

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

**THE ECONOMIC AND ENVIRONMENTAL POLICY EVALUATION
OF INLAND WATER TRANSPORT DEVELOPMENT IN
BANGLADESH**

John F. Brooks

4 November 1998

**M. Phil. Development Studies Project
MASSEY UNIVERSITY, NEW ZEALAND
Course Supervisors: Prof. John Overton, Prof. Anton Meister**

MASSEY UNIVERSITY LIBRARY



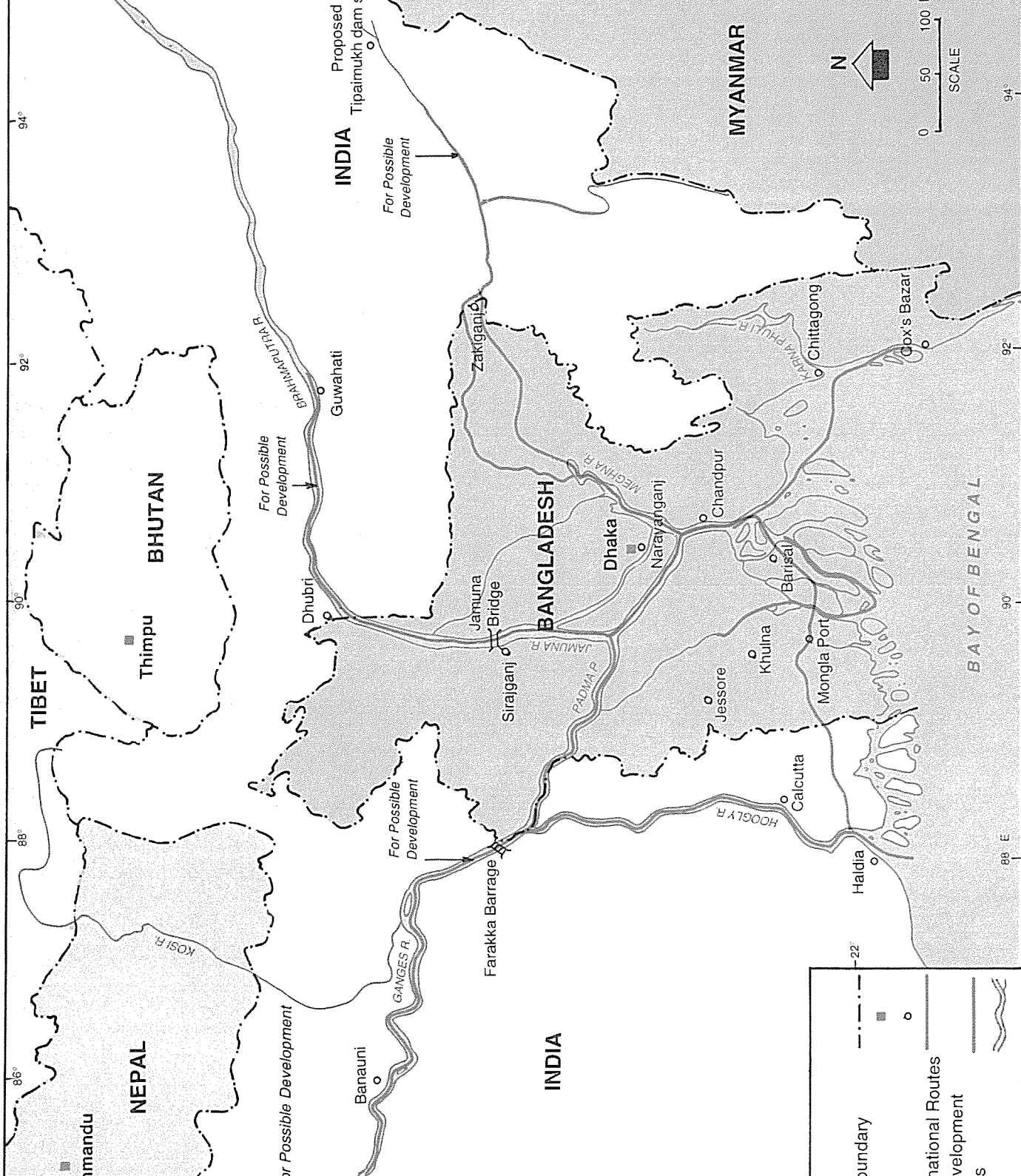
1062006531

TABLE OF CONTENTS

	<i>Page</i>
Table of Contents	(i)
Map of Bangladesh Waterways	(iii)
List of Tables and Figures	(iv)
Glossary of Terms	(v)
Abstract	(vii)
I. INTRODUCTION	1
A. Background	
B. Objectives	
C. Methodology	
II. LITERATURE REVIEW	5
A. Inland Water Transport Development	
B. Historical Aspects of Sub-Regional Transport Development	
C. Lessons From the Literature Review	
III. THE TRANSPORT SECTOR IN BANGLADESH	37
A. Description of the Transport Sector	
B. The Socio-Economic Aspects of Inland Water Transport	
C. The Hydraulic Context	
D. The Ports, Shipping and Inland Water Transport Interface	
E. Inland Water Transport Organisation, Policies and Projects	
F. Sub-regional Transport Route Development	
IV. WATER RESOURCES DEVELOPMENT IN BANGLADESH	53
A. Background to Water Resources Development and Policy	
B. International River Basin Management	
C. Kalni-Kushiyara River Management Project	
V. ECONOMIC AND ENVIRONMENTAL EVALUATION, AND PROJECT PROPOSALS	72
A. Comparative Valuation of Transport Environmental Impacts	
B. Economic Benefits of Inland Water Transport	
C. Proposed Assam to Calcutta Inland Water Transport Project	
D. Proposed Northwest Area Container Port Project	
E. Proposed Greater Dhaka Inland Water Transport Project	

F.	Proposed Dhaka Port Development Project	
G.	Conclusions on Inland Water Transport Development	
VI.	POLLUTION MITIGATION ISSUES FOR WATER TRANSPORT	87
A.	Introduction	
B.	Ports and Shipping Pollution Risks in Bangladesh	
C.	Institutional and Legal Framework	
D.	Oil Pollution Mitigation Measures	
E.	Proposal for Inland Water Transport Based Eco-Tourism	
F.	Proposal for Ports Environmental Management	
G.	Conclusions and Recommendations on Water Transport Pollution	
VII.	ENVIRONMENTAL POLICY ASPECTS OF INLAND WATER TRANSPORT	109
A.	Policy Objectives for Water Resources and Water Transport	
B.	Background to Transport Policy in Development	
C.	Strategies for Transport Policy	
D.	Transport Policy Instruments	
E.	Environmental Policy Proposals for Inland Water Transport	
VIII.	CONCLUSIONS AND RECOMMENDATIONS	129
A.	Conclusions	
B.	Recommendations	
	BIBLIOGRAPHY	132
	APPENDICES	140
1.	Maps Relating to the Transport Sector in Bangladesh	
2.	List of Key Persons Met	
3.	Kalni-Kushiyara Project Area	
4.	Stakeholder Seminar Statement for the: Kalni-Kushiyara River Management Project	
5.	Cost Estimates and Schedule for Ports Environmental Management Project	

MAP : MAJOR INLAND WATER TRANSPORT ROUTES



(authoritative)

LIST OF TABLES AND FIGURES

	Tables	Page
1	Characteristics of Asian Rivers	14
2	Characteristics for Navigation of Selected Asian Rivers	15
3	Transportation of Coal by different Modes of Transport	26
4	Transport Modal Shares	38
5	Registered IWT Vessels: 1945	43
6	Comparison of the IWT Systems of Bangladesh and China	44
7	Government Investment Programme for Water Transport	47
8	Classification of River Routes in Bangladesh	49
9	Investments Facilitate Nepalese Transit Trade	52
10	World International Rivers	53
11	Traffic Survey Results	68
12	Financial and Ecological Cost Ratios for Transport Modes in Germany	72
13	External Costs for Road and Rail in Sweden	72
14	Environmental Impact of Dhaka-Narayanganj River Port	90
15	Environmental Conservation Rules Applicable to Ports and IWT	96
16	Proposed Action Plan for Road Vehicle Tax Changes	118
17	Rail Policy Implementation	119
18	IWT Policy Formation	120
19	Overview of Environmental Management in Bangladesh	121
20	Environmental Policy Options	122
	Figures	
1	Projected Modal Traffic on Main Transport Corridors	39
2	Ministry of Shipping: Organisation Chart	48
3	Design Concept for Sundarbans Safari Vessel	101
4	Policy Framework for Sustainable Transport	112
5	Policy Problem Tree for the IWT Sector	128

GLOSSARY OF TERMS

AADT	Average Annualized Daily Traffic
ADB	Asian Development Bank
ADTA	Advisory Technical Assistance
AL	Awami League
ALGAS	Asian Least-Cost Gas Abatement Strategy
BIWTA	Bangladesh Inland Water Transport Authority
BIWTC	Bangladesh Inland Water Transport Corporation
BIWTMAS	Bangladesh Inland Water Transport Master Plan
BR	Bangladesh Railways
BRTA	Bangladesh Road Transport Authority
BRTC	Bangladesh Road Transport Corporation
BWDB	Bangladesh Water Development Board
BUET	Bangladesh University of Engineering and Technology
CCF	Commodity Conversion Factor
CHT	Chittagong Hill Tracts
CIDA	Canadian International Development Agency
CO	Carbon Monoxide
CPA	Chittagong Port Authority
CPI	Consumer Price Index
DANIDA	Danish International Development Agency
DMB	Disaster Management Bureau
DOE	Department of Environment
DOS	Department of Shipping
EC	European Commission
EGM	Expert Group Meeting
EIA	Environmental Impact Analysis
EIRR	Economic Internal Rate of Return
EPA	Environment Planning Act
EPWAPDA	East Pakistan Water and Power Development Authority
FAP	Flood Action Plan
FPCO	Flood Plan Coordination Organization
FW	Future With (Project)
FWO	Future Without (Project)
GBM	Ganges, Brahmaputra, Meghna River Basin
GDP	Gross Domestic Product
GEF	Global Environmental Fund
GOB	Government of Bangladesh
HYV	High Yielding (Rice) Varieties
ICT	Inland Container Terminal
IEE	Initial Environmental Examination
IMO	International Maritime Organization
ISO	International Standards Organization
ISSA	Inland Ship Safety Administration
IWAI	Inland Waterways Authority of India
IWT	Inland Water Transport
JRC	Joint Rivers Commission
LAD	Least Available Depth
LPG	Liquid Petroleum Gas
MARPOL	Marine Pollution Convention (1973/78)

MOA	Ministry of Airways
MOC	Ministry of Communications
MOEF	Ministry of Environment and Forest
MOF	Ministry of Finance
MOP	Ministry of Planning
MOS	Ministry of Shipping
MOST	Ministry of Surface Transportation (India)
MPA	Mongla Port Authority
MPTFS	Port Masterplan and Trade Facilitation Study
MRA	Mississippi River Authority
MWR	Ministry of Water Resources
NGO	Non-Governmental Organization
NOx	Nitrogen Oxide
NPV	Net Present Value
NTPC	National Transport Policy Committee (India)
NWMP	National Water Management Plan
NWP (I and II)	National Water Plan (Phases I and II)
OECD	Overseas Economic Cooperation Fund (Japan)
O&M	Operations and Management
OPRC	Oil Pollution Preparedness and Response Convention (1990)
PCP	Project Concept Paper
PIANC	Permanent International Association of Navigation Congresses
PM ₁₀	Particulate Mater (less than 10 microns)
PRC	People's Republic of China
RAS	Research and Advisory Services
RHD	Roads and Highways Division
SCF	Standard Conversion Factor
SOLAS	Safety of Life at Sea Convention (1974)
SO ₂	Sulphur Dioxide
SRF	Sundarbans Reserved Forest
STCW	Standards of Training, Certification and Watch Keeping Convention
SWMC	Surface Water Modeling Center
TER	Total Economic (Crop) Revenue
TEU	Twenty Feet Equivalent Unit (standard container measure)
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and Pacific
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
VLCC	Very Large Crude Carrier
WB	World Bank
WHO	World Health Organization
WTO	World Trade Organization

ABSTRACT

Throughout Asia, transport and water resources have followed generally separate paths of development and policy. This is particularly clear in Bangladesh where abstraction of surface water for irrigation, both higher in the international basin and within Bangladesh, contributed significantly to reduced channel depths for navigation. Similarly, dredging for channel improvements has had lower priority than embankment construction for flood protection and all weather road and rail services. These have impeded drainage and have constrained the significant informal inland water transport services. Other constraints include a weak legislative and policy framework, and policy implementation and enforcement are weak in both sectors. Also, dredging is split under two public sector entities, with little incentive or encouragement of private sector involvement.

In Europe and the USA, flood protection improvements, both by river training and dredging, have gone hand in hand over 200 years, and river user management is integrated and controlled under comprehensive legislation, policy, and institutional and user systems. The study has found that some initiatives along these lines are being taken in Bangladesh, especially under an ongoing National Water Management Plan due for completion by 2001, and some project initiatives are being considered. However, concerted effort is needed to recognize the economic and environmental benefits of inland water transport vis-à-vis other transport modes, and to design water resources development projects which also cater to this potential, and allow for inland water transport to make a significant contribution to cost recovery of the waterways improvement.

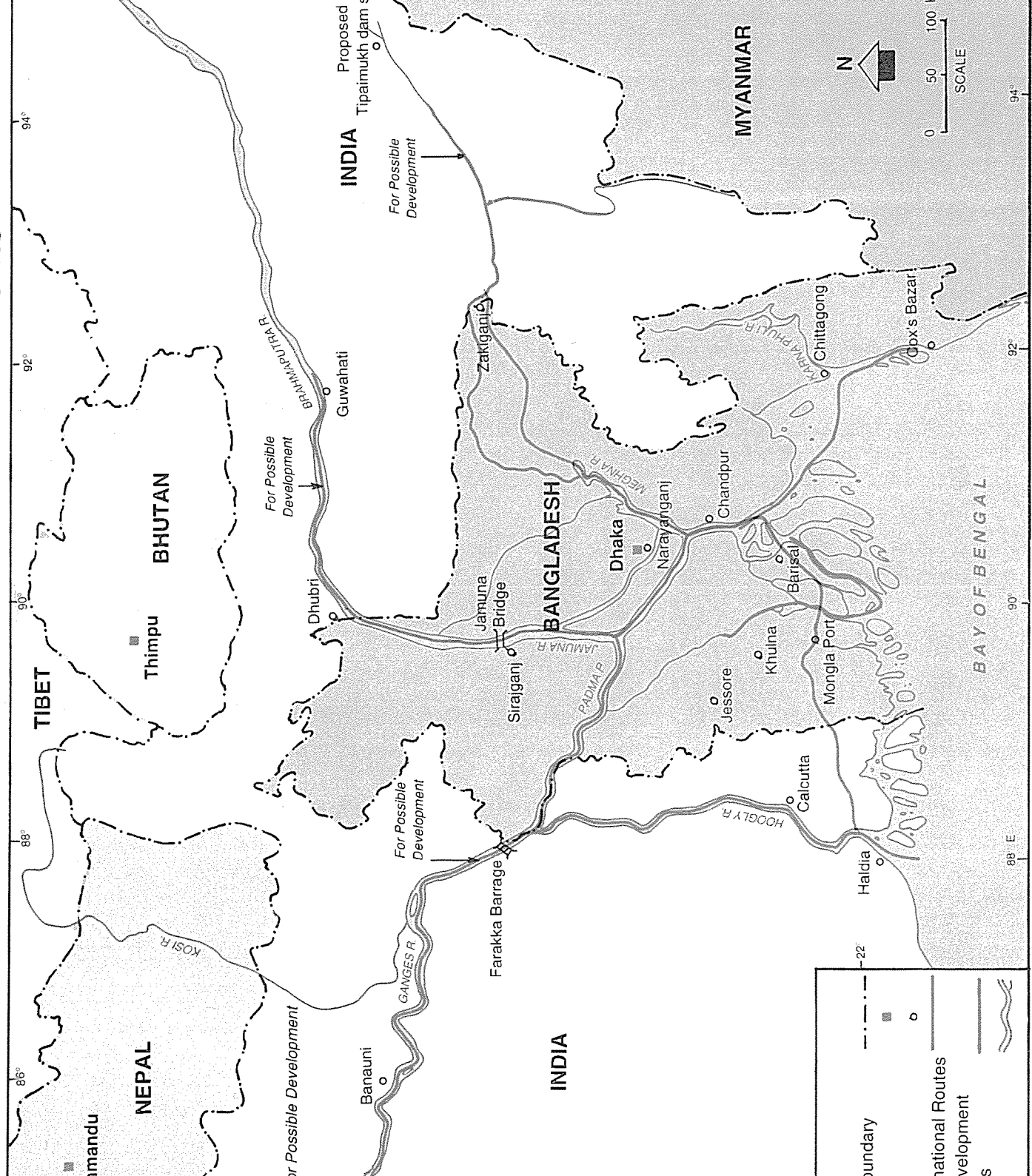
Several potential projects have been identified which will help to address the situation. In parallel, further efforts to build international cooperation among the riparian states and measures to mitigate the potential pollution impacts of inland water transport need to be put into place quickly.

TABLE OF CONTENTS

	<i>Page</i>
Table of Contents	(i)
Map of Bangladesh Waterways	(iii)
List of Tables and Figures	(iv)
Glossary of Terms	(v)
Abstract	(vii)
I. INTRODUCTION	1
A. Background	
B. Objectives	
C. Methodology	
II. LITERATURE REVIEW	5
A. Inland Water Transport Development	
B. Historical Aspects of Sub-Regional Transport Development	
C. Lessons From the Literature Review	
III. THE TRANSPORT SECTOR IN BANGLADESH	37
A. Description of the Transport Sector	
B. The Socio-Economic Aspects of Inland Water Transport	
C. The Hydraulic Context	
D. The Ports, Shipping and Inland Water Transport Interface	
E. Inland Water Transport Organisation, Policies and Projects	
F. Sub-regional Transport Route Development	
IV. WATER RESOURCES DEVELOPMENT IN BANGLADESH	53
A. Background to Water Resources Development and Policy	
B. International River Basin Management	
C. Kalni-Kushiyara River Management Project	
V. ECONOMIC AND ENVIRONMENTAL EVALUATION, AND PROJECT PROPOSALS	72
A. Comparative Valuation of Transport Environmental Impacts	
B. Economic Benefits of Inland Water Transport	
C. Proposed Assam to Calcutta Inland Water Transport Project	
D. Proposed Northwest Area Container Port Project	
E. Proposed Greater Dhaka Inland Water Transport Project	

F.	Proposed Dhaka Port Development Project	
G.	Conclusions on Inland Water Transport Development	
VI.	POLLUTION MITIGATION ISSUES FOR WATER TRANSPORT	87
A.	Introduction	
B.	Ports and Shipping Pollution Risks in Bangladesh	
C.	Institutional and Legal Framework	
D.	Oil Pollution Mitigation Measures	
E.	Proposal for Inland Water Transport Based Eco-Tourism	
F.	Proposal for Ports Environmental Management	
G.	Conclusions and Recommendations on Water Transport Pollution	
VII.	ENVIRONMENTAL POLICY ASPECTS OF INLAND WATER TRANSPORT	109
A.	Policy Objectives for Water Resources and Water Transport	
B.	Background to Transport Policy in Development	
C.	Strategies for Transport Policy	
D.	Transport Policy Instruments	
E.	Environmental Policy Proposals for Inland Water Transport	
VIII.	CONCLUSIONS AND RECOMMENDATIONS	129
A.	Conclusions	
B.	Recommendations	
	BIBLIOGRAPHY	132
	APPENDICES	140
1.	Maps Relating to the Transport Sector in Bangladesh	
2.	List of Key Persons Met	
3.	Kalni-Kushiyara Project Area	
4.	Stakeholder Seminar Statement for the: Kalni-Kushiyara River Management Project	
5.	Cost Estimates and Schedule for Ports Environmental Management Project	

MAP : MAJOR INLAND WATER TRANSPORT ROUTES



(authoritative)

LIST OF TABLES AND FIGURES

	Tables	Page
1	Characteristics of Asian Rivers	14
2	Characteristics for Navigation of Selected Asian Rivers	15
3	Transportation of Coal by different Modes of Transport	26
4	Transport Modal Shares	38
5	Registered IWT Vessels: 1945	43
6	Comparison of the IWT Systems of Bangladesh and China	44
7	Government Investment Programme for Water Transport	47
8	Classification of River Routes in Bangladesh	49
9	Investments Facilitate Nepalese Transit Trade	52
10	World International Rivers	53
11	Traffic Survey Results	68
12	Financial and Ecological Cost Ratios for Transport Modes in Germany	72
13	External Costs for Road and Rail in Sweden	72
14	Environmental Impact of Dhaka-Narayanganj River Port	90
15	Environmental Conservation Rules Applicable to Ports and IWT	96
16	Proposed Action Plan for Road Vehicle Tax Changes	118
17	Rail Policy Implementation	119
18	IWT Policy Formation	120
19	Overview of Environmental Management in Bangladesh	121
20	Environmental Policy Options	122
	Figures	
1	Projected Modal Traffic on Main Transport Corridors	39
2	Ministry of Shipping: Organisation Chart	48
3	Design Concept for Sundarbans Safari Vessel	101
4	Policy Framework for Sustainable Transport	112
5	Policy Problem Tree for the IWT Sector	128

GLOSSARY OF TERMS

AADT	Average Annualized Daily Traffic
ADB	Asian Development Bank
ADTA	Advisory Technical Assistance
AL	Awami League
ALGAS	Asian Least-Cost Gas Abatement Strategy
BIWTA	Bangladesh Inland Water Transport Authority
BIWTC	Bangladesh Inland Water Transport Corporation
BIWTMAS	Bangladesh Inland Water Transport Master Plan
BR	Bangladesh Railways
BRTA	Bangladesh Road Transport Authority
BRTC	Bangladesh Road Transport Corporation
BWDB	Bangladesh Water Development Board
BUET	Bangladesh University of Engineering and Technology
CCF	Commodity Conversion Factor
CHT	Chittagong Hill Tracts
CIDA	Canadian International Development Agency
CO	Carbon Monoxide
CPA	Chittagong Port Authority
CPI	Consumer Price Index
DANIDA	Danish International Development Agency
DMB	Disaster Management Bureau
DOE	Department of Environment
DOS	Department of Shipping
EC	European Commission
EGM	Expert Group Meeting
EIA	Environmental Impact Analysis
EIRR	Economic Internal Rate of Return
EPA	Environment Planning Act
EPWAPDA	East Pakistan Water and Power Development Authority
FAP	Flood Action Plan
FPCO	Flood Plan Coordination Organization
FW	Future With (Project)
FWO	Future Without (Project)
GBM	Ganges, Brahmaputra, Meghna River Basin
GDP	Gross Domestic Product
GEF	Global Environmental Fund
GOB	Government of Bangladesh
HYV	High Yielding (Rice) Varieties
ICT	Inland Container Terminal
IEE	Initial Environmental Examination
IMO	International Maritime Organization
ISO	International Standards Organization
ISSA	Inland Ship Safety Administration
IWAI	Inland Waterways Authority of India
IWT	Inland Water Transport
JRC	Joint Rivers Commission
LAD	Least Available Depth
LPG	Liquid Petroleum Gas
MARPOL	Marine Pollution Convention (1973/78)

MOA	Ministry of Airways
MOC	Ministry of Communications
MOEF	Ministry of Environment and Forest
MOF	Ministry of Finance
MOP	Ministry of Planning
MOS	Ministry of Shipping
MOST	Ministry of Surface Transportation (India)
MPA	Mongla Port Authority
MPTFS	Port Masterplan and Trade Facilitation Study
MRA	Mississippi River Authority
MWR	Ministry of Water Resources
NGO	Non-Governmental Organization
NO _x	Nitrogen Oxide
NPV	Net Present Value
NTPC	National Transport Policy Committee (India)
NWMP	National Water Management Plan
NWP (I and II)	National Water Plan (Phases I and II)
OECD	Overseas Economic Cooperation Fund (Japan)
O&M	Operations and Management
OPRC	Oil Pollution Preparedness and Response Convention (1990)
PCP	Project Concept Paper
PIANC	Permanent International Association of Navigation Congresses
PM ₁₀	Particulate Mater (less than 10 microns)
PRC	People's Republic of China
RAS	Research and Advisory Services
RHD	Roads and Highways Division
SCF	Standard Conversion Factor
SOLAS	Safety of Life at Sea Convention (1974)
SO ₂	Sulphur Dioxide
SRF	Sundarbans Reserved Forest
STCW	Standards of Training, Certification and Watch Keeping Convention
SWMC	Surface Water Modeling Center
TER	Total Economic (Crop) Revenue
TEU	Twenty Feet Equivalent Unit (standard container measure)
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and Pacific
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
VLCC	Very Large Crude Carrier
WB	World Bank
WHO	World Health Organization
WTO	World Trade Organization

ABSTRACT

Throughout Asia, transport and water resources have followed generally separate paths of development and policy. This is particularly clear in Bangladesh where abstraction of surface water for irrigation, both higher in the international basin and within Bangladesh, contributed significantly to reduced channel depths for navigation. Similarly, dredging for channel improvements has had lower priority than embankment construction for flood protection and all weather road and rail services. These have impeded drainage and have constrained the significant informal inland water transport services. Other constraints include a weak legislative and policy framework, and policy implementation and enforcement are weak in both sectors. Also, dredging is split under two public sector entities, with little incentive or encouragement of private sector involvement.

In Europe and the USA, flood protection improvements, both by river training and dredging, have gone hand in hand over 200 years, and river user management is integrated and controlled under comprehensive legislation, policy, and institutional and user systems. The study has found that some initiatives along these lines are being taken in Bangladesh, especially under an ongoing National Water Management Plan due for completion by 2001, and some project initiatives are being considered. However, concerted effort is needed to recognize the economic and environmental benefits of inland water transport vis-à-vis other transport modes, and to design water resources development projects which also cater to this potential, and allow for inland water transport to make a significant contribution to cost recovery of the waterways improvement.

Several potential projects have been identified which will help to address the situation. In parallel, further efforts to build international cooperation among the riparian states and measures to mitigate the potential pollution impacts of inland water transport need to be put into place quickly.

THE ECONOMIC AND ENVIRONMENTAL POLICY EVALUATION OF INLAND WATER TRANSPORT DEVELOPMENT IN BANGLADESH

CHAPTER I

INTRODUCTION

A. Background

Throughout Asia, transport and water resources development policies have been formulated and implemented in significant isolation of each other (Akatsuka, Asaeda and Brooks, 1994). In Bangladesh, the use of river water for industrial and water supply remains at a low level and attention has been focused on the development needs of self sufficiency in agriculture based on water abstraction for irrigation and the construction of embankments for flood protection. This has been at the expense of inland water transport (IWT) which relies on year-round adequate depths and unobstructed navigation to achieve the necessary economies of scale and avoidance of transshipment costs, to realise its cost competitiveness and lower adverse environmental impacts vis-à-vis other transport modes. The focus of transport development in Bangladesh over the past three decades has been to improve of the road, and to a less extent, the railways network.

The IWT sub-sector has less adverse environmental impact than road or rail development. In particular, IWT is the most energy efficient mode of transport and consequently has lower pollution emission costs. It is also the most economically cost efficient transport mode for lower value bulk traffic over long distances. With Cost-effective altatia to transshipment IWT can provide a more valued role in sustainable development. Measures to encourage the use of IWT by dredging existing waterways and by undertaking river training works to provide greater reliability and economies of scale, help to delay road and rail congestion, and minimise the relative environmental costs of the latter two modes. Investment in IWT may also delay investment in road and rail capacity increases. Thus, the alienation of productive land resources and human settlements may also be delayed or avoided. Dredging and river training also help to reduce the economic costs of disastrous flooding, resulting in increased agricultural yields and avoided damage to infrastructure, leading to investment in more intensive land use. In light of rapidly growing rural population in Bangladesh, the impact of which has been manifested in unsustainable urban migration, urban degradation and increasing poverty (ADB, 1996a), this would also help create economic growth through rural industry and cost-efficient transport (Ahmed, R. and H. Mahbub, 1990).

As indicated in Map 1 and Appendix 1, the advantages of IWT are especially relevant in Bangladesh where the Ganges, Brahmaputra and Meghna (GBM) rivers have built an extensive delta which comprises the large majority of the seasonally flood prone land area (Rasheed, K.B.S, 1995). The IWT sector has a long tradition in Bangladesh and is the only means of transport during disastrous flooding. Moreover, few of the nearly 70,000 villages in Bangladesh are more than 10 km from a potentially navigable waterway. The population of over 120 million is only about 20 percent urbanised and per capita gross development product (GDP) is only about \$250 (km) annum, while the average population density is nearly 800 persons per square kilometre (sq km), a figure that is expected to double in the next 30 years (UNICEF, 1997): 3. This determines that land is the most vital resource for sustainable economic development, and that least cost rural transport is vital in poverty reduction strategies.

Compared with over \$3 billion of foreign aided investment in roads and bridges, and about \$300 million in rail since the independence of Bangladesh in 1971, IWT has received less than \$100 million in IWT development assistance (Brooks, 1995a). During this process, road and rail embankments, and river embankments intended to reduce flood risks, have often interfered with the natural drainage system and have tended to block traditional navigation routes. This may have also contributed to flooding and erosion, and has also prolonged the retention of flood water in some areas. At the same time, agricultural policies in Bangladesh and the upper riparian areas of India have focused on irrigation and barrage construction. This has led to upper basin water abstraction, significantly reduced lower riparian water availability in the dry season. The practice has also contributed to increased salinisation in lower estuarine areas. Maintaining lower riparian flows for year-round navigation has had low priority.

These developments are characterised by inadequate cost recovery for the maintenance of flood protection and irrigation schemes. Adopting a maintenance dredging approach to flood protection would ensure that reliable and adequate water depths are maintained, allowing for charges to IWT users for dredging cost recovery. However, embankment construction and empolderment have required that cost recovery be centered on the more difficult and less certain avenues of government budgeting, and charging near subsistence based farmers who benefit from surface water retention schemes for irrigation and increased yields from flood protection embankments.

A more sustainable approach to irrigation would be ensuring that a high water table is maintained as a result of the seasonal flooding and using this as a criteria for defining the limits of agricultural development. This may imply less reliance upon low value irrigated rice production which takes 75 percent of the productive land area, towards increased cash surplus for more intensive land use and investment in rural industries, leading to increased demand for more efficient and competitive transport.

There is particularly a need to adopt a more integrated approach to water resources and transport in the interests of sustainable development and sub-regional cooperation affecting the international context of river basin management. However, the separate planning, policy making and administrative frameworks of each sector, and an historically bilateral approach to international water resource agreements based on political considerations, have institutionalised a failure to seek out opportunities for sustainable river basin development.

In the transport sector, the major roads of Bangladesh are congested by trucks, which compete for space with socially adapted non-motorised transport and polluting and dangerously operated light motorised vehicles. This mix of traffic and the lack of often basic traffic engineering solutions to improve safety, and lack of driver education, contribute to Bangladesh having one of the worst road accident records in the world. Road and rail traffic both suffer long delays in awaiting river crossing ferries, especially during the dry season when silted channels and reduced depths impede ferry navigation. Much of the bulky and lower value road and rail traffic would be more suited to IWT provided adequate maintenance dredging is carried out. Moreover, demand for containerisation is expected to increase rapidly in the foreseeable future, assisted by planned development at Chittagong and Mongla ports, road and rail improvements, and intermodal exchange facilities. This traffic is also potentially suited to an improved IWT and efficient inter modal exchange network.

A more sustainable approach to both water resources and transport development may therefore be to facilitate IWT development, allowing more cost-efficient distribution of bulk and containerised traffic, accompanied by a policy framework which ensures that transport mode options minimise the relative environmental impacts, especially regarding the demand for roads and associated conversion of productive land resources, and non-renewable and polluting energy usage.

B. Objectives

The research objectives, applied to Bangladesh, are to:

- contribute to the objectives of an ongoing National Water Management Plan (NWMP)¹ which aims to adopt a more integrated approach to water resources policy;
- examine the environmental aspects and mitigation measures for IWT; and
- outline the potential for cooperation with India on IWT development.

C. Methodology

The research commences in Chapter II with a literature review covering water resources and transport planning and policy in regions of the world where IWT has an important role, and where lessons may be applied to the undeveloped IWT sector in Asia. In view of the international context of the GBM region, the literature review extends to the socio-political relationships governing economic cooperation between Bangladesh and India.

A review of transport and IWT sector planning, policy, and institutional capacity in Bangladesh is in Chapter III. The framework of water resources management follows in Chapter IV, including the economic and environmental aspects of IWT as a user of water resources under the *Kalni-Kushiyara River Management Project*, which is programmed for Asian Development Bank (ADB) financing in 2001. The potential for generated IWT traffic benefits, potential for cost recovery of maintenance dredging from IWT revenue and current lack of sub-regional cooperation on water resources planning in the upper riparian areas of India are highlighted. These provide a useful background for the investment decision making process.

The economic and environmental aspects of IWT are taken further in Chapter V by examining international IWT routes offering distance saving transit opportunities for India via Bangladesh, examining the land acquisition and resettlement issues which can be avoided or delayed by IWT versus road or rail investment, and addressing the quantification of environmental benefits of IWT for reduced energy requirements and therefore reduced emission of pollutants.

Chapter VI recognises that while IWT is a relatively environmentally friendly mode of transport and a water based approach to ecotourism in the ecologically sensitive Sundarbans Reserved Forest (SRF) area may be appropriate, oil pollution is the main environmental risk associated with IWT development. The chapter focuses on the lack of

¹ The World Bank financed NWMP Final Report is due for completion in 2000 (See Chapter IV, Part A2.)

a comprehensive national oil spill contingency plan and proposes that this should be implemented to take account not only of IWT concerns but also the interface between IWT and seaports. To help mitigate this key environmental threat, under a policy framework which advocates the development of IWT, an advisory technical assistance (ADTA) project costing a total of \$0.5 million is one of the main proposals of the research. Implementation of the ADTA is to go hand in hand with recommended investments costing about \$2.0 million for navigational aids and pollution control equipment. The proposed investment are being considered for ADB financing.

