Report and Appendix.

The Summary briefly illustrates the findings of the whole study. The Main Report consists of 17 chapters and presents current road, railway and inland waterway transport profile, formulation of transport master plan and the scope of work for Phase II.

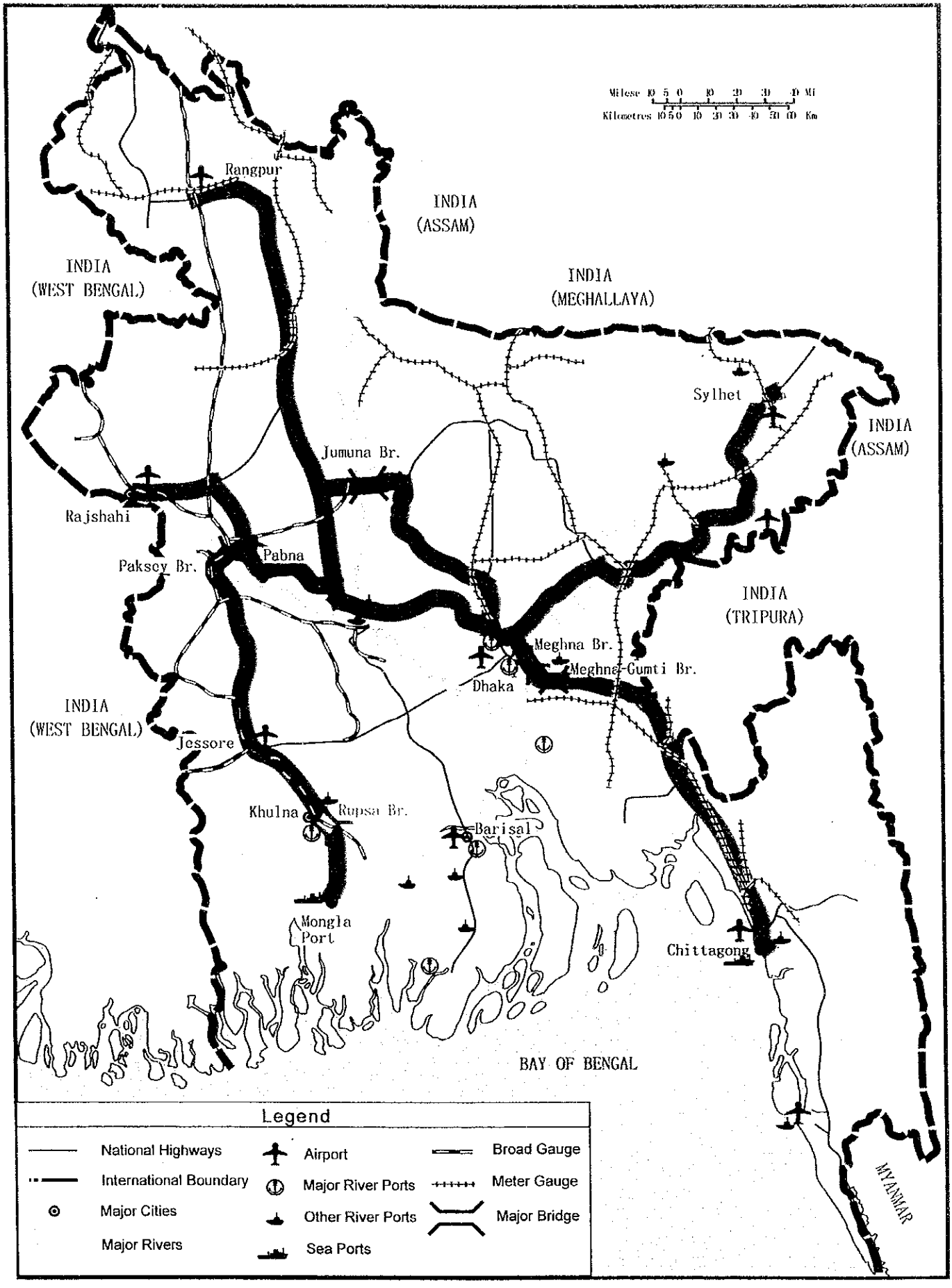
It recommends that the Study should proceed to Phase II as soon a s possible. The Appendix contains the supporting data including detailed results of several field surveys carried out by us in Bangladesh.

We wish to express grateful acknowledgment to the personnel of your Agency, Ministry of Foreign Affairs, Advisory Committee, Ministry of Transport, Ministry of Construction and Embassy of Japan in Bangladesh, and also to officials of the Ministry of Communications, Government of Bangladesh for their assistance extended to the Study Team. The Study Team sincerely hopes that the results of the Study will contribute to the development of road network in Bangladesh.

Yours faithfully,



Kenji Maruoka
Team Leader
The Study on Construction of the Bridge over the
River Rupsa in Khulna (Phase I)



Map of Project Area

DEFINITIONS AND ABBREVIATIONS

(1) Agencies

AASTHO	American Association of State Highway and Transportation Officials
ADB	Asian Development Bank
BBS	Bangladesh Bureau of Statistics
BEPZA	Bangladesh Export Processing Zone Authority
BIWTA	Bangladesh Inland Water Transport Authority
BIWTC	Bangladesh Inland Water Transport Corporation
BR	Bangladesh Railways
BRTA	Bangladesh Road Transport Authority
BSC	Bangladesh Shipping Corporation
BWDB	Bangladesh Water Development Board
CPA	Chittagong Port Authority
CPT	Calcutta Port Trust
DOE	Department of Environment, Ministry of Environment and Forestry
JICA	Japan International Cooperation Agency
JMB	Jamuna Multipurpose Bridge
KCC	Khulna City Corporation
KDA	Khulna Development Authority
LGED	Local Government Engineering Department
MPA	Mongla Port Authority
OECF	Overseas Economic Cooperation Fund
PWD	Public Works Department
RHD	Roads and Highways Department, Ministry of Communications
RIC	Regional Inspection Center
WB	World Bank

(2) Technical Terms and others

5FYP	5th Five Year Plan
ADP	Annual Development Program
ASTM	American Standard for Testing of Materials
B/C	Cost Benefit Ratio
BEB	Broad gauge, Electric, Bonvardier
BG	Broad Gauge
BITSS	Bangladesh Integrated Transport System Study
BS	British Standards
BTSS	Bangladesh Transport Sector Study
CD	Chart Datum
CDS	Calcutta Dock System
CHT	Chitagong Hill Tract
DWT	Dead Weight Tonne
EAM	Equilibrium Assignment Method
EIRR	Economic Internal Rate of Return