This leads to an examination in Chapter VII of the policy and institutional changes needed to ensure that the economic and environmental benefits of advocating IWT development can be achieved, together with a critical review of whether such changes are realistic and achievable on a timely basis, and to what extent the private sector can be expected to participate in meeting the objectives.

The research findings were discussed with a wide range of experts and concerned individuals in Bangladesh (see Appendix 2). However, the conclusions and recommendations for further study and policy consideration, as summarised in Chapter VIII, are entirely those of the author.

CHAPTER II

LITERATURE REVIEW

A. Inland Water Transport Development

1. Introduction

The civilisation of humankind has taken place everywhere along waterways, such as the Tigris-Euphrates, Nile, Mekong and the Rhine. Major metropolitan areas owe their location to estuarine seaport development. Access to reliable drinking water, irrigation, fisheries, and trade opportunities linking hinterlands via rivers with foreign trade were the basis of such development. With the development of rail and road technology, IWT has nevertheless declined worldwide in terms of its relative importance as a transport mode. However, in Europe and the People's Republic of China (PRC), where it has had historical importance, IWT is experiencing renewal attention in meeting multi-modal transport objectives for economic efficiency.

The review examines the conditions and development prospects in the latter areas such as Europe and the United States of America (USA). It also examines the Asian context, in particular, the PRC, where IWT development has a similarly long history to Europe. The review highlights the development potential in Asia by noting the policy and technical inputs in Europe and the level of research, planning, investment and integrated management necessary for IWT to compete cost-effectively with other transport modes. The review concludes with an examination of the historical aspects, which govern IWT development potential in Bangladesh. This is an important dimension given an apparent political impasse on policies affecting sub-regional cooperation and the main economic advantage of IWT in providing least cost transport solutions over long distance with minimal interruption. This is important to a theme of the research, which examines the economically and environmentally efficient use of international water resources of the GBM river basin for IWT.¹ In particular, the research gives importance to the potential revival of a distance saving international transit route across Bangladesh, linking the eastern states of India with Calcutta, in West Bengal.

Aspects of the literature review relating to the role and organisation of IWT in Bangladesh are covered in Chapter III in relation to the transport sector as a whole. The background and inter-relationships with the water resources sector literature is covered in Chapter IV, with the environmental valuation and mitigation aspects are in Chapters V and VI, respectively. The policy framework and measures to effectively promote IWT, in Chapter VII, also cover the relevant literature.

¹ In Bangladesh, the Ganges is called the Padma and the Brahmaputra is called the Jamuna.

2. Europe

(a) Historical Perspectives

In Europe, IWT was important in the United Kingdom and fostered the industrial revolution from 1760 to 1830 but there was a lack of investment to achieve increasing economy in line with industrial demand for transport the United Kingdom and IWT was overtaken by rail and highways construction in the nineteenth and twentieth centuries. An important element was the acquisition of waterways by the railway companies after 1845. It needs to be recognized that the geography of the United Kingdom does not favor low cost river transport and requires major investment lock gates to overcome physical barriers. Also, river flows are small and only small lock dimensions are possible, which limit the economics of scale and inland penetration. In 1990, only about 2,300 km of waterways existed. These carried only 6 million tons of cargo (Sriraman, 1998: 107).

However, IWT has retained a significant role in domestic and international transport in the Benelux countries, France and Germany, and eastward through the Danube basin, where rivers are longer, wider and have reasonable depth (Bombis et al. 1991:vii). In continental Europe, larger and connected river basins have contributed to the advantages of IWT in long distance transport and where IWT development has been integrated with engineering solutions for flood control. In the Rhine basin, river morphology has been progressively controlled in the past 150 years and a near equilibrium has been attained between average discharge and depths. During floods, erosion is confined to the main channel by training works such as groynes, spurs, training walls, cross bunds and embankments and a natural tendency towards braiding and over spill into the wider flood plain is largely prevented. In the Netherlands, the River Act ensures that no works can be carried out without flood computations, and compensatory works and regulatory works for high water management are carried out in a coordinated fashion. These were based on detailed knowledge of the river established over the 150-year period (Bombis et al.: 114).

Bombis et al: 116-127 also reveal that human interference in the Rhine delta can be distinguished in several phases. In the period 1000 to 1500 AD, dykes were erected by farmers and villagers, resulting in closure by about 1500. The old flood plain was reduced from a width of 10-30 km to about 500-2,500 m along all the river branches. The water boards established by about 1500 to control floods in the system still exist today. With confinement of the channels, many ice jams occurred between 1500 and 1850 due to complete icing over shallow braided lengths. With the spring melt, this resulted in dyke bursts and tragic flooding. After 1850, cross bunds using natural materials (willow, sand and clay) were erected in the flood plains by the water boards, with revetments where dykes were located close to the main channel. Gradually, the cross bunds were also used as access to ship loading/unloading points along the rivers. This period coincided with the development of the steam engine and steel construction of vessels, and sail and manpowered vessels were gradually replaced, creating opportunities for larger, deeper drafted vessels. This led, around 1850, to larger scale river works serving both the interests of flood control and IWT. Meanwhile, a more integrated authority had been created around 1800, the Rijkswaterstaat, and river normalisation was gradually adopted. Under the system, the river training works ensure maximum natural scouring of the main channel accompanied by dredging in hard bottom areas and the prevention of embankment overtopping by ensuring that cross bunds were

low enough to be submerged during floods. This allowed maximum uninterrupted discharge over the cross section of the flood plain.

As shipping developed, the process was facilitated by canalisation and lock gate systems, allowing control of the river and lateral connection by shipping between the main river streams. These works and their continuous refinement and maintenance, leading to near equilibrium, has been achieved only over many years. However, the early embankment (dike) construction and deposition being confined to the artificially narrowed flood plain, led to gradual raising of the river beds. As a result, and also due to coastal sand dunes, the lower Rhine Basin is characterised by many protected areas of the former wide and now under nourished flood plain areas being below water level. This ensures that large economically productive and densely settled areas of the Netherlands today rely for their safety on continued maintenance of the river works. This justifies major public expenditure and support.

While a major flood prevention research effort continues in Europe, a number of recent PIANC publications deal with the relationships between flood protection and navigation. Some of these are referred to in the section dealing with the economic analysis and integrated water resources management. Others of a more technical nature reveal the complexity of the hydraulic issues relating to barrages, canals, reservoirs and over flow dike construction which aim to control flooding while also assisting navigation, both in northwest and southern Europe. The following examples were discussed at a 1995 PIANC Conference on Inland Waterways and Flood Control: Rizzoli, J.L. (1995) on river deepening and channel widening to regularise water channel depths, and removing meander sediment deposition effects to increase flood capacity; Baldock (1995), de Hann (1995), Della Luna et.al. (1995), Engels (1995), Hiver (1995), Lalaut (1995) on flood monitoring models; and Fischer (1995), and Wike (1995) on flood warnings to shipping.

In Engels: 6, it is noted that Rhine gauging stations over the past 100 years reveal that more 100 year floods have occurred in the past 12 years than the previous 120 years. While climatic change may be a factor, landscape sealing such as by urban paving and river straightening appear to amplify flood height. In the case of over spill dikes, Elskens: 3 notes that while the length of diked area rather than width provides the most effective way of reducing the height of storm surge tides and major floods, the area of land behind the over spill dike can be used for agriculture, since inundation generally occurs less than once each year. However, such dikes are very expensive to construct since about 1 meter of water height may overtop the dike and the provision of adequate landside slope protection becomes very important.

(b) Policy and Administrative Concerns

The most significant world focus of IWT activity today exists in the Netherlands which has an IWT fleet of over 6,000 vessels each having about 350 to over 3,000 tons capacity (PIANC, 1992: 1993). In particular, the ports of Rotterdam and Amsterdam were developed mainly because of their location in relation to river based hinterlands. As noted in PIANC, 1992: 97, improvements to the hinterland waterways began 1,000 years ago and in the past 200 years the development of IWT has been progressively integrated with flood protection, protection from saline intrusion, and ensuring the integrity of other water usage, such as for the conflicting interests of industry, municipal water supply, and irrigation.

This has progressively involved legislation, commencing with the Rivers Act of 1908, which was designed to maintain the rivers in proper condition: protection against floods and tides and meeting the needs of shipping (PIANC, 1992:139). Integrated planning has followed, leading to the 1990 Netherlands Water Management Plan (PIANC, 1992:10), including 800 municipalities tied to 12 provincial water boards, standing committees and the Council of Public Works of the Ministry of Transport and Public Works. The 20 Council members are drawn from diverse interests representing the provincial and municipal councils, water boards, natural sciences, judiciary and industrial interests. They provide independent judgment on the plans and reports of the various committees, which represent road, motorist, shipping and trade interests.

(c) Integrated Transport and Competition in Europe

The growth of IWT in Europe was rapid following invention of the steam tug, which gave upstream passage by loaded vessels greater reliability and speed. The first organised trade routes were built under Napoleon and as steam engine propulsion became more refined and experimentation and hydraulic research and technology advanced, river training works, dredging and canalisation proceeded rapidly, and, unlike the UK, IWT competed effectively with the growth of railways during the middle Nineteenth Century. This led to the Act of Manheim in 1867 guaranteeing free passage of shipping over 800 km of the Rhine between Basle and the North Sea, transiting four countries (PIANC, 1992:57).

With development of the diesel engine and adoption on the Rhine in the 1960's of the 1950's Mississippi River pusher tug and navigational aids technology, IWT has remained an effective transport mode in Europe, assisted greatly by the early location close to the river banks in the Nineteenth and early Twentieth Century of German steel, mining and other industries requiring large bulk shipments of materials and finished goods. This facilitated economies of scale over uninterrupted 24 hour passage for vessels of about 2.5 meters draft. Today's groups of 3,000 ton barges and pusher tugs of up to about 3,000 horsepower operate throughout the Rhine Basin. Coasting vessels also penetrate far inland, and a large fleet of owner-operator self propelled river vessels of 300-1,500 tons navigate an integrated and standardised system of canals and controlled rivers. Social systems for operators have also improved steadily, including compulsory education for barge children and crew training schemes. Currently, a fleet of 10,000 vessels ply the Rhine catchment and PIANC, 1992:97 reports that 150 million tons of cargo annually pass the German-Netherlands border.

However, Bombis et al. note, that while IWT remains important, the European Commission (EC) countries face persistent unsatisfactory economic performance in the IWT sector. There are also issues concerning congested roads and IWT's environmental benefits, and the challenge for establishment of a more homogenous market in the midst of significant interference in the transport industry over many years by individual member states. This has led to revolving distortions of the balance between demand and supply in the IWT market. By 1988, the demand/supply ratio for the dry cargo fleet had worsened by 15 percent which was not fully compensated by 8 percent scrapping in 1990 under an EC old for new policy, meaning that new ships could be added to the fleet only when old vessels are withdrawn or a penalty paid (Bombis et al.: vii). The general trend over several decades has, therefore, been towards owner-operators with one ship, without shore based support. These vessels offer the lowest operating costs, as owners appear willing to accept lower profits. From a management

and marketing perspective it can be appreciated that this trend has resulted in significant vertical disintegration of the IWT sector and forgone opportunities for IWT to integrate fully with other transport modes. In 1987, larger ship-owning companies formed only 5 percent of the enterprises, owned 27 percent of the vessels and 37 percent of the fleet capacity (Bombis et al.: viii). The process has led to confrontation rather than a partnership between shipping and shore based activities, and foregone development of entities, which combine IWT, port operations and road haulage operations where these have economic advantage.

The trend also reveals that owner-operators meet more efficient larger operations by reducing their maintenance, insurance cover, provision for salaries and welfare such as superannuation, and providing higher human input. This is not sustainable or socially desirable and has led to over capacity. Among the difficulties, investment decisions are based on varying seasonal needs and imprecise market signals, as well as over optimistic expectations for the future as traditional owner operators become locked into their operation, with the vessel itself often representing the only asset for meeting the costs of owner retirement. Thus, the exit barriers are high, and made higher by lack of training for alternative livelihood. On the other hand, entry barriers are low where the cost of small second hand vessels is minimal and where nautical or commercial knowledge is not overly specific, where direct experience through the lower ranks counts as the main qualification. This tends to reinforce family based ownership traditions.

The main weaknesses of the IWT sector in Europe, therefore, are vertical disintegration, price instability, lack of investment in waterways infrastructure where expansion plans, especially in Eastern Europe, are constrained by differing national policies and technical standards, and a strong individualism among operators. This restricts commercial cooperation and lacks sufficient internal means to assess the role of IWT in the logistical chain relative to transport modes and markets.

(d) Containerisation of Inland Water Transport

Nevertheless, in the last decade, IWT has witnessed fuller integration with the logistic transport chain by the adoption of container traffic. In a study by the Netherlands Rhine and Shipowners Association (CBRB, 1995) it is noted that maritime containerisation in the 1960's and 1970's resulted in significant loss of market share by IWT as a result of port terminal design catering mainly to road and to a lesser extent, rail interface for the inland distribution of containers. This situation was accompanied by the perception that IWT could not achieve the time savings and door-to-door benefits of road for the distribution of higher value container cargo. However, increasing highway congestion, the high cost of road network expansion in Europe, and the fact that after a 2 to 3 week ocean passage the incremental inland distribution time of IWT over trucks averages only 1-2 days. This has begun to put the matter into perspective. This is leading to the redesign of sea port container terminals to provide dedicated rather than shared IWT equipment. Opportunities for contractual relationships between maritime carriers, terminal and IWT operators have also improved. The CBRB study notes that IWT container flow between Germany and Europe grew from 5 percent in 1978 to 35 percent in 1993. In the same period, rail share declined from 20 percent to 3 percent and IWT volume has increased at a faster rate than for roads. In that period, container flow to the German hinterland doubled, to 800,000 containers. Moreover, IWT container vessel size increased from about 80 TEU to an average of about 160 TEU, with some pushbarge

combinations carrying 350 TEU (CBRB: 27-33). Waterways are optimally suited to container traffic if 4 layers of containers can be stacked. Low bridges, therefore, present bottlenecks and reduced opportunities for market penetration. For example, Strasbourg is limited to a 3 high stack and on the Rhine Main-Danube canal 200 TEU vessels can stack only 2 high. Nevertheless, cost effectiveness is often sufficient with only 2 layers (CBRB: 42). While tariff setting is at the IWT operator's discretion on the Rhine, this is not so for a number of European countries, and in some cases, such as the Le Havre-Paris route, distances are far greater by IWT than by land transport. Further, the channel tunnel between the United Kingdom and Europe is already allowing rail to recover some market share from coastal shipping which can penetrate the European Rivers (PIANC, 1992b). Clearly, the analysis and policy framework for economically efficient solutions must allow for modal advantages to be recognised and exercised by the market as a whole.

(e) The Outlook for Eastern Europe

The significant political and economic transition in eastern Europe over the past decade has resulted in trade revival and cooperation between west Europe and the former Soviet Union countries. It has also made cost efficiency an essential element of planning among the former command economies since 1989.

The principal development is the Trans European Motorway (TEM) from Gdansk to the Persian Gulf, via the Bosphorus Bridge and several feeder routes. About 4,000 km of this 10,000 km route are already in use and 3,000 km is under construction. Under the TEM, 15-day ocean passages from the Baltic to the eastern Mediterranean can be avoided for high value cargo in favor of a 3-day road lorry trip. The Trans European Railway (TER) is also envisaged for integration by 2010.

One of the constraints against IWT sharing in this development has been in matching river depths, widths, bend radius, rock dimensions and bridge clearance of eastern Europe with those of the west. While the scope of works requires major, long-term investment, a number of feasibility studies have proved to be profitable (Andruszkiewicz et al., 1996:24). The principal standard being adopted is that of European Class IV, with depths of 2.8-4.0 m and bridge clearance of 8 m and 12 m for power lines. This should enable the transit of 110 m long motor barges and 185 m long push barge trains with a capacity of about 3000 dwt.

One of the principal IWT routes is the Rhine-Main-Danube Canal, which was opened in 1992, and is connected to the wider hinterland through the Black Sea port of Constantza. Legislation changes, customs harmonization and fleet modernisation are among the developmental concerns. In Yugoslavia, the 650 km Danube-Vardar-Aegean was first envisaged in 1900 and in 1980, its development was estimated to cost \$400 million with annual traffic of 10 million tons, increasing to 20 million tons (Muskatironiv, 1996: 357). The project was envisaged by Muskatironiv: 358 as offering an opportunity for Yugoslavia to recover its economy after the imposed sanctions of recent years. A connection from the Danube to the large Polish rivers of Odra and Wisla is also envisaged by 2005 by development of the 250 km Vah Waterway (Oblozinsky, 1996:362). This would integrate with road and rail services to the Slovakian inland port of Bratislava. The Vah crosses the most industrialized part of Slovakia.

In Belarus, where river navigation is well developed with a fleet capacity of about 230,000 dwt, additional works are nevertheless required to meet European Class IV

standards. The present main concerns relate to the avoidance of environmental degradation due to oil spills and human waste disposal from ships, notwithstanding the significant energy cost savings by IWT. According to Rydzkowski and Wojewodzka-Krol (1996): 439-453, environmental protection should be one of the main criteria in transport development and assistance to the environmentally friendly mode of IWT should be a basic direction of activity. Investment in upgrading Polish IWT standards to facilitate integration with western European IWT is therefore justified from this perspective.

In a 1994 paper, the same authors noted that investment in transport in Poland since 1995 was only 6 percent of total national expenditure compared with up to 20 percent in EEC countries (Rydzkowski and Wojewodzka-Krol (1994): 25. They also refer to the lumpy nature of infrastructure investment and the indivisibility of IWT investment with water resources benefits, compared with other transport modes. The authors therefore note the temptation of under-investment in IWT.

3. The United States of America

In the USA, IWT began in the seventeenth century with the use of rivers in their natural condition as routes of exploration, which soon became transport highways' for settlers. This led to canal construction, and between 1800 and the civil war, the steamboat and canal development was rapid and in 1860, an average of 10 steamboats arrived at New Orleans each day (Howe et al, 1969: 9). However, with the suspension of river commerce during the civil war, railways development became dominant up to about 1918. The impetus for rejuvenating IWT came from technological improvements in maritime propulsion and naval architecture in the late nineteenth and early twentieth century and the heavy transport burden of World War I. By 1964, the 40,000 km US IWT system having depths of over 2.7 meters¹, mainly the Mississippi, Atlantic, and Gulf waterways, handled over 17,000 vessels with a total capacity of nearly 20 million tons. Many of these vessels were 9,000 HP pusher tug-barge trains with capacities of nearly 50,000 tons. By comparison, a 6,000 HP railway locomotive has a capacity of 6,000 tons (Howe et al:10).

Much of the recent development was through canalisation and highly mechanised lock construction and operations, and since 1828 has been under the control of the Army Corps of Engineers and federal funding.

The management of water resources in the USA is therefore in federal hands and navigation is considered an important element, alongside flood protection and power generation dams, and in trade off with irrigation, recreation and urban needs. The tradeoffs are made easier by a policy, which has maximised the storage capacity of the river.

Container on barge (COB) systems should be competitive on such an extensive network. However, only the Columbia-Snake River System has been profitable (Boggerts, 1994: 6). The main reason for this is the high level of intermodal exchange efficiency and the US Shipping Act of 1984 which enabled ocean container shipping lines to develop double-stack rail-container services, which today operate about 40 major destinations. One such rail train can carry 400 containers, compared with 50 containers on a US IWT river barge. The success of this system, which contrasts with the growth of IWT for container handling in Europe, is due partly to rail-bridge tunnel conditions, which

¹ The routes do not include the Great Lake system, which is considered an extension of ocean transport.

allow double stacking, but also to the level of cooperation and planning for time-sensitive cargo.

The long history of involvement of the Corps of Engineers in the management of US rivers has provided an important means to balance environmental concerns with those of navigation and flood control. In addition, the Mississippi River Commission (MRC) has been in existence since 1879, and provides a means for integrated planning of dike strengthening and dam construction¹. In spite of these efforts, however, there have been 17 major floods on the Mississippi since 1882 (Galloway & Manous, 1994:154). Also, the engineering works have had some environmental costs.

The Mississippi is clearly a river constrained from its natural meandering, and rejuvenating effect of spreading fertile sediments across the flood plain and wetlands during floods. However, flood protection benefits since 1928 are estimated by Galloway and Manous: 156 to be \$144 billion and there is no turning back on costly protective works, although river bed height has gradually increased and levees have become higher. Achieving sustainable development in the basin, however, has emerged as a major challenge. To attain this, MRC and the Corps of Engineers are shifting the focus of flood protection to non-structural solutions, such as relocation and land control. Areas between levees and the river are being left as fish and wildlife habitat, and care is being taken in sourcing earth for levee strengthening. Also, dam operations are taking greater account of fish life cycles, and regulated diversion of river flow onto wetlands to help sustain them environmentally.

4. Asian Development Prospects

(a) Introduction

Apart from a brief article by Hochstein (1990), the only source of information on IWT development prospects in Asia as a whole is an unpublished article by Akatsuka, Asaeda and Brooks (1994). The latter note that several Asian rivers are major international waterways such as the Amur [Covering the People's Republic of China (PRC), Mongolia and Russia], the Mekong (Cambodia, PRC, Laos, Myanmar, Thailand and Vietnam), the Brahmaputra (Bangladesh, the PRC and India), the Ganges (Bangladesh, India and Nepal) and the Indus (Afghanistan, India and Pakistan). Unlike Europe, which has the longest history of continuous modern international development of IWT, Asia also contains a number of very large domestic rivers with navigable lengths exceeding 1,000 km. Among these are the Huang He and Chang Jiang rivers in the PRC, the Chao Phraya, in Thailand; the Irrawaddy, in Myanmar; and the Narmada and Mahanadi, in India. The total year-round 1 metre or above navigable length of Asian rivers, about two-thirds, exceeds 150,000 km. most of which is in the PRC. However, total route length is also seasonal and inexact.

¹ Since 1928, over 3,000 km of levees, 250 dams, 4 floodways and 250 km of river shortening works have been constructed accompanied by continuous dredging by the Corps of Engineers and the Tennessee Valley Authority (Galloway and Manous:154, and World Bank 1997:21-23).

(b) Classification of Asian Rivers

In attempting to classify Asian rivers for transportation purpose, Akatsuka, Asaeda and Brooks suggest an hydraulic approach based on seasonal variation in available river depth. Accordingly, they classify Asian rivers into three main groups. Himalayan, Equatorial and Arid-Monsoonal. The **Himalayan** rivers are typified by discharges which are determined by an extreme range of precipitation, involving post-winter snow melt and the seasonal monsoon. It is normal to experience channel depths of up to about 10 meters in the wet season, decreasing to below 2 metres during the dry season. For example, at three points of the Mekong river system, the water level increases to more than 6m in July and reduces to less than 1m in the dry season. This leads to significant variation in the payload of river traffic. **Equatorial** type rivers are typified by those of Indonesia which experience little variation in their discharge volume, being influenced by a mainly equatorial climatic regime. The **Arid-Monsoonal** rivers, such as the Indus, are those which are nourished mainly by monsoonal rains but flow through arid regions. Consequently, while these rivers experience seasonal variation in depth their runoff is typically rapid. The general characteristics of Asian rivers are summarised in Table 1, while Table 2 summarises the navigable depth characteristics of selected Asian rivers.

Table 1: Characteristics of Asian Rivers

River System	Location	Length (km)	Drainage Basin (10 ³ km ²)	Average Discharge (m ³ /s)
Himalayan Group				
Mekong	South China Sea, Vietnam.	4180	811	14200
Brahmaputra	Bay of Bengal, Bangladesh.	2480	580	19200
Salween	Gulf of Martaban.	2820	324	10000
Ganges-Bhagirathi	Bay of Bengal, Bangladesh-India.			
Irrawaddy		2510	952	11650
Red	Andaman Sea, Myanmar.	1990	409	12660
Ghaghra	Gulf of Tonkin, Vietnam.	1150	120	3900
Chao Phraya-Nan	Ganges, Bihar-Utter Pradesh, India. Gulf of Thailand.	1080	127	2200
990			150	883
Equatorial Group				
Kapuas	South China Sea, Borneo, Indonesia.	1010	102	
Makaham	Makassar Strait, Borneo, Indonesia.	720	80	
Barito	Java Sea, Borneo, Indonesia.	650	100	
Arid-Monsoonal Group				
Indus	Arabian Sea, Pakistan.	2880	1165	6640
Arab-Euphrates-Kara	Persian Gulf, Iran-Iraq.	2430	1105	2860
Su	Arab, Iraq.	1850	373	1250
Tigris	Ganges, Utter Pradesh, India.	1530	359	
Yamuna-Chambal	Indus, Pakistan.	1520	533	3080
Panjnad-Sutlej	Bay of Bengal, Andhra Pradesh, India.	1460	313	3180
Godavari	Bay of Bengal, Andhra Pradesh, India.			
Krishna	Irrawaddy, Myanmar.	1400	259	1990
Chindwin		1110	114	4000
Other Rivers				
Yangtze	East China Sea, Jiangsu, PRC.	5980	1827	32190
Huang	Gulf of Chihli of Yellow Sea, Shandong, PRC.	4840	771	1530
Zhu-Xi-Hongshui-Nanpan	South China Sea, Guangdong, PRC.	1960	426	12500
Han	Yangtze, Hubei, PRC.	1500	174	1200
Ussuri-Ulakhe	Amur, PRC, Russia.	900	193	953

Source: *World Facts and Figures*, Wiley-Interscience, (1989), in Akaksuka, Asaeda and Brooks (1994).

Table 2: Characteristics for Navigation of Selected Asian Rivers

River System	Characteristics for Navigation
Himalayan Group	
Mekong	Navigable from the river mouth up to Kratie (km 547) and from Kinak (km 733) up to Chiang. Wet season from May to September, depth 10-12m. Dry season from January to April, depth 1.2-2.3 m.
Irrawaddy	1,600 km year-round navigable from mouth up to Bhamo, seasonal navigation extends to Myitkyna. Wet season from May to October, depth 8-12.2 m. Dry season from December to March, depth 1.2-2.6m.
Chao Phraya	Large-sized vessels can reach the to Chao Phraya Dam and from Chao Phraya Dam up to Sawan Province (98km). Wet season from May to November, depth 10-12m, dry season from December to March, depth 1.2-2.3m.
Equatorial Group	
Kalimantan Area	The rivers in the region are wide, smooth and have no seasonal variation. Vertical tidal effects can be observed up to 200 km inland. There are a number of sand bars near the estuaries of the rivers that restrict sea-going navigation.
Kapuas River	About 400 km navigable, depth 10-15m.
Kahayan River	About 500 km navigable, depth 10-25m.
Barito River	Year-round navigation 700 km, depth 10-20m.
Arid-Monsoonal Group	
Indus	Navigable 7 months of the year, water level higher than 3m. However, there are a great number of structures (mainly bridges and weirs) which would need remodeling to link channels. In the dry season, the water level is 1.5m.
Other Rivers	
Xijang	Navigation is mainly focussed on the middle and lower reaches. The important route from Nanning to Guangzhou is 847km (120-150 ton vessels can navigate all-year-round) but is below the requirements of most transportation.

Source: Akatsuka, Asaeda and Brooks (1994).

In classifying rivers for transportation, it is also necessary to consider river morphology. The overall river regime depends on characteristics such as river bed slope, the Froude number (a measure of turbulent flow) and the ratio of the average channel depth and width. Most Asian rivers have extremely low slope profiles which results in a meandering regime over most of their navigable length. Meandering is caused by complex relationships involving the characteristic helical flow of rivers and alternating bars of reduced river depth whose downstream margins are gradually eroding. As erosion

proceeds, the rivers gradually adopt a meandering morphology. However, at change of profile between mountain and flat flood plain, or where sediment load is very high, or where there have been recent major course changes (as for the Jamuna in Bangladesh where there was a major avulsion about 200 years ago), a dynamic braided morphology exists.

As far as transport is concerned, the characteristic excessive length and alternating bars of a meandering river morphology and the unstable depths and directions of braided channels, are very important. However, because IWT is a low energy mode, excessive length is not necessarily a major problem especially for the movement of bulk cargos. It is the alternating bars, which are formed during bankful conditions and persist during dry season discharge levels and the unpredictability of river island *char* formation in braided streams which become a major limiting factor for navigation. The operating draft of vessels is therefore defined by these restrictions. In the Mekong, the limiting draft is 1.0 meters; and in the Chao Phraya it is 1.2 meters. In the Mekong from January to March the average maximum payload of a 50 ton barge is only 27 tons, and for a 300 ton barge, average maximum payload is reduced to 120 tons. Similar limitations prevail in the Chao Phraya river. In Bangladesh, as in many other Asian rivers, this is accompanied by a generally raising of riverbeds due to upper basin erosion and relatively low investment in dredging.

(c) Hydraulic Characteristics and Transport Operations

The formation of meanders and their related bar heights can be predicted with some degree of accuracy which has important implications for the management of IWT. If such predictions can be made more accurate, the overall efficiency and reliability of IWT in Asia would be considerably improved. While there may be a wealth of local knowledge in Asia on water level changes, it is not systematically recorded or well communicated and relatively few field observations, mainly in India, have been made in Asia. Accordingly, Akatsuka, Asaeda and Brooks suggest there is no adequate basis to confirm the applicability of theoretical analysis. Moreover, the theoretical predictions are based only on idealistic circumstances regarding river mechanisms and the river must be in a stable condition to allow accurate predictions. However, in regularly flooding rivers, even for meandering rivers, the river channels are not stable for sufficiently long periods to achieve an equilibrium in bed morphology. In this context, detailed and regular hydrographic survey is the basis for research, planning and useful management information systems for IWT development and management. However, this basis is generally lacking. In Bangladesh, modeling and establishment of the Surface Water Modeling Center (SWMC) and field recording site since the disastrous 1998 flood have improved the situation. Further training and modeling development as knowledge of river behaviour improves will need reinforcement.

(d) Multiple Usage of Asian Rivers

The potential for development of IWT in Asia is also described briefly and broadly by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP, 1985) as offering the following opportunities in Asia: least cost relief of choked land based transport, stemming of urban concentration, improving socio-economic conditions, saving energy, accessing remote and disadvantaged regions, providing a means for technology transfer, and overcoming costly transport development needs in flood prone areas. The UNESCAP also mention that while new industries tend to locate

near roads, large concentrations of population are along inland waterways and many IWT systems are already in place, and that incremental costs may be comparatively low. Moreover, IWT is an uncultured employer in many undeveloped countries and may provide a major resource for self determined development. It is also evident, however, that the social and economic fabric, particularly for large rural communities, is woven tightly around IWT systems and any development will incur some disturbance of this fabric. Bangladesh is a prime example in this context (Khan and Choudhury, 1995).

The complexity is also better recognised when taking into account the high cost of engineering solutions which might help to overcome the seasonality of navigational access to hinterlands. Moreover, while the hydraulic processes and regimes of major rivers in Europe and the USA have been studied in detail during 150 years of major economic growth, and engineering solutions have been experimented and fine-tuned, hydraulic engineers in Asia do not yet have the necessary amount of data to predict accurately the seasonally driven responses of the many large Asian rivers, especially in monsoonal Asia. The problems for IWT development are increased further when taking into account the dependence of most Asian agricultural systems on water resources, especially for irrigation. Irrigation consumes large amounts of water and is normally given higher priority than transportation, and dry season flows may be seriously reduced. River flow and sediment load stability is also seriously affected by the high rate of deforestation in Asia. Further, there is an increasing application of hydroelectric power to meet the needs of developing industry and urban growth. In many cases, this has been advanced without considering lock gates for navigation.

Despite the high potential for multiple usage of Asian rivers little systematic evaluation has been carried out concerning IWT except for the Mekong river, for which integrated development plans have been established (ADB 1996a)¹. Irreversible development without consideration for multiple use of rivers will create problems for future generations. On the Indus River, for example, the construction of weirs and bridges has completely negated the river's resource as a transportation mode on certain stretches. On the Chao Phraya, the excessive use of water for irrigation has lowered the water level, seriously reducing the efficiency of transportation. Masterplans based on thorough surveys are therefore vital if past mistakes are to be avoided. To draw up such masterplans it will be necessary to first assemble a wide range of data, and especially to develop a more informed basis for predicting the hydrological behavior of Asian rivers.

However, numerous surveys have been carried out regarding the development potential of Asian river systems for energy resources exploitation, through hydroelectric power generation and the use of water resources for irrigation. This work, except for recent PRC projects, contains little reference to river transport. While UNESCAP has conducted separate studies on regional applications and maintenance of IWT these demonstrate similar lack of integration with conflicting usage of the resource. It is also noteworthy that international conferences and journals indicate a very low level of interest in the IWT aspects of Asian rivers. On the other hand, research papers relating to European IWT are generally well represented in the literature, particularly by the Brussels based PIANC and the EC.

¹ Development plans and feasibility studies have been initiated for an Upstream Lancang-Mekong River Navigation Improvement Project (\$77 million), Mekong Delta Navigation Improvement Study (\$3.4 million), to provide economic benefits to Cambodia and Vietnam, and Red River Navigation Improvement Project (\$22 million. To date, none of these has resulted in an investment project.

(e) Sectoral Studies

The only other Asia regional IWT study was conducted in 1985 by a UNESCO IWT Programming Mission. This study was a brief overview of the status and development outlook for IWT in Bangladesh, the PRC, Indonesia, Malaysia, Myanmar, Pakistan, Philippines, Sri Lanka and Thailand. Since 1985, there have been more detailed IWT studies by the World Bank for individual countries such as the PRC (1987 and 1994) and Bangladesh (1991). The ADB has also conducted IWT projects and advisory studies in Indonesia, for Kalimantan and Sumatra (ADB. 1989).

A review of these studies leads to the following conclusions: (i) there have been cases in which the amount of water diverted for irrigation has substantially increased after the completion of an irrigation project, leading to a marked decline in the navigability of rivers; (ii) surveys of IWT have often been confined to the IWT sector alone and adequate attention has not been given to the linkage with other modes of transport. However, some projects, such as those of the ADB on the extensive south-eastern swamplands of Kalimantan, are confined to areas where IWT offers the only practical transport solution; and (iii) the UNESCO IWT review did not address the perspective of river engineering (hydrology and hydraulics).

A range of common problems in IWT are revealed by the various studies. For example, there is a lack of literature relating to comprehensive planning based on the conservation and utilisation of entire river systems. As a result, maintenance and dredging programs for navigation channels have been developed on an ad hoc basis as problems occur locally. These are frequently implemented without comparative studies of alternative schemes. Other common problems are a lack of suitable natural material for river training works, need for rehabilitation to make better use of underutilised floating craft-particularly where the operation of vessels is in the hands of the public sector, uncoordinated administration by government agencies, lack of training or enforced navigation regulations and safety practices, a general lack of detailed comparative analysis with other transport modes, inadequate hydraulic and operational data, and inadequate integrated research between water resources management authorities. Given the historical importance and development potential for IWT in Asia and in spite of the valuable but limited scale training role of UNESCO, the conclusion that detailed IWT data is fragmented and incomplete remains valid. In particular, data on the hydraulic behavior of Asian rivers as it relates to transport development, is especially scarce and weakly coordinated. For example, PIANC's *Guide to Inland Water Transport Development*, as presented to the March 1992 Permanent Council for Developing Countries (PCDC) Seminar, at Surabaya, was based entirely upon experiences gained in Europe and the guide was only able to allude to possible applications in developing countries. It is also notable that the only widely available text on the economic appraisal of IWT is an American classic (Howe, et.al. 1969). No comparable volume has ever been written for the Asian situation.

The only body which has endeavored to address the Asian situation as a whole is UNESCO, Bangkok, though its Transport, Communications and Tourism Division. However, it has had only a limited role, although its training workshops are of value. Due to limited resources, UNESCO reintroduced in 1995, after a 5 year hiatus, its IWT Expert Group Meeting (EGM) approach. The 1995 meeting was attended by delegates from 13 Asian countries, the Mekong River Commission, the United Nations Development Programme (UNDP), International Labor Organization (ILO) and the ADB.

This reflects an effort to reawaken development planners to the potential for IWT improvement in economic development.¹ Following the EGM, ESCAP conducted 3 training seminars in 1995, in Vietnam and the PRC (UNESCAP, 1995). Nevertheless, the common thread revealed by UNESCAP's ERG is that the IWT sector shares low priority among the regional governments in the provision of adequate financing, maintenance of large and inefficiently utilised government owned fleets of IWT vessels, river port and navigational facilities, inadequate training of operators, and lack of investment in modern technology.

(f) Bilateral Assistance for Inland Water Transport

Detailed information on the fragmented bilateral assistance in IWT is difficult to obtain without conducting visits to a wide range of governmental agencies in the countries concerned. However, UNESCAP (1990), indicates that the governments of Belgium, Germany, Netherlands, Norway and the United Kingdom have assisted Bangladesh, the PRC, India, Indonesia and Myanmar. An exception to the fragmentary nature of assistance is Bangladesh, where most of the above countries have assisted and where an IWT masterplan of limited scope was prepared with assistance by the Netherlands. UNESCAP also conducted a seminar in 1980 on the maintenance of inland waterways, which focused on Bangladesh.

It is the role of country boats which has been the primary focus of interest in Bangladesh by the bilateral agencies, particularly by Norway and the Netherlands, in the interests of poverty reduction and rural development. For Japan, while the construction of a Dhaka IWT terminal and a pilot scheme for IWT container vessels could hold the key to development of an IWT container distribution network (GOB, 1995), the matter has not progressed beyond the feasibility study stage. According to the OECF, the reason is uncertainty regarding the resolution of severe institutional issues and congestion at Chittagong Port, making private sector investment elsewhere in the transport chain extremely risky (pers comm. OECF, 1998, Dhaka). A recent proposal which may break this impasse is by Stevedoring Services of America, to construct a new container terminal at Patenga, Chittagong, together with investment in the Dhaka IWT terminal (Independent, 12 August 1998: 7).

(g) Multilateral Lending Agency Activity

Both the World Bank and the ADB have provided investment loans to the IWT sector. However, there is a lack of emphasis on IWT in their overall lending portfolios. For example, of the ADB's approximately \$2 billion in port and shipping sector loans, less than \$60 million, for projects in Indonesia and Myanmar directly assist IWT. The World Bank's IWT lending program in Asia totals only about \$330 million, for loans to Bangladesh, Myanmar, the PRC and Thailand, and two-thirds of this amount is for the PRC loan. It is surprising that only one IWT loan has ever been approved for the PRC, which has a profound history in IWT development (World Bank 1995).

¹ The Expert Group Meeting country papers reveal that in Bangladesh, Cambodia, Lao People's Democratic Republic, Myanmar and Vietnam, IWT shares between 20 and 35 percent of transport activity, while in India, Indonesia, Malaysia, the PRC and Thailand, the IWT share of total ton-km transported is 3 to 10 percent.

An encouraging but relatively minor investment to redress the gap of investment in the IWT in Bangladesh, compared with roads and to lesser extent railways, is an 1991 World Bank loan of \$41 million. The World Bank has apparently reached the same conclusion as the bilateral agencies since the project has an emphasis on institutional strengthening, but will also provide physical infrastructure to address deficiencies in safety (mainly overloading and poor maintenance), low vessel utilisation, planning, hydrographic surveying, dredging, navigational aids and provision of river port pontoons (World Bank, 1991). The World Bank also focused on adapting the BIWTC and BIWTA from purely government agencies to more commercial and financially sustainable entities with the objective of divesting infrastructure management and investment to the private sector. Such policy is based on findings that country boats are significantly underutilised, that necessary institutional improvements are only being slowly implemented and that roads have become the dominant transport mode in Bangladesh. It may also be a valid regionwide conclusion that an important reason why IWT development has not apparently been competitive with other transport modes or attractive to some funding agencies, is the preponderance of government involvement, not only in the form of cumbersome bureaucracies but also through inefficient involvement in IWT fleet operations. Certainly, slow government implementation of the World Bank's 1991 approved *Third Inland Water Transport Project* has been responsible for withholding the processing of a fourth project (World Bank 1997).

In 1980, the World Bank also provided a \$38 million IWT loan to Thailand. This project comprised the dredging of shallow portions of the Chao Phraya, the expansion of two ports on the Nan River and the procurement of a pusher tug and barges designed to act as a demonstration of the benefits of new technology. The only other significant World Bank loan for IWT was in 1974, for \$24 million to Myanmar. This project focused on avoiding decreased capacity by the rehabilitation and replacement of vessels, provision of navigational aids, slipways and repair yard equipment.

An ADB loan to Myanmar for \$15 million (ADB, 1980), addressed the rehabilitation of Myanmar's 9 outports, several of which are located within the river systems where they provide an important interface between the extensive IWT served hinterlands and coastal and foreign trade shipping. The project provided dredgers, port service craft, moorings and pontoons to facilitate passenger and cargo transfer, and the construction of slipways and navigational aids for night-time travel. From the 1989 Project Completion Report for this project (ADB, 1989), it was notable that while maintenance is a vital problem in the port and shipping sector, it is far less of a problem in the non-saline river ports, indicating that IWT investments may have viable utilisation for many years. It was also considered significant that in common with many of the other major rivers of Asia, the hydraulic regimes of the Irrawaddy and other principal Myanmar rivers remains imperfectly understood, in spite of the country's historical dependence on its rivers for the conduct of both domestic and foreign trade.

The ADB's IWT loan to Indonesia (ADB, 1991a), assisted in the improvement of navigation on 4 canals in south and central Kalimantan, and on the Mahakham River, in east Kalimantan. The canals, originally constructed as irrigation channels in the early 1960s, are conveniently oriented to interlink the generally north-south flowing Kahayran, Kapuas and Barito rivers, and they rapidly became a multi-use resource, including the provision of water and sanitation needs for ribbon like squatter communities stretched along the canal banks. Dredging, bank protection, construction of silt traps, the relocation of squatters and institutional development for the government's

administration were addressed under the project. The improvements were made in the interests of more effectively linking, at least cost, the principal ports of Banjarmasin and Samarinda with their resource rich but swampy and flood prone hinterlands. A significant finding of the feasibility study for the project was that engineering solutions to provide distance savings for bulk cargo export traffic on the Mahakham river, by cutting channels through the neck of 20 large meanders, was not economically viable. This finding demonstrates both the importance of traffic volume and the energy efficiency of IWT. A major reason, however, for the projects' marginal viability was the failure to adopt a low cost solution for canal bank protection. In view of uncertain ability to control bank damage by squatter communities using the canal water resources for day-to-day water usage needs, high-cost timber facing was used rather than low-cost vegetation planting (ADB, 1994).

Wider regional attention being given to IWT during the past few years is illustrated by preliminary studies in Papua New Guinea (PNG), which has two large river systems, namely the Fly and Sepik rivers, which serve large, flood prone hinterlands. Although the Fly River has been a major avenue for several years as the supply line for the Ok Tedi mining venture, these rivers had never been studied as IWT systems prior to 1991, and only then as a brief adjunct to a nationwide Transport Efficiency Review conducted by the World Bank. The hydraulic regime, in particular, was not examined in this study. These rivers provide the only transportation means for about 350,000 people in dispersed communities and are served mainly by small vessels. The government proposed to the ADB that pilot studies be commenced to establish a framework for encouragement of the private sector, in an effort to more effectively link these communities with the wider economy. However, these proposals were not progressed due to apparent poor capacity of the government in aid utilisation and consequent focus on higher priority projects. Furthermore, pilot studies anywhere tend to prolong public sector investment rather than encourage private sector investment.

(h) The People's Republic of China

The PRC has the largest scale of IWT usage in Asia. Brooks (1995) reports that the total navigable length of the IWT network in the PRC varies seasonally according to depths available but is about 110,000 km for year-round depths of one meter or more about 6,000 km are navigable by vessels of more than 1 metre draft compared with over 50,000 km of rail track and nearly 1,000,000 km of paved roads. The IWT sector handles only about 3 percent of inland freight traffic and less than 1 percent of national investment in transport has been spent on IWT, of which the major routes are concentrated on only 4 rivers and the Grand Canal. Only 8 percent of the total route length can accommodate vessels of more than 330 tons (World Bank, 1995: 4). In recognition of a need to communicate its IWT development objectives to the donor community the Ministry of Communications (MOC) organised an ADB sponsored seminar in December 1995 which outlined the background and the Government's renewed interest in the IWT sector. Several of the seminar papers outline that while the IWT system, which has existed since construction in the fifth century of the Grand Canal to facilitate troop movements between Beijing and Hangzhou (Yang Weize: 4), was neglected in the thrust to industrialisation since the 1948 formation of the modern state and road and rail investment between the 1960s and the mid-1980s. However, under the plan, a long term development strategy for IWT is envisaged, centering on the completion of a national IWT network. Six major trunk routes will be dredged to accommodate 1,000 dwt vessels on the Changjiang, Zijiang, Grand Canal, Huaihe, Songhuajiang and the Heilongjiang rivers.

This is in addition to supplementary river development to accommodate vessels of 300-500 dwt. Developing waterways linking inland regions to the more developed coastal areas is a priority. Completion of this network has progressed steadily since the mid 1980s.

The most important use of IWT in the PRC has always been in Jiangsu Province in the lower reaches of the Changjiang River, Huaihe River and Changjiang River delta area. Water bodies comprise 17 percent of the provincial area of over 100,000 sq. km. and IWT is responsible for between one-third and one-half of transport activity. Nearly 80 percent of the provincial towns and villages are accessible to IWT. Nevertheless, neglect of the man made canals and natural waterways has resulted in siltation and severe congestion, especially in the vicinity of locks. Moreover, one-third of the more than 12,000 bridges and many pipe lines and tight river bends severely constrain the passage of vessels. The average size of vessels is less than 50 tons and most berths in the 600 river ports can only accommodate vessels of less than 300 tons. However, while cargo handling is predominantly by man handling, (Yang Weize: 4) reports an average productivity of between 30-50 tons per hour which is surprisingly high by international shipping standards for any form of break bulk cargo. Clearly, investment in berths and dredging could have major impact on the overall improvement of transport efficiency. Under the MOC and provincial government plans the main channels will be rehabilitated to facilitate the navigation of 100 ton capacity vessels throughout the province. At the heart of the development is full cost recovery from lock use charges to vessel operators, other levies on Shipowners for the compensation of resettled persons and any loss of agricultural land and flood protection works to facilitate river bank location of new industries. In short, the strategy aims at sustainable transport development in an area generally unsuited to rail and road construction. Unlike in Bangladesh, however, the area has witnessed reservoir construction for over several centuries, avoiding significant seasonal variation in water depth.

The Guangxi Autonomous Region is the other main area of recent IWT development, although it has been important since the Qui and Han dynasties, focused on linking the Xijiang-Changjiang rivers and inter connecting canals. As in the delta area, IWT has been neglected since the 1950's, and in the period to 1970, about 300 dams were constructed, obstructing navigation on 21 tributary rivers. Virtually no dredging has been carried out (Chen Zhuogin: 2-3).

To improve the Hongshuihe River navigation, a 136 metre lock chamber was constructed with a minimum depth of 1.7m, sufficient for 300 ton vessels. The focus of cost recovery is the development of water powered electrical generation, utilising the 17.3m head of water. The energy produced is 340 million kwh and the pay back period for the investment was estimated at only two-years. The backwater extension of the dam, which integrates the lock system, has transformed 22 dangerous upstream shoals into calm lake conditions, reducing transport costs and improving safety. However, the encroachment on upstream settlements and agricultural activity is not clear from Chen Zhuogin's account.

The remaining sections of IWT most suited for development appear to be those which improve transport links between the poorer western provinces and the higher income coastal areas, and those sections which would facilitate better access to growth centers and national transport networks from upstream inland provinces. Financing is needed for a broad range of physical and operational constraints in the IWT network, such

as: river ports, dredging and river training works, lockgates incorporating the needs of other river resources users, navigational and communications systems, and addressing institutional changes to facilitate efficient integration of IWT improvements with the nationwide transport system as a whole.

Over the next decade, it is estimated that the PRC will require investments totaling about \$500 billion in infrastructure aimed to reduce transport bottlenecks. Sources of financing beyond the capabilities of the government and the international aid community will be needed. An important concern is to adopt greater market liberalisation and early identification in the government's planning and approval process of opportunities for the private sector to finance the development requirements, either alone or in association with the government and multilateral financing agencies.

In the seaport sector, where relatively high financial returns are possible especially for bulk cargo and container handling, joint venture partnerships between port authorities and experienced foreign port operators have had some success. However, there are series issues in the establishment of win-win agreements, measures to provide welfare services for workers accustomed to a wide range of social support by port authorities, dealing with port community and local authorities accustomed only to public sector operations, and strong tariff and planning controls by MOC which encourage low and subsidised tariffs by competing municipal ports (Brooks, 1995b). This matter is being addressed under ongoing ADB technical assistance (ADB, 1998).

Until the 1980s, almost all IWT operations were carried out by government shipping organizations. Ship operators were government departments, prices were set by MOC and the State Pricing Bureau, and cargoes were assigned by state planning authorities. During the 1980s, these controls were progressively relaxed and state shipping companies, such as the Changjiang Shipping Corporation, now operate independently of local State Navigation Administrations. The IWT sector has also been opened up to private operators and collectives. Tariff controls and cargo allocation controls by the government have also been relaxed. In conjunction with this liberalisation, the number of shipping enterprises on the Chiangjiang rose to 800 in 1986 and reached 2000 in 1994.

While this denotes progress in liberalisation, route entry is still controlled and there is no interaction between the various river basin authorities (World Bank, 1995: 4). Moreover, while the road network increased by 61 percent from 1986 to 1993 and rail routes increased by 8.2 percent, IWT route lengths increased by only 0.7 percent. Many hydropower dams have been built without consulting other agencies and without provision of ship locks to facilitate navigation in spite of IWT offering potential lower operating costs due to energy savings (World Bank: 4-6). While single users such as steel plants, power stations and cement factories operate their own berths, it is still difficult for general cargo operators to obtain the required permission. In general, a program to complete the deregulation of pricing and route entry, while retaining safety regulation in the public sector and ensuring overall transport planning does not restrict IWT, would enhance the efficiency of the industry and lead to more reliable, commercially motivated services. In particular, the World Bank study reveals that IWT construction and maintenance is not self financing. The main source of revenue is a levy on shipping revenue which permits only minimum river port construction and maintenance which is inadequately subsidised by the MOC. Less than 1 percent of total national capital investment was allocated to IWT since

1948. Fees based on the carrying capacity of vessels is a source which is yet to be explored.

IWT development in the PRC is spared the complexity of international considerations, such as faced in Europe and in some areas of Asia, notably between Bangladesh and India, and in the greater Mekong sub-region. Differing legislation and administrative frameworks between the states and municipalities of one country can also be a hurdle for river resources management. The PRC is not spared from these latter constraints. While the MOC is responsible for investment planning and the preparation of national regulations and guidelines on policy for IWT in the PRC, there are hurdles to resolve for the efficient implementation of development plans, involving the design, maintenance and management of interprovincial IWT systems as a result of provincial and municipal level communications bureaus having separate controls to the 7 river basin navigational planning offices, all of which operate independently to other water user interests and which require central MOC approval for development and financial planning (Chen Jinchun: 2).

The ongoing Three Gorges Project on the Yangtse River is an example, where the primary objective of power generation to serve large coastal city development in the Shanghai region benefits IWT by improving navigation all the way up to Chanjiang, some 1,500 km inland, for ocean going vessels. However, alleged flood protection benefits of the alluvial plains is not supported by the reserve capacity of the ribbon like nature of the upstream lake formed by the dam and the fact that several large river catchments enter the Yangtse below the dam. This is quite apart from the potential heavy siltation at the lake head near Chongqing Port, the displacement of more than one million people and the loss of the aesthetic value of the Three Gorges (Brooks, 1995b).

In the Yellow River basin about 0.8 million square miles are threatened by floods with the most devastating occurring in 1954 and 1998. This area contains 40 percent of the PRC's population and 60 percent of industrial and agricultural activity. Flood control works limit the impact of a 1:50 year flood. However, many problems remain. The protected areas have led to significant investments in agriculture and industry while uncontrolled protection works have weakened river basin drainage, making flood risks harder to manage, and the Flood Control Regulations of 1991 and Water and Soil Conservation Laws of 1992 are difficult to enforce. Soil erosion leading to rapid siltation is a major problem in the PRC. Riverbeds are elevated as a result of sedimentation, which raises flood peaks and threatens the age-old dikes. The riverbed rises annually as over one quarter of the 1.4 billion tons of annual sediment load of the river is deposited. Several major reservoirs and dams are filling rapidly, losing their capacity to regulate floods and the Three Gorges Dam has limited capacity for flood control (World Bank, 1997: 21-23).

The World Bank's appraisal report for first IWT Project in the PRC proposed a more balanced approach to IWT development on the Ziangjiang river system in Zhejiang, Hunan and Guangxi provinces, linking to the Pearl River delta near Hongkong. The project also includes a substantial institutional and financial reform package consistent with market economics and aims to improve the efficiency of physical and institutional linkages between IWT and land transport services (World Bank, 1995: 9). The total cost of the project is \$508.5 million at 1994 prices (World Bank, 1995: 21), comprising earthdams, shiplocks, roads over the dams, river training navigational aids, shoal removal, power plant construction, and river port construction, and completion is

expected by 2001. The project is an encouraging first attempt to adopt a multisectoral strategy to IWT development in the PRC, addressing the lack of intersectoral coordination that has reduced the role of IWT over the past 50 years.

The potential environmental impacts have been identified as relating to channel upgrading, dredging, water pollution, ship wastes, noise and generated industrial pollution related to the port areas. Aquaculture and fisheries impacts, and destruction of cultural relics were also highlighted in the environmental impact assessments. (Hunan University, 1993; and Guangxi Electric Industry Design Institute, 1991). The principal mitigation measures being adopted are to minimise the inundated areas behind dams by the careful assessment of dam sites, removal of shoals during winter to reduce turbidity impacts on the fisheries, construction of fish ladders (as also being done for sturgeon in the Three Gorges Project), adoption of a shipping pollution plan, and removal of cultural relics in advance of water inundation. About 12,000 affected people are also being resettled in conformity with World Bank guidelines that their economic prospects will not be adversely affected, and if possible, improved. The latter includes assistance in the creation of new farmland and its management, in addition to compensation. A Dam Safety Panel has also been formed under World Bank approved terms of reference.

The main economic benefits of the project are avoided costly traffic diversion to roads and rail, savings in cargo-handling and ship waiting time costs, economies of scale by the introduction of larger river vessels, and the additional electrical supply. The anticipated benefits were compared with a 'do-nothing' scenario involving continued under utilisation of the rivers, worsening river congestion, and spill over of traffic to the more costly highways mode. A queuing model approach was adopted in which transport unit cost savings were obtained, reduction of travel distance for river traffic, eliminating road user costs, and reduction of vessel operating costs due to faster times. Environmental costs were recognised although benefits were not quantified in the analysis. Nevertheless, it was recognised that reduced water pollution and avoided coal burning by use of hydroelectric power could be substantial (World Bank, 1995: 35).

Of importance to sustainability, the financial analysis focused on the establishment of autonomous entities, promoting productivity and self sufficiency of the beneficiaries by relaxing arbitrary government tariffs to avoid price distortions for each major activity. The main risk was regarded as the timely provision of Government funds to support the World Bank loan. Each major operation (channels, dams and shiplocks, hydropower plants and ports) have been designated as separate profit and accounting centres, with shared operating costs of the dams. Cost recovery will be exercised through periodic tariff hikes with new tariffs for the new shiplock and power plants. However, the shiplocks will be exempted from provincial taxes on profit to encourage economic development. As may be expected, the project is highly sensitive to tariff adjustments and a revenue decline of 30 percent would require subsidy to ensure a positive operating ratio.

(i) India

Sriraman (1998) has noted that while IWT offers many advantages over transport modes it is not possible to create a major route alignment without the pre-requisites provided by nature and technical and institutional pre-requisites to use the channel to advantage. Depth, gradient and stability of the channel and the cost effectiveness of canalisation and shallow draft vessels of adequate capacity, and suitable legal and regulatory arrangements are examples of these pre-requisites.

The cost effectiveness of IWT was established by the National Transport Policy Committee (NTPC), (1980) (see Table 3). More recent work by Rao and Kumar (1996) reveals that the transport cost of IWT is Rs. 0.37 per ton. km, compared with Rs.0.96 for road and Rs.0.50 for rail.

**Table 3: Transportation of Coal by Different Modes of Transport
(Cost in paise per ton km.)**

Distance (km)	Rail Cost Diesel per (Wagon Load)	Road Trans. Cost (Truck Load)	IWT Costs (Self Propelled vessels capacity at 100% and 75% load factor)		
50	44.2	24.2	11.2	8.6	8.0
			(13.6)	(10.4)	(9.4)
100	25.7	18.3	7.2	5.3	4.6
			(8.9)	(6.5)	(5.8)
300	12.6	14.7	4.8	3.2	2.7
			(6.2)	(4.9)	(3.4)
800	8.8	11.3	3.8	2.5	2.1
			(5.0)	(3.3)	(2.6)
1250	8.0	10.3	3.6	2.4	1.9
			(4.8)	(3.1)	(2.5)

Figures in brackets represent the cost at 75 percent load factor

Source: Report of the National Transport Policy Committee, Planning Commission, Govt. of India (1980), in Sriraman (1998):103.

The bulk of commodities entering the early market of India and the suitable alignment of river channels leading to export ports such as Calcutta, and the opportunities provided by steam propulsion, are noted by Sriraman: 109 to have given a tremendous boost to IWT in the eighteenth and nineteenth centuries. These were accompanied by the important presence of the East India Company. Moreover, river transport was the only reliable mode available in this period of India's development.

A similar condition is noted to have prevailed with the Buckingham Canal in 1806, which ran for over 700 km parallel to the south east coast. The period from 1875 to 1900 marked a period of decline for IWT with the development of rail. Subsequent road development became a competing mode over short distances. Interestingly, Sriraman: 109 also observes that if a well developed IWT system had existed during the second world war, the logistical supply of combatants could have been facilitated.

A review of IWT potential emerged after independence with the advent of economic planning. A 1959 IWTC study emphasized the value of reviving IWT if industry would locate near navigable waterways. However the Assam to Calcutta route was the only one recognised as having potential for development (see Chapter VI) (Sriraman: 110). A multi-modal approach was then proposed in the mid 1960s under a system of cross subsidisation and pooling of freight rates for the economic development of Assam. A centrally planned approach to other connected long distance river development is also noted under the NTPC (1980) and UNDP (1983) as reported Sriraman: 112, for the transport of coal, oil and timber.

In 1986 India established the Inland Waterways Authority of India (IWAI) to maintain and regulate the system. Nevertheless, IWT transport of iron ore over a 250 km route length centered on Goa accounted for 97 percent of total Indian IWT traffic in 1986 (SCTP, 1988), while the total navigable length of rivers is reported by the Ministry of Surface Transportation to be over 14,000 km (MOST, 1996). Lack of modern vessels and other infrastructure, and inadequate budget support for development is regarded by the SCTP as a major problem for the future of IWT in India.

Poor organisational relationship between the states of India is cited as a major reason for IWT not meeting its potential for long distance transport of lower value traffic. On the other hand, central planning may also be a problem. In particular, a UNDP mission of 1993, presumably reflecting government views, suggested that part of the problem could be solved by reserving some traffic flows for IWT over selected river sections. Clearly, socio-political issues are at the heart of the problem, with state boundaries and central planning both possibly interfering with market forces. Why these issues do not also constrain road and rail development may be rooted in perceived advantages for these sectors. While this could provide an interesting area for research, it is clear that the national boundary between India and Bangladesh may have further hindered the logic of developing the former transit route between Assam and Calcutta. This potential as discussed in Chapter VI from a purely economic rationale. Based on the European experience, what is also necessary in India, is for the Government to encourage private sector development of IWT routes, penetrating the hinterlands of major ports. The benefits of helping to decongest road transport and low transport costs do, however, need to be communicated since large scale IWT operations in India have virtually disappeared.

B. Historical Aspects of Sub-Regional Transport Cooperation

1. Background

On 1 January 1997, an agreement between Bangladesh and India became effective for sharing waters of the River Ganges (Bangladesh Times, 2 January 1997). This was an historical event, raising prospects of regional cooperation in the use of common economic resources. It followed a bleak period in bilateral relations after a unilateral decision by India in 1976 to use the newly constructed Farakka barrage, about 30 km from the border with Bangladesh, to divert dry season flow of the Ganges away from Bangladesh¹. Similarly, hopes of greater regional accord were raised in January 1997, when the Government of Bangladesh hosted a United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) *Workshop on the Asian Highway and Asian Railway*, both envisaged to pass through Bangladesh (ESCAP, 1997). The economic advantages also extend to sub-regional trade, which would considerably elevate the

¹ In Bangladesh, the waters are vital to irrigation and ecological stability over a large area in the southwest of the country, including salivation in the Sundarbans, which contains the world's largest remaining stand of mangroves. They are also needed to sustain inland water transport (IWT) which is used for the transport of one-third of the nation's freight (Government of Bangladesh (GOB), (1994)). In India, the waters are considered by the Government to be vital for the maintenance of navigable depths at the nationally important West Bengal river port of Calcutta (Crowe, 1995:19).

importance of the Bangladesh port of Chittagong (ADB, 1997)¹. On 1 April 1997, the foreign ministers of Bangladesh, Bhutan, India and Nepal met in Kathmandu to advance the notion by discussing potential regional investment projects (Rezaul Karim: 1997).

The opposition Bangladesh National Party (BNP), which had been the ruling Government's ruling party between 1992 and 1996 and which won about 40 percent of parliamentary seats in the last general election, has poured cold water on these visions for cooperation with India. On 23 March 1997, BNP declared both the water sharing agreement and pursuit of transit agreements with India as *treasonous, and a conspiracy against the sovereignty and independence of the country* (New Nation, 20 March 1997), and declared an effective one working day *hartal* (national strike) as a demonstration against both.² The escalation of protest was also threatened and both parties held large rallies in Dhaka to demonstrate the extent of their relative support.

The main objective of this section is to examine whether BNP's success in making regional cooperation a development issue is a cause concern by development agencies, to the extent that their advocating regional cooperation in development policy may be counter productive and contribute to national disunity.

The national identity of Bangladesh, as an independent, Muslim dominated, linguistically elegant and geographically distinctive culture has been progressively defined from the time of the Moguls until the present³. The suppression of Muslim identity during the British time is a common literary theme [for example, Khan (1962): 63-71, (Ahmed (1974), Muhith (1992): 35-52, and Novak: (1994): 86-89]. Following the 1793 Permanent Settlement system in East Bengal, a large number of Hindu traders from Calcutta became wealthy landowners (*Zamindars*) and took control of large estates. Also, the Muslims,

¹ With the end of cold war and hostilities in Southeast Asia, recent perspectives on 'global village' trade, and advantages in time savings over sea borne routes, it was considered that here was a dream initiated in the 1950s whose time has come (Rahmatullah, 1997:1). Moreover, sub-regional cooperation in the greater Mekong River basin is making sound progress (ADB, 1994:1-27), as it is in other regions of the world such as with the European Community and between the USA and Mexico (Banerjee, 1996: 3).

² Observance of the *hartal* is not necessarily indicative of universal support by the populace. Such observance is merely an element of avoiding conflict as *hartals* in Bangladesh have always been accompanied, whether organised by the ruling Awami League (AL) or the BNP, by alleged use of hired thugs to violently enforce non-observance. The position taken is that the main opposition party would not use the concept of regional cooperation as a central issue unless it felt some confidence of political correctness.

³ Bangladesh achieved independence from Pakistan in 1971 after a short civil war, which is estimated to have cost the lives of 3 million Bangladeshis. Only 25 years before that, East Pakistan, where Bangladesh now stands, was created with the 1947 partition of Britain's Indian Empire, after nearly 200 years of colonial rule. Before the British time, East Bengal was occupied for about 500 years by Muslim groups, including the Moguls. These groups had gradually converted the Bengalis from Hinduism. The Hindu groups had in turn displaced Buddhist kingdoms. The people of East and West Bengal have a common language in Bangla and inhabit the extensive Ganges-Brahmaputra delta, where floods, monsoonal typhoons and droughts significantly govern the pattern of life and livelihood. The significant difference is that the west is peopled mainly by Hindus and the east mainly by Muslims. This was reinforced during partition by large scale migration between the two, so that today's Bangladesh is more than 90 percent Muslim. When the British arrived in Bengal to found Calcutta in 1690, which was the capital of British India to 1911, Bihar, Orissa and Bengal formed a single state governed by native rulers, semi-independent of the Mogul emperors in Delhi. The native rulers' original capital was Dhaka, the present capital of Bangladesh.

perhaps in sullen resentment (Muhith: 36), did not share in the educational progress of Bengali Hindus under British rule and failed to gain important government posts in Calcutta. This process was reinforced when Persian was replaced by English as the official language of the courts in 1837. Thus, while the Bengali Hindus flourished under the British, the Muslims became introverted, marginalised and resentful. This increased after an abortive and poorly organized liberation struggle in 1857¹.

The Muslim League was established in 1906 and became a strong political force in India. Hindu Muslim relations deteriorated throughout the 1920s and 1930s, and by 1940 the idea of a separate Muslim state finally took shape. It was resolved by the Muslim League that since Congress was opposed to the partition of India into several states, the case for partition into two states, one predominantly Hindu and one Muslim should be supported. In other words, the East Bengal Muslims accepted that joining West Pakistan in a bid for separate identity would serve their purpose in achieving autonomy from Hindu India.² Some authors, such as Muhith: 52, have argued, realistically, that religious frenzy and bigotry were always present in West Pakistan and this prevented sacrifices displayed by East Pakistan for the sake of a Muslim Pakistan nationhood, while distinctive East Pakistan (East Bengal) nationhood remained an unfulfilled objective.

Nationalist feeling in Bangladesh was reinforced throughout the years of partnership between East and West Pakistan, from 1947 to 1971. The period was marred by insensitive suppression of the Bangla language, culture and East Pakistani representation among the positions of responsibility in government [Sayeed, (1960), Muhith: 62-87, Novak: 83-84, Hasan Zaheer (1994)]³. The search for political identity by East Bengal was manifested through student led language riots in 1952. This followed growing resentment after Urdu and English were adopted in 1948 as the only two languages of the Assembly. This was understandably insulting to East Pakistan (Salauddin Ahmed: 81). Bangla was spoken by over 50 percent of the total population of

¹ In 1895, the *Origin of the Musselmans of Bengal* was translated from the original Bengali revealing a new awareness among Bengali Muslims of their respectable identity (Salahuddin Ahmed, 1987:55). In 1896, the Mohammedan Reform Association was set up in Calcutta, and with similar new organisations led a renaissance of Muslim intellectualism in India. By 1903, this had led to a plan for the partition of Bengal, wherein the Province of East Bengal and Assam would be predominantly Muslim, with its capital at Dhaka. This plan was annulled in 1911, and appears to have been overshadowed by a tide of militant Hinduism fanned by the arrival of Gandhi in 1915 and the end of the first World War.

² As described by Jeffrey (1981: 96-100), the British missions which visited India in 1946 to settle the withdrawal by Britain, for which there was increasing demand by India and willingness by a war fatigued Britain, were faced with a Hindu led Congress which wanted all India unity in independence, and a firm Muslim League stance which wanted a separate Muslim state, Pakistan. The Government of Britain, concerned about the civil commotion in India, decided to transfer power as quickly as possible, with Mountbatten winning over his reluctant friend Nehru and then the intransigent Gandhi whose earlier vision lacked nation building practicality.

³ The suppression of East Pakistan was exacerbated by much clearer and technically coordinated development planning in India. In general, the Pakistan of 1947 was relatively ill equipped for government. While Pakistan inherited a reasonable share of the elite civil service of British India, the Muslim League politicians had only hazy development goals and virtually none had a technical background. The strongest element, also resulting from the British time, was a trained and disciplined army, which was relied upon extensively in management of the new country. As a result, and with the death of the visionary Jinnah, as a founding father of Pakistan, within one year of partition, the Muslim League quickly lost influence.

Pakistan (East and West) and is a culturally rich and expressive language, while the culture is also rich in a legacy of Hindu myth and romanticism, providing a clear differentialism from fundamental Muslim thought (Abu Abdullah: 141)¹.