EPZ	Export Processing Zone
EPZ	Export Processing Zone
FDI	Foreign Direct Investment
FIRR	Financial Internal Rate of Return
FYP	Five Year Plan
GDP	Gross Domestic Product
GIS	Geographic Information System
Ghat	Platform to the water's edge
HDC	Haldia Dock Complex
ICD	Inland Container Depot
IEE	Initial Environmental Examination
IRR	Internal Rate of Return
ISIE	Initial Social Impact Examination
LFS	Labor Force Survey
LPG	Liquefied Petroleum Gas
MG	Meter Gauge
MMT	Multi Modal Terminal
MPA	Mongla Port Authority
MPADP	Mongla Port Area Development Project
NGO	Non Governmental Organization
NH	National Highway
N.P.V	Net Present Value
NWR	North West Region
O & M	Operation and Maintenance
OD	Origin and Destination
PAPs	Project Affected Persons
PC	Prestressed Concrete
PCU or pcu	Passenger Car Unit
PKMS	Passenger Kilo Meters
POL	Petroleum Oil Lubricants
RA	Result of Alignment
RAO	Road Area Occupancy
RCS	Road Census Survey
RND	Road Network Density
ROW	Right-of-Way
RRP	Railway Recovery Program
SHWL	Standard High Water Level
SMA	Statistical Metropolitan Area
SOB	Survey Of Bangladesh
SOE	State Owned Enterprises
SPT	Standard Penetration Test
STRADA	System for Traffic Demand Analysis developed by JICA
TBM	Temporary Bench Mark
TC	Traffic Count
TEU	Twenty Equivalent Units
TKMS	Ton Kilo Meters
Tk	Taka
VAT	Value Added Tax
Zila	Administrative sub-unit of Division and group of Thanas

PROJECT SUMMARY

1. COUNTRY	The People's Republic of Bangladesh
2. NAME OF STUDY	The Study on Construction of the Bridge over the River Rupsa in Khulna (Phase I)
3. COUNTERPART AGENCY	Roads and Highways Department, Ministry of Communications
4. OBJECTIVE OF STUDY	To formulate a master plan for integral components of transport development and construction plan of the Bridge

1. STUDY AREA Khulna city, Mongla Port and its surroundings

2. TARGET YEAR Year 2015

3. ECONOMIC FRAMEWORK 5.0 % p.a.(1996/97 - 2014/15)

4. DEMAND FORECAST FOR MONGLA PORT

1) Cargo Demand for Mongla Port in 2015	5,811,000 tons (excluding Nepalese Cargo)
2) Nepalese Cargo for Mongla Port in 2015	400,000 tons (including 41,000 TEUs of Containers)
3) Cargo Handled at Jetty in 2015	2,125,000 tons (including 242,000 TEUs of Containers)

5. TRAFFIC DEMAND FORECAST

Traffic Demand on the Bridge in 2015 Western Route 11,153 veh./day

6. FORMULATION OF TRANSPORT MASTER PLAN

Development Scenario-2 : the Bridge with Multi Modal Terminal is evaluated as the optimum alternative for the Study from the following aspects;

a) Although it is presumed that most of these container cargo would be transported by land transport means through the improved future land transportation networks in the hinterland of Mongla Port, the major portion of the inland transport of the port cargo would be still performed by inland water vessels.

b) Although future land transportation network will be improved toward the north as the hinterland of Mongla Port, Cargo Movement beyond Khulna subject to rail transport is estimated 478,000 tons/year at most, that is medium.

7. SETTING OF ALTERNATIVE PLANS AND EVALUATIONS

(1) Evaluation on Alternative Plans for Railway Extension to Mongla Port

- The scheme of railway extension to Mongla Port opening has negative financial internal rate of return (FIRR) at all alternative plans.
- The sensitivity analysis also reveals that freight revenue could not collect debts without purchasing costs of locomotives and wagons.
- The scheme of rail-cum road bridge is to be studied as an alternative plan of road bridge considering railway extension beyond Year 2015.

Alternative	Outline of Scheme			Internal Rate of Return (IRR)	
	Route	Bridges	Rail-cum	Total Investment	w/o Loco & wagon
ALT R-1	Eastern R.	Bhairab/Atai/	x	-40.0%	-18.4%
ALT R-2	(B Route)	Atherobaki & 6 Br.	0	-39.2%	-5.4%
ALT R-3	Western R.	Rupsa & 6 Br.	x	-39.7%	-15.2%
ALT R-4	(A Route)		0	-39.4%	-8.9%

(2) Selection of Route Location of Khulna Bypass

The **Western Route** is superior to the eastern route not only from the qualitative viewpoints of planning parameters but also economic indices.

Alternative		Route Location	Direct Construction Cost			Economic Analysis			Social Costs			Affected Houses
			Bridge	Others	Total	IRR	B/C	N.P.V	Land	Comp.	Total	
1	ALT 1-1	Western R.	1,341.1	1,186.8	2,527.9	30.5%	3.01	M.Tk. 3,711	73.2	19.7	92.9	25
2	ALT 1-2	(A Route)	1,718.1	1,195.4	2,913.5	27.7%	2.62	M.Tk. 3,432				
3	ALT 1-3		1,874.4	1,191.5	3,065.9	26.7%	2.49	M.Tk. 3,323				
4	ALT 1-4		2,126.9	1,168.6	3,295.5	25.4%	2.32	M.Tk. 3,162				
5	ALT 1-5		2,180.2	1,351.0	3,531.2	24.1%	2.17	M.Tk. 2,988				
6	ALT 3-1	Eastern R.	2,581.0	1,467.7	4,048.7	13.2%	1.09	M.Tk. 282	167.6	107.6	275.2	297
7	ALT 3-2	(B Route)	3,307.2	1,541.9	4,849.1	10.9%	0.92	-M.Tk. 295				
8	ALT 3-3		3,607.1	1,511.0	5,118.1	10.2%	0.87	-M.Tk. 491				
9	ALT 3-4		4,011.7	1,462.5	5,474.2	9.4%	0.82	-M.Tk. 751				
10	ALT 3-5		4,196.2	1,818.8	6,014.9	8.2%	0.75	-M.Tk. 1,138				

(3) Evaluation on Cross Sectional Configuration

- Among five alternative plans*1 on the selected western route, **ALT 1-3** is selected as the most recommendable alternative plan for Phase II study of Rupsa Bridge form technical and economical viewpoints.

Note : *1 is referred to Fig. 1 (page V).

OUTLINE OF THE STUDY

The Study on Construction of the Bridge over the River Rupsa in Khulna (Phase I)

- Study Period : July, 1998 - March, 1999
- Counterpart Agency : Roads and Highways Department (RHD), Ministry of Communications

1. Background of the Study

The Government of Bangladesh has exerted great efforts in the construction of bridges as well as the improvement of transport network connecting Dhaka, the capital city of the country, to four major regions severed by the rivers of Jamuna, Padma (Ganges) and Meghna, each of which is crisscrossed by thousands of tributaries and branches of the major rivers.

Khulna city, the 3rd biggest city and the hub of commerce and administration in the south-western region, will be connected to Dhaka by the all-weather and non-river interruption road after the completion of on-going Paksey Bridge. However, National Highway No.7 as a major arterial road in the study area has serious traffic bottlenecks, and the incremental congestion of the ferry terminal at Rupsa ghat increases transport costs as well as aggravating the severance of the local community. On the other hand, Mongla Port, as the 2nd port in Bangladesh, is expected to play an expanded role in future in consideration of integral components of transportation development and increasing traffic to the east and the north, and further, to the sub-regional freight traffic movement to India, Nepal and Bhutan.