It was only in 1956, after several years of coalition provincial governments and severe division, that a constitution came into force. However, only East Pakistan, as a result of its disgruntled middle class, showed any interest in elections. The likely shift of power from vested interests in the west to the Bengali politicians was not acceptable and the constitution was abrogated and martial law declared in 1958 which only fueled resentment in the east. The civil service was little better as a force in the democratization of East Pakistan. Inherited from the British. It was elitist and West Pakistan dominated. This, coupled with inward looking import substitution policies, resultant monopolies, government inefficiencies, failure to match India's major currency devaluation which hindered exports, and unequal draining of financial resources for West Pakistan dominated development, all led to deepening resentment in East Pakistan and a desire to be rid of their new masters. Following a devastating flood in East Pakistan in 1970 which killed over half a million people, West Pakistan assistance was significantly less responsive than that of foreign donors. Coupled with the postponement of elections after a period of renewed political confidence by the AL, Bangladesh began its War of Liberation in March 1971.

Following an AL inspired call for independence to a massive crowd at Dhaka, the War of Liberation was characterized by swift and merciless Pakistan army led massacres. These were reported widely in the world press which had witnessed the events at first hand [for example, Time Magazine (3 May 1971)]. While the Bangladesh forces were poorly organized, the support of the people and their flocking to training camps resulted in a strong guerrilla movement. However, this was no match for the professionally trained Pakistan army. India entered the fray partly because it was worried that factional, Beijing leaning communist interests were developing in the liberation movement, and these might run freely in West Bengal and the seven sister provinces of India (Zaheer: 182-3).

If Pakistan had won the war then India would have found it harder to pursue the vision expressed by the powerful Bharatiya Janata Party (BJP) party, of a united greater India, as during the British rule. However, dominant political sentiment in India was mainly against West Pakistan (Moudud Ahmed, 1991: 251). A divided Pakistan would also strengthen India's position in its series of border wars and continued poor relations with Pakistan. India also knew that it had the support, including weapons, from the Soviet Union which had taken action through diplomatic avenues to retain international interest, thus paving the way for India to 'come to the rescue' of Bangladesh (Zaheer: 282-4, 316-7). It would have been difficult to convince the friends of Pakistan, such as the United States and China that, given the overwhelming nationalist support of the people of Bangladesh for the War of Liberation, the situation had been created by India. India could therefore be seen to have politically benefited only indirectly from intervention, while directly leading to resolution of the problems on its borders involving 10 million refugees. However, the expected involvement of India came only after several months of diplomatic discussions with the major powers and in the United Nations, and Pakistan accepted an

¹ Rabindra Nath Tagore, who won the Nobel prize for literature in 1913 against candidates which included Thomas Hardy, is the most revered Bengali language poet and author.

Indian negotiated cease-fire in December 1971. In view of the faction ridden Bangladeshi forces and the non-arrival of the AL leader until January 1972, it is understandable that the Indian Army, rather than Bangladesh, took control of the cease fire operations and the refugee repatriation program. Thus, while Bangladesh met its overall nationalistic objective in independence, it felt humiliation that Indian assistance was necessary to finish and manage the aftermath. Moreover, while nationalist in spirit, the factionalism which flourished during the war provided a legacy of internal mistrust and division, heightened by the insensitivity of the Pakistan army which had strengthened a strong nationalist sentiment but provided no opportunity for democracy to grow in East Pakistan¹.

The AL Government lasted only until 1975 and was marred by a rapid decline into one party, one man rule by its leader Sheik Mujib, whose brand of nationalism proved autocratic (Ashraf Ali et al, 1996: 82). After his assassination by unknown assailants, he was followed by the quasi military governments of Zia (1975-81) who had formed the BNP in the vacuum created by one party rule, and Ershad (1982-91). Both of these nationalistic governments failed to provide any progress in democratization. The BNP and present AL governments which followed, both of which are strongly nationalistic, are the first real steps in the democratization of Bangladesh.

Also, Ahmed Kamal (1997) has correctly referred to the overwhelming odds of successive governments in dealing with burgeoning population, the world's densest rural population, huge foreign debts, and a corrupt and inefficient bureaucracy. These obstacles, fueled by a legacy of nationally focused factionalism, have reduced governments to reactionary commentators rather than progressive architects and do little to curb disaffection among the political elite, weakened entrepreneurial spirit and poverty stricken and uneducated urban immigrants (Bhadra and Bhadra (Eds), 1997: 20-47)². In this barren context, political debate is fiercely nationalistic but reduced to '*whatever you say we will not agree*' (Bayes, 1995). Garnering support is realized by simplifying issues to generate mass rallies in which to display party specific support (Ahmed Kamal, 1997). Khan (1996): 2, also provides detailed analysis in support of the view that the principal objective of political parties in Bangladesh is simply to be on the winning side and is indicative of poorly developed democratic processes. The War of Liberation occurred exactly 25 years ago and fashioning political issues in terms of deeply felt nationalist interests is a certain means of winning attention. In reality, there is little to chose between the BNP and AL positions on water sharing and transit.

2. Discussion

The Ganges water sharing is a matter of common interest to whatever Government of Bangladesh is in power. Deciding on how to allocate the low dry season flow is a problem for both India and Bangladesh and will never be resolved satisfactorily without augmentation of total available flow. This is why no lasting treaty has ever be initiated in the past and why mere words that *the water will be shared* will not end the matter. The main alternative solution to the AL hastened treaty, is that proposed by

¹ The Pakistan Army was equipped with two billion dollars worth of United States military supplies under the Mutual Defense Treaty of 1954 which was intended mainly as a balance against Soviet titling India, was well honed during the Kashmir War of 1948, and almost exclusively manned by initially British trained Punjabis.

² Nearly half of the 120 million Bangladesh population are in poverty. Urban growth, mainly through employment seeking migration is about 6 percent per annum, while male urban household member unemployment is 22 percent in Dhaka (ADB, 1996).

Bangladesh in the past and which is advocated by BNP to involve Nepal, for headwater construction of dams to allow storage of a measure of the wet season flow, for release during the dry season (Crowe: 176). However, this proposal is unlikely to be politically acceptable to India. Apart from introducing additional ecological issues, it puts India at the mercy of Nepal as far as water flow in the Ganges is concerned. While India has considerable influence in Nepal today, there is no certainty that an expansionary China may not one day have greater influence over Nepal. This could be a major perceived problem for India while Bangladesh has always maintained good relations with China. This is one indication that issues concerning sub-regional cooperation in South Asia are not merely South Asian. Moreover, international effects such as the oil crisis of the 1970s, the IMF and multilateral aid agencies such as the World Bank and the Asian Development Bank have had considerable influence in shaping Bangladesh economic development policy for a quarter of a century (Bhadra and Bhadra, 1997: 46-57). These all denote that Bangladesh development cannot occur in isolation.

Another dimension is that without partition, the issues on water sharing and transit would have been settled internally. One of the reasons why they emerge as issues is that the GBM basin and the transport infrastructure, including the port of Chittagong, were all part of one political system until 1947. Both water sharing and transit also have a geographical logic which conforms with the British sphere of earlier control. However, the international borders adopted since 1947 are based mainly on religious differences which adds to the present complexity of resolving cooperative effort.

An environmental only approach, rather than a predominantly economic growth model as pursued by the World Bank and ADB, may raise less worry among the smaller countries of Bangladesh, Bhutan and Nepal that economic cooperation amounts to handing over of national control to the dominating neighbor, India, especially considering the already 'staggering imbalance of trade' between India and its smaller neighbors (Rezaul Karim, 1997). However, it is not realistic to expect that the environmental problems can or should be effectively handled independently of economic efficiency. Moreover, as history has shown, the growth of nationalism in Bangladesh appears to rule out any willing return to a greater India political unit. While AL is accused by the BNP of pandering to India, by signing a bilateral water sharing agreement, AL did not renew, in March 1997, the 25 years *Friendship, Cooperation and Peace Treaty* signed with India in March 1972¹.

The issue of transit for Nepal to the Bangladesh ports of Mongla or Chittagong, as an alternative to the existing Calcutta, would achieve more as a gesture of goodwill than the modest economic benefits. Since any route out of Nepal southwards must pass through India, and with only minor distance saving, worry over an alternative route through Bangladesh also appears to be overstated. However, It would be a major symbolic act by a large dominant neighbor that it is prepared to give as to take and would be an important spark of cooperative effort. Negotiating arrangements for India to transit Bangladesh by road, rail, IWT could, however, achieve major distance savings and,

¹ According to the interpretation of Indira Ghandi, referred to in Bangladesh as the *Indira Doctrine* (Atiur Rahman, 1985:23), Article 9 of the Treaty did not preclude India from intervening in Bangladesh to ensure peace. This was threatened during coup attempts in Bangladesh in the late 1970s. However, Bangladesh has had a better rapport with later Indian Prime Ministers, and the fear of India is unjustified.

therefore, economic benefits in reaching the Indian seven sister eastern states, or for these states to use the port of Chittagong, or for the North western region of Bangladesh to gain access to Calcutta Port, are politically more difficult for Bangladesh. Nevertheless, Bangladesh may earn high revenues from transit by India as well as from potential trans-Asian traffic under the proposed Asian Highway (see Map 2). As such, it is an cooperative opportunity and both parties appear to recognize this.

It is noteworthy that BNP, not AL first signed a United Nations accord on behalf of Bangladesh regarding the Asian Highway. The only new element introduced by the AL, which the BNP finds so treacherous, is that the AL not only agrees to a route through Chittagong and southward to Myanmar, as does the BNP, but also proposes a second route, through the north east part of Bangladesh. The BNP's concern is only that India may use transit rights as a means to attack rebels, via this latter route, in the seven sister states. However, it is unlikely that India would risk diplomatic ostracism by using an international corridor for troop movements, as revealed in its delicate diplomacy prior to involvement in the Bangladesh War of Liberation. Such action would risk the entire Asian Highway concept and international pressure would be brought to bear. Moreover, an Inland Water Transit Agreement between Calcutta and Assam, through Bangladesh, was renewed by the BNP Government in 1995, which serves to further reveal inconsistencies in their criticism of the AL. It is doubtful, anyway, that dealing with rebels in the eastern states would ever require more than a quietly managed action through the existing Indian corridor to the north of Bangladesh. Interestingly, neither the AL or the BNP appear to have any comment that the north east Bangladesh connection to an Asian Highway would serve mainly as a gateway to and from China, whose economy is expanding rapidly in the south west part of the country, and who may value an outlet to the Bay of Bengal. A Chinese presence would also help balance political power by improving economic penetration of the seven sister states of India. Nevertheless, superpower involvement in South Asia, especially during the Cold War, during the formulative years of the newly independent regional states has probably accentuated the complex local frictions (Emajuddin Ahamad, 1985: 39). However, there is no basis to assume that underlying nationalist sentiment in Bangladesh has been diluted in the process.

The established forum to address the issues is the South Asian Association for Regional Cooperation (SAARC) which was formulated in 1983 after an idea first introduced by President Zia of Bangladesh, in 1978 (Emajuddin Ahamed: 12). While Pakistan may not currently agree to Indian transit if pursued through SAARC, this forum is a valuable means for the formulation of new regional strategies in a complex environment and will help to build accord at many levels. Time used in building understanding would be well spent. According to the BNP view, this may be more appropriate than restricting the debate to the four countries directly concerned, and thereby weakening small power influence against India, amounting to collusion between the AL and India. This appears as a political opportunistic appeal to uneducated masses rather than a justification of AL treason (Tabarak Hussain, 1997). The other SAARC nations are not affected directly¹. Moreover, the potential links include Myanmar and China. What, therefore, is the rationale to artificially restrict inevitable efforts in forging win-win economic benefit? Further, most Asian groupings, for example, APEC and ASEAN, accommodate sub-

¹ The other SAARC nations are Maldives, Pakistan and Sri Lanka.

regional 'growth triangles.' The bulk of these benefits arise from intra-industry trade for which political constraint is counter productive to sustainable development (Fukasaku: 1995: 28).

3. Conclusions on Sub-Regional Cooperation

In conclusion, while the BNP has succeeded in making a serious issue out of efforts by the ruling AL to significantly improve the efficiency of sub-regional transport and opening trade and water sharing opportunities, their strategy appears to be politically opportunist rather than nationally destructive. Nationalism is strongly embedded in the Bangladeshi mind. It has been defined and built progressively, starting with semi independence under the Moguls about 450 years ago, alienation of Muslim interests under the British, and subjugation of Bengali language, culture and democratic debate under Pakistan. While the War of Liberation brought factionalism, such events often do. The factionalism is considered national, Bengali Muslim, in spirit. Because successive governments since independence have been autocratic and the emergent country has faced many problems concerned with population, poverty and natural disaster, there has been little opportunity to develop a sophisticated democracy. As a consequence, debate is constrained to black and white positioning by the political parties. Much of the 'debate' focuses upon nationalism. The nationalist feeling has not only survived but has developed over these many years, protected from greater economic ravages in recent decades by benevolent international development aid.

In an atmosphere of dependency on aid, tightly held reins of the IMF, prevailing poverty, a unique geographical context, and set backs by recurrent natural disasters, appeal to nationalist sentiment is an indication of underlying strength. This is being nurtured in a young democracy, which recognizes education as an important vehicle for development. While the legacy of a violent history is also likely to accompany such development this may be regarded as normal until democratic processes become more deeply entrenched.

The government agreements and proposals over water sharing and transit expressed by the opposition as treasonous, are in reality, relatively innocuous in terms of political threats involving India. India has always been wary of offending the world powers, as demonstrated when considering intervention in the War of Liberation. Even with regard to nuclear testing, India has moved quickly to propose acedence to the International Test Ban Treaty after its 1998 demonstration of strength.

Examination of the issues reveals no substantial differences between the political parties. Both have strong accord with international efforts based on building trade relationships. Both of the main political parties also make strong appeals to Bengali Muslim nationalism which is tempered by a legacy of Hindu romanticism. This sets it apart from Muslim fundamentalism. It denotes a firm basis for national growth and potential win-win accord between Bangladesh and its neighbors.

Nevertheless, development agencies which inevitably have major influence in an economy which relies on aid for one-third of its GDP, should refrain from taking a driving seat. Moreover, the matter may be best handled in the context of sustainable development of the GBM basin as a geographical region, in consultation and gradual full accord with SAARC. While SAARC is a young and valuable entity, there is no threat to the unity of SAARC by efforts to forge economic sub-groups. As increasingly recognized

worldwide, wherever national spirit is strong, economic cooperation leads eventually to creatively strengthened awareness of other nations' problems. Expression of a more benevolent nationalism will emerge with growing experience in democracy and participatory processes.

C. Lessons From the Literature Review

Under the European framework, decentralised interests on IWT reach a compromise under a unitary state organisation. This framework has facilitated a progressively integrated approach to water resource usage, especially in the Netherlands, which is considered an important theme for the development of IWT in Asia. These perspectives also have other important implications in the Asian development context. In undeveloped water river systems, where channels are not confined, intermediate steps may lead to worsening flood impacts as works undertaken in one location impact areas lower in the flood plain, while it is clear that normalisation requires detailed knowledge of river behavior and well integrated management. In the USA and the PRC, it is apparent that an intermediate stage exists, where dyke construction, over many centuries in the PRC case, has led to the raising of river beds in the lower reaches of rivers and devastating flood still occur. In Bangladesh, human interference over the past 50 years has also increased flood risks and the principal lesson is that a cautious and integrated approach are both vital, commensurate with management capacity and investment resources.

The conclusions on current literature are that Asia offers attractive prospects for a greater role of IWT in economic development. However, such a role will encounter many problems resulting from IWT's historical importance, yet relative neglect in development programs and research, complex administrative frameworks and, in many notable cases, uncompetitive government participation in IWT operations. In many situations, sunk costs and the intervention of dams, low bridges and road and rail embankments without adequate culverts for IWT may preclude IWT achieving its inherent benefits as a low energy, environmentally friendly mode of transport, especially over long distances. Nevertheless, there also appear significant opportunities for the integration of IWT and water resources development, especially for flood protection and the beneficial use of dredged material. A major lesson of the European, USA and PRC situations is the early recognition of the relationships between flood control and opportunities for IWT to take advantage of the engineering and information systems required for effective flood control.

However, the lessons of Europe and the USA also extend to the need for optimal use of maritime technology, particularly in the use of pusher tugs and low draft modular barges, where these can be combined to maximise deadweight capacity under a pusher barge arrangement, especially for the inland distribution of historically important bulk cargoes, and increasingly, for the cost effective distribution of containers. To compete effectively with road and rail, it is clear that seaport and inland terminals will need to cater specifically for the efficient handling of containers, rather than share equipment with ocean going vessels if IWT is to achieve the necessary opportunities for intermodel integration. In addition, the potential inefficiencies of vertical disintegration and over capacity risks of Europe, including the social dimensions, must be assessed in the policy framework. Not least, while IWT may have energy cost savings potential over other transport modes, the risks of oil, and noise pollution and associated training of operators must also be addressed in the interests of other water users.

The most significant areas for future research in IWT development in Bangladesh are, therefore, as follows: (i) integrated water resources management at the river basin level, including effective measures on transborder issues, as well as the recognition and measures to address historical and political constraints, (ii) socio economic aspects, (iii) hydraulics and sedimentation, (iv) classification of waterways, (v) hydrographic surveying, (vi) dredging technology-including low cost engineering applications, (vii) the operations management of navigation, (viii) shallow draft and low cost propulsion in vessel design, ports and terminal location and layout, and (ix) the environmental regulation of shipping, (x) refinement of integrated cost-benefit analysis of water resources and IWT projects, and (xi) measures for cost recovery and maintenance. All of these areas are complex and none are mutually exclusive which suggests the need for well integrated masterplanning and management systems. However, before useful planning can be attempted, and to ensure that piecemeal development does not have adverse impacts on flood protection, land and settlement losses and navigation elsewhere in the river system, more hydraulic research and monitoring needs to be undertaken to better understand the fundamental character of rivers in Bangladesh. This needs to be underscored by an international river basin approach to ensure that flood protection and river abstraction works are economically efficient and sustainable. During the intervening period, new IWT projects will need to include provision for the careful monitoring and analysis of hydrological processes accompanied by an experimental approach in selected areas.

Of particular importance, as now being adopted in Europe, the cost-benefit analysis and policy framework of transport planning needs to recognise the environmental and economic benefits of IWT vis-à-vis unconstrained road capacity increases, and a more determined integration of water resources and transport policy and planning.

It also needs to be recognised that the major differences between the developed and Bangladesh in the integration of flood protection, agriculture and IWT strategies, is the low level of investment resources and near subsistence rural society in Bangladesh. Land shortage and the social impacts of devastating riverbank and *char* erosion have major importance in Bangladesh. The recent USA approach of returning flood plain areas adjacent to river channels to their natural habitat, and the application of overspill embankments in both the USA and Europe, may have application in Bangladesh, accompanied by improved channel dredging efficiency. While land shortage may appear to constrain application of the 'natural habitat' approach being taken in the USA, river bank and *char* erosion, and unpredictable land losses to the rivers are a major cause of poverty and landlessness in Bangladesh. Another major difference is the important informal transport sector which can easily be adversely affected by large-scale flood protection and waterway development schemes. Land shortage and the vessel ownership and usage in the country boat sector is not well documented and the geological, environmental and agricultural importance of annual flood plain rejuvenation by the monsoon floods in Bangladesh has only recently been taken account of in economic development planning. The literature and issues relating to this are taken up in Chapter IV.

CHAPTER III

THE TRANSPORT SECTOR IN BANGLADESH

A. Description of the Transport Sector

1. Administration and Modal Shares

The gross domestic product (GDP) in Bangladesh showed a growth of 4 to 5 percent a year during the first half of the 1990s and this is expected to continue for some years ahead¹. Reflecting a growing and increasingly diversified economy, the demand for transport has increased rapidly over the same period, at an average rate of 8 percent for passengers and 7 percent for freight (Government of Bangladesh (GOB), 1994a). Road transport is the principal mode of transport, which in fiscal year 1992/93 accounted for 60 percent of freight movements and 75 percent passenger transport (see Table 3). It is likely that roads, which provide highly flexible and relatively low-cost door-to-door transport, will continue to meet an increasing share of transport demand in the future, while the railways and IWT should cater to mainly long-distance freight traffic, especially for bulk and container traffic. The transport system is both extensive and diversified, comprising over 130,000 kilometers (km) of roads of which about 12,000 km are paved; 2750 route km of railway lines; about 5,970 km of classified IWT routes; two major seaports (Chittagong and Mongla) with a combined throughput of 12 million tons; and 7 airports, two of which are equipped to handle international traffic (Dhaka and Chittagong) (see Appendix 1). The system provides relatively satisfactory services, but considerable potential remains for reducing transport costs and improving the quality of services, mainly through removal of capacity bottlenecks including problems of mixed motorised and non-motorised traffic, upgrading of infrastructure and vehicles and IWT vessels to facilitate the inland distribution of containers, completing the construction of the Jamuna Bridge linking the east and west regions of Bangladesh, and upgrading and construction of feeder roads to serve villages not yet connected to the all-weather system.

The transport demand projections in Table 4 take 1999/2000 as the base year after the completion of the Jamuna Bridge in mid 1998. The projections assume that the influence of efficient long haul freight train operations with a rail line on the Jamuna Bridge will ensure that rail retains importance, and the upgrading of Mongla and Chittagong ports will improve the efficiency of access to the northwest hinterland. The predictions assume overall annual growth rates of 5.4 percent for passenger traffic and 7 percent for freight transport (GOB: 1994a: 3.9).

¹ While the weaknesses of GDP as a measure of environmental sustainability are acknowledged, it is a well understood measure of economic growth. Incorporating environmental values in GDP is a long term objective, possibly in conjunction with the refinement of satellite environmental national accounts. However, while an IUCN mission visited Bangladesh in 1997 to examine the adoption of satellite accounts by the country, this approach has not yet been attempted in Bangladesh.

Table 4: Transport Modal Shares (Percent)

Year ^{a/}	Road		Rail		IWT		Total	Ton. Km (billion)	Pass. Km (billion)
	Frght.	Pass	Frght.	Pass	Frght.	Pass			
1974/75	35	54	28	30	37	16	100		
1984/85	48	64	17	20	35	16	100		
1988/89	59	68	11	17	30	15	100		
1992/93	61	75	7	12	32	13	100		
1999/00	74	69	6	11	20	20	100	14.5	95
2004/05	74	69	7	12	19	19	100	20.3	121
2009/10	74	74	7	7	19	19	100	28.4	155

Source: GOB (1994a): 2.1 and 3.9. *Note: The fiscal/statistical year in Bangladesh is from 1 July to 30 June.*

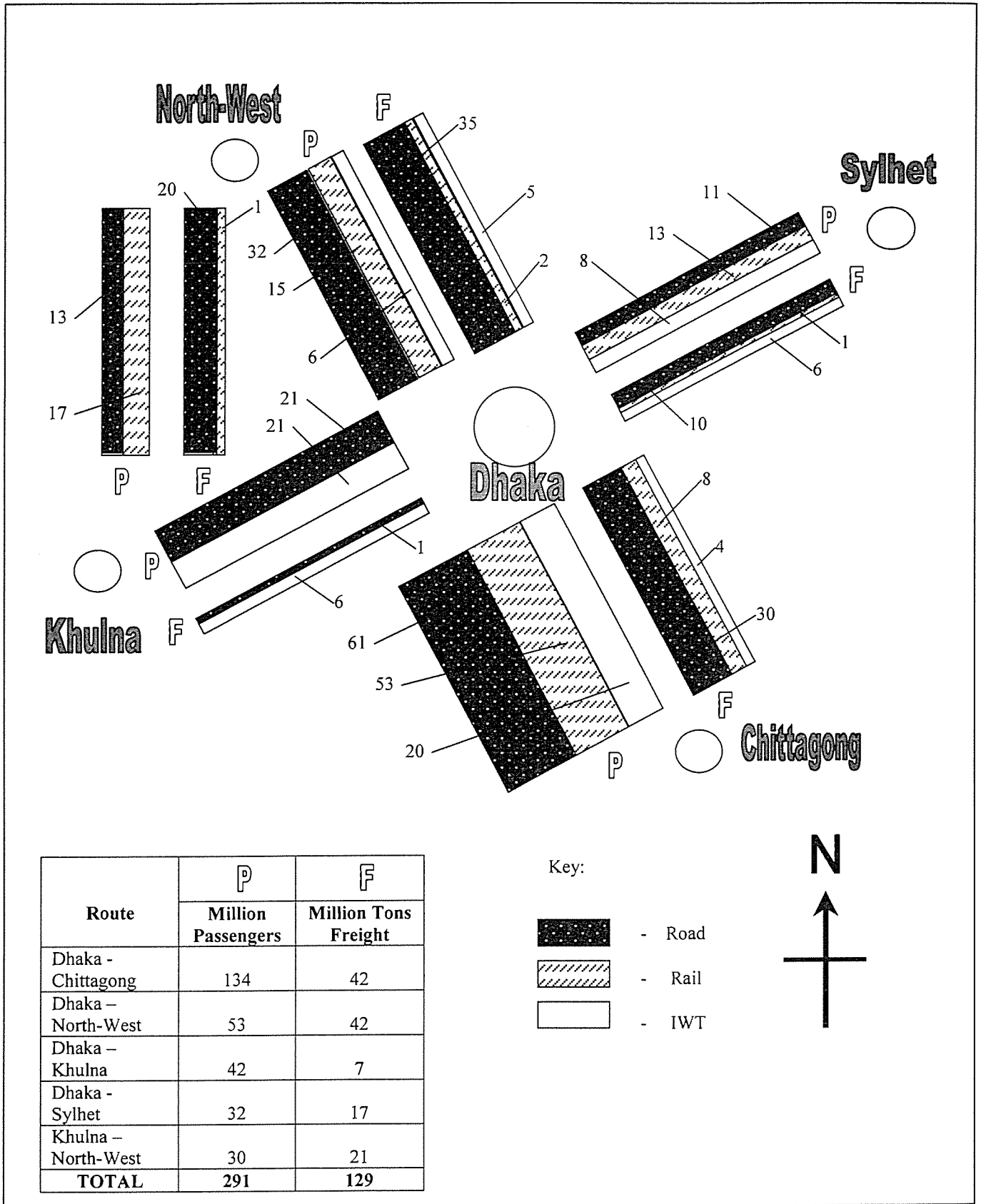
2. Transport Policy and Strategy

The transport sector is supervised under four separate ministries: the Ministry of Communications (MOC) for road and rail, Ministry of Shipping (MOS) for IWT and ports, Ministry of Aviation (MOA) for airports, and the Ministry of Local Government and Rural Development (MLGRD) for rural roads and waterways infrastructure. The investment policies of these ministries are determined by the Ministries of Planning and Finance (MOP and MOF). This framework is characterised by bureaucratic complexity, lack of policy instruments, a weak statistical base on which to monitor policy effectiveness, and poor enforcement of those policy instruments which do exist.

Poverty reduction is the major objective of Bangladesh's developmental strategy. Increases in GDP and per capita income are the main development goals under the strategy. Development policy is focused towards improving the efficiency and capacity of a transport network that integrates the national with external markets through improved port facilities. This is also reflected in the Government's policies regarding development of the main transport corridors shown in Figure 1: Dhaka-Chittagong, Dhaka-Northwest, Dhaka-Khulna, Dhaka-Sylhet, and Khulna-Northwest. In the Fifth Five-year Plan (FFYP) for 1997-2002 these arteries are referred to as *strategic corridors* (GOB, 1997: XVII-3). However, while the corridors and services potentially offer multimodal competition and efficiencies, in reality transport planning and intermodal exchanges lack integration and the Planning Commission are weak. Never have transport investment targets been met under the 5, five-year plans (GOB, 1998a:161). Moreover, while development is project oriented, severe generic implementation issues rooted in poor governance delay individual projects by years (Brooks, 1998) and severe bottlenecks and multimodal inefficiencies remain on the main transport corridors.

In rural transport, the poor status of road maintenance and weakly financed local institutions are major constraints to the delivery of social services and access to markets for agricultural produce. To ensure that sustainable rural development objectives are achieved an integrated, people centered and least cost policy approach is being adopted in the provision of rural infrastructure. This includes providing roads engineered to meet non-motorised transport demand which can be maintained locally, and efficient connections with both formal and informal IWT services to meet household level demands.

Figure 1: Projected Modal Traffic on Main Transport Corridors (2015)



Source: Compiled from GOB (1998a): 30

3. Modal Characteristics

(a) Roads

Road policy directives are implemented by the Roads and Highways Department (RHD) and the Local Government Engineering Department (LGED) for rural roads. RHD also operates 70 ferries and carries out road maintenance using its own equipment. A separate authority, the Jamuna Multipurpose Bridge Authority (JMBA), has control over the Jamuna Bridge operations, including tariff setting, and has appointed an international contractor to manage and maintain the bridge from its inauguration in June 1998. While a Government parastatal, the Bangladesh Road Transport Corporation (BRTC) has a role in bus and truck operations, road transport in Bangladesh is highly competitive, operates largely free of tariff and other restriction on entry, and it is profitable. However, because of the poor condition of the network and congestion due to sub-optimal competition by rail and IWT, and constraints of river ferry crossings, road transport is unreliable and costly. This constrains economic development and mobility of the population. Road transport is regulated mainly under the *Motor Vehicle Ordinances* of 1983 and 1984, which provide for the registration of motor vehicles, control of transport vehicles, and road traffic regulation. Upgrading of these controls and ensuring the reliability of data is a vital first step in the refinement of any environmental policy affecting transport. Such efforts have been supported by ADB financed technical assistance, following which the Bangladesh Road Transport Authority (BRTA) was established in 1988 under World Bank and United Kingdom financing. The BRTA is computerising vehicle and new driver license registrations, vehicle inspections for issuance of fitness, non-pollution emission certificates, and collecting a road tax. The ADB has also assisted BRTA with technical advice and loan support for the ongoing construction of vehicle inspection centres and staff training at Dhaka, Chittagong, Rajshahi, and Khulna (ADB, 1994b). A further key issue is road safety. Bangladesh has one of the worst traffic accident records in the world. While the reliability of safety statistics is still being improved under United Kingdom assistance, Bangladesh's official road deaths per 10,000 registered vehicles are about 60 per year, compared with less than 2 per year in highly developed countries (ADB, 1995).

In spite of the relative higher investment in roads than in other transport modes, most highways are congested and suffer from an unsegregated mix of motorised and non-motorised traffic, and serious lack of pollution emission controls. The problems are especially acute in urban areas. These problems are compounded by lack of driver education. Poor safety engineering and lack of adequate operations and maintenance (O&M) provision are also severe constraints, accompanied by weak institutional capacity to administer and enforce policy instruments.¹

To take advantage of regional cooperation potential, completion of the Jamuna Bridge will not only link the east and western regions of Bangladesh by road, and facilitate major distance savings for India in serving its eastern states and accessing on 1 September 1997 to allow Nepal transit cargo to access Bangladesh ports. This will offer a potentially viable alternative to the historical use of Calcutta Port. However, operational success of the transit agreement depends upon the provision of additional bridge and road infrastructure improvements costing about \$100 million in the short term and about

¹ For example, RHD administration and accounting manuals prepared in 1994 with ADB assistance have still not been approved by the MOF in 1998.

\$400 million in the longer term (Brooks, 1997b). The critical investment needs are the Rupsha Bridge near Mongla Port, a Dhaka by-pass and completion of improved road links to Chittagong Port, and the improvement of both Chittagong and Mongla ports. These investments are under preparation by Japan, ADB and the World Bank. The Dhaka by-pass is anticipated to be the first private sector financed road investment in Bangladesh.

(b) Railways

The Government's focal policy in the rail sector is to commercialise and restructure Bangladesh Railways (BR) into a more market oriented and efficient entity. Under ADB technical assistance (ADB: 1995), BR's core business has been identified as long-distance bulk freight traffic, with gradual reduction of unprofitable inter-city passenger traffic. The former is being targeted in conjunction with ongoing expansion of an inland container depot at Dhaka, the acquisition of special purpose rolling stock, and progressive adoption of container block-train operations. Maximising the use of rail capacity to move freight traffic will be less costly to the overall economy and will help to curb further increases in environmental damage, worsening road safety and traffic segregation problems. Accompanied by the removal of inter-city rail passenger subsidies and greater use of inter-city buses for passengers, rail network capacity will be maximised for freight services. The loss of freight traffic share by railways since the 1970s is indicative partly of the advantages of road in meeting mobility demand and partly to a lack of rail marketing, inappropriate pricing and low efficiency by rail authorities as a purely government department.

The policy measures for BR as formulated under the ADB financed Jamuna Bridge Rail Link Project (ADB, 1997a), include (i) further restructuring by the year 2003 into an autonomous, market-responsive entity under a five-year plan, (ii) further resource and asset rationalisation, (iii) a quality assurance program, (iv) staff reductions of 25 percent by the year 2005 to reflect changes in demand and business opportunities, (v) transformation of the railway network to reflect changes in demand and services, particularly through closure of branch lines, (vi) tariff restructuring by mid 1998 to assist rail in meeting its natural market, and (vii) linking the currently segregated network by constructing a rail line on the Jamuna Bridge and the progressive conversion of track to a dual broad and metre gauge system. The latter will link east and west Bangladesh and facilitate rail traffic movements from West Bengal (in India), through Bangladesh, to the eastern states of India, such as Tripura and Assam. In the longer term, it will also facilitate the potential use of Chittagong Port by the east Indian states, instead of the 800 km longer northern corridor route to Calcutta.

(c) Ports

Bangladesh relies on its two international ports for most of its overseas trade. Chittagong Port provides for more than two thirds of total international trade. Mongla Port provides mainly for international trade links with Bangladesh's southwest region. While Chittagong Port Authority (CPA) and Mongla Port Authority (MPA) are semi-independent of the MOS, their autonomy is very limited. Planning, budget setting and expenditure all require MOS approval and foreign exchange earnings from shipping tariffs are remitted entirely to Central Government. A proposed IWT container terminal at Dhaka, for which a feasibility study has been prepared by Japan (OECF, 1996) would help meet the potential for efficient inter modal activity and provide competition between the various modes, and could also encourage greater use of Mongla Port for container traffic.

The World Bank and ADB have conducted a Port Master Plan and Trade Facilitation and Ports Upgrading Study, respectively. These define the future role of Bangladesh's ports (World Bank, 1996; ADB, 1997). While it is a common policy among the latter aid donors that the private sector should take the lead for investment in the port sector, the ADB study is examining short-term public sector investments needed to help remove serious existing congestion at Chittagong and Mongla in the handling and distribution of containers. The proposed loan will be accompanied by a policy agenda and covenants aimed to ensure private sector investment in any expansion of the ports, and a single operator for the container terminal.