Under such circumstances, the construction of bridge over the Rupsa river will realize the strategically important transport network between Dhaka, Khulna and Mongla without river interruption.

In response to the request of the Government of Bangladesh, the Japan International Cooperation Agency (JICA) dispatched the preparatory study team headed by Dr. Yuzo AKATSUKA, and both parties have agreed to the Scope of Work for the Study in March, 1998.

2. Study Objectives

The objectives of the Study are as follows;

(1) to formulate a master plan for integral components of transport development surrounding the Rupsa bridge;

(2) to formulate a plan for construction of the bridge over the river Rupsa in Khulna; and
(3) to transfer technology to Bangladesh counterparts.

3. Study Area

The study area covers Khulna city, Mongla Port and its surroundings in the south-western region consisting of Khulna Division, Barisal Division and Faridpur Zila of Dhaka Division.

4. Target Year

The target year of the plan is the year 2015 which accords with that of the studies implemented by the World Bank.

5. Outline of the Study

The Study was conducted regarding Rupsa Bridge and integral components of transport development surrounding the Bridge in accordance with the agreed scope of work.

5.1 Socio-Economic Framework

The Study was conducted on the basis of three possible economic frameworks for the future of Bangladesh, namely high growth, medium growth and low growth, taking the various economic forecasts such as 5FYP, WB, ADB and "Bangladesh Integrated Transport System Study" (Bangladesh Government, Planning Committee, June 1998) as preconditions.

Medium case of 5.0 % as long-term annual target for GDP growth is adopted for the forecast of cargo demand handling at Mongla port and traffic demand forecast.

5.2 Demand Forecast for Port Cargo

1) Cargo Demand of Mongla Port in 2015

The total port cargo demand for the Bangladeshi two seaports of Mongla and Chittagong is projected by commodity using correlation analysis with the GDP, and the total cargo at Mongla Port in 2015, excluding that to/from Nepal, is projected at 5,811,000 tons after examining the future shares of both ports due to inland transport development.

2) Demand Forecast for Nepalese Cargo

Assuming 4.0% annual growth of the Nepalese economy, the total Nepalese seaborne cargo is projected to reach 1,994 thousand tons in 2015 (476 thousand tons in '97/'98). This volume of cargo is allocated to the three ports, Mongla, Chittagong and Calcutta, and it is presumed that the most probable case is the one where Mongla Port has shares of 50% for dry bulk cargo and 20% for general cargo. The estimated volume of the Nepalese cargo handled at Mongla Port in 2015 is 400 thousand tons including 41 thousand TEUs of containers.

3) Cargo Handled at Jetty

The cargo that will be handled at the jetty is projected on the assumption that a small amount of bulk cargo in addition to all of container cargo and break bulk cargo will be handled at the jetty. The total cargo volume, all of which is to be transshipped by land transport modes, will reach more than 2 million tons (160 thousand tons in '97/'98).

5.3 Traffic Demand Forecast

Traffic assignment simulation is carried out using the software STRADA (System for Traffic Demand Analysis) supplied by JICA, using forecast future OD tables developed by socio-economic framework and future road network.

Based on the assignment results by case, traffic volumes crossing the bridge over the Rupsa River are analyzed by type of vehicles. Traffic demand on the Bridge for the year 2015 is forecasted 11,150 vehicles/day in the recommended case.

5.4 Formulation of Transport Master Plan

Deliberating the roles and functions of the Bridge as well as planning parameters supported by engineering considerations, three components of Khulna Bypass, Railway Extension to Mongla Port and Multi Modal Terminal were studied as related transport facilities.

Present Rupsa Ferry becomes serious traffic bottleneck to sustain Mongla Port and future development at the port area, and Khulna Bypass should be located in the western side of the Rupsa river to alleviate traffic congestion at Rupsa Ferry.

Development Scenario-2 : the Bridge with Multi Modal Terminal is evaluated as the optimum alternative for the Study from the following aspects;

a) Although it is presumed that most of these container cargo would be transported by land transport means through the improved future land transportation networks in the hinterland of Mongla Port, the major portion

of the inland transport of the port cargo would be still performed by inland water vessels.

b) Although on-going Paksey Bridge will be completed and future land transportation network will be improved toward the north as the hinterland of Mongla Port such as North-Western Region and Nepal, Cargo Movement beyond Khulna subject to rail transport is estimated 478,000 tons/year at most, that is medium.

5.5 Preliminary Engineering Study

(1) Highway Engineering Study

1) Major Design Controls

Highway Bridge

Design Speed	: 60 km/h
Maximum Grade	: 3.0 %
Minimum Vertical Curve at Crest	: 2,000 m

Rail-cum-Road Bridge

Maximum Grade	: 1.0 %
Minimum Vertical Curve at Crest	: 3,000 m

2) Study on Type of Rail-cum-Road Bridge

The scheme of rail-cum-road bridge in a whole stretch (ALT 1-6) was set aside from alternative plan of road for the following reasons;

- It is not reasonable that the vertical alignment of road should comply with considerably flatter grade of that of railway only to share the space of bridge to result in huge increase of bridge cost.
- There's a physical problem that the initial 4-lane road bridge has to be modified to a rail-cum-road bridge with a single track and 2-lane. It may be a seriously problem for RHD to have invested in such an inefficient manner.

3) Study on Alternative Cross Sections (Refer to Fig. 1)

The cross sections of five alternatives are studied based on undivided 2-lane with sidewalks warranted by traffic demand forecast as well as considering traffic characteristics and the scheme of rail-cum-road bridge only on main bridge.

(2) Bridge Engineering Study

Although the Study is still at a master plan level with limited data and information, the bridge engineering study aims at selecting suitable type of bridge and structures as far as it may be practical, giving basis for cost estimates and summarizing technical data and information for succeeding engineering study.

1) Main Bridge

Rupsa, Bhairab and Atai Bridge having the required minimum span length of 100 m, and Atherobaki Bridge of 50 m are separately examined. As the Main Bridges cross over the rivers, and are comparatively of a long span, the selection was made based on such factors as i) navigational requirements, ii) topography and geology, iii) river conditions, iv) aesthetics, v) constructability (degree of ease on construction), vi) construction cost, vii) construction period, viii) maintenance, ix) aviation requirements and x) technology transfer/new technology.