The main constraints to improved operations at Bangladesh ports include (i) lack of autonomy and accountability of port authorities, (ii) inadequate inland distribution systems, (iii) institutional barriers for a private sector role, (iv) lack of modern cargo-handling equipment, and (v) intransigent labor unions. The Government and development partners' strategy in the port sector is to help (i) improve the productivity and efficiency of port operations, (ii) encourage market responsive management, (iii) promote the role of private sector investment, and (iv) accommodate the needs and anxieties of the ports' labour.

(d) Inland Water Transport

More than half of the country's land area and 75 percent of the commercial activities are located within 10 km of a navigable waterway throughout the year. However, the IWT sector has not received a significant share of development attention. Only about \$60 million total aid donor investment has been made (Akatsuka, Asaeda and Brooks, 1994), compared with about \$1 billion by the ADB and similar amount by the World Bank in transport generally in Bangladesh. Moreover, IWT planning policies and management have not been integrated clearly with the overall water resources framework.

The IWT sector is a cost and energy efficient alternative to roads and railways, and can help reduce traffic congestion and air pollution from fuel emissions. It is especially cost-effective in carrying bulk cargo over long distances and has potential for the inter-modal transport of containers. During floods, it is the only way to ensure that relief goods reach flooded areas. Also, improvement of the river depths and the provision of river training works could help to reduce flood risks. River transport improvements could also avoid or delay the alienation of land and avoid the social dislocation which occurs in the expansion of road and rail transport infrastructure.

The two sea ports of Bangladesh, Chittagong and Mongla, are linked by IWT to almost all of the more than 60,000 villages in Bangladesh and possibly nearly 1 million small vessels provide informal IWT services, in addition to the over 4,500 registered vessels of the formal sector shown in Table 5.

Table 5: Registered IWT Vessels: 1995

Types of Vessels	Private Sector			Public Sector			Total		
	Number	Carrying Capacity		Number	Carrying Capacity		No.	Carrying Capacity	
		pass No.	Cargo (Tons)		pass No.	Cargo (Tons)		pass No.	Cargo (Tons)
Passenger	249	94,884	20,149	13	6,231	769	262	101,115	20,918
Coastal Launch	1510	109,988		12	2372	1110	1522	2,112	1110
Ferries	-	-		70	5,894	2,624	70	5,894	2,624
Cargo Launch	1,527	-	367,297	6	-	1,910	1,533	-	369,207
Tankers	121	-	72,281	12	-	12,226	133	-	100,323
Coasters	156	-	76,899	56	-	16,081	309	-	
Lighters	766	-	237,144	157	-	55,530	923	-	292,692
Total	4,329	204,882	773,770	286	14,497	90,250	4,672	120,379	786,874

Source: GOB (1996)

Development emphasis in the transport sector has, in spite of the importance of IWT, been given to less energy efficient roads and to a lesser extent, railways, while water resource development has focused on irrigation, flood protection embankment construction, and to a minor extent, domestic and industrial use, rather than adopting a dredging policy for flood protection which would also assist IWT development, as practiced in Europe and the USA. The result is deteriorating depth of waterways due to minimal dredging effort, competing use of surface water for irrigation, blocking of navigational routes by embankments, low and narrow bridges and often inadequate provision of culverts, and salinisation in coastal areas. Deforestation has also accelerated siltation in recent years. Siltation has also been compounded by seriously reduced flows during the long dry season as a result of the abstraction of river water for irrigation, both in the upper riparian country, India, as well as in Bangladesh. The IWT sector is in need of urgent development focus and clearer integration with water resources management to realise its economic benefits.

Thus, as in many in other countries, IWT in Bangladesh is faced with competing uses of water resources. For example, in Europe, IWT development has been allowed to decline over the last 150 years, where revival of IWT for container traffic in the past 15 years, resulting from road congestion, is now proving cost effective but is constrained by low bridges (NEA, 1995). Also in Bangladesh, significant opportunities exist on main IWT routes for the movement of containers, as well as increasing the volumes of bulk and lower-value cargo, provided that inland terminals and efficient barging arrangements can be established for year-round exchanges.

It can also be mentioned that although IWT output has increased over time it is still not comparable with the IWT output of some Asian countries, particularly the PRC, which is the most intensive user of water transport in the region. A comparison of the IWT systems is in Table 6, which reveals that the passenger intensity of IWT in Bangladesh is higher than that of the PRC but the freight intensity is lower. In terms of passenger and freight tons, the performance of IWT in Bangladesh is significantly lower than that of the PRC, indicating a potential for development.

Table 6: Comparison of the IWT Systems of Bangladesh and China

Items	Bangladesh	PRC
Passenger-km (Billion)	10	15
Freight ton-km (Billion)	3	200
Navigable Waterways (km)	5,970	108,000
Inland Ports	150	1,000
Freight Traffic Intensity (ton-km)	1,250,000	1,851,900
Fleet Capacity (Million ton-km)	0.86	7.6

Sources: GOB (1994)/GOB (1996a)

Note: Figures of Bangladesh relate to 1996 while those of the PRC relate to 1990-91.

B. The Socio-Economic Aspects of Inland Water Transport

Bangladesh have always depended on rivers for the transport of goods and people. It is only since the colonial period with the advent of railways and since partition with the gradual and now dominant construction of roads that the situation has changed. Nevertheless, apart from a formal IWT sector which carries about one third of the tonnage of officially-recorded traffic¹, the role of the informal IWT sector is a major element of rural life and livelihood, and is especially important during the annual deep flooding of the flood plains from July to September.

Investment in the country boat sector was virtually ignored by the development agencies until the *World Bank's Third Inland Water Transport Project* in 1991 (IWT3). Development needs of the sector were also considered in the *Bangladesh Transport Sector Study* (GOB, 1994).² There have also been only a few detailed studies, while statistics are mainly informed guesses. The first study was Rahman (1963) in which the type and sizes of boats and their economic activities were mainly descriptive.

During the 1980's, joint Norwegian and Netherlands studies reported on the sector, leading to a major publication by Jansen et al (1989). A few studies also reported on the outlook for the mechanisation of country boats (Khan and Chowdhury, 1985 and NOAMI, 1994), with the latter's proposals for the improvement of hull designs and the development of demonstration boatyards forming the IWT3 country boat component.

The country boats, of which Jansen et al: 74, in quoting Rahman (1963), indicate 165 different types, are all shallow draft and suited to the silted, changing pattern of deltaic channels. Khan and Chowdhury: 318 note that about 85 percent of the 120 million population of Bangladesh was rural in 1983 and 80 percent of the 68,000 villages in Bangladesh are within a few kilometers of a navigable waterway, but without direct access to mechanised transport. Today, 80 percent of the total 120 million populations of

¹ The border-line between formal and informal IWT traffic is not clear. However, GOB, 1994b: 24, in drawing on 3 historical sources [BIWTMAS (1989) GOB (1994a)] and BIWTA questionnaires, noted up to 60 percent under-reporting of traffic between districts. Total (formal and informal) traffic is about 35 million tons, of which the formal sector carries about 12 million tons. In ton-m terms, however, the formal sector accounts for about 70 percent of all IWT traffic (GOB, 1992b: 27).

² While the informal sector has gradually mechanised, Jansen et al: 31 suggest a bias in the approach to development where non-motorised informally operated land and river transport had 2-3 times the carrying capacity of trucks in Bangladesh in 1977, and accounted for 80 percent of employment.

Bangladesh is still rural, and poor, and while mechanisation of transport has increased, river access remains the main transport opportunity for village dwellers. Country boats also offer not only lower operating costs and avoid the costs of road construction and maintenance but are indispensable during monsoon floods, especially when the annual floods exceed normal level and duration, such as in August-September 1997 and again in 1998.

Partition from India in 1947 weakened the position of IWT and strengthened that of railways. Most of the vessels that plied the orders of East Bengal before 1947 remained in India after partition. With only 450 km of roads, mainly within urban areas, the country's transport services were dominated by the railways (Jansen et al:15). As relations with India normalised, IWT transit traffic to Assam resumed, but this was cut short by the India-Pakistan war in 1965. However, it was roads which received development attention and the railways and rail bridges were most badly affected by the war of liberation in 1971. In the aftermath, transportation was nationalised with a gradual encouragement of the private sector since 1975, accompanied by major public investment in developing the national road and bridges network. In spite of the investment through the 1980s and 1990s under several ADB, World Bank, OECF and bilateral donor projects focused on rural infrastructure, rural transport remains poorly developed, and due to lack of recurrent financial and weak institutional resources, maintenance of rural roads and bridges is inadequate. While Sen, 1998: 16 asserts that rural households in Bangladesh with good road access have 13 percent higher incomes, and that therefore rural road infrastructure development is the key to rural development, this ignores the importance and the potential for country boat operations and their lower costs compared with road development and user costs. Clearly, more study is needed to quantify the economic benefits of the country boat sector and to give this more attention in poverty reduction strategies and planning.

The aid dependent nature of much of Bangladesh's development had led to Jansen's (1989) view of a preoccupation with the 'best from the west' accompanied by conditional lending and indifference towards rural transport services, which legitimises mechanised transport and neglects non-mechanised transport or the modal efficiencies offered by IWT. While mechanisation in IWT allows more competition with road transport, efforts in the mid 1980s to improve the efficiency of the then dominating use of sail in the country boat sector have been abandoned rather than optimised. In the space of a decade, sail-driven vessels have become relatively hard to find. Mainly, the vessels are now propelled by converted low-lift irrigation pumps, without silencers or effort to minimise pollution, both at the expense of the former rural tranquility of Bangladesh. However, the NOAMI 1994 study recognises the reality of modernisation. By making country boat operations more efficient and less polluting, through improved mechanisation strategies, a competitive edge for the lower-cost informal IWT sector can be retained. This may help to offset land based non-motorised rural transport infiltration by small, noisy and dangerously driven trucks and polluting two-stroke motor cycle units. In the worst case scenario, without policy or regulatory intervention, there will simply be a progressive environmental and social degradation through uncontrolled mechanisation of road and IWT transport sub-sectors.

C. The Hydraulic Context

Bangladesh's rivers are natural waterways and are susceptible to morphological and hydrological changes. These changes directly influence the navigability

of rivers. Most of the land area of Bangladesh comprises the deltaic confluence of the GBM river system. While tidal impacts are felt over 200 km inland, the river stretches which are not near the sea also show high and low water levels due to changing water discharge patterns between seasons. The wet monsoon months are June to October and the dry period is from November to May. During the monsoon, there is an excess of water and reduced LAD is not a problem. During the dry season, water levels reach their lowest point during March and April. As the waters recede, the saturated groundwater level drops and the value of surface water as a source of irrigation increases. As water is withdrawn from the rivers less is available for IWT, and navigability. During this period, many routes cannot be used.

During the dry season, the Ganges and the Jamuna, the Brahmaputra River which originates in Tibet and flows mainly through India, is named Jamuna River in Bangladesh rivers recede and the resultant *char* formations greatly hamper navigation on the main routes. This disturbs access to the river banks which seriously impedes the vital ferry operations. Rivers such as the Karatoa dry out during irrigation of the winter crops during January to May. This situation is compounded by an estimated 1.2 billion tons per year of sediment which is transported downstream and inadequate dredging (BIWTMAS, 1989: 69).

Tidal rivers are also deteriorating due to decreased water flow from upstream connectors. The areas flooded by tides have decreased due to empolderment which has further increased siltation. Upstream water abstraction for irrigation has led to increased salt water penetration inland causing loss of the tidal prisms; this has additionally compounded the siltation problems. Due to the low lying delta character of Bangladesh, tidal influence penetrates about 200 km from the sea coast. These effects can be summarised as follows:

- Abstraction of water for irrigation, industrial and domestic usage;
- Reduction of cross boundary flow;
- Silting of offtakes due to more intensive cultivation and deforestation; and
- Reduction in tidal volume due to empolderment.

The relationship between water depth and stream-flow depends on many factors. However, only 20 percent of the abstracted water eventually flows back, which is a constraint to navigation. The condition of many smaller rivers will further decline as long as water abstraction for irrigation continues.

D. The Ports, Shipping and Inland Water Transport Interface

Bangladesh still have no official shipping policy. However, it has been announced that such a policy is to be adopted by the Government with the following objectives, as supported by the Fifth Five-Year Plan (FFYP) investment plans for 1997 to 2002 (Independent, 1997a):

- Increase productivity and efficiency of the sea and river ports;
- Develop safety administration standards;
- Create more opportunities for IWT;
- Improve training facilities for marine officers and cadets;
- Procure adequate equipment for efficient container handling; and

- Identify areas where privatisation should be encouraged.

The overall investment plans in the maritime sector of the government under the Draft FFYP are shown in Table 7.

Table 7: Government Investment Programme for Water Transport (1997-2002)

Government Investment Programme	Cost (Billion Taka) (Tk 46 = \$1)		
	Ongoing Projects	New Projects	Total
IWT Dredging	0.5	0.1	0.6
Inland River Ports and Landing Facilities	2.9	0.9	3.8
Mongla Port Dredger	0.6	0.6	1.2
BIWTA/BSC Ferries and Other Vessel	0.9	0.8	1.7
BIWTC/BSC Vessel Rehabilitation	0.4	-	0.4
Chittagong and Mongla Port Container Terminals	-	5.0	5.0
Maintenance Dredging at Mongla Port	0.3	0.1	0.4
Other	0.3	0.1	0.4
Total	5.9	7.6	13.5

Source: GOB (1997a)

Note: Private sector investment of about \$1.0 billion is also expected for ocean going vessels, inland container depots and port facilities.

E. Inland Water Transport Organisation, Policies and Projects

1. Organisation and Inland Water Transport Routes

While MOS has overall responsibility for IWT, the Inland Ship Safety Administration (ISSA), under the Department of Shipping (DOS) was established in 1997 under the World Bank's Third IWT Project. The recently introduced ISSA, in addition to setting safety rules and regulations for IWT, is expected to handle environmental monitoring such as oil spills. However, nearly two years have passed awaiting the Government's approval of the necessary legislation, while the organogram and the entity currently exists virtually in name only (see Figure 2). The BIWTA, also under MOS, provides dredging services, pilotage and navigational aids, hydrographic services, management of inland ports and landing facilities, tariff setting for BIWTC and private operators, and training and research. The Bangladesh Inland Water Transport Corporation (BIWTC) is a Government owned and operated shipping company, providing ferry services at four major river crossings and operating passenger and cargo services in the coastal areas.¹

¹ The BIWTC has 274 vessels including 24 passenger vessels, 33 ferries, 8 tugs, 90 inland cargo vessels, 54 bay crossing cargo vessels and 65 ancillary vessels. Most of the fleet is inoperable (DANIDA: 1997).

Figure 2: MINISTRY OF SHIPPING:
ORGANISATION CHART

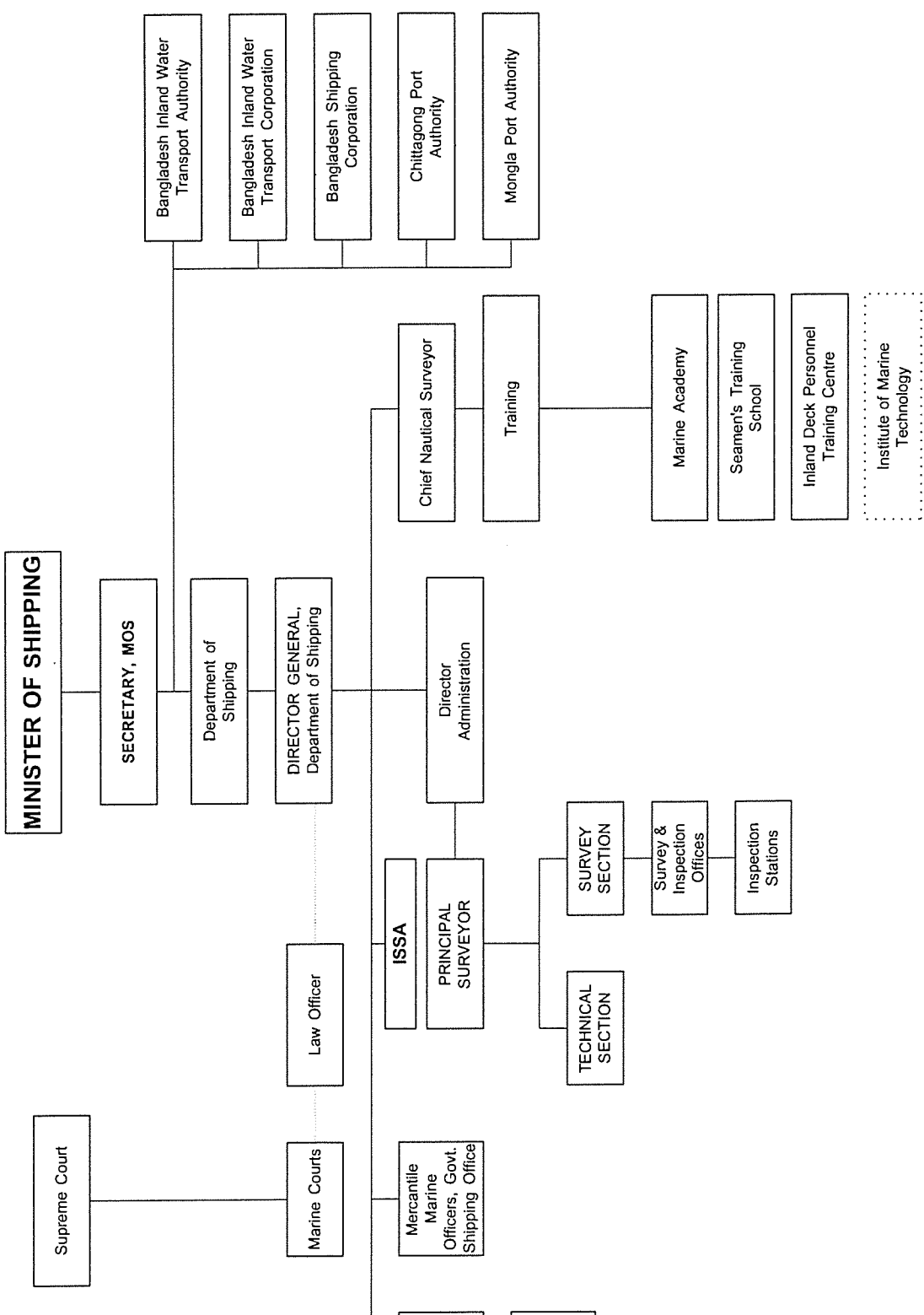


Table 8: Classification of River Routes in Bangladesh

Class of Route	Status	Least Available Depth (LAD) (metres)	All seasons Length (km)
I. Trunk Chittagong/Dhaka Khulna/Mongla/Narayanganj	Perennial	3.6-3.9	685
II. Transit Linking northeast and northwest regions to Class I.	Perennial	2.1-2.4	1,000
III. Feeder Routes	Perennial	1.5-1.8	1,885
IV. Feeder Routes	Seasonal	1.5	2,400
Total			5,970

Source: BIWTMAS (1989)

Eighty-six river routes totaling nearly 6,000 km have been classified by BIWTA into 4 types according to navigability and economic importance as shown in Table 8. However, due to siltation and neglect of maintenance dredging BIWTMAS (1989) estimates that about 500 km of these route lengths do not currently meet their class criteria, including the Kalni-Kushiyara and round Dhaka routes (see Chapter 4B and 5F). This is a disappointing trend, indicative of the ease in which lack of investment in IWT maintenance can go un-noticed in the short-term, unlike road maintenance neglect.

2. Development Policies

The main development policies of the Government affecting IWT are summarized by DANIDA (1997) as follows and taken up in greater detail in Chapter VI:

- Improving the waterways by dredging, navigational aids for 24 hour operations and development of inland container ports and rural landings;
- Improving the safety of IWT and the informal country boat sector;
- Promotion of the private sector in dredging, surviving and shipping; and
- Enhancement of operational and organisational efficiency for financial sustainability.

3. Development Assistance

The World Bank financed Third Inland Water Transport Project (IWT3) was approved in 1991 for a loan of \$45 million (World Bank, 1991). However, the Project has been slow in meeting its objectives for cost efficient management and the adequate supervision and enforcement of regulatory improvements, including those relating to the safety and environmental objectives of the ISSA. The IWT3 project addresses the improvement of waterways safety and environmental controls, and the effectiveness and financial management of BIWTA and BIWTC, improvement of BIWTA dredging capacity and productivity, and the provision of hydrographic survey equipment and landing pontoons. A country boat component addresses extension services for the informal IWT operators. Accordingly, progress will need to be made in meeting the present objectives, before an IWT4 project can take up implementation of the longer term institutional changes. To assist in this process over a 10-15 year horizon, Denmark has conducted an Inland Water Transport Sector Policy and Strategy Study (DANIDA, 1997).

Under the World Bank financed *Port Masterplan and Trade Facilitation Study* (MPTFS), in addition to the formulation of an investment and institutional development strategy for the port sector and more efficient linkages to the hinterland, improved port environmental management needs are also being identified. The MPTFS Report has been integrated with the Final Report of the ADB financed feasibility study for the Ports Efficiency and Access Project to be financed under ADB loan in 1998. A close accord has been established between Government transport entities, ADB, the World Bank, OECF (Japan) and other bilateral donors on the need for a common understanding on transport policy and investment objectives, especially for the encouragement of the private sector.¹

The ADB financed study addresses the short term investment needs of both Chittagong and Mongla ports. The objective is to help resolve severe congestion at Chittagong Port and to improve the efficiency and safety of navigation at both ports. The Project may also include the financing of equipment, facilities and advisory technical assistance to ensure that oil spill contingency planning and port environmental management can be conducted effectively (See Chapter 7, Part F).

F. Sub-regional Transport Route Development

1. Inland Water Transport

In spite of the political constraints on regional cooperation discussed in Chapter II, Bangladesh and the Indian states of Bihar, West Bengal and Assam could build on the *Protocol on Inland River Transport*, especially for transit cargo, and achieve distance savings of over 400 km to Calcutta, and about 800 km if using Chittagong Port instead of Calcutta. Under this agreement, Bangladesh can use the Indian ports of Calcutta, Haldia and Dhubri while India can use the Bangladeshi ports of Narayanganj and Mongla for inter-country trade. This agreement was first adopted after the partition of India and perpetuates historically important routes between Calcutta, Mongla and Narayanganj with links to India via the Jamuna River to Dhubri and the Kushiya River to Zakiganj in Assam. However, the route was closed following the border war between India and Pakistan in 1965. Although re-opened following the independence of Bangladesh in 1972, cargo volumes have gradually dwindled to insignificance due to siltation of the channels and a virtual absence of dredging. IWT improvements on the Karnaphuli River linking Chittagong Hill Tracts (CHT) with Mizoram, in India, would also establish a link between the southern areas of the eastern states of India and Bangladesh.

These plans could be realised through the following strategies: regular dredging, provision of improved navigational aids to facilitate navigation, encouragement of private sector investment in container river ports having 24 hour intermodal container terminals (ICT) located where road and rail links are suitably close to navigable rivers. Notable locations for ICTs could be at Dhaka or Narayanganj, Khulna, Dhubri, and Bhuapur near the Jamuna Bridge. All such ICTs would allow cost effective transfer of containers from Chittagong well into the hinterland, avoiding the congested urban area of Chittagong and the congested highway to Dhaka.

¹ Project programming and implementation is conducted in a fully consultative manner, including sub-sectoral local consultative groups to monitor and exchange views on policy and project implementation.

As revealed by the literature review for Europe, the incremental time required for carriage of containers by IWT over road, is negligible as far as the total ocean passage plus hinterland distribution is concerned, and can be effectively offset by lower IWT costs if economies of scale and efficient ICTs are provided. All of the above mentioned IWT routes are Class I or II, with available year-round depths of 2.5-3.5 meters under present conditions. These depths are similar to those in the Rhine River basin where container barge traffic employing modern technology has increased rapidly in the past decade.

2. Road and Rail Considerations

In the GBM region there are only three ports (Calcutta, Chittagong and Mongla) and Nepal and Bhutan are landlocked. Effectively, the latter two countries have access only to Calcutta and Haldia ports based on land transit agreements with India. In June 1997, a regional cooperation conference was held in Kathmandu where a transit route for Nepal via India and Bangladesh was agreed upon, using the East-West Highway in Nepal and across the 70km wide Indian corridor to north-west Bangladesh. However, potential for route development to expedite traffic flows via the Bangladesh ports require investment totaling about \$1.4 billion. However, such investment would also, and mainly, facilitate Indian trade (Brooks, 1997a). The new transit routes would offer the ports of Chittagong and Mongla as alternatives to the long-standing arrangement for the Indian port of Calcutta, which is congested. The present agreement, which focuses on road transport, became operational on 1 September, 1997 (*The Independent*, 2 September 1997). However, notwithstanding a lack of trade facilitation instruments, without implementing most of the other significant investment in bridges and improved roads in Bangladesh, it is unlikely that these ports can compete with Calcutta in the medium term, in spite of the inefficiencies at Calcutta (see Table 9). However, potential benefits include:

- Congestion at Calcutta Port would ease and competition with Bangladesh ports will increase port efficiencies;
- Nepal's exports and trade between Nepal and Bangladesh would also become more cost-effective;
- Bangladesh ports would receive increased revenue. While this requires increased port capacity, especially at Chittagong which is heavily congested;
- Existing port infrastructure at Mongla Port, which is closer to Nepal, is underutilised and could be upgraded at relatively low cost. This will be more accessible for road trucks after construction of the proposed Rupsha Bridge in 2003, following anticipated financing by Japan.

**Table 9: Investments to Facilitate Nepalese Transit Trade
(\$ million)**

Efficient Access to Mongla Port	Short Term	Longer Term	Efficient Access to Chittagong Port ^{d/}	Short Term	Longer Term
Rupsha Bridge	65 ^{a/}	170	Feni Chittagong Highway	60	
Mongla Rail Link ^{d/}	-	50	Double Rail Bhairab-Tongi	-	50
Paksey Bridge	15 ^{b/}	215	Dhaka-by-Pass	-	150
Mongla Port Upgrading	10 ^{c/}	25	Chittagong Port Development ^{e/}	40	200
Border Road Improvements	10 ^{f/}	10	Border Roads	(as for	Mongla)
Total	100	470		100	400

Source: Brooks (1997a).

- a/ Cost is for a two-lane road bridge only. A road-cum-rail bridge is estimated to cost \$170 million with a further \$50 required for a Mongla-Khulna railway connection. The latter has been found to not be viable in the foreseeable future (ADB, 1994).
- b/ Short term cost option for conversion of one of the two existing rail-lanes to a road-lane.
- c/ Comprising cargo handling equipment, container storage facilities improvement, harbor dredging, navigational aids and least cost river training work.
- d/ Rail links to the border with India and to Nepal could be via Biratnagar.
- e/ The short term investments would optimise the use of existing port capacity, while the longer term investments would be for construction of additional container berths at the adjacent New Moorings site in Chittagong and by the private sector at Patenga Point.
- f/ Estimate only

While the transit agreement focuses on road transport, rail transit opportunities are a feature of the ADB financed *Jamuna Bridge Rail Link Project*. While rail is more energy efficient than road transport, it also requires major investment in bridges and drainage structures, as well as land acquisition and resettlement. From Table 8, none of the required investment costs in road infrastructure are necessary for the transport of Nepal and Bhutan cargo by IWT, only a suitably equipped ICT at Dhubri, which has present navigable depths of about 2.0 meters and no low bridge constraints.¹ The Joint Rivers Commission (JRC) could be a potential coordinator for sustainable GBM management. However, its achievements have so far been minor and fragmented due partly to insistence by India that all agreements relating to water sharing should be negotiated bilaterally, as discussed further in Chapter 4.

¹ The Jamuna Bridge, completed in June 1998, has a minimum air draft of about 12 metres during the monsoon flood and about 16 metres during the dry season. Regulation of IWT will be necessary due to the serious consequences of any damage to a gas distribution line to be hung below the bridge deck.

CHAPTER IV

WATER RESOURCES DEVELOPMENT IN BANGLADESH

A. Background to Water Resources Development and Policy

1. Geographical Context

Bangladesh is the lower riparian country of the 1.5 million square kilometer (sq. km.) GBM basin which has an average combined mean flood discharge of over 112,000 cusecs (GOB, 1998a: 6). The area has a total population of over 600 million which is growing at over 2 percent per year and has an average per capita GNP of only \$250. It is the twelfth largest basin in the world, with the fourth largest discharge and the highest quantity of sediment transported (GOB, 1998b: 2-4). 5 countries, Bangladesh, Bhutan, the PRC, India and Nepal, compared with 2 for the Mississippi and 12 for the Danube share the water resources (see Table 10).

Table 10: World International Rivers

River	No. of Countries	Catchment Area		Annual Runoff	
		(000km ²)	Rank	(km ³)	Rank
Danube	12	810	12	200	10
Nile	10	2,960	4	30	12
Niger	10	1,210	9	192	11
Zaire	9	3,820	2	1,250	2
Zambesi	8	1,200	10	223	9
Amazon	7	6,150	1	6,300	1
Lake Chad	6	1,910	6	-	-
Aral Sea	6	1,618	7	-	-
Mekong	6	790	13	470	5
La Plata	5	2,830	5	470	5
GBM	5	1,480	8	971	3
Mississippi	2	3,270	3	580	4
Indus	2	970	11	238	8
Irrawddy	1	430	14	428	7

Source: GOB (1998b) :1

Bangladesh, with an area of 144,000 sq. km comprises the world's largest delta through which the combined discharge flows. A total of 53 rivers enter Bangladesh from India, either as distributaries of the GBM or as rivers emerging from the Meghalaya Hills of Assam or other smaller rivers (See Map in Appendix 1). Of the 3 main rivers, the Brahmaputra, has the highest annual run-off of 537 km³ (49 percent). The Ganges has an average run-off of 501 km³ (46 percent) and the Meghna, 59km³ (5 percent).

The rivers are sustained between June and September by the south-west monsoon and by Himalayan snowmelt over a longer period. Between November and March the discharge rate reach a minimum, marked by low rainfall and winter locked snow in the Himalayas, accompanied by severe water shortages. The high monsoon rainfall

also gives rise to local runoff and ponding within Bangladesh. Major changes in river courses occur in Bangladesh, which are attributed to major floods, the most recent of which occurred in 1988 and again in August-September 1998¹. The flood inundated two-thirds of the country and caused nearly 2,500 deaths (USAID, 1990). Lateral erosion of the channel banks and braided shoals (*chars*) of the channel occurs throughout the year and is a major cause of landlines and stress among the rural poor, in a country which has an average population density of over 800 per sq.km (Itofer and Messerli, 1997:19). This is an increasing problem given that the over 120 million population of Bangladesh is expected to double by 2050 (UNDP, 1996).

The GBM region has a limited area for cultivation and it is necessary to increase the land unit yield through irrigation. The total amount of water that can be stored in reservoirs to be built in the future is estimated at about 240 billion m³ (GIF, 1997: 3). While most planned reservoirs are in the mountainous regions of Nepal, Bangladesh, while generally fertile, has only marginal potential storage due to the lack of suitable valleys and very low gradient of rivers. Only about 1,000 km of the major river channels, possibly augmented by high cost dredging and barrage construction, offer a source of water storage in the country, sufficient only to balance demand over a few weeks of the leanest period, in March (GOB, 1998: 4). The low gradient of rivers also makes the country vulnerable to cyclone induced flooding. Tidal surges of up to 4 meters occur above the normal high tides of about 3 meters produced by pre and post monsoon cyclones in the Bay of Bengal. In 1970, these caused the loss of about 225,000 lives and a further 150,000 lives in 1991. Storm warning improvements in the past few years have been able to prevent such losses. Crop losses due to these floods also occur, exacerbated by saline intrusions. Reduced dry season flows due to abstraction of water in India and Bangladesh for irrigation also result in saline intrusions, accompanied by ecological damage. However, especially in the coastal areas, including the World Heritage Site of the Sundarbans Reserved Forest, ecological adjustments to a certain measure of salinisation is a feature of the delta, where normal tides penetrate over 200 km inland.

2. Demand for Water Resources

The concentration of 80 percent of rainfall within the 5 month wet season from June to October, when rainfall is more than double evapo-transpiration, is compounded by dry season rainfall of less than one-third potential evapo-transpiration. While the rivers provide marginal storage capacity, the deep alluvial strata of Bangladesh provide a natural reservoir which can be drawn down in the wet season. This is tapped by villagers for drinking water and by farmers for irrigation. However, abstraction costs rise with depth and river abstraction is also resorted to in the dry season. It is estimated that only about 20 percent of abstracted water returns to the river channels, leading to further reduced channel flows during the dry season which additionally impedes navigation and increases saline intrusion. As population and use of HYV rice by the dominantly rural population increases, this problem is certain to become worse, including the vicinity of urban areas where there is high municipal demand for water². Industrial expansion and loss of productive land for infrastructure, including roads, will also lead to increased

¹ Floods in Bangladesh are a complex process involving the synchronisation of separate river flows in the GBM, short term discharge peaks of the Brahmaputra and from the Meghalayan Hills, rainfall within Bangladesh and spring tides (Itofer and Messerli :12 – 27).

² While only about 20 percent of the population is currently urban. The urban rate of population increase is more than double that of rural areas due mainly to migration. Dhaka is expected to increase from about 9 million at present to about 20 million by 2010 (ADB, 1996a).

recourse to irrigation for agriculture to meet increased staple food demands, namely grains, with demand growth for rice expected to increase by 1.5 percent per annum to 2015. By 1997, over 1.2 million shallow tubewells wells were in use and deepwalls for larger scale agriculture are also increasing (GOB, 1998c: 10-11). By 1993-4, HYV represented 40 percent of the *aman* crop and 90 percent of the *boro* crop.

A key concern is the extent to which shallow tube well growth for irrigation, which has doubled over the past decade, can be sustained, since deep tubewell (force-mode) technology is too expensive to be used for boro cultivation by most farmers. Fisheries are also an important consideration and provide about 80 percent of animal protein for the population. There is increasing concern over the impact on this resource of salinity, empolderment and use of herbicides for high yielding varieties (HYV) of rice. The herbicides also degrade topsoil quality and cohesion, leading to soil losses and poison the inland fisheries.