Rupsa, Bhairab and Atai Bridge (Required minimum span length=100 m)

Superstructure : Continuous PC Box Girder (Tapered Girder Depth)
Substructure : Wall Type with Ellipse Cross Section
Foundation : Cast-in-situ Concrete Pile

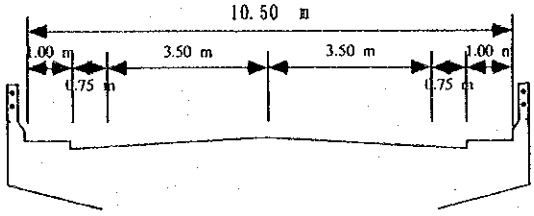
Atherobaki Bridge (Required minimum span length=50 m)

Superstructure : Continuous PC Box Girder (Uniform Girder Depth)
Substructure : Wall Type with Ellipse Cross Section
Foundation : Cast-in-situ Concrete Pile

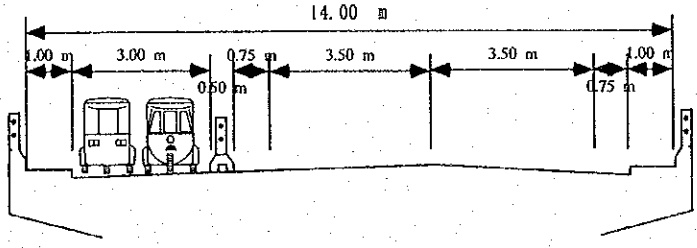
2) Approach Bridge

Factors dominating selection of the Approach Bridge are construction economy and constructability including the experience achieved in this country, somewhat different from those for the Main Bridge.

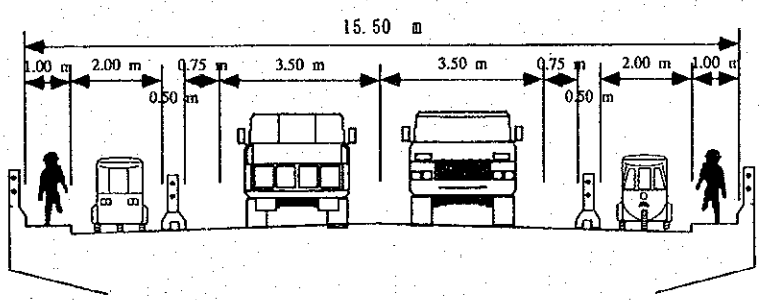
Superstructure : PC Composite I-girder (Span length=30 m)
Substructure : Wall Type with Rectangular Cross Section
Foundation : Cast-in-situ Concrete Pile



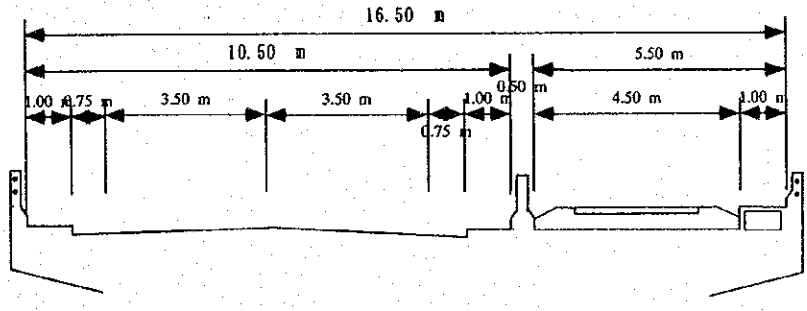
ALT 1-1 / 3-1



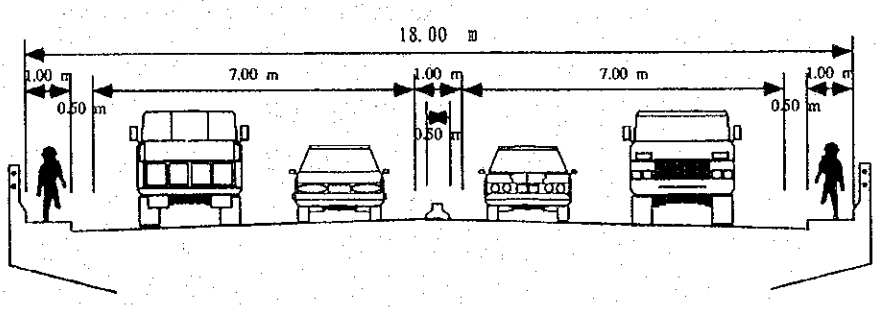
ALT 1-2 / 3-2



ALT 1-3 / 3-3



ALT 1-4 / 3-4



ALT 1-5 / 3-5

5.6 Initial Environmental and Initial Social Impact Examination

(1) Impacts on Social Environment

Hundred percent household survey was conducted along the social baseline through interview survey. The most issued social environment is found a severance of community. However, it is likely possible to move to adjacent farmland because the land holding rate rises nearly 90% and very limited number of tenant farmers or non-land holding farmers are found. On the other hand, since the surveyed area is a typical neighboring town or small-sized intensive farming in the suburbs of Khulna city, high positive or favorable impacts brought by road development are anticipated.

It is necessary to conduct more detailed survey along the social baseline in the course of implementation of the project, and plans for land acquisition and resettlement of affected inhabitants are required. Although no serious impact on natural environment is found due to passing open or farmland, some mitigation measures against drainage and irrigation channel will be required during construction and operation stage.

(2) Social Cost

Approach section of the Bridge except the space of river channel will incur social costs related to road development such as land acquisition and property compensation, and its degree or extent depend upon land use. Such social costs of the eastern route are estimated approximately three (3) times as high as that of the western route.

5.7 Alternative Plans and Evaluations

(1) Alternative Plans for Economic and Financial Analysis

Benefits are brought by savings of transport costs stemmed from traffic demand forecast on each alternative route, and they are estimated the same as among alternative plans on each route. Therefore, variation of project cost by each alternative plans can be covered by sensitivity analysis.

A financial analysis is conducted assuming Rupsa Bridge levying toll. Only ALT 1-1 : Undivided 2-lane with Sidewalks is analyzed because the Study is still at a master plan level and amount of toll revenue is estimated the same among each alternative plans.

(2) Evaluation on Alternative Plans for Railway Extension to Mongla Port

The scheme of railway extension to Mongla Port opening until Year 2015 has

negative financial internal rate of return (FIRR) at all alternative plans as shown in Table 1. The sensitivity analysis also reveals that freight revenue could not collect debts even if purchasing costs of five locomotives and 700 wagons are set aside from project cost.

Based on the Railway Recovery Program (RRP) agreed upon between the Government and ADB, by which Bangladesh Railway is obliged to act commercially, it is difficult to envisage a new rail line between Mongla and Khulna.

However, the scheme of rail-cum road bridge is to be studied as an alternative plan of road bridge because it never deny the possibility of railway extension beyond Year 2015.

Table 1 Results of Financial Analysis and its Sensitivity Analysis

Alternative	Outline of Scheme			Internal Rate of Return (IRR)	
	Route	Bridges	Rail-cum	Total Investment	w/o Loco & wagon
ALT R-1	Eastern R.	Bhairab/Atai/	x	-40.0%	-18.4%
ALT R-2	(B Route)	Atherobaki & 6 Br.	0	-39.2%	-5.4%
ALT R-3	Western R.	Rupsa & 6 Br.	x	-39.7%	-15.2%
ALT R-4	(A Route)		0	-39.4%	-8.9%

Notes :

1) Construction costs comprise fill, bridge, ballast, sleeper, rail and signaling.
2) O & M costs are estimated on the assumption that 5 locos & 700 wagons are purchased.
3) The scheme of rail-cum-road bridge is to share the portion of main bridge only.

(3) Selection of Route Location of Khulna Bypass

The western route of Khulna Bypass was recommended from the qualitative viewpoints of planning parameters such as land availability, future traffic demand, social aspects, construction economy and river morphology.

Table 2 presents additionally quantitative comparison of each route location, and it reveals that the western route is superior to the eastern route at almost all aspects, especially economic indices.

Therefore, the comparison and evaluation of cross sectional configurations are to be made only for the western route.

Table 2 Construction Costs and Indices of Economic Analysis of Alternative Plans

Unit : M. Tk.

Alternative		Route Location	Direct Construction Cost			Economic Analysis			Social Costs			Affected Houses
			Bridge	Others	Total	IRR	B/C	N.P.V	Land	Comp	Total	
1	ALT 1-1	Western R.	1,341.1	1,186.8	2,527.9	30.5%	3.01	M.Tk. 3,711	73.2	19.7	92.9	25
2	ALT 1-2	(A Route)	1,718.1	1,195.4	2,913.5	27.7%	2.62	M.Tk. 3,432				
3	ALT 1-3		1,874.4	1,191.5	3,065.9	26.7%	2.49	M.Tk. 3,323				
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5	ALT 1-5		2,180.2	1,351.0	3,531.2	24.1%	2.17	M.Tk. 2,988				
6	ALT 3-1	Eastern R.	2,581.0	1,467.7	4,048.7	13.2%	1.09	M.Tk. 282	167.6	107.6	275.2	297
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10	ALT 3-5		4,196.2	1,818.8	6,014.9	8.2%	0.75	-M.Tk. 1,138				

Notes :

1) Direct construction cost of bridge covers costs between abutments and excluding 10% contingency.
2) In Rail-cum-Road bridge, direct construction cost of Approach Bridge for railway is not included.
3) 100 m span Continuous PC Box Girder with Cast In-situ Concrete Pile for Rupsa/Bhairab/Atai Bridge
4) 50 m span Continuous PC Box Girder with Cast In-situ Concrete Pile for Atherobaki Bridge
5) 30 m span Composite PC I-Girder with Cast In-situ Concrete Pile for Approach Bridge
6) 12% per annum discount rate applied to B/C and Net Present Value (N.P.V)

(4) Evaluation on Cross Sectional Configuration

ALT 1-3 is selected as the most recommendable alternative plan for Rupsa Bridge form the following reasons;

i) Rupsa Bridge is located in the urbanized area of Khulna and major users are expected local commuters. It is necessary to deliberate transport means for citizens such as auto-rickshaws and motorcycles, and accordingly separated lanes for slow-moving vehicles accommodate commuters as well as contribute traffic safety and steady flow of traffic.

ii) Since mixed traffic of slow-moving vehicles causes present traffic congestion taken place on National Highway No. 7, it is desirable that separated slow-moving vehicles enhance traffic safety as well as smooth traffic flow.

iii) This scheme has remarkable advantage to expand 2-lane carriageway up to 4-lane just in case that traffic demand might increase beyond forecasted one.

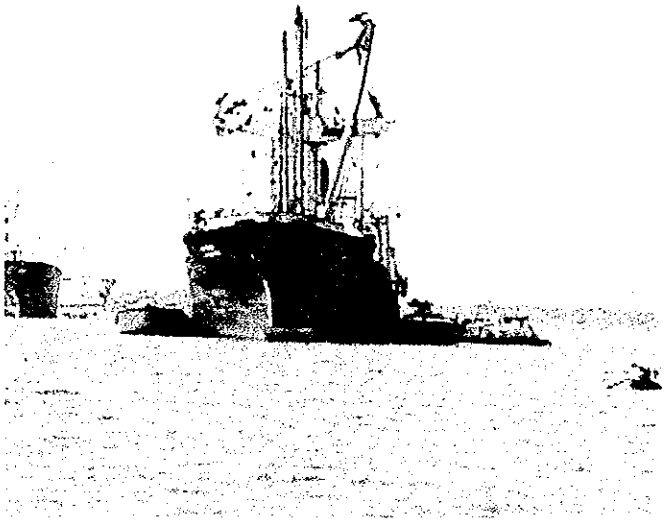


Photo-1 : Mongla Port

94% of cargo is handled at the mooring and anchorage berths.
This implies that Mongla Port greatly depends on inland
water transport for hinterland cargo movement.
Mongla Port has suffered from siltation due to a river port.

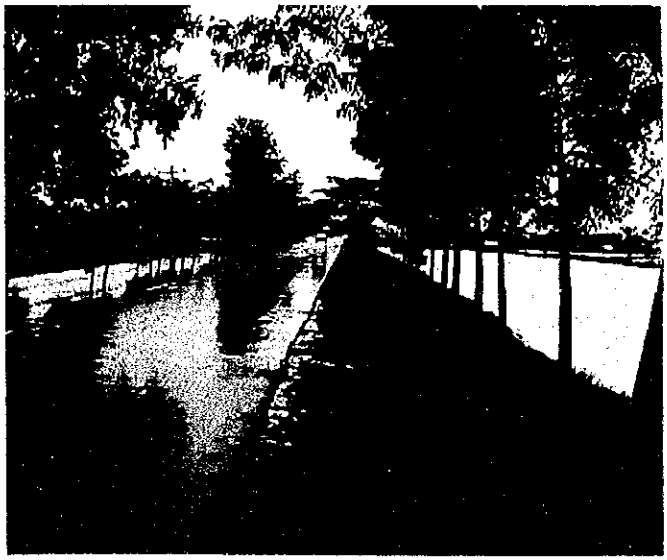


Photo-2 : Khulna-Mongla Road

Khulna-Mongla Road which was developed in 1985 by ADB assistance is designated as a major arterial road, but traffic volume remains low at 1,000 - 1,500 veh./day.
Rupsa Ferry, which exists on Khulna-Mongla Road, is so congested that it becomes the traffic bottleneck to hardly exploit the regional development potential.

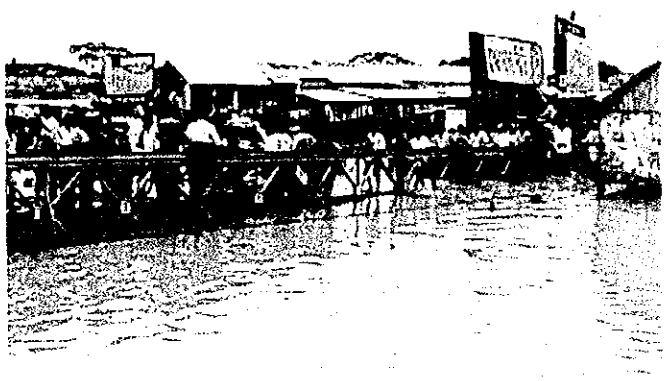


Photo-3 : Access Bridge at Rupsa Ferry

3 m high tidal fluctuation takes place at Rupsa Ferry.
The access bridge is always inundated during spring tide, and it cause to make traffic congestion worse.