3. Water Resources Policies and Plans

Following independence in 1971, water resources development was embodied in the series of five year plans, culminating in the present Fifth Year Plan (FFYP) 1997-2002. However, it commenced with a United Nations assisted plan following the floods in 1954-56. The East Pakistan Water and Power Development Authority (EPWAPDA) was set up in 1959 and continued under the Bangladesh Water Development Board (BWDB) after independence. In 1983, the National Water Council was established as the interministerial body responsible for policy formation and regulation of the sector. It created the Master Planning Organization to prepare a National Water Plan (NWP), of which the Phase One (NWPI), was completed in 1986 and Phase Two (NWPII) was completed in 1991.

While the earlier plans concentrated on irrigation, large scale development could not proceed with confidence due to construction of Farakka Barrage, in India, in 1974. As no long-term treaty was negotiated until 1996, there was no assurances that major investment would be secured from diversion of the Ganges water.

The NWPI and NWPII set out projections of resources and demands for 20 years, namely 2005 and 2010, respectively. The plans were based on estimates of the net cropped area and irrigable area in 5 regions of Bangladesh, plus the available ground and surface water resources. The NWPI envisaged the construction of barrages on the Ganges and Brahmaputra starting in 1993 and with completion in 2018. Shorter term strategic plans focused on minor irrigation schemes, flood control and drainage. The NWP II also envisaged barrage construction. Regional studies were conducted in parallel with NWPI, taking into account potential sharing agreements on transboundary rules to 2025. All of these, including NWPI and NWPII, regarded IWT requirements, and other non-agricultural development and protection needs, as secondary concerns.

After 40 years of water resource planning efforts, data collection and recognition of the complexities involved, the vision of a long-term sustainable system has been embodied in the objectives of a National Water Management Plan (NWMP) (GOB, 1996). The plan is being prepared over a three-year period commencing in late 1997. Under the plan, it is recognised that developing an enhanced capacity to undertake planning, using a multi-sectoral approach based on environmental sustainability and people's participation, cost recovery and institutional strengthening (GOB, 1996: 6). Huq.

S. (1998): 6, has referred to a need to shift in the NWMP from a former participatory process comprising beneficiary monitoring in water resources development to a new paradigm. This would involve a regional and national rather than project perspective, where people are consulted from the outset with respect to priorities. A fundamental need is more reliable estimates of both ground and surface water availability. While 1991 estimates under NWP indicated a net surplus of 1.4 billion cu.m of groundwater in 2010, after considering domestic, industrial, agricultural and IWT requirements, more recent estimates indicate that actual usage has been greater than expected (World Bank, 1997:VII). This is coupled with the mentioned concerns regarding the cost of force-mode systems and a recent discovery that deep well extraction is accompanied by wide spread arsenic poisoning placing about 30 million people at risk (Majumder, 1997) and possibly 80 million (Steinberger, 1998: 9). It is believed that the arsenic is the result of geological processes but since these layers are being tapped it has emerged as an environmental and social issues with some wells having 200 times the WHO safe level of 0.01 mg/l UNICEF, 1997: 23).¹

Optimal water resource planning is now also seen as not only a multisectoral issue but also balancing regional diversity in Bangladesh in terms of hydrological processes. This raises the issue of establishing water rights for different users and their projected needs.

In spite of the inevitable problem of increased dry season abstraction of river water for irrigation, the NWP's objective towards navigation complement those of BIWTMAS, to allocate sufficient water discharge for smooth navigation. Recommendations in NWP I included the allocation of 40 percent of the regional river discharge to navigation and fisheries combined, 59 percent to agriculture, and the remainder to urban water supply and industries. However, there is little information on how these shares were determined or if they are sustainable (NWP 1991: 2-19).

4. Flood Action Plan and Inland Water Transport

(a) Background

Synchronisation of flood peaks at the end of August 1988 of the Ganges, Brahmaputra, Meghna, backwater effects upstream of their confluences and spring tides in early September 1988 which impeded flood recession, were a rare event and surpassed all previous records. However, a similar event also occurred in 1987 (GOB, 1988: V), and the floods of 1998 are more serious than in 1988 due to their longer duration.

Catastrophic damage to crops, roads, railroads, towns and villages, fisheries, livestock and extensive loss of life in 1988 made it imperative that a comprehensive flood protection program be undertaken. Initially a Flood Policy Study was undertaken by the government and UNDP. Later, experts from France and Bangladesh prepared a *Pre-feasibility Study of Flood Control*. USAID, Japan and the ADB also

¹ One of the ironies is that since independence in 1972, UNICEF has assisted and encouraged, through education programs, the use of well water in Bangladesh to avoid the use of contaminated surface pond water for household use. With 97 percent of the population now using well water, reversing the trend in favor of treated surface water will be difficult (Steinberger, 1998: B13).

assisted in these studies. Under World Bank coordination, FAP aims and policies were gradually widened in the 1990s to encompass a water resources management strategy.

Flood Action Plan (FAP) studies since 1989 have progressively widened to help provide not only a long term plan for flood control but also, drainage, which would be appropriate technologically, environmentally and socially. The principle is that the plan should work harmoniously with other aspects of water management in terms of long term development goals and the needs of the people. However, there are many continuing examples of villagers making 'public cuts' of embankments to avoid unwanted ponding or restricted normal flooding to facilitate agricultural or fisheries nourishment or boat access.

Each region of Bangladesh has unique differences in demand for water resources. Thus, regional studies were undertaken as the building blocks of the FAP. To better coordinate the potential and pitfalls of developing an area, more generalised studies were also carried out to complement the regional studies. These deal with issues related to the environment and social aspects. The five regional studies are: FAP 2: North West Regional (NWR) Study; FAP 3: North Central Regional (NCR) Study; FAP 4: South West Regional (SWR) Study; FAP 5: South East Regional (SER) Study; and FAP 6: North East Regional (NER) Study.

Flood control is the decisive factor of the national water management policy enshrined in the FAP and the regional studies have led to better planning and design of flood control structures like empolderments and sluice gates. Many such structures were also constructed in the 1960s without the benefit of studies, often resulting in drainage problems. The historical context is also compounded by road and rail construction directly across the general north to south drainage pattern. Ideally, the planning should also incorporate the IWT sector and not hamper navigation. Unfortunately, this is not always easy and the FAP studies gave priority to embankment construction on the main rivers and extensive training works on other rivers, accompanied by extensive dredging and improved flood forecasting. A complex management structure has led to delays in studies and the implementation of projects.

To study the effects of flood control works on river morphology, FAP 24, River Surveys Project, was divided into two phases. Phase One, a hydrological study, was completed in 1992. Its objectives were to improve hydrological data collection, analysis, quality control, establishment of a database and determination of relevant study topics for Phase Two. Phase One has established the database with a long-time series of historical data for the main stations of the major rivers. This will continue in Phase Two. A Morphological Impact Assessment Study for the main river system has been started and will also look into the problems of IWT.

In spite of these comprehensive efforts, some Non-Governmental Organisations (NGOs) and individuals consider that several components of the FAP are not sustainable by depriving flood plain areas of rejuvenating nutrients, contributing to salinisation, eutrophication, and having adverse social impacts. It is also suggested that some flood protection components favor high income members of urban communities. (Adnan and Sufiyan, 1993; Hughes, Adnan and Dalal-Clayton, 1994; Haggart, 1994; Research and Advisory Services (RAS), 1995 (a) and 1995 (b).

It has also been suggested that merging of the FAP with the NWP was a strategy to divert attention from shortcomings in the FAP (RAS 1995a: 10). Nevertheless,

the FAP has widened from flood control and mitigation to a comprehensive water resources management perspective. The hydrological, social, cultural and environmental elements of the FAP are complex and open to inevitable debate. Many of the criticisms have been branded as imaginary (Assafaddoula, 1993: 2). However, there has been an acknowledgment by the FAP coordinators that more active participation of local communities in the FAP was warranted at the outset (Government of Bangladesh and World Bank 1992: 45; RAS 1995b: 26 and 34). Consequently, the need for detailed participation led to a pilot study under CIDA financing of FAP 6. The pilot study approach has proven useful and has revealed a need to continue monitoring in 1998-9 at the two pilot study villages (see Section-D).

(b) Weaknesses of the FAP

The World Bank (1997:19-21) has outlined the following FAP weaknesses :

- Major criticism against embankment construction are: (i) loss of land needed for embankments; (ii) breaches due to river erosion; (iii) adverse impact on fisheries by eliminating flood water penetration; and (iv) possible downstream flooding.
- Most FAP studies do not adequately consider the role of sediments in their preservation of the delicate physical delta system;
- River embankments and polders prevent sediment spreading and compensating what is a generally subsiding area, as the result of tectonic adjustment of movements in the Indian Plate, the eastern folded belt, and the Himalayas;
- While the FAP has shifted from flood protection to integrated water management, the role of groundwater was not properly considered and the full water potential was not determined;
- No acceptable method was developed to ensure ecological balance between the wet and dry seasons. Under the FAP, it was confidently expected that EIAs under each project would be adequate; and
- As frequently encountered under complex research carried out by many entities over a long period, there was insufficient synchronisation between the 27 FAP component studies.

(c) Lessons of Flood Management

In spite of the weaknesses the FAP has revealed the following lessons:

- Both structured and non-structured interventions may contribute to flood control, as well as water management generally;
- Improved flood forecasting, disaster management and floodplain zoning can make important contributions to integrated water management;
- Sound embankments can be important to the integrity of urban areas and controlled flooding in rural areas;
- River bank protection works have social benefits as refuge areas against flooding, and can safeguard water management infrastructure;
- It is important to ensure a fair share of water to all users during the dry season;

- Improved conveyance of flood flows and enhanced land reclamation can also contribute to improved management of the flood prone delta;
- It is important to maximise beneficiary participation in projects and to develop the institutional framework; and
- Adherence is vital to EIA and other guidelines on project assessment and participation.

5. National Water Management Plan

The ongoing NWMP, which is financed by the World Bank, has a formidable task. The World Bank recommendations include:

- Taking stock of total water availability, making use of the FAP findings and the Ganges Accord (1997) with India;
- Estimating projected total water needs reflecting corrections of the NWP projections;
- Selecting ecologically sensitive flood protection measures with synergistic linkages to diverse economic activities;
- Designing policies for integrated water resource management, including water-use rights, assignment of responsibility for water quality, and public-private sector sharing of operations and maintenance (O&M) responsibility; and
- Developing institutions and a legal framework to support the policy, planning and operational framework for integrated and non-conflicting water resources management.

Water management revolves around the wet and dry seasons, for which separate management strategies are needed. In the wet season, water management has to deal with flood protection, proofing and drainage. While agriculture, settlements and urban areas require flood protection, agriculture also needs the rejuvenating silts and photosynthetic process which occur during floods. Fisheries and IWT also depend on flooding, and conflicts arise. A solution is possible in terms of optimising society's needs by assigning water rights on a user pay principle. This approach requires that local community group interests are recognised and where overall policies are reflected in appropriate laws and regulations to prevent exploitation by interest groups. The FAP studies have provided valuable lessons to guide policy and planning on these lines.

In the dry season, the critical tasks are the provision of adequate municipal water supply, addressing ecological concerns, providing for irrigation and maintaining minimum depths for IWT. These concerns focus on the cost and availability of groundwater extraction, and the promotion of private sector investment and farmer, municipal and IWT user participation in meeting operations and management (O&M) and capital cost recovery.

Meeting these concerns requires an institutional framework which government authorities have not provided. The Water Resources Planning Organization (WARPO) has been established to undertake policy and sector planning. This, and the BWDB, need to provide for the private sector to assume as much responsibility as possible and shared responsibilities with grass root organisations. These concerns control the NWMP strategies in the period to 1999.

B. International River Basin Management

South Asia has 21 percent of the world's population but generates only 3.4 percent of the world's income. In the past, economic cooperation among the GBM basin countries has been limited, due mainly to historical political reasons (see Chapter 2, Section B). Another area which can be harnessed is the abundance of natural resources such as forests, minerals and Himalayan water. While Bangladesh and India signed a 30-year bilateral water treaty in December 1996 on sharing the Ganges River water, the treaty is rather ineffective due to the general lack of water flow in the lower Ganges during the dry season due, at least in part, to the abstraction of water by India for irrigation. India has also been reluctant to consider a tripartite agreement to include Nepal or the possible storage of water higher in the basin by construction of a high-basin dam in Nepal. While high-dam construction also carries ecological and social risks, the GBM basin is especially endowed for beneficial intra-regional projects involving hydropower, flood prevention, IWT, ecological watershed management and reforestation, with the latter contributing to reduced siltation in Bangladesh (ADB 1997b; World Bank, 1997). These advantages should be examined in detail for a range of technical and managerial solutions.

With the help of the Ford Foundation, India, Bangladesh and Nepal are looking into potential areas for cooperation on complementary water management schemes. An international seminar in March 1998 sponsored by Japan, ADB and the World Bank considered its future and highlighted progress made in the Greater Mekong Sub-region which identified a river transport and port improvement projects (ADB, 1994). The Mekong projects identify the areas which need developing to form a workable regional network of energy grids, roads, railways, telecommunications and IWT. While water resource basins have individual characteristics and user needs, the Mekong studies, illustrate a potential for similar efforts in the GBM basin. The rivers of the GBM region carry 214 million hectometers of water to the sea. To harness the potential benefits, the following objectives have been identified (ADB, 1997b):

- Development of the GBM rivers and their tributaries;
- Cooperation in the fields of environmental management, tourism, establishment of export processing zones and human resource development; and
- Development of roads, railways, ports, IWT and telecommunications networks.

Policy dialogue and institutional arrangements in Bangladesh alone will not solve the GBM issues. Without putting all projects in the region on a more participatory basis, where local communities are fully involved in the analysis of their own soil and water conservation problems, sustainability will be sub-optimal (Hinchcliffe, 1995). The socio-political aspects of upper GBM basin use and interference with the water resources, and the competency and accord among local authorities responsible for river basin management, are the most significant uncertainties for sustainability of the project, particularly with regard to India's possible intention to construct the Timaipukh Dam, which could have unknown impacts on the project.

The World Bank's environmental guidelines, that it uses as in financing projects on international rivers, would be a useful basis for policy and legislative dialogue among the riparian countries of the GBM basin. The guidelines require that a country

undertaking a project notifies other countries in the basin with the aim of ensuring that they are not harmed. In the longer term, a mechanism has to be developed to enforce the rules for preventing and mitigating transboundary damage. The United Nations should have the mandate to perform this task (Rasheed, 1994: 34). The Helsinki *Convention on the Use of Transboundary Watercourses*, signed in 1992, would also be a useful framework to adopt (Rasheed, 1994: 30). The problem for Bangladesh is that it is the lower riparian country while India, as the main upper riparian country, has far greater economic independence. To help solve this issue, influence of the United Nations and international donor community should be applied.

C. Kalni-Kushiyara River Management Project

1. Background

The Project area is in the two-million sq. km GBM watershed (see Appendix 3). The monsoon and Himalayan snow melt runoff which drains the region is both seasonally and geographically skewed, and about 95 percent of the water which enters Bangladesh originates outside of the national boundaries. As illustrated by devastating saline intrusion and desertification downstream of the Farakka Barrage, constructed by India in 1977 about 30 km from the border with Bangladesh, and the uncertainties concerning the possible Timaipukh dam about 200km upstream of the Project area, there is hardly any joint management of the natural watershed resources among the riparian countries (Ahmad, Q. K. 1994: 12). Moreover, excluding Tibet, in the PRC, the region contains about 0.6 billion people of which about 20 percent are in Bangladesh and 75 percent are in India, with Nepal and Bhutan having the remainder. Collectively, the region contains nearly 50 percent of the world's poorest people who rely on agriculture and water resources as the mainstay of poverty reduction efforts (Ahmad: 3). Nationally oriented efforts to distribute water resources more equally among these populations between the monsoon and dry seasons is a major concern to the four countries.

This reliance upon water resources, the devastating results of deforestation high in the watersheds affecting runoff and sedimentation in Bangladesh, control the most important environmental, social and economic concerns which govern the overall sustainability objectives of the project. Nevertheless, there is much that Bangladesh can do on its own (Haggart, et al. 1991: 19) and the project is the first example in Bangladesh of a mainly a dredging oriented approach and beneficial use of dredge spoil which could achieve sustainable benefits for both rural communities and national transport services.

2. The Project Area

The annual normal flood (*borsha*) in Bangladesh, between June and October, is associated with the monsoon which pours up to about 10 meters of rain and Himalayan snow melt each year into the GBM river basin. These make the land fertile by providing moisture and fresh silt which is vital to crop production and the spawning of fish species. Bengali peasant life is keyed to this predictable event that sustains rural livelihood and culture (Zaman, 1993 : 987). The destructive impact of normal flooding is limited by cropping patterns and settlement adjustments. However, abnormal floods (*bonna*) occur frequently, bringing severe loss of life and destruction to standing crops and infrastructure. Even in normal floods, river bank erosion causes the displacement of many subsistence based communities. In a country where average population density is nearly

800 per sq. km. and population growth exceed 2.5 percent per annum, this is a major and underrated problem (Adnan, 1991 : 63; Zaman, 1996 : 691).

In the project region of the bowl-shaped 6,000 sq. km. Sylhet depression, river bed siltation has increased over the past three decades. This is due mainly to upper basin deforestation, drainage congestion resulting from urban infrastructure, road construction, the compartmentalization of water bodies for agriculture and fisheries, and a natural/man-induced avulsion on the Markuli River which resulted in some 15 million cu. m. of silt being catastrophically introduced into the river system. As a result, not only have monsoon floods become more devastating, but pre-monsoon flash floods have increased and post-monsoon drainage has become slower in the area, where the normal floods, which persist continuously over the six-month monsoon season create a virtual inland sea of about 300,000 ha. These normal floods limit primary agricultural production to a single planting of *boro* dry season rice during a shortened flood risky dry season.

Distinctive among other regions of Bangladesh, pre-monsoon floods risks occur in the project area between March and May and last up to two-weeks. These destroy the pre-harvest *boro* and impact disastrously on the 1.9 million population in the area. Population density in the project area is 565 sq. km, and while low compared with the overall average in Bangladesh, population density is increasing and more than 55 percent of households are landless agricultural workers on the average 1.1 ha owner occupier farms. Fifty percent of the population are in hard-core poverty (less than 1,805 calories per day). Average annual net farm income, excluding the approximately Tk 10,000 (\$240) value of food production, is only Tk 15,000 (\$350). Of this total, about 80,000 people, in 50 villages, live within 100 meters of the river bank, and would also benefit directly from river stabilisation due to reduced bank erosion (CIDA, 1997 : E.27-63).

The river bed siltation has not only increased river bank erosion and channel instability but has also filled in important fishery scour holes (*duar*). Without the project, it is predicted that the lower Kalni-Dhaleshwari River will be abandoned, along with major erosion and sedimentation problems on the Baulai river. The Cherapur Khal is consequently expected to enlarge further and form a major distributary channel. This would induce bank erosion and add an extra sediment load of about 15 million tons to the Baulai River. Downstream from the diversion, the Kalni River flows would be reduced, especially during the dry season.

The beneficial use of the dredge spoil to construct or strengthen village platforms has a major social value and is an innovation not systematically adopted in the past. The past and existing policy of BWDB and BIWTA, apart from one relatively unsuccessful attempt by BIWTA on the Kushiya River, is to dump dredge spoil back into the river where it is expected to disperse naturally. Under existing arrangements, the two river closures at Markuli and at Beramohomna, erected on the Kalni-Kushiya River to control flooding, seriously hinder cargo and passenger traffic. In both places, the barrage is a barrier to navigation for almost 10 months of the year, while protecting the *boro* crops from pre-monsoon and monsoon floods.

Navigation has also been progressively impeded over the past three decades due to gradual siltation and lack of maintenance dredging. The river is a key part of the now silted and almost insignificant IWT route linking north-east Bangladesh with the rest of the country and forms part of the international IWT route linking Assam, in eastern

India, with Calcutta. This is permitted under the bi-annually renewed *Protocol on Inland River Transport and Trade*. Locally, the river and its many *khals*, provide the only means of transport for cargo and passengers between the *haors* and five market centers along the river, as the monsoon season deep flooding of the lower Kalni-Kushiyara basin precludes road construction. Most villages in the project area therefore depend on the river for the transport of jute, fertiliser, cement, molasses, wood, sand and boulders averaging 210,000 tons per annum in and out of the 5 market towns along the river. Without the project, dry season traffic in and out of the flood plain area would be possible only through the Baulai River and via Sherpur, by bullock carts or head loads (CIDA, 1994: 33-36).

Historically, the Kalni-Kushiyara River was a Class I navigation route throughout the year, with a least depth of 3.6 meters. However, due to siltation, the river currently drops to Class IV (0.9 meters) during the second half of the dry season, which is a severe limitation on the economies of scale and reliability of IWT. The situation could be further affected by the proposed Tipaimukh Dam construction in India, on the Barak River¹.

3. Scope and Implementation Schedule

The project aims to virtually eliminate the risk of pre-monsoon floods, hasten post-monsoon drainage, improve agriculture, fisheries and navigation, stabilise the river and help to sustain village communities. This would be achieved by: (i) river training and two loop cuts to stabilise sinuosity and avoid a potentially disastrous natural avulsion, reducing the river length by about 7 km to encourage bed scouring; (ii) upgrading monsoon flood submersible embankments; (iii) channel and shoal dredging; (iv) use of dredged material to increase the size and elevation of about 40 village platforms (VPs) to a height of about 5 meters above the surrounding flood plain, and construction of about 40 additional VPs during the post construction O&M phase of the project; and (v) provide boat landings. Total capital dredging and excavation would be 14 million cu. m. The proposed VPs, each aimed to sustain about 150 households, would have an average size of 3.2 ha, each requiring about 0.2 million cu. m. of dredged material. Some of the VPs would cater to currently landless people in the project area. The balance of 5.5 million cu.m. of dredged spoil would be used for river improvement works over the approximately 100 km length of river in the project area (CIDA, 1997: 49-54). Social workers and gender specialists in the two pilot study villages are expected to provide a useful understanding of potential refinements to the project over the period 1998-9.

With completion of the feasibility study and a pilot study in December 1997, the *Kalni Kushiyara River Management Project* has been programmed for ADB financing, the project would be implemented over 9 years, following the pilot study conducted in 1994-7, which will continue to be monitored in 1998-9 and subjected to a study of the cost recovery and institutional sustainability aspects under an ADB financed technical assistances in 1999. Detailed design, tendering of dredging and land acquisition would be completed in the year 2000. Dredging operations would commence in the year 2001 and net benefits should commence by about 2006 and have been calculated over a project life of 30 years.

¹ The Kushiyara River becomes the Barak River in India.

4. Anticipated Benefits

The expected benefits from the project relate to agriculture, navigation, protection of existing and new homesteads, fisheries and wetland habitats, reduced migration to urban areas elsewhere in Bangladesh and improved socio-economic conditions. Dredging spoil will be used to construct the VPs. The location of the villages would be limited by the ability to pump dredged material from the river bed to up to about 0.5 km from the river bank. Under the pilot study, two existing villages near Ajmiriganj, namely Gazaria and Kakailseo, were selected, and a total of about 300,000 cu. m. of fill was completed in June 1996. An evaluation of erosion protection options has been carried out, together with participatory planning of new land use for the extended platform area of 3.3 ha at Gazaria and 3.1 ha at Kakailseo. Based on historical data and the hydraulic model developed under the pre-feasibility study, the channel has aggraded by about 1.0 million cu.m. per year over the period 1963 to 1988. Annual post project aggradation in the project area is expected to be about one half of this volume. Maintenance dredging will therefore be needed if the project is to be sustainable.

5. Environmental Aspects

The environmental aspects affecting sustainability of the project are the local impacts of dredging and excavation during implementation, and the longer term local and possible off-site impacts, resulting from the altered hydrological conditions and land-use. These have been examined under an initial environmental examination (IEE) and a literature review and a sediment/water quality investigation by the Bangladesh University of Technology and Engineering (BUET). In addition, the ongoing dredging operations of BIWTA have been examined to deduce appropriate maintenance dredging monitoring methods. The sediments are uncontaminated alluvium, comprising mainly quick settling sand. The confined disposal on land will be generally beneficial if cutter-suction dredging and pipeline disposal methods to dike reclamation sites are adopted, as in the pilot study. Negative impacts will occur only if disposal occurs on productive wetlands, which can be avoided. Care will also be needed to avoid causing turbidity problems. Control of the cutter suction head and the disposal and settling rate within the dikes, and planting of vegetation near the sluice discharge pipes have avoided significant adverse impacts to fisheries and wetlands during the pilot study.

About 800 ha will be required for disposal of dredged spoil and river straightening. This will cause a medium-term loss of cultivable land. Topsoil recovery and extension of homestead gardens on the reclaimed VPs will offset this loss in the medium term, especially if sand tolerant grasses and vegetables are planted and cow dung is used to develop the VP soil profiles.

The wetland impacts are difficult to assess. The project area contains many important perennial wetlands (*hoars* and *beels*). These provide a diversified habitat of nearly 20,000 ha for wetland flora and fauna, including sedges and meadows, turtles, and many migratory birds, such as adjutant storks, steppe eagles, ospreys, sandpipers and various duck and geese species. Human interference from irrigation, ponding for fisheries, and poaching has already impacted adversely on these areas. This problem could be addressed under the existing *Convention on Wetlands of International Importance, Especially Waterfowl Habitat, Ramsar, 1971* (IUCN, 1996). The project is not expected to have significant impact on the normal monsoon seasonal flooding, and will have positive environmental impacts by reduction of the pre-monsoon floods.

6. Social Aspects

The field discussions confirm that pre-monsoon flooding and destruction of the *boro* rice crop is the most important problem facing the local communities. Drainage congestion which delays the *boro* planting is the second most important problem, while erosion due to monsoon season wave attack on homesteads and the negative affects of siltation on fisheries are also viewed seriously.

Apart from ensuring that VPs are each constructed during one dry season, before floods can destroy the new dike earthworks, institutional concerns are also a major risk for sustainability of the VPs. This applies not only in terms of equitable land use, but also for least cost using community labour and local renewable materials. So far, the villagers have failed to organize themselves adequately under the pilot study. However, it is noted that individual homestead lands on the flood plain extend in strip form away from the base of the village platforms. Discussions with the villagers have examined whether individual responsibility for platform slope maintenance, for the width of each land holding, would be acceptable.

Navigational impediments and near closure of river ports such as Ajmiriganj are also considered problematic by residents in the project area. The participatory discussions reveal a strong interest in the use of dredge spoil to systematically raise the VPs as community resources are not adequate to implement this opportunity on a sustainable basis. From the participatory discussions, it is also anticipated that risk reduction from pre-monsoon floods due to the project will help to avoid growing landlines in the area. This will also offer livelihood choices other than migration to already overstressed urban areas, especially Dhaka.

To withstand wave erosion during succeeding monsoon floods, low-cost options are being experimented, such as placing locally manufactured bricks, planting wave energy absorbing *targah* (a type of water hyacinth), placing bamboo fencing with a mat of *challa* grass against the earth slope, and planting a wave screen of fast growing trees and grasses a few meters from the slope toe. This is accompanied by community based enforcement efforts to prevent animal grazing on the embankments.

Land pressures are such that villagers participating in the pilot study have been slow to recognise the value of tree screen planting which itself occupies a few metres of valuable land. Experiments are being made using *hijzal* and *koroch* grasses which can be harvested to make income earning mats which have been used traditionally as a fish aggregating device. Moreover, the *challa* grasses can also be recovered after rotting and combined with cow dung for use in the green manuring of the mainly sandy dredged material of the VPs. The pilot study villagers were not sufficiently well organised to combine their resources for effective recovery of topsoil prior to the in-filling operations. Further institutional problems have emerged due to conflict between village groups and land-grabbing of the newly completed raised platform areas by powerful individuals in the two villages. As a result of the VP extension at Gazaria, it has been decided by the village council to incorporate a designated area for soccer, which would also be usable for *boro* drying and emergency storage of harvest should flood warnings allow. There is concern, however, that the least powerful homesteaders, especially the households led by widows and other landless people, will not receive an adequate share of the new land. This could dilute the achievement of the project objective to equitably increase homestead gardens and space the dwellings sufficiently far apart to improve sanitation, allocate separate

shelters for livestock which are currently housed inside the existing crowded houses, and to provide adequate storage and drying capacity for the *boro* rice.

Gender specialists financed by CIDA are following up on this aspect under the monitoring program. Gender specialists are also working to win the confidence of women's groups. Women formed about 70 percent of the three dyke construction forces in the pilot study and there are encouraging signs that the women have learned to bargain for higher wages and withstand the pressures of high interest money lenders for further development of the VPs. The project will contribute significantly to the employment of women in an area previously untouched by large scale works suited to their labour resources.

Many examples of homestead destruction by erosion affecting health, sanitation and homestead gardens have been identified in the project area. While having some similarities to the constant threat of erosion and homestead destruction facing the *char* people of the braided Jamuna River, the situation in the Kalni-Kushiyara River is less dynamic due to its meandering rather than braided morphology. The project communities are much more sustainable and competition for the new lands is not combative, as in the Jamuna river, where *char* land is said to be controlled by locally powerful landlords with private armies, who operate largely outside of the legal system (Zaman, 1991). However, an ongoing study by a German anthropologist finds the latter issue to have been exaggerated (Schmuck, pers.comm, 1998).

7. Economic Analysis

(a) Project Costs

The total financial costs of the project are estimated to be about Tk. 2.8 billion (about US \$64 million) excluding loan charges and the economic costs are Tk. 2.4 billion. Annual operations and maintenance costs are estimated at Tk. 100 million.

(b) Agricultural Benefits

Increased agricultural yields would be expected due to reduced pre-monsoon flood damage. Crop damage due to over-bank spills and breaches in the river banks during the pre-monsoon season would be reduced from 278,000 ha to 227,000 ha and flood-free lands would increase from 6,000 ha to 51,000 ha. This would enable farmers to harvest more local *boro* rice. This may also induce farmers to replace some local with HYV of *boro* rice. Reduced depth of flooding would also modestly reduce damage to local broadcast *Amman* rice. There would be no changes in full monsoon flooding, apart from a shortened period resulting from improved post monsoon drainage. Thus, cropping patterns for both future with (FW) and future without (FWO) would remain similar, while dry season fodder crop cultivation would increase modestly.

Crop yields are unlikely to improve in the FWO condition due to the risk of pre-monsoon flash floods. The economic prices are based on the Flood Plan Coordination Organization (FPCO) guidelines, where financial prices have been converted to 1995 economic prices by commodity conversion factors (CCF), which take account of the difference between domestic prices and border prices. The total economic crop revenue (TER) is calculated as follows: $TER = \text{Cultivated Area} \times \text{Average Yield} \times \text{Economic Price}$. For the total cultivated production in tons under for the present, FWO and FW scenarios in the

costs of crop production, including labour, fertiliser, irrigation draught animals, seeds and pesticides, are calculated and CCF are applied in line with FCPO guidelines.

The net return for each crop has been calculated by subtracting the costs of production from the expected gross revenue for the present, FWO and FW conditions. Having carried out a net return for each crop, expected incremental net returns under the 1:2, 1:5 and 1:10 year pre-monsoon flood regimes can be calculated for the FWO and FW scenarios. It is assumed that net agricultural benefits are zero for pre-monsoon flood periods smaller than 1:1.4 (bank full) and for the 1:20 year flood (complete inundation). It is further assumed that the estimated annual agricultural benefits can be expressed as a function of pre-monsoon flood frequency which can be graphed against the incremental benefits. This approach indicates an average annual agricultural economic benefit of Tk. 374 million, or about Tk. 1,348 per ha. (US\$33), amounting to a 14 percent margin per ha. per year. Agricultural benefits are expected to accrue in year 4 (40 percent), and increase at about 20 percent per year to a maximum in Year 7. In summary, the project should increase rice production from 615,000 tons to 697,000 (a 13.4 percent increase). However, non-cereal production may decrease from 34,900 tons to 29,000 tons (a 6 percent decrease). Labour requirements to sustain the net increase would also climb by about 10 percent. This implies a reduction of under-utilised labour, including increased post-harvest activity by women, their traditional activity.

(c) Fisheries Benefits

The project is expected to facilitate fish migration by increasing river depths during the dry season and reducing the siltation of *beels*. The two cuts will accelerate the elimination of 6 *duars*, which is a negative impact. This can be offset by increased fish production by the construction of a fishpass to an area impounded under an earlier project where fisheries have declined in recent years. In the FWO scenario, a significant decline in fisheries of 12 percent is expected due to sedimentation. On the flood plain, a gradual decrease of 2 percent per annum in fish production is expected without the project, while the *beels* could witness a significant decline of 15 percent. These estimates are based on a multiplication of the area of each habitant with the corresponding per hectare production. The incremental increased production between the FWO and FW scenarios is estimated at 1,329 tons. Fish species market prices were obtained from a two-year survey under the project feasibility study. The average weighted market prices are Tk 50/kg for open capture fish and Tk 75/Kg for pond culture fish. A standard conversion factor (SCF) of 0.9 was applied to obtain the economic prices. Fishery harvest costs take into account the amortised cost of boats and gear, bamboo, rope, maintenance and labour. The expected annual net economic revenues will be Tk. 43.7 million at maturity (Year 9).

(d) Socioeconomic Benefits

Expected socioeconomic benefits are numerous, and can be grouped under 5 headings: The (VP) flood and wave protection, VP homestead gardens (fruit and slope protection), VP grain drying, quality of life, and reduction of O&M. Proxy and order of magnitude values were estimated in light difficulties in quantifying the benefits. Some 50 villages comprising 13,271 households are located within 100 meters of the Kalni-Kushiyara River in the project area. Channel stabilisation would benefit this population directly. Average annual flood damage was estimated in a social survey of 1994-95 based on 28 villages, assuming a 50 percent reduction in damage costing Tk 1,200 for

each of the 13,271 households. These benefits would build up over a period of 8 years, commencing at 40 per cent in Year 5. Additional river bank protection benefits totaling Tk. 15 million per year would accrue from avoided spontaneous river diversion, damage to land and homestead protection works at Chesupur Khal, and increased channel stability outside of the village areas. Reclamation of land at the two loop cuts and increased agricultural land on two platforms (61 ha) not used for homesteads, would yield a further Tk 8.2 million in net benefits. The VP flood and wave erosion protection is the third socioeconomic benefit. During the construction phase, 47 VPs will be built, of which 44 will either expand and strengthen existing villages or comprise new village sites. These 44 VPs will cover an additional area of about 247 ha and involve 6,250 households. During the O&M phase (Years 9-30), additional VPs totaling about 200 ha will support a further 5,000 households (about 150 persons per VP). Assuming a net benefit of Tk 1,191 per household for new or expanded VPs and Tk 777 per household for 31 old VP area improvements, the total net benefits will be nearly Tk. 13,400 million.