Photo-4 : Traffic Congestion at Rupsa Ferry

Two ghats in both sides exist at Rupsa Ferry to operate two ferries simultaneously during peak hours, transporting daily passengers of 50,000 - 60,000.
Motorized vehicles manage to pass among predominant non-motorized traffic, consisting of pedestrian, rickshaws and carts.

Photo-5 : Khulna Terminal at Rupsa Ferry

Very high non-motorized traffic exists at Khulna terminal, while high volumes of buses are found at Rupsa terminal.
Short trips are dominant in Khulna side and medium and long trips prevail in Rupsa side.

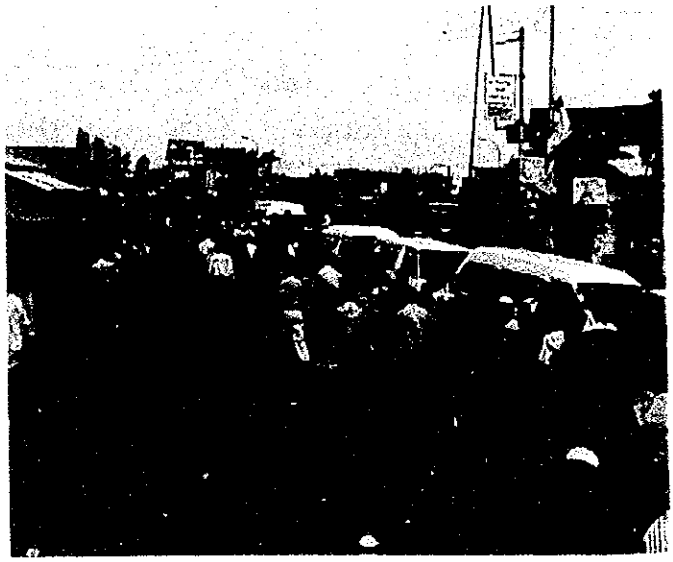
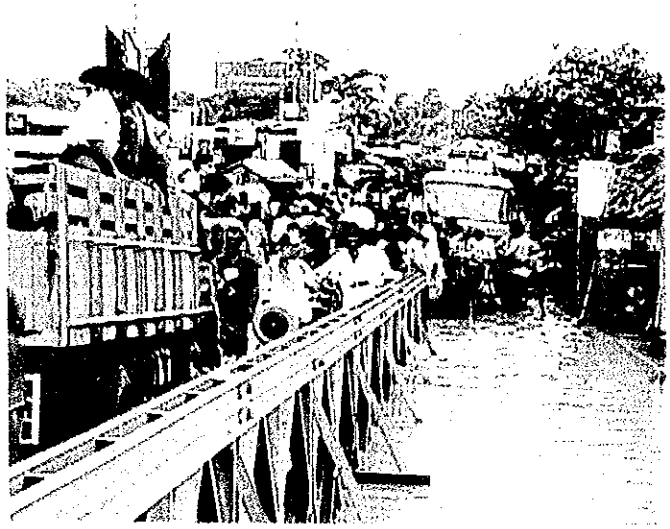


Photo-6 : Serious Traffic Congestion

Considerable number of passengers saturate traffic capacity to cause serious traffic congestion for motorized traffic.
It is often observed at peak hours that both directions of traffic conflict on approach road and access bridge.
The scheme of bridge construction is deemed a drastic measure to improve the situation.



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CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background

The Government of Bangladesh has exerted great efforts in the construction of bridges as well as the improvement of transport network connecting Dhaka, the capital city of the country, to four major regions severed by the rivers of Jamuna, Padma (Ganges) and Meghna, each of which is crisscrossed by thousands of tributaries and branches of the major rivers.

Khulna city, the 3rd biggest city and the hub of commerce and administration in the south-western region, will be connected to Dhaka by the all-weather and non-river interruption road after the completion of on-going Paksey Bridge. However, National Highway No.7 as a major arterial road in the study area has serious traffic bottlenecks, and the incremental congestion of the ferry terminal at Rupsa ghat increases transport costs as well as aggravating the severance of the local community. On the other hand, Mongla Port, as the 2nd port in Bangladesh, is expected to play an expanded role in future in consideration of integral components of transportation development and increasing traffic to the east and the north, and further, to the sub-regional freight traffic movement to India, Nepal and Bhutan.

Under such circumstances, the construction of bridge over the Rupsa river will realize the strategically important transport network between Dhaka, Khulna and Mongla without river interruption.

In response to the request of the Government of Bangladesh, the Japan International Cooperation Agency (JICA) dispatched the preparatory study team headed by Dr. Yuzo AKATSUKA, and both parties have agreed to the Scope of Work for the Study in March, 1998.

1.2 Study Objectives

The objectives of the Study are as follows;

(1) to formulate a master plan for integral components of transport development surrounding the Rupsa bridge,
(2) to formulate a plan for construction of the bridge over the river Rupsa in Khulna, and,
(3) to transfer technology to Bangladesh counterparts.

1.3 Scope of the Study

1.3.1 Study Area

The study area covers Khulna and Mongla citics as shown in Fig. 1.3.1.

1.3.2 Target Year

The target year of the plan will be the year 2015 which accords with that of the studies implemented by the World Bank.

1.3.3 Concept of Work Flow

Fig. 1.3.2 shows the concept of work flow for the Study.