Production benefits on the expanded VPs will also accrue from homestead gardening, fruit tree production and slope plantations. The pilot study reveals that additional production valued at Tk. 20,000 per ha by the villages should occur rapidly over about 25 percent of the VP areas, provided nutrient enhancement such as water hyacinth and straw are added to the clayey overlay. Fruit tree development, currently vulnerable to erosion, is also expected. Grain drying will also be facilitated by the increased VP areas. Taking flood frequency estimates into account, net benefits of Tk. 271 per household are estimated.

Quality of life benefits will also intangibly result from the expanded VPs, including improved sanitation, water supply, safety and security. Based on current Government health expenditures of Tk. 115 per person (BBS, 1994) total benefits are taken Tk. 16.0 million. Thus, while individually small, when applied to the total population the quality of life benefits are very significant. In addition, existing submersible embankments along the Kushiara River would benefit from reduced O&M, namely, the avoided cost of closing breaches. These benefits are estimated to be Tk 1.75 million.

(e) Inland Water Transport Benefits

In 1965, following a border war between India and Pakistan, when Bangladesh was East Pakistan, the then all season Class 1 (LAD 3.6 meters) IWT route between Assam, across Bangladesh to Calcutta, was closed, and maintenance dredging ceased. While the *Protocol on Inland Water Transport* was re-introduced in 1972, virtually no maintenance has been undertaken and the route has gradually degenerated to a seasonal, Class IV route (LAD less than 1.4 meters). Moreover, siltation has also extended throughout the various connecting unclassified routes. A traffic survey over the Project area in 1995 provided the results as shown in Table 11.

Table 11: Traffic Survey Results

Item	Dry Season	Monsoon Season	Annual
No. of Vessel Trips(000)	147,680	657,207	822,887
Total Cargo (000 tons)	179.3	292	441
Passengers (000)	3,333	6,356	9,689

Source: CIDA (1997)

Of the total cargo, the main items are paddy and milled rice (21 percent), fertiliser (19 percent), construction materials, fruit and vegetables (10 percent) and consumer goods (4 percent). The potential benefits result from: (i) passenger time savings, estimated at Tk 16 million (Tk 20 per passenger); and (ii) freight rate savings, expressed as the difference in freight charges between IWT craft operating on Class II routes, (the project target all season LAD) and country boats operating on unclassified routes. For the categories of transport identified, namely: (i) project area, (ii) re-handled or transshipped cargo, and (iii) through traffic, the transport benefits total Tk 238.5 million. Of this amount, only Tk 36 million (15 percent) is considered as through traffic, not generated from or destined to the project area, of which the international traffic is considered insignificant and has not been quantified in the CBA.

Fertiliser is mainly a dry season cargo and is estimated to generate about 73 percent of the total transport benefits. The total cultivated area within 5 km of the river (139,000 ha) has been considered, based on 3 percent annual growth rate (the national average). Re-handling and transshipment benefits occur due to the tendency for commodities to move through wholesale and local markets. The through traffic is also considered to be mainly fertiliser (160,000 tons) from the existing plant at Fenchuganj, and the Shah Jalal plant which is expected to commence operation in the year 2000.

Paddy rice is sold during the monsoon season and production of 30,000 tons is predicted within 5 km of the river. The area also imports rice, 24,000 tons of paddy (equivalent) from Bhairab Bazar and 6,000 tons of paddy (equivalent) from Habiganj. While most of the paddy crop moves during the monsoon season, it currently incurs storage charges which could be virtually eliminated under improved all season river depths. These, and most other items, such as petroleum, oil and lubricants are estimated to either grow at 3 percent per year, or remain at present levels. Construction works occur during the dry season at 0.97 tons per capita, amount to 72,690 tons.

Of note, while the pre 1965 international traffic was important, this has amounted to only about 24,000 tons per year in recent years, for the Kushiyara, Jamuna and Mongla Port routes combined. Even at 100 percent growth based on the proposed Kushiyara development, the total project benefits would only amount to Tk 4.4 million based on freight costs of US\$4.50 per ton. As a result, this category of benefit is insignificant. Consequently, in the overall economic analysis, IWT benefits amount only to 4.5 percent of total net benefits.

(f) Project Economic Viability

The net benefits (total difference between the FWO and FW conditions) have been discounted at 12 percent, which is in line with FPCO guidelines and the usual criteria of the proposed financier, the ADB. The life of the project has been taken as 30 years. On this basis, and taking year 1 as the initial year of expenditure the project is robust 3 with an NPV of Tk 531 million and EIRR of 17.2 percent. In the sensitivity analysis, the project remains viable. An increase of 20 percent in the capital and O&M costs would result in an EIRR of 13.4 percent. The post-construction dredging costs would have to increase by 180 percent, for the EIRR to fall to the break-even point of 12 percent. Since agricultural benefits are 79 percent of total benefits, the project is sensitive to agricultural benefit changes. However, these would need to fall by 28 percent to reduce the EIRR to the break even point. A 100 year flood, which could eliminate the benefits of

a complete year, say at Year 10, would reduce the EIRR to 10.0 percent. A two-year delay in benefits would also be required to drop the EIRR to 12.9 percent.

The main risks to the project are: (i) the unknown intentions of the Government of India to construct a major dam, at Timaipukh, about 200 km upstream on the Barak River, for which a feasibility study has apparently been carried out by India; and (ii) the lack of cost recovery or reliable O&M arrangements. In this regard, post-construction dredging is estimated at about Tk 100 million per year for 0.5 million cu.m.

The perspective taken in this study is that while lack of provision in the CBA for generated through traffic may be regarded as conservative and demonstrates the viability of the project for flood damage reduction, this approach is short sighted. It ignores the potential of IWT to generate international revenue and the likely potential of IWT for cost efficient socially and environmentally desirable competition with other transport modes for long-distance bulky traffic. It also denies a role for IWT to share in the justification and evaluation of water resources development projects, which is provided for under the Government's policy framework. The matter is particularly significant because the project design is virtually silent on the matter of effective cost recovery and institutional managements during the important post - construction O&M phase, for which significant revenue benefits are needed for maintenance dredging. Generated through traffic could help to meet the O&M costs and would be relatively easier to collect from Indian shipowners who would derive major benefits by transiting Bangladesh, rather than from the local informal shipping community or mainly subsistence based population in the project area. Even modest taxation instruments, which would be inadequate to meet sustainable O&M, may also be resisted by the poor communities and would dilute efforts to lift their surplus income. Nevertheless, a contribution by these communities to O&M is also needed in the interests of a market oriented approach and may help to build ownership.

8. Cost Recovery and Management Issues

The weaknesses revealed in the 1997 Draft Final Report of the project, are that: (i) it does not explore the future possible intention of India to construct the upstream Timaipukh Dam which could have unknown impacts on the project; (ii) there are inherent O&M and institutional management weaknesses; and (iii) increased through traffic by IWT which could contribute in a major way to O&M cost recovery were disregarded. Apart from recommending a stakeholder committee to oversee the project monitoring after Year 9, the low capacity of the individual and largely subsistence based population to contribute to the O&M costs of the project were, however, recognised for VP protection works and the 2 year community based follow up study is an important contribution to this important aspect. Nevertheless, lack of attention to overall O&M has been the main reason for the failure of other agriculture-water resource oriented projects in the past. Without well managed maintenance dredging and reliable O&M financing, the key *boro* rice damage avoidance benefits would be lost within a few years.

It is the potential for diverting national trunk and international IWT traffic from road and rail which may particularly encourage more integrated and sustainable international river basin management. Based on subsequent discussion, including a stakeholder seminar to discuss the project (see Appendix 4), the Final Report, in May 1998 has included an appendix which considers these concerns, while the cost benefit

analysis retains the conservative approach of not including potential generation of IWT traffic. This aspect is expanded upon in Chapter V, Part B.

As noted, the most significant issues for sustainability remain cost recovery and the institutional arrangements for the capital and maintenance dredging of the river channel, VP improvements, and the potential for a more integrated strategy between water resources and transport development. Given the low-cost and some revenue earning potential from the wave absorbing grasses being used for erosion protection, and the high level of pre-monsoon flood risk reduction for homesteaders by building the platforms, this latter approach could be acceptable to the local communities. Severe seasonal floods govern the economic history and outlook for development in Bangladesh and sustainable O&M mechanisms involving affected communities should be further explored with respect to sustainability.

It is useful to note from the literature review that IWT development in Europe and the USA, especially during the early years, rode on the back of flood protection efforts. The literature review also reveals that the environmental and socio-economic concerns of highway congestion costs give IWT a potentially sustainable impetus for investment provided mitigation measures are adopted. While the project feasibility study has partly addressed these aspects for O&M of VPs, it has still not integrated the potential for significant generated international and national IWT traffic under the project. It is proposed that negotiation of a suitable fee by India for through transport under the *Protocol on Inland Water Transport and Trade* could be a major source of at least O&M cost recovery. This could be passed on by India to IWT users under annual vessel licensing fees and Bangladesh could do the same for its larger domestic vessels, say, with a draft of 2.4 meters which is the Class II LAD intended under the project. The Protocol could also be expanded from the present bi-annually renewable arrangement to a 10 to 15 year horizon, and perhaps include an escalation clause related to any increase in sedimentation or reduction of water flow arising from upper basin deforestation, or upper basin diversion of water for irrigation. This would also contribute to improved management of the GBM basin as a whole and help to reduce the vulnerability of Bangladesh to actions higher in the basin. These matters should be pursued as an opportunity for policy dialogue, with potential lessons for the GBM region as a whole.

Ensuring efficient maintenance dredging arrangements is a major concern based on the inefficiently used capacity of the BIWTA and BWDB fleets, which are obsolete, and poorly managed (World Bank, 1991:18). While the World Bank's *Third Inland Water Transport Project (IWT3)* is addressing this issue for BIWTA, the strategic plan does not include privatization of the BIWTA dredging fleet or its possible combination with the BWDB dredging fleet.¹

¹ This potential could be considered in 1999 under the World Bank's proposed *Fourth Inland Water Transport Project*.

CHAPTER V

ECONOMIC AND ENVIRONMENTAL EVALUATION, AND PROJECT PROPOSALS

A. Comparative Valuation of Transport Environmental Impacts

1. Fuel Efficiency and Safety

The comparative ratios of environmental pollution and energy use costs for road, rail and IWT, show substantially lower costs for IWT, as indicated in Table 12 for Germany.

Table 12: Financial and Ecological Cost Ratios for Transport Modes in Germany

Item	IWT (1350 dwt vessel)	Rail (Train)	Road (Trailer Unit)
a. Financial	.25	.32	1.00
b. Pollution			
- Air	.28	.27	1.93
- Noise	.00	.68	.35
c. Energy Use Ratio	2.0	2.0	8.7

Source: Bombis et al. (1991): 51-53

These relative values for Germany are comparable for Sweden (see Table 13). With regard to safety benefits, the Swedish data shows that rail is much safer than road. In Bangladesh, road accidents relate mainly to pedestrians and bus passengers, often involving collisions with trucks. While IWT should also be much safer than for road, and diversion of road traffic to IWT should help to reduce road accident costs, IWT accidents will be higher in Bangladesh than in Europe due to serious overloading with passengers and passengers constituting a major portion of IWT activity, unlike in Europe. While the statistics shown are for Sweden, a benefit transfer approach could be adopted by applying a deflator index for Bangladesh, as suggested by ADB (1996).¹

**Table 13: External Costs for Road and Rail in Sweden
(Kroner)**

Type of External Effect	Road Traffic	Rail Traffic
Accidents	13,890	183
Noise/Air/Wear and Tear	35,037	602
Total	49,017	785

Source: Hansson (1996): 5

¹ The ADB approach recognises the lack of quantified environmental and safety cost data in developing countries. While these are being improved, it is reasonable to consider similar impacts in developed countries which have been quantified in many cases. Pricing global impacts such as trans-boundary pollution and contribution to greenhouse gases is a particular problem in the benefits transfer approach. These are examined in relation to *the Asia Least Cost Greenhouse Gas Abatement Strategy (ALGAS)* and in Chapter VII for oil pollution by water-based traffic where mitigation measures are also proposed.

Based on Table 12 IWT has operational cost advantages over rail if economies of scale are present. The 1,350 deadweight ton (dwt)¹ vessel in Germany would require Bangladesh Class I depths which prevail only between Chittagong and Dhaka. Class II depths, of 2.4 m LAD limit vessels to about 500 dwt and the same economic benefits of scale would not be possible. In Bangladesh, rail is subsidised to offsetting poor management², including marketing weaknesses. This partly accounts for its loss of market share for freight traffic vis-à-vis roads, especially for bulk traffic. Although 90 percent of IWT freight is carried by the private sector, freight rates are controlled. If these are freed up, IWT should be able to compete effectively with both road and rail.

If IWT routes were improved to Class II including for transit cargo, it is likely that IWT would gain diverted traffic at the expense of railways under the existing institutional, policy and gauge inefficiencies of rail, and especially in view of the higher investment costs for road. Fuel is currently subsidised and subsidies must be removed if the price mechanism is to work in ensuring that the fuel efficiency benefits of IWT are realised.

2. Example of the Jamuna Bridge Rail link Project

(a) The only project in Bangladesh and the first in Asia in which the quantification of environmental impacts have been applied to transport is the ADB Financed *Jamuna Bridge Rail Link Project* at a total cost of \$ 240 million, 70 percent of which is financed under an ADB loan (ADB, 1997c: 1-6). As was noted in Table 12 the pollution effects of rail transport are similar to those of IWT except that there is a greater risk of oil spill accidents with IWT, which should be, weighted in the CBA. Accordingly, a similar conceptual approach could be adopted for IWT as for rail. Where IWT has additional benefit over rail is in the marriage with water resources development and avoidance of land acquisition and resettlement.

(b) Project Details

The main objectives of the *Jamuna Bridge Rail Link Project* are to (i) remove BR's critical bottleneck at the Jamuna river ferry crossing by providing a fixed railway link over the Jamuna Bridge, connecting to the two railway networks, (ii) assist in the timely financial recovery of BR, (iii) contribute to the integration of the less developed northwestern region with the more developed eastern region of the country, and (iv) open up new direct strategic rail transport corridors between Bangladesh, Bhutan, India, and Nepal, and India transit traffic from West Bengal to the eastern states of India. The project comprises a new dual gauge railway line totaling 99 km between Joydevpur, over the Jamuna Bridge to Jamtoli and the conversion of 250 km of meter gauge on the western side to dual gauge.

¹ Deadweight is the difference between a ship's loaded and unladen displacement in tons and measures the total carrying capacity, including cargo, fuel, stores, passengers and crew.

² Rail subsidies are applied overtly for passenger traffic and are also hidden by large government budgetary allocations to cover financial losses when depreciation is included. Financial improvements have been made over the past few years by staff reductions, scrapping of obsolete infrastructure and the establishment of a marketing department. However it will be several years before subsidies are removed.

(c) Analytical Approach

The economic analysis of environmental impacts requires a comparison of the project viability with the FWO situation. The project will lead to increased transportation of freight and people via rail and lessen volumes in the alternative forms of transport, specifically road transport. It is estimated that the project will reduce transit time between Dhaka and points west of the river by about four hours. The project leads to avoid impacts due to a reduction in fuel emissions compared to the current emissions of road transport.

The economic analysis of environmental impacts has been carried out in four stages: in the first stage, avoided stressors or pollutants are identified and quantified. The quantification is based on the estimated reduction in fuel consumption of shifting the transport of commodities from trucks to freight trains. Based on the Initial Environmental Examination (IEE), a shift in the mode of transport from road to rail reduces fossil fuel consumption by 0.006 liters per ton-kilometer. Using standard technical coefficients, the reduced fuel consumption was translated into avoided amounts of TSP, CO, SO₂, NO_x and CO₂ using data from the Philippines. In the second stage, impact screening is carried out for each stressor. In the third stage, an attempt is made to place monetary values on the impacts using the ADB Benefits Transfer Method. The IEE provides a partial quantification in terms of loss of agricultural land and crop loss. These values are integrated into the economic analysis of the project.

(d) Results of the Analysis

The project will lead to avoided environmental emissions such as CO, SO₂, NO_x, CO₂ and various other particulate matters. In the second stage, these stressors are screened for their potential impacts on four major groups, human health, human welfare, environmental resources, and global systems. The following major impacts are significant:

Human Health Impacts: Increased Morbidity and Mortality from Air Emissions (TSP, SO₂, and NO_x)

Fine particulate matter is formed by PM₁₀, NO_x and SO₂ emissions. Health studies focus on airborne particles that are small enough to be inhaled deeply into the lungs (PM₁₀). Aerosols of PM₁₀ size resulting from the combustion of fossil fuels include sulphate and nitrate aerosols, acid aerosols, and other chemical constituents. Their impacts include both premature mortality and chronic acute respiratory disease.

Human Welfare Impacts: Reduced Visibility and Materials Damage from Air Emissions (TSP, SO₂ and NO_x)

- Visibility Impacts occur from particulate matter (less than 2.5 micrometers in diameter) that is emitted directly from industries or is formed in the presence of sulphur dioxide and nitrogen oxide gas emissions can reduce visual range.
- Building and materials impacts occur from particulate matter and acid deposition from SO₂ emissions that can damage materials. This can include surface soiling, surface erosion, blistering paint, discoloration,

corrosion and tarnishing of metals and electronic components, fading, reduction of fabric tensile strength, and spalling of buildings and monuments.

Human Health Impacts: Morbidity and Mortality from Accidental Death and Noise

- Accidental death is generally lower in railways than for roads.
- Noise and vibration affect morbidity if conflict with living areas. These zones include line traffic, terminal areas and rail marshaling yards. Morbidity effects of noise and vibration include discomfort and headaches.

Human Welfare Impacts and Environmental Resources Impact: Decreased Aesthetic and Social/Cultural Value and Decreased Bio-diversity from Noise

- Aesthetic, social/cultural value and bio-diversity impacts occur mainly from noise pollution. Noise may especially affect bio-diversity by altering species habitat and corridors. In Bangladesh, a principal issue is the impact on migratory birds that arrive in large numbers.

(e) Valuation Methodology

Following identification of the major environmental impacts and their influence on human health, human welfare and socioeconomic activities to the impacts the third stage has allocated such given economic values to the impacts. Some of the methods require a substantial amount of primary data, time and field investigations, which are not available. Thus, the benefit transfer method was used. The method adopts the use of results from similar valuations conducted in different parts of the world with proper adjustments to the project.

From the results of original research in the USA, adjustments were carried out in applying these to Bangladesh for (i) GDP differentials between the USA and Bangladesh; (ii) population differentials between USA and Bangladesh; and (iii) updating the prices to 1997. For inflation adjustments, the GDP deflator of Bangladesh was used. The GDP deflator is computed in the ADB's key indicators (ADB, 1997d). It is current GDP over constant GDP and expresses the growth of GDP in real terms. The GDP deflator is used instead of the CPI because it reflects all goods and services product by the economy rather than certain specific commodities in the CPI basket. For example, 1995 GDP is 583.8 divided by base year GDP of 406.9 to give an implicit deflator of 173.9 (Key Indicators 1996, for Bangladesh). After taking the proportion of the project area's per capita GDP, to the national per capita GDP, the GDP deflator is used to bring the adjusted value into the current year.

(f) Valuation of the Health Impacts of Air Pollution

The health impacts of air pollution can also be quantified as a benefit in the CBA of an IWT project, as a result of diverting road truck traffic. Air pollution data in Bangladesh is poor, but sampling at urban centres in 1990 and 1996 reveal and compensation costs for resettled people for the worsening effects of suspended

particulate matter, SO₂ and lead, indicating that these greatly exceed World Health Organisation (WHO) guidelines. In the low rainfall months, lead levels in Dhaka are higher than in Mexico City or Bombay (World Bank, 1997). To perform the analysis accurately, the analysis should focus on diesel fuel emission impacts in main highway corridors including urban townships where road congestion would also be increased due to truck operations, and population increase forecasts of about 5.2 percent per annum. These impact more adversely on the urban poor

The health impacts of air pollution are most easily estimated through dose response functions at various locations in the world. The World Bank (1997) estimates are that if pollutant levels in four urban centres studied in Bangladesh are reduced to WHO standard levels nearly 900,000 incidences of hospital admission and minor sickness costs could be avoided. Clearly, more analysis would be needed to quantify amounts under IWT development and the valuation would also need to be converted to Bangladesh costs. However, the implications are that significant economic benefits could be achieved.

(g) Economic Analysis

For the economic assessment of environmental impacts both high and low unit values were used. With and without project NPVs were calculated using the ADB's usual threshold discount rate of 12 percent. This reveals that the project design leads to improvements in the overall environmental conditions in the project area. There are many other environmental impacts excluded from the economic analysis due to methodological difficulties or lack of data. Therefore, the estimated economic benefits of environmental impacts are conservative and have some impact on the overall cost benefit analysis of the project as a whole. From the analysis, reduced emission damage is only 1 percent of the total project benefits. Accordingly, pollution damage reduction requires much more than modal shifts based on lower freight and operating costs, it also requires strong regulatory and enforcement measures in road transport backed by enforcement of fuel emission and noise control for IWT. The land acquisition and compensation costs for resettled people along the 99 km new alignment are \$19 million. It is here where the relative natural resource and qualitative social benefits of IWT can be recognised most significantly. It is also valid that the IWT benefits may be increased through river engineering works to increase depths and maximise economies of scale in freight transport. In particular, these costs may also realise flood protection benefits. Rather, as revealed for North West Europe and the USA in the literature review in Chapter II, it is flood protection works which have helped to ensure an important role for IWT. A similar opportunity is presented in Bangladesh under the proposed *Kalni-Kushiyara River Management Project*.

(h) Global Impact

It is recognised that environmental impacts are not confined to the immediate location or at the country limit but involves impacts on the global level. The project will improve the local environment through avoided SO₂, NO_x, TSP and other emissions. Accordingly, the project will also lead to avoided CO₂ emissions (by about 185.75 t/yr). The economic value of CO₂ emissions were assessed using the Bank's *Economic Evaluation of Environmental Impacts: A Workbook*.

3. The Asia Least-Cost Greenhouse Gas Abatement Strategy

In April 1994, Bangladesh ratified the United Nations Framework Convention on Climate Change (UNFCCC) which came into force in March 1995. Since then, Bangladesh has taken several steps to assess the possible national impacts of climatic change. In particular, it has been estimated that the effect of continued climatic change resulting in one metre of sea level rise in this deltaic and heavily populated country would inundate one fifth of the land area and affect over 20 million people (ADB, 1994). Assessment has also been made of Bangladesh's contribution to the national load of greenhouse gas (GHG) emissions and specific steps that would have positive feedback in curbing the emissions have been identified. The ADB co-financed *Asia Least-Cost Greenhouse Gas Abatement Strategy (ALGAS) Study* reported the redeeming feature that Bangladesh has one of the world's lowest per capita commercial energy consumption rates at 56 Kgoc/yr in 1990 and that over 60 percent of the commercial energy comes from natural gas. Moreover, the largest source of GHG is biomass, while the largest user of energy is the urea fertiliser industry which utilises natural gas and state of the art technology (BCAS, 1998:12). However, power generation accounts for about one-third of commercial energy consumed and diesel. Transport, is also a significant source of GHG. The ALGAS Study revealed that of the 12,088 Gg of CO₂ released from the energy sector, 1,875 Gg is from the transport sector. While this is insignificant globally, there is a moral perspective as well as an opportunity to secure revenues from tradable emission rates under the abatement strategy. Support to the UNFCCC's objectives are especially in Bangladesh's interests given its low-lying deltaic morphology and vulnerability to sea level changes initiated by global warming. The ALGAS proposed strategy has noted a recently commenced project to encourage the use on domestically sourced natural gas power for vehicles, the phasing out of two-stroke baby taxis in favour of four stroke engines, and the costs and benefits of importing new rather than reconditioned engines which currently proliferate the transport sector. However, the Study is silent on the possible contribution of IWT as the most energy efficient transport medium. It would be useful to conduct a study of this potential as an adjunct to the strategy and in the CBA aspects of transport planning and policy generally.

B. Economic Benefits of Inland Water Transport

Of the three potential transport benefits for the *Kalni-Kushiyara River Management Project*, as discussed in Chapter IV, the local villagers are totally dependent on small informal 'country boats' during the six-month monsoon flood season. The project will include small landing facilities at the VPs and riverside markets (*hats*). Approach channels to the *hats* will also be deepened. However, while the latter inputs will contribute to the stability of the VP's and river protection works, the transport benefits are mainly of a social nature. The same rationale applies generally in Bangladesh except to note that many informally used channels have been blocked by flood protection, road and rail embankments in the past. Most readily quantifiable benefits will accrue from the improvement of navigation in the main river through channel deepening, offering economies of scale and reduced transport costs for traffic between the *hats* and larger *bazars*. However, benefits for the through traffic from the north east region to Dhaka or Chittagong and international traffic between the eastern Indian states to Calcutta are considered by CIDA to be virtually nil based on existing traffic via the heavily silted route.

Nevertheless, not only could economies of scale be achievable by facilitating the passage of deeper draft vessels, but seasonal navigability for Class I and

year-round Class II (year round) vessels could be restored to pre 1965 conditions. The national and international traffic could develop by the diversion of land based traffic at a lower cost by IWT, and with increased demand for transport. This would help to reduce road congestion and improve road safety in both Bangladesh and India, with measurable energy efficiency, deferred investment and avoided land acquisition and resettlement costs for road improvements. Low value commodities such as construction materials, some consumption goods, grain, timber, jute and tea exports are the most likely commodities. Diversion of the 56 million tons of freight traffic to the roads would incur additional costs of about Tk 77 Billion (\$1,700 million) per year, based on BIWTC's charges of Tk 0.12 per ton.km, which are less than 10 percent of BRTC's charges. Ultimately, container traffic penetration based on Chittagong Port, for India and Bangladesh, especially for tea exports and consumer goods imports could take advantage of the improved river conditions. Although the use of Chittagong Port, and transit arrangements by India are a sensitive political issue (Evidence, 1996, XIV. 29: 7), the economic opportunity for creating economic win-win situations are clear, in spite of political opposition cries in Bangladesh of *treasonous pandering to a large neighboring state* (see Chapter II, Part F).

As noted in the literature review in Chapter II, the penetration of IWT in the total container traffic of Europe during the past decade is significant, avoiding costly dislocation of land based infrastructure and avoiding further congestion of road networks, wherever bridges can be altered or constructed with sufficient air draft for container barges carrying up to about 300 TEU (twenty foot equivalent units). While Chittagong Port is heavily congested and container handling facilities are severely deficient, expansion and improved operation of the port is being examined under ADB and World Bank financed studies. Discussions indicate significant potential private sector investment interest in IWT container operations, at Chittagong and Mongla ports provided that river based ICT are provided, such as planned for Dhaka Port. Multi-modal choice will be possible by rail and road especially from Chittagong Port, in line with on going projects to expand the rail-based ICT at Dhaka, commercialisation of BR and upgrading of the Chittagong-Dhaka-Jamuna Bridge highway under ADB and OECF financing of the *Jamuna Bridge Access Roads Project*.

As referred to in Chapter II, the development of IWT has lagged in Asia, due mainly to seasonal variation of water flows, institutional weaknesses, lack of development focus, and unsuitable construction of bridges which limit available air-draft. However, it has major historical significance, especially in countries such as Bangladesh, where low bridges are not present on the main river routes. While IWT cannot match the mobility advantages of road transport, lower energy usage per ton km are less for IWT than for road and at least as efficient as for rail transport. These provide for reduced fuel emissions. Improved health and safety from diverted traffic from road congestion, which are additional quantifiable environmental benefits. In Bangladesh, additional major economic benefits of fostering IWT are (i) the avoidance of agricultural and settlement land loss needed for road and rail network expansion and widening, (ii) avoided social costs of involuntary resettlement incurred in road and rail development, (iii) the contribution to agricultural and urban communities of channel stabilisation and river bank protection investments needed for both flood protection and navigation, and (iv) facilitating post-flood disaster relief and construction operations. All of these benefits are in the interests of environmental, social and economic sustainability. As noted in Chapter II, apart from recent Mekong basin and PRC studies, virtually no research has been conducted in Asia on the integrated benefits of IWT navigation, agriculture and disaster

reduction. The *Kalni-Kushiyara River Management Project* and proposed Ganges barrage studies should be opportunities to advance this area. Agriculture and flood protection may benefit IWT through dredging for added river depths, river straightening and training works, and induced scouring of river beds. These contribute to economies of scale and reliability of IWT services, reduced route maintenance costs, and should encourage competition between transport modes. Intangible benefits, such as preserving rural tranquillity and aesthetics, and avoided encroachment on natural habitats and loss of bio-diversity are also important.

All of the relative benefits to facilitate IWT should, where possible, be quantified, not only to add to the viability of IWT projects and transport policy framework but to provide a clearer linkage with integrated water resources management and allow for greater transparency in the use policy instruments aimed at cost recovery. The relative benefits of IWT have been under estimated or ignored in past projects. The rationale for most water resources projects has been to show that agricultural, socio-economic and minor transport services in the area are sufficient to justify a project. While such projects provide for improved efficiency of IWT benefits by deepening channels, they do not take route linkages sufficiently into consideration that would allow the diversion of road and rail traffic. They also do not address avoided congestion and bottlenecks by the diversion of traffic or low cost transshipment or other intermodal investment opportunities. The concerns here are that: (i) unless the low cost of IWT potential is recognised in Bangladesh there will be additional sunk cost public expenditure in roads and rail expansion, making it harder for IWT to realise its potential, resulting in economically sub-optimal investments, and (ii) it may forego opportunities for transport and water resources cost recovery.

Land acquisition for road and rail network expansion and capacity improvement are priced at market value and compensation for the loss of infrastructure and income is valued at replacement prices. For an IWT project, these costs can be avoided, unless a canal or new channel is being constructed. Where meander cut-offs are involved, there may be some loss of land, but new land and resultant oxbow lake resources are also created for fisheries and agriculture. The cut-offs would take place naturally over time, sometimes disastrously, and the latter may be avoided by expeditious river straightening.

For the *Kalni-Kushiyara River Management Project*, there are no roads in the project area and IWT is the only transport mode except for dry season bullock carts and headloads. Accordingly, there are no significant land acquisition savings associated with the IWT aspects of the project. However, in the future without the project (FWO) scenario, siltation of the rivers would continue and IWT would be further constrained. Without IWT, demand for the construction of all season roads would increase, with accompanying loss of productive agricultural land and resettlement of communities. This process has already commenced under a government financed project to link Azmiraganj and near by villages to the highway network. Road construction costs are high in view of the need for embankments, bridges and culverts to avoid impeding natural drainage. Because this is not an immediate intention in the project area, then the cost of road construction in the project area would have to be discounted, say to Year 10, if the avoided costs are included as a benefit under the future with the project (FW) scenario.

C. Proposed Assam to Calcutta Inland Water Transport Project

The prospects for IWT services would be improved by restoring the Kushiyara River to its *former glory* as a direct link for through traffic, between Assam and Calcutta, and Assam and Chittagong port, both including international transit through Bangladesh. This opportunity would be attractive to India because the distance savings are about 400 km from the eastern Assam inland port of Zakiganj on the Kushiyara-Berak River,¹ through Bangladesh to Calcutta or Chittagong, compared with an overland route entirely through Indian territory to Calcutta. Apart from the 1997 agreement for the transit of Nepal traffic, an overland transit agreement between Bangladesh and India has never existed, mainly because of political reasons, but it does exist under the Protocol for IWT, which is easier to monitor in security terms. As demonstrated for Nepal cargo in Chapter III, Part F., in the case of transit through Bangladesh from Assam to Calcutta there are major and costly land transport bottlenecks to overcome, which favour IWT development.

For roads, the main bottlenecks comprise the ferry crossings at Bhairab Bazar and Mawa following completion of the Jamuna Bridge in June 1998 and the Paksay Bridge in 2001. In addition, even domestic road traffic through the Dhaka area will suffer from severe delay due to congestion until after completion of the Dhaka by-pass, which is unlikely before the year 2005.

For rail, apart from lack of some bridges, most of India, including parts of the eastern states, is on broad gauge, while most of Bangladesh is on meter gauge. The *Jamuna Rail Link Project* is introducing dual gauge track into Bangladesh, but will be several years before Indian traffic can transit Bangladesh to Tripura without a change of gauge, and several years more to Assam. Thus, as demonstrated in Europe, while IWT is inherently slower than road traffic, the existing bottlenecks in land transport and costs of overcoming them, and 24 hour operations without the extensive support services needed for road and rail would make IWT a possible competitive option for some time sensitive cargo, as well as the traditionally non-time sensitive traffic. IWT, rail and road could eventually compete for a wide range of freight traffic. Assuming price liberalisation, IWT will always have cost and energy efficiency advantages over road and rail, especially for bulk cargo over long distances. As noted, IWT also has the advantage of not requiring new land, while dredging, has additional agriculture and flood risk reduction benefits.

The land conversion and relative modal investment cost savings are also significant for IWT. Average market value land acquisition and compensation costs for the *Jamuna Bridge Access Roads Project*, involving the widening and strengthening of national road sections, is about Tk 2.7 million per km. Civil works, including bridges, safety measures and supervision costs are about Tk 50 million per km. The high costs of road projects in Bangladesh are partly accounted for by embankment construction, bridges and culverts for flood proofing and to preserve natural drainage. In Bangladesh, all weather roads must be constructed on top of embankments. Additional land acquisition for borrow pits are therefore needed. While these can be converted to fish ponds, there is resettlement of communities and small business losses which tend to be established close alongside the road alignments. About two years of income losses and livelihood training are needed to establish fish ponds. These are additional economic costs unless significant income can be demonstrated. Road maintenance costs, including periodic resealing, are about Tk 1.0 million per km/year. According to the World Bank, 1991: 117, IWT dredging

¹ The Kushiyara River becomes the Berak River in India.

costs are Tk 25 per cu.m. For the *Kalni-Kushiyara River Management Project*, this amounts to about Tk 3.0 million per km for the capital dredging (actually deferred maintenance) and Tk 0.13 million per km/yr for maintenance dredging. In addition, unlike road and rail construction, river channel improvements can be limited to shallow areas, which do not necessarily extend the full length of an IWT route. Accordingly, IWT improvement and maintenance costs in Bangladesh potentially are much lower than for roads especially if expensive river training works are avoided or where cross benefits for agriculture and flood protection can be quantified. Similar advantages of IWT apply to rail network expansion. With rail, capacity increases associated with gauge increases do not usually require additional land acquisition. Laying double tracks for network expansion presents the same land acquisition and resettlement problems as for road improvement. This is a major concern in Bangladesh given the previously mentioned existing 800 per sq. km. current settlement and projected doubling of the population by 2050. The *Jamuna Bridge Project*, completed in June 1998 involves the compensation of over 120,000 people.