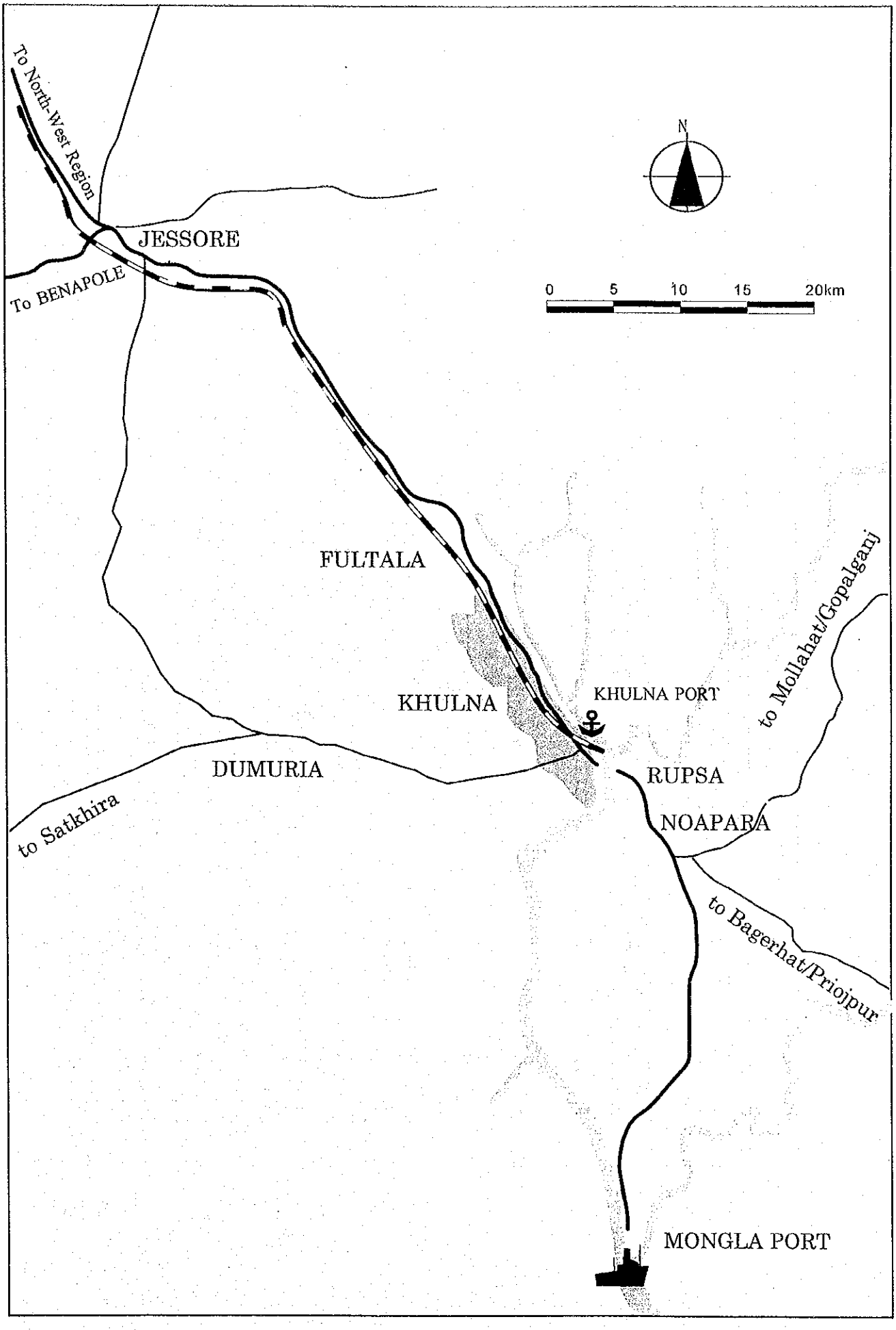

Fig. 1.3.1 Map of Study Area

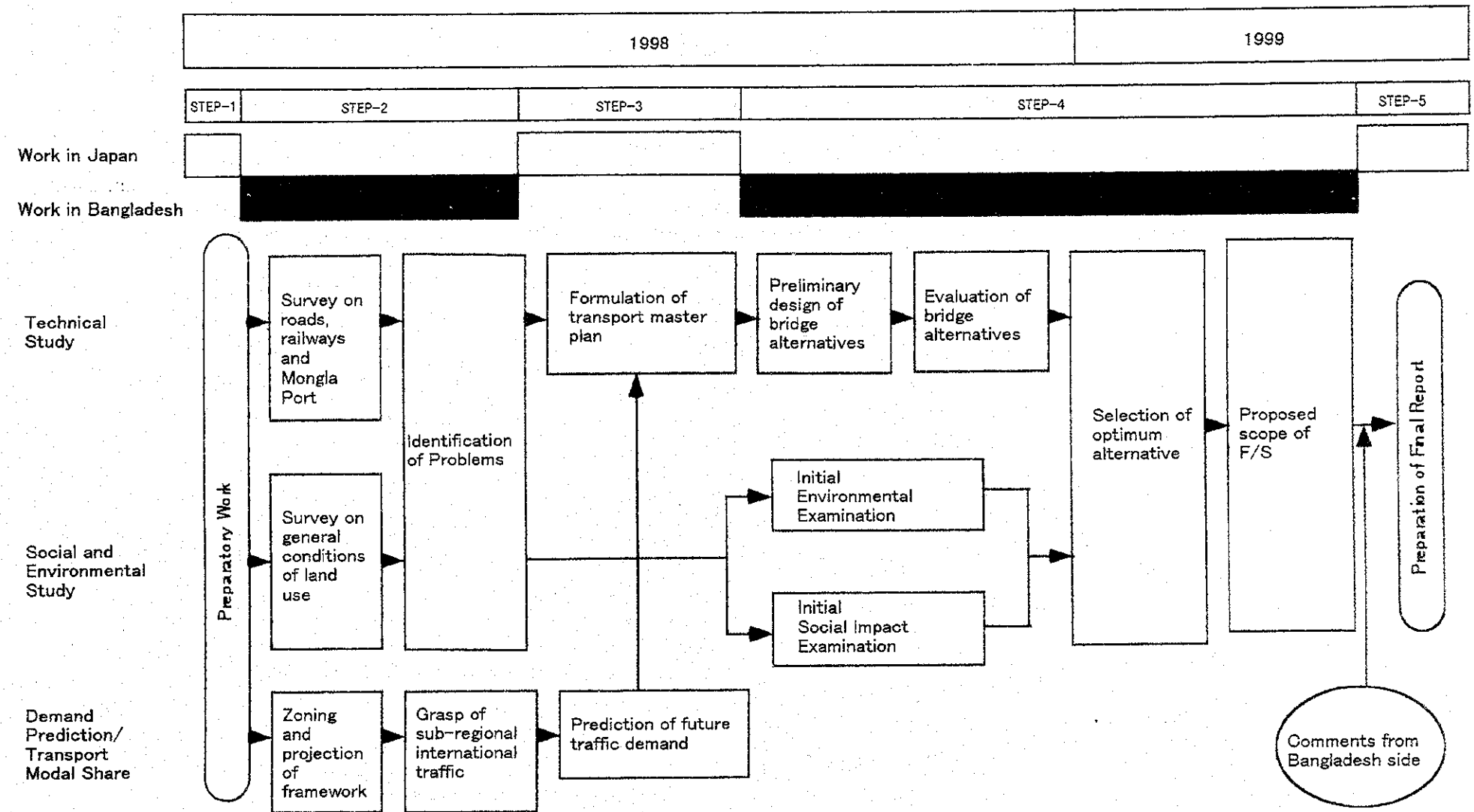

Fig. 1.3.2 Concept of Work Flow

1.4 Study Organization

The JICA Study Team closely collaborated with the Bangladesh counterpart personel from various organizations of the Bangladesh Government. The following committees are set up for the entire duration of the Study:

- Steering Committee of the Bangladesh Government, and
- JICA Advisory Committee.

The Study Organization is shown in Fig. 1.4.1.

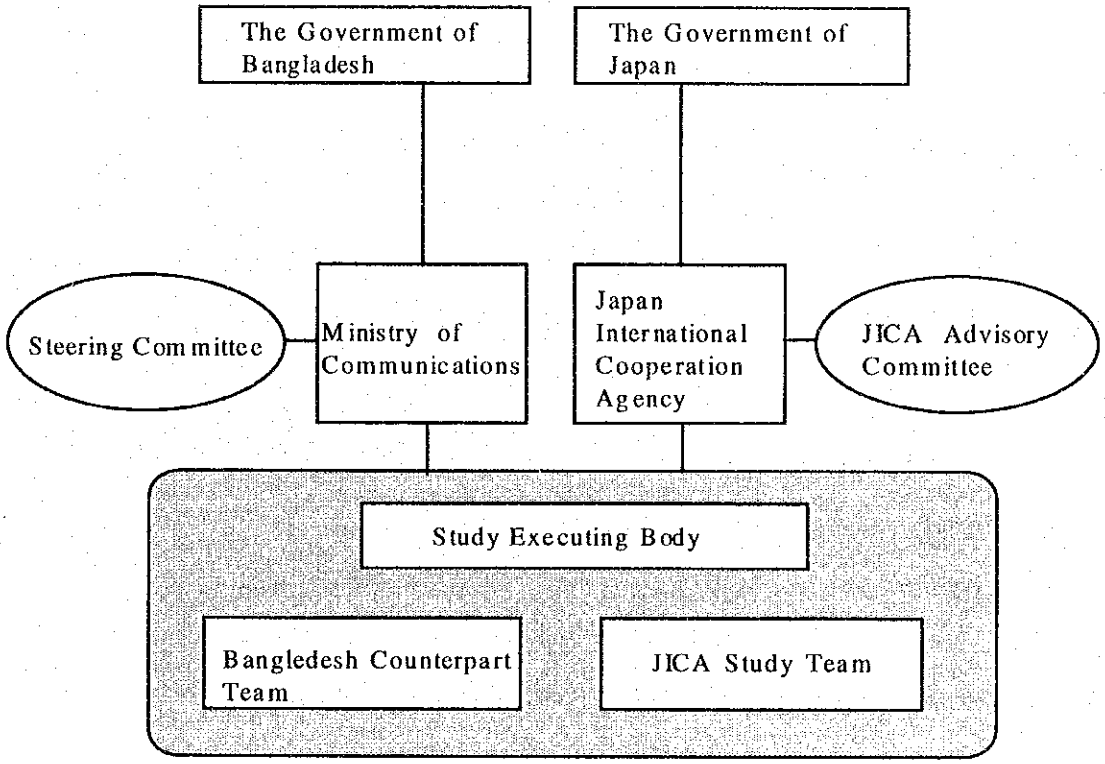

Fig. 1.4.1 Study Organization

The members of the Government's steering committee (Bangladeshi Steering Committee) and counterparts (Bangladeshi Counterparts), JICA Advisory Committee and JICA Study Team for execution of the Study are as follows:

(1) Bangladeshi Steering Committee

Name	Position/Organization
1) Mr. Syed Rezaul Hayat	Secretary of Roads & Railways Division

		as the Chairman
2)	Mr. Sohel Ahmed	Additional Secretary of Economic Relations Divisionas the Member
3)	Mr. SK. Mainuddin Ahmed	Division Chief of Planing Commission (Physical Infrastructure Division) as the Member
4)	Mia Mohammed Mostaque	Deputy Secretary of Ministry of Shipping as the Member
5)	Mr. Md. Abdus Sattar	Additional Chief Engineer of Roads & Highways Department as the Member
6)	Mr. Md. Syed Ahmed	Addl. Director General/I of Bangladesh Railway as the Member
7)	Mr. Md. Safiullah Khan	Chief Engineer (Civil & Hydrolic) of Mongla Port Authority as the Member
8)	Mr. Pervez Anwar Khan	Chief Engineer of BIWTA as the Member
9)	Mr. Liakat Ali Sarif	Chief Engineer of Khulna City Corporation as the Member

(2) Bangladeshi Counterparts

	Name	Position/Organization
1)	Mr. J. B. Barua	Additional Chief Engineer of RHD Khulna Zone as the Coordinator
2)	Mr. Mahbubur Rahman	SE Planning Monitoring & Evaluation of Roads & Highways Department as the Team Leader
3)	Mr. Habibur Rahman	Executive Engineer of Traffic Engineering Division, Roads & Highways Department as the Road Engineer
4)	Mr. Md. Mushfiuqr Rahman	Additional Chief Engineer, West (Bridge), Bangladesh Railway, Rajshahi
5)	Mr. Ashraf-ul-Islam	Executive Engineer of Bridge Design Division-2 (West), Roads & Highways Department as the Bridge Engineer

6)	Mr. Md. Khalilur Rahman	Planning Officer, KDA as the Regional Development Specialist
7)	Mr. G.M. Masudur Rahman	Assistant Engineer (Civil), KDA as the Regional Development Specialist

(3) JICA Advisory Committee

	Name	Position/Organization
1)	Dr. Yuzo AKATSUKA	Chairperson Professor/Dean, Faculty of Regional Development Studies, Toyo University
2)	Mr. Gohei TOKUNAGA	Honsyu-Shikoku Bridge Authority
3)	Mr. Hidetsugu MOCHIZUKI	Japan Highway Public Corporation
4)	Mr. Noboru TANEDA	Japan Railway Construction Public Corporation
5)	Mr. Hitoshi SANADA	Hokkaido Development Agency
6)	Mr. Kenji KURODA	Overseas Economic Cooperation Fund

(1) JICA Study Team

	Name	Position/Assignment
1)	Mr. Kenji MARUOKA	Leader/Traffic-Transportation Planning
2)	Mr. Jiro KOYAMA	Bridge Planning/Construction Planning /Cost Estimation(Bridge)
3)	Mr. Kazuto HONDA	Traffic Survey and Analysis
4)	Mr. Tsutomu KUDO	Traffic Demand Forecast
5)	Mr. Masato YAMASHITA	Port Planning
6)	Mr. Susumu NARUSE	Port Demand Forecast/Inland Transport Planning
7)	Mr. Tomoaki TAKEUCHI	Road Planning/Construction Planning /Cost Estimation(Road)
8)	Mr. Hisashi KOSHIMIZU	Transportation Planning (Railway)
9)	Mr. Nobuyoshi KAWAI	Construction Planning /Cost Estimation(Railway)
10)	Mr. Fumiyoshi KUBOTA	Hydrology Survey/Natural Condition Survey
11)	Mr. John SPURR	Economic/Financial Analysis
12)	Mr. Yoshitoshi KOBAYASHI	Environmental Assessment /Resettlement Action Plan

13) Dr. Venkatachalam ANBUNOZHI Coordinator

1.5 Final Report

The Final Report contains integrated parts of work components taking into consideration a series of discussions with the RHD and other agencies concerned during the course and study in Bangladesh.

The Final Report consists of the volumes as listed below:

Volume I : Main Report
Volume II : Appendix

The Summary Report was prepared separately.