The estimated transit traffic between eastern Assam and Calcutta is about 2 million tons per year (ADB, 1997a), mainly grain and fertiliser, which are heavy, relatively low value bulk cargoes and lend themselves well to rail or IWT carriage. Tea exports from Assam are more valuable, but are highly suited to containerized transportation by IWT. If 50 percent of this traffic were to travel by IWT through Bangladesh, it may be expected that India would contribute significantly to the IWT maintenance cost recovery in Bangladesh. Full IWT maintenance cost recovery for the Kalni-Kushiyara section of the Assam to Calcutta route amounts to a charge of about Tk 100 per ton (\$2.50). Of major importance, only the Kalni-Kushiyara section of the route requires major investment in channel depth improvements as elsewhere on the route, Class I and II depths already exist. On these sections, the only investments required, apart from maintenance dredging, appear to be for efficient cargo handling terminals which could be financed by the private sector, and for navigational aids. If appropriately sited, the inland terminals could facilitate onward, door-to-door intermodal transport by road. Also of great significance, this route could be tapped for foreign trade cargo by the Eastern Indian states for the use of Chittagong Port, rather than the distant Calcutta Port. Since Chittagong Port is heavily congested, this would require additional investments at Chittagong, especially for dedicated IWT facilities, which are anyway required for the Chittagong to Dhaka IWT route development. As revealed in the literature review, use of IWT for container distribution in Europe took off significantly once dedicated IWT container handling in seaports eliminated potential queuing costs for ocean vessels.

India could defray the IWT route development cost recovery charges against time savings and road and rail development costs in transport, while contributing to sustainable benefits for flood risk reduction and IWT and domestic IWT improvements in Bangladesh. Most importantly, this would provide the necessary maintenance cost recovery to sustain the river improvements. While cost recovery of water resources development by IWT user charges may be regarded as an inequitable cost recovery mechanism, since the agriculture beneficiaries in Bangladesh would not be required to contribute, in effect, a subsidy, the alternative is to tax the near subsistence beneficiary farmers who benefit from the water resource improvement. Not only is this socially undesirable, it has proven many times to be very difficult to implement, whereas it would be very easy to collect from the closely scrutinized international IWT as it crosses the border between India and Bangladesh.

Nevertheless, to ensure market competition with road or rail, a general tax on local inhabitants for flood protection could also contribute to the maintenance dredging costs and be collected by existing local government authorities, as could an annual increment on existing registration fees for local Bangladesh vessels. Because of the inherent problems of allocating and monitoring water usage rights among specific farmers, complicated land tenure arrangements and poor statistics on land ownership, a general tax rather than a production per household tax would be less difficult to administer and would reduce opportunities for corrupt practices, such as misreporting and collusion. The disadvantage is that the poorest farmers would be effectively taxed at a higher rate than wealthy farmers. Thus, a general tax and the total tax recovered would be rather low. Conversely, economies of scale in agriculture would be favoured which could have economic, if not necessarily social benefits in the medium term. To meet 50 percent of the maintenance dredging costs for the Kaini-Kushiyari Project, for example, would require Tk. 300 per directly benefited household which is much higher than the calculated additional income from the project (See Chapter IV). Accordingly, a token tax on households may be required. Subsidy by the transport users may still leave the transport users willing to pay, especially for the international traffic. Clearly, negotiation of suitable user fees for Indian IWT vessels would be critical and the political dimensions referred to in Chapter II, Section B would need to be taken into account, particularly since the existing fees charged under the present 2 year renewable *Protocol on Inland Water Transit* would need to be raised.

D. Proposed Northwest Area Container Port Project

The ADB financed *Northwest Region Development and Investment Study* (ADB, 1998: 25), noted that waterways are very important for the economy of the Northwest area and four river ports at Chilmari, Siraganj, Bahgarbari and Nagabari are significant for the transfer of mainly bulk commodities. In addition, numerous *ghats* serve the local communities. However, due to India's construction of the Farakka barrage in 1977 and consequent reduced water flow in the Ganges River, IWT transport has declined in recent years. Completion of the Jamuna Bridge in June 1998 and the ongoing *Jamuna Bridge Rail Link Project* will result in further loss of competitiveness of IWT in providing transport links between the region and Dhaka, Chittagong and India. While the January 1997 water sharing treaty with India on the Ganges water resources may modestly improve the dry season flow, it is only during the wet season that Class II depths can be generally expected to prevail. In recognition of the obvious transport time savings for both road and rail via the Jamuna Bridge, the competitiveness of IWT with other modes could be ensured by attention to deferred maintenance dredging of the regional rivers. This should be together with a study on the strategic location of a future container port which is accessible by all three transport modes. This option does not appear to have been given serious consideration in the feasibility study for the over \$900 million *Jamuna Bridge Project* (ADB, 1994). The examination of IWT options in the CBA for the project is limited to transport time savings and maintenance dredging savings against road and rail ferry operations in the immediate bridge area. This is a major example of how cost efficient IWT development options in the future must now deal with sunk costs in transport infrastructure. Nevertheless, it is also an opportunity for a further feasibility study to reveal the potential for all three modes to compete, especially for not only bulk and low value cargoes, such as oil fuel, fertilisers, bamboo, rock and cement, but also for direct delivery to the sea ports of containerised traffic which may be expected to develop with the mainly time saving advantages provided by the Jamuna Bridge. This deserves further analysis, beyond the rather blinkered visionary and politicised dream of bridging the Jamuna River.

It appears from brochures and public speeches for the June 1998 opening ceremonies of the Jamuna Bridge that the donor community has fallen into the political vision that only a bridge may lift the northwest region from its relative disadvantageous location for economic development (JMBA, 1998; World Bank, 1998; OECF, 1998; and ADB, 1998). This perspective needs to be challenged and a proposed *Northwest Region Container Port Project* that gives a fair attention to IWT benefits should be examined carefully.

E. Proposed Greater Dhaka Inland Water Transport Project

In 1993, the government prepared a preliminary study of a *Greater Dhaka Water Transport Development Project* (GOB, 1993). The study was initiated by a recognition that many of the natural canals (*khals*) in the Dhaka city area had been lost to unauthorised land grabbers, siltation and the construction embankments and box culverts. This is a revelation of the lack of overall urban planning and rather sudden recognition that many of the water route options had been lost irretrievably. In particular, it noted that while Dhaka is entirely surrounded by an inter-connected river and *khal* system (see Map, Appendix 1), this is now heavily silted and encroached upon in key areas. Moreover, while the Dhaka and Narayanganj port areas are heavily congested on their landward side, they generate a large amount of local freight and passenger traffic that cannot use the natural waterways due to similar problems.

Dhaka increased significantly in importance from about 1610 due to transfer of the capital of the Moghul state of Bangla from Rajmahal. The Buriganga River was the hub of trade and two artificial canals were dug to facilitate transport services within and to expand the city. The canals also served in flushing urban waste (GOB, 1993: 3). The government's report indicates the findings of Islam (1989) that even in 1886, the Dholai Khal was an important intra-city waterway. A series of development plans in 1918, 1954, 1959 and 1980 all found that improvement of the khals seemed warranted. However, in the face of rapid urbanisation in the 1980s and recognition that the population of Dhaka may reach 20 million by 2015, it was decided, in 1989, to proceed with a *Dhaka Integrated Flood Protection Project*, the first phase of which, for the western rim of Dhaka, was financed under an ADB loan (ADB, 1991b). The resulting embankment has caused 7 *khals* to lose their links with the peripheral rivers and today, unplanned land reclamation and haphazard encroachment has led to the continued rapid loss of surface water channels in the city and its environs, including the Dhola Khal. Today, this *khal* is an open sewage ditch truncated by several congested inner city highways with clogged drainage pipes passing beneath the roads. It is noteworthy that during the feasibility study for the project, the Department of Environment expressed apprehension that the project may lead to further loss of the canal drainage system and aesthetically prized water bodies within the city (DOE, 1989). These gloomy apprehensions have proven correct, including the virtual demise of several once pristine lakes within the city. An added problem is constrained surface water drainage compounded by uncontrolled urban waste disposal leading to the rapid flooding of city streets and low lying residential areas during the monsoon season.

The study revealed that Dhaka and Narayanganj ports and numerous ghats on the Buriganga and Lakhya rivers handle about 12.6 million passengers and 2.6 million tons of river traffic per year. It was proposed that some of this cargo could be transhipped or on-carried via 13 re-excavated *khals* out of the total 22 *khals* to destinations and origins within the city, thus contributing to reduced road congestion. However, there are three bridges over the peripheral rivers, of which only the Mirpur

Bridge, with a headroom of 4.9 meters is passable by small IWT vessels. The result is that a river *ghat* for cargo exchange, especially for rock by larger IWT vessels from northern Bangladesh, has developed informally in the bridge area. The unplanned nature of the ghat adds to the significant road congestion in the bridge area. The other 2 bridges, for road and rail at Tongi, have headroom of only about 1 metre which effectively blocks a round Dhaka route. Moreover, tidal streams flowing up the east and west side of Dhaka meet in the Tongi area with resultant heavy siltation for which maintenance dredging costs would be high. Further, if Phase Two of the *Dhaka Urban Flood Protection Project* is proceeded with by construction of an embankment down the eastern side of Dhaka, then all the remaining natural drainage *khals* would be cut off from the peripheral rivers. The practical solution remaining is to improve the navigability of the peripheral rivers by dredging shoal areas between Dhaka Port and Mirpur and between Narayanganj and Tongi, improve the river port facilities, especially at Mirpur, and to regenerate the remaining important khals, including the provision of lock gates where feasible. Based on discussions with the World Bank in June 1998, these proposals may be considered under a *Fourth Inland Waterways Project* in 1999.

F. Proposed Dhaka Port Development Project

In 1996, the ports of Chittagong and Mongla handled a total of 13 million tons of cargo, of which about 70 percent passed through Chittagong Port and 30 percent was through Mongla Port. Of this amount, almost all of the nearly 300,000 TEU¹ container traffic, which has grown from about 50,000 TEU since 1986, is handled at Chittagong and is expected to more than double to about 640,00 TEU in 2003 (ADB, 1998: 8). About 60 percent of this traffic is in 40 foot containers and 75 percent is destined for the Dhaka area (ADB, 1998: 7). With an average annual daily traffic (AADT) on the main Chittagong-Dhaka highway of over 7,000 vehicles, many of which are laden trucks, the road is congested. This is especially apparent in the cities' approaches. The situation is made worse by existing customs and bridge constraints which require that containers are unloaded in the port area and container cargo is on-carried by 7 ton capacity trucks. This is inefficient, and while ongoing road upgrading and attention to customs regulations will improve the situation, rail capacity is only expected to increase from one to two block trains per day to help alleviate the situation in the foreseeable future. An IWT barge service would be less costly and would provide greater competition between the modes and delay further investment to increase road capacity. Containers could also be delivered by barge or small feeder ships to Dhaka from Mongla Port. Both IWT routes are Class I and based on the experience of European waterways cited in Chapter II, each barge could carry about 100-250 TEU, depending on the designs adopted, at the limiting draft of about 3.5 meters.

This opportunity has been recognised in the OECF financed feasibility study for the *Dhaka Port Development Project*. The study has proposed the construction of a 160,000 TEU capacity terminal with container barges of about 100 TEU (GOB, 1995a: 3-22) and an approximately even share of the total container traffic between roads, rail and IWT. Based on interviews with domestic ship-owners for the present study, strong interest would be forthcoming by the private sector to participate in the barge operations. Also, the Government is presently negotiating with a private USA firm for the construction of a dedicated container terminal at Patenga Point, Chittagong together with the proposed

¹ A TEU is the standard international measure for container traffic, being equal to a twenty-foot long container with an average capacity for Bangladesh traffic of about 12 tons.

Dhaka Port terminal. This is an encouraging outlook for the IWT sector. However, while the project will complement the proposed *Greater Dhaka Water Transport Development Project*, the concept needs to be extended and made for deeper penetration into the hinterland for containerised IWT, after the fashion of Europe and the USA, by dredging the major rivers in conjunction with water resources and flood protection schemes.

G. Conclusions on Inland Water Transport Development

The main conclusions of this chapter are as follows:

- The main economic benefits of IWT development in Bangladesh over road and rail are: (i) the significant avoidance of land acquisition and resettlement costs; (ii) contributing to the reduction of poverty inducing costs and of river bank erosion; (iii) opportunity for additional flood protection benefits, since the deepening and straightening of rivers maximises channel capacity in dealing with floods and reduces the period of post-flood retention of water; and (iv) energy savings through scale economies in the transport of heavy and bulky freight, including containers where intermodal exchanges are efficient.
- Unlike major embankment construction, which, however, may also be used to elevate roads and rail above flood level, as areas of refuge during floods, river bed dredging may be limited to short channel lengths of critical depth.
- The benefits associated with each transport mode and flood protection schemes must be evaluated in an integrated fashion, particularly taking into account geographical conditions, settlement location, the sunk cost of transport investments already incurred, technology, and the pattern of traffic forecasts and flood risks.
- The development of IWT routes in Bangladesh would have international transport as well as domestic transport IWT and water resources benefits. To this end, the *proposed Kalni-Kushiyara River Management Project* opens the possible revival of IWT services between Assam, Calcutta/Haldia and Chittagong. Dedicated IWT cargo and container facilities at the seaports and elsewhere on the river routes accompanied by a *Greater Dhaka Water Transport Development Project*, the OECF recommended *Dhaka Port Development Project*, and the Northwest Area Container Port proposed in the *Northwest Region Development and Investment Study*, would add significantly to the competitive use of the main river channels of Bangladesh vis-à-vis road and rail transport development.
- It appears from the *Jamuna Bridge Project* and related ongoing projects, as well as the deterioration of once significant intra-city IWT in Dhaka, that political sway may have blinkered national decision makers and donors that roads and bridges, as a highly visible means of attractive time savings in transport, should have overwhelming priority as a means of economic development. The rigid bureaucratic structure may also have inhibited an integrated water resource transport river-basin approach to sustainable development. A detailed study of this hypothesis is beyond the scope of the present research. Nevertheless, such research may be useful in the interests of sustainable transport development, and Bangladesh would provide an ideal location for a detailed study.

- In terms of pollution avoidance, the lower energy usage of IWT and rail results in lower emission of pollutants than for road transport. While major user cost savings result from reduced fuel expenditure, the health and human welfare benefits of one transport mode over another are almost insignificant in the overall economic analysis for the case study adopted, while the global impacts of CO₂ emissions by transport in Bangladesh are insignificant. Accordingly, since there is higher demand for road transport due to its door to door facility than for IWT and rail, the pollution impacts of transport must be addressed not only by avoiding fuel or freight subsidies but must be accompanied by strongly enforced environmental regulations.
- The principal likely environmental risk of IWT, compared with road or rail, is that of oil spills, both as cargo and fuel. In Bangladesh, IWT oil tankers have capacities of up to about 1,500 tons, and the principal environmental risk would be from oil pollution following a collision. This risk and proposed mitigation measures are examined in Chapter VI. Secondary risks, which are also a regulatory and training matter, are the potential for minor oil spills during refueling or pumping of contaminated bilge wastes and noise pollution. These risks are particularly significant since regulations governing the noise emission of passenger vessels and country boats in the informal sector are inadequate and are not enforced. These risks may be at least as high as the reduced noise pollution from trucks under a policy framework which encourages the diversion of road freight traffic to IWT and where enforcement of environmental regulations are notoriously weak.
- A further environmental risk, results from navigation induced hydraulic forces. These effects are generated by IWT vessels in the form of waves and currents and are a function of ship speed, hull shape, relative cross sectional area of the channel and submerged portion of the vessel. In general, they result from water movement following displacement by the ship's hull. While field investigations and use of models have been extensive and useful, determining the ship versus natural hydraulic events is very complex as revealed by Martin and Maynard, 1994:151-6. The potential adverse environmental impacts include ecological losses in side channels and backwater areas adjacent to main river channels following the resuspension of sediments, dewatering of banklines and turbulence. Determining the threshold values affecting mortality is a key area for research (Martin and Maynard:162).

CHAPTER VI

POLLUTION MITIGATION ISSUES FOR WATER TRANSPORT

A. Introduction

Among the various transport policy issues to be addressed it is clear that if these are designed to encourage the economic and environmental advantages of IWT vis-a-vis other transport modes, careful mitigation of the environmental risks of IWT, as referred to in Chapter V. G, should be adopted. The main risks are pollution due to inappropriate dredge sport disposal, pollution associated with the handling of hazardous cargo and oil spills, and navigational safety. Failure to address these issues will lead merely to further environmental degradation. In view of the natural high sediment load and lack of industry except in the Chittagong, Dhaka and Khulna port areas, and consequently widespread contaminated sediments oil pollution appears to be the most significant of these risks.

A series of major oil-spills by ships, such as those involving the Torrey Canyon, 0.9 billion barrels (bb) (1967); Odyssey, 1.0 bb (1968); Amoco Cadiz, 1.6 bb (1978); Atlantic Empress, 1.9 bb (1979); Khark V, 0.6 bb (1989); and the Exxon Valdez, 0.3 bb (1989), have led to public outcries. While such incidents have been publicised widely, many other major spills of more than 0.1 bb have occurred over the years, and many minor daily spills and deliberate disposal go unreported. In 1990, about 0.7 billion tons of oil entered the sea in transporting and handling the world's demand for the use oil products (Lloyds of London, 1990: 6), or about 2-3 percent of the total volume of oil carried by shipping (IMO, 1995a).

Sharpened public concern about the major spills have helped organisations such as the International Maritime Organisation (IMO), which was formed by the United Nations in 1948 but lacked any significant impact until the early 1970s, in its formulation of several important conventions aimed at maritime safety and environmental protection. More recently IMO Guidelines' have been formulated to implement Principle 15 of the Rio Declaration and Agenda 21, including recent efforts towards port state control for the detainment of sub-standard vessels.

Significant as the IMO achievements are, since without them maritime pollution problems would be much worse than they have been, these efforts have taken years to ratify internationally and implementation remains an unfinished and difficult task. The conventions have also been diluted through criticism by world shipping interests as lacking adequate sense of commercial realism. The cost of retrofitting a very large crude oil carrier (VLCC) to meet double-hull United States legislation is estimated at \$30 million. However, this is estimated to raise the cost to consumers of less than \$0.01 per gallon of fuel. Also, the United States Oil Pollution Act of 1990, which carries unlimited liability following the \$2 billion cost of cleaning up after the Exxon Valdez, has had useful effect in forcing shipping operators and insurers to adopt a more environmentally responsible approach to the problem (Lloyds: 10).

Enforcement outside of the United States is more difficult. Moreover, inspection surveys aimed to help prevent major oil spills are physically difficult. For example, very large crude carrier (VLCC) has a volume of around 300,000 cubic meters

and a total height to climb in inspecting the quality of the structure has been calculated at 10,600 meters, or 2,000 meters higher than Mount Everest (IMO News, 1995: XII). While the regular inspection of smaller vessels may be less daunting, the tendency of developing countries to acquire vessels beyond their normally accepted economic life and for their national legislation and survey resources to be inadequate is an indication that oil spill risks are a valid environmental concern. Moreover, 75 percent of oil spills are attributed to human error (Fingas, et al., 1979). In particular, the training of domestic ship operators in developing countries is well below the standards adopted for international shipping under IMO's Standards of Training and Certification of Watch keeping Conventions (STCW, 1978).¹

B. Port and Shipping Pollution Risks in Bangladesh

1. Chittagong Port

Chittagong Port has the only oil refinery in Bangladesh and is the only international port for oil shipments, with transshipment to inland ports by IWT. International oil tankers up to about 200,000 dwt bring crude and various grades of oil cargo totaling about 3.5 million tons direct from Gulf ports to Chittagong. Due to depth constraints at the port these transship crude oil at the outer anchorage to smaller, 14,000 dwt vessels, which escalates risk of spillage. Frequent spills also occur at the alongside berths of Chittagong Port, as well as apparent deliberate discharge of tank washing residues in the absence of waste oil reception facilities. The refinery and oil storage tanks are also reported to release sludge oil into the harbour.

The normal nearest approach of international tankers to the Sundarbans Reserved Forest (SRF) is approximately 150 km to the southeast. If such vessels are well off their normal course there could be a serious pollution risk to the SRF in the event of a collision in the Bay of Bengal, especially if during restricted visibility during the monsoon season. However, the prevailing wind direction during the monsoon is south to southwest. While this is an onshore wind, it is Chittagong and Cox's Bazar that would likely be at greater risk than the SRF. During a typhoon in May 1998, two tankers collided at the outer anchorage resulting in a serious oil spill. In principal, there should be sufficient time to mount an international effort in the event of a serious offshore spill. Wave action and evaporation would also help to reduce coastal pollution risks in the time taken for an oil slick to move onshore where the greatest ecological and economic damage would occur. While the careless discharge of oily wastes by tankers after tank washing have been significantly reduced worldwide in recent years as a result of new technology and international conventions, Bangladesh is not a party to the relevant conventions since 1954 and Chittagong Port lacks waste oil reception facilities. Bangladesh is therefore reliant upon the professionalism of international mariners and the standards of technology applied at shipboard level. This is a calculated risk based on international and trading partner country requirements for such vessels. There is no similar training for domestic shipping and IWT operators.

An additional environmental concern at Chittagong arises from the shipbreaking industry conducted over 15 km of open coastline, resulting in uncontrolled

¹ A STWC (1995) Convention, with even higher standards, has now superceded STCW (1978). Problems and issues in upgrading IWT and non-convention shipping standards will be addressed by UNESCAP, Bangkok, at a regional conference in November 1998.

dispersion of tank residues from up to 50 vessels under various stages of reduction to scrap steel at any one time. Additional environmental impacts occur from spillage and dust incurred during the handling of large volumes of bulk fertilisers and cement, which are washed mainly by rain into the harbor. The result is turbidity, sediment contamination and ecological degradation in port areas, apart from other industrial and urban effluent.

International vessels of all types may carry about 70 tons of diesel fuel oil, giving rise to oil spill risks from, grounding or collision. General cargo vessels approaching Chittagong Port in ballast or partly loaded may also discharge water ballast to minimise their longitudinal trim in approaching the shallow outer bars. While the introduction of water borne species taken aboard as ballast from this source is a risk factor it has never been studied in Bangladesh. However, there is no apparent evidence of past problems. Considering the deep water environment outside of the bar area where most de-ballasting would occur and that some ballast loading will also have taken place in the deep ocean after leaving a foreign port to compensate for stability loss due to fuel burning, the environmental risk from ballast discharge may be insignificant.

Other pollution risks from port operations include dredging, solid waste disposal, runoff from port yard areas, and spillage of dangerous chemical cargo. Noise pollution can also be a problem in port areas and in some cases elsewhere, strong lights due to port operations have been known to confuse newly hatched turtles and migratory birds.

2. Inland water Transport and Mongla Ports

At Dhaka Port, where about 400 IWT vessels dock each day and 2,500 passengers per day board vessels for all parts of Bangladesh, other ship related activities causing water pollution include ship breaking, dredging, repair and berthing of disused vessels, many of which have sunk at their moorings. There is also extensive industrial activity along the river bank and both industrial and urban effluent is uncontrolled. The only sewage treatment plant in Bangladesh, which receives and treats sewage from Dhaka, discharges directly into the Buriganga River near the BIWTA passenger ferry terminal. A recent environmental audit is summarised in Table 14.

Table 14: Environmental Impact of Dhaka-Narayanganj River Port

Activity	Potential Impact
<p>Construction of Inland Container Port. Total land area 89 acres.</p> <p>Inland shipping carrying fuel, oil, cement, food grains, jute and related products, fertiliser, stone, petroleum and petroleum products.</p> <p>Ship maintenance and repair.</p> <p>River dredging.</p> <p>Dockside industries including match factories, timber processing, power generation, wicker baskets manufacture, iron foundry, stone crushing, coconut oil processing, metal fabrication, textile and dyeing, steel mills, rice cooking, chemical industries, jute processing, brick works and rice mills.</p>	<p>Site runoff from construction work. Post-construction impacts.</p> <p>Potential for hazardous cargo spill and cause environmental damage.</p> <p>Release of toxins into the environment.</p> <p>Remobilisation of contaminants within aquatic sediments.</p> <p>Poor process management and waste control can result in release of pollutants into air and water. Industrial production releases contaminants into the port areas.</p>

Source: Nuttall (1997)

The IWT shipping operations are on a 24-hour basis and a collision involving a tanker at night would present the greatest problems for prompt containment on the main routes of a spill. The MOS has recorded only a few major incidents in the past.

Passenger and IWT cargo vessels, some of which are tug-assisted barges, each carry about 10 tons of fuel oil. It is estimated that along with international shipping at Mongla Port, the total fuel oil carried close to the SRF may amount to about 250,000 tons per year. These vessels enter the Pussar River at Mongla Port and their route passes through the middle and to the north of the Sundarbans. These include IWT vessels operating along the Class I route between Mongla and Khulna. About 100 IWT vessels per year, carrying a total of about 2,000 tons of fuel oil are also in transit to and from Calcutta. These vessels also follow the IWT route via Mongla Port part of which is through the western portion of the SRF. They operate under the *Protocol on Inland Water Transit and Trade* which has been renewed every two years since 1972 and was renewed again in November 1997. Under the Protocol, Bangladesh receives a fee for the maintenance and navigational marking of the channels and the adequacy of these facilities and the fee paid by India should be reviewed especially if the route is developed as proposed in Chapter V. Small oil spills from any of the above vessels is a constant risk and would be difficult to contain in the strong current regime of the Pussar and other main rivers, especially if occurring at night or in winter fog. In general, the emphasis should be on preventive measures.

In the SRF, the most relevant dredging related studies are by Farleigh (1983) and the Danish Hydraulic Institute (1993). The studies conclude that the river bed sediments are mainly fine sands and there is a net sediment transport upstream of about 300,000 cum during the dry season and about 900,000 cum downstream during the monsoon season. Intermittent maintenance and deferred maintenance dredging has been

carried out inefficiently in the past decade using domestic resources. The government planned to seek bilateral financing for an MPA dredger to be based permanently at Mongla Port. However, following discussion with the ADB, the underutilised Chittagong based dredger will be deployed periodically to Mongla. This dredger may be expected to dredge channel shoals between the Pussar River entrance and Mongla Port and in the port area. Total maintenance dredging needs are in the range 4-5 million cum. per year and could be supplemented by low cost river training works at Mongla Port to improve the natural flushing mechanism of the river. The long distance to the sea would make offshore disposal very expensive and past dredge spoil has been used for reclamation. The use of designated disposal sites in the river or offshore will have to be considered in a few years.

While likely to be significant, heavy metal residues in dredged material from industry are unrecorded at Chittagong, Dhaka and Khulna. Nevertheless, the pollution impacts due to past maintenance dredging have apparently been negligible elsewhere in Bangladesh in view of the generally low industrialisation of the country. Potential turbidity and mangrove blanketing impacts could occur in the northern extremity of the Sundarbans due to the proposed dredging program and disposal in the river in future years. The environmental impacts of dredging can be mitigated by the use of suction hopper techniques and the careful selection of disposal sites. The high natural sediment load of most rivers and a strong tidal regime may offset the risk of serious impacts and the potential river training works at Mongla Port will help to minimise dredging needs and enhance natural channel scouring.

Solid waste and sewage disposal from ships lacking onboard containment facilities can be a significant problem in major ports and their approaches, but is not a serious problem in the relatively minor port of Mongla where most operations are conducted in the high energy river anchorage area. However, Mongla Port Authority (MPA) does not have a garbage disposal service for the international vessels which engage in midstream cargo operations and this deficiency should to be addressed.

Due to the present limited activities at the alongside berths at Mongla Port, pollution risks from surface runoff is low. However, no special provisions appear to be made for the in-port storage of dangerous goods. This could become an increasingly important factor in future years and mitigation measures to treat port runoff will be considered under the proposed *Ports Efficiency and Access Project*, especially for containers. These would be loaded at the exporting port and normally managed on board the vessel in accordance with the International Maritime Dangerous Goods (IMDG) Convention. Accordingly, the packaging may conform with international Standards. Nevertheless, accidental spillage due to loss overboard of containers or drums containing dangerous goods is a risk in the event of a ship stranding at the Pussar River entrance or resulting from major collision damage. In port storage is also on issue considering the current dwell time of containers in Chittagong is very high, averaging 27 days, compared with international norms of about 7 days.

A further possible pollution risk would result from any decision to carry out cargo operations in the Pussar River entrance which is being considered by the government. The rationale for this is to avoid the reduced depths and cost of maintenance of dredging at Mongla Port and would likely involve the transfer of containers to IWT vessels by direct transshipment or via a new port. Prima facie, the rationale for construction of a new port in the area is weak but may have economic value for IWT container exchange about half-way between Mongla Port and the Pussar River entrance

where the difficult siltation problems associated with the existing alongside berths can be avoided. In the latter event, minor spills during any refueling, leakage from tug boat or sinking of any IWT vessels associated with the operations, noise pollution and strong lights from night cargo operations, and port labor accommodation and recreation within the Sundarbans would be the main issues. A government study has examined extension of the existing road from Mongla Port southward into the Sundarbans to transport port labor and cargo to the river entrance. The main impacts of this incursion of industrial activity in the project area can be partly avoided by transshipping into IWT vessels and the use of floating accommodation for labor. However, the most environmentally responsible action would appear to be a focus on the improvement of Mongla Port and to improve navigational aids in the channel approaches rather than allow new port construction within the SRF.

3. The Sundarbans Reserved Forest

Following completion of an ADB financed feasibility study for the *Biodiversity Conservation in the Sundarbans Reserved Forest Project* (ADB, 1997c), an investment project and loan of \$60 million is being considered for approval in 1998. The feasibility study did not address water transport pollution risks in the project area. Neither did it recognise the potential for reduced environmental impact by basing eco-tourism development on water transport. Rather, it proposed a system of lodges and tracks which might lead to further environmental degradation and permanent settlement of the area. The SRF comprises the world's largest contiguous mangrove ecosystem of 10,000 square kilometers and the project aims to provide sustainable and integrated management of the area, which is home to 2 million relatively poor people and many threatened and unique species of wildlife, including the Bengal Tiger.

Apart from additional government financing, co-financing is anticipated under the Global Environment Facility (GEF), bilateral sources, an NGO financing foundation and private sector interests.

The feasibility study has proposed the following components:

- (i) bio-diversity and sustainable resource management;
- (ii) economic development linked to conservation;
- (iii) eco-tourism and marketing; and
- (iv) effective management of the SRF.

The Pussar River, which is one of the interconnecting distributaries of the Ganges River, bisects the SRF where it enters the Bay of Bengal. The river has a dynamic erosion and sedimentation profile and flows are dominated by a strong tidal regime rather than river discharge.¹ The river entrance has an extensive bar and the channel contains a number of shoals that are dangerous to navigation. Mongla Port, the second international port of Bangladesh, is located 85 km from the river mouth and lies

¹ At Khulna, over 100 km inland, the average land elevation is only 1.5 meters above datum, while the average tidal difference at the Pussar River entrance is about 2.5 meters. Saline intrusion is a problem and empolderment was carried out in the 1960s. This led to reduction of the drainage area and natural flushing, followed by increased siltation. The situation has been compounded by construction in the 1970s of the Farakka Barrage about 30 km above the Bangladesh border on the Ganges River and deforestation in the upper catchment areas of the river system.

only 3 km above the northern margin of the SRF. The port operations are governed, as are all of the northern Bay of Bengal ports, by draft limitations which are partly mitigated by the semi-diurnal tidal regime. The draft limitations and location of the port, away from the main oceanic trade routes, determines that container shipping is a feeder operation based on Singapore and to a minor extent, Colombo. Due to the lack of adequate hinterland connections and siltation at the berths, container and general cargo operations are inefficient and 90 percent of cargo handling activity takes place at mid-stream buoys. This also determines that mainly outdated and older age break-bulk shipping use the port. Mongla Port handled about 3 million tons of cargo in 1996, comprising mainly cement, food-grain and fertiliser imports, and jute product exports. Other general cargoes, including small amounts of dangerous chemicals, are of minor importance, and are carried mainly in containers that currently total about 18,000 TEU per year. Overall traffic is forecasted to grow at about 5 percent per year.

Minor improvements to Mongla Port facilities are planned under the proposed ADB financed *Ports Efficiency and Access Project*. The port could grow in relative importance to the heavily congested Chittagong Port following economic development of the north-west region of Bangladesh and the improvement of hinterland connections, including minor transit trade volumes for Nepal for which an agreement was reached between Bangladesh, India and Nepal in September 1997. Depending on political dimensions and improvements in the hinterland connections, Mongla could also serve as an alternative port to Calcutta for future West Bengal traffic in the longer term.

At Khulna, approximately 30 km upstream from Mongla Port, the river is too shallow for international shipping operations and port and shipping activities are limited to IWT, including cargo transshipped by barge from international vessels at Mongla Port, and the handling of about 7,000 tons per year of domestic oil tanker cargo which is transshipped from Bangladesh's only oil refinery at Chittagong Port. The latter traffic is handled by domestic tankers of about 400-1,000 dwt and is transported along a major IWT route just north of the SRF. A collision and major spillage in this area would be carried by strong tides and residual currents deep into the SRF as could a spillage during oil transfer at the Khulna oil depot.

4. Types of Port and Shipping Pollution Within the Sundarbans

In the SRF, 30 percent of the area is water and it is important to examine the various potential sources of pollution from ports and shipping in this relatively roadless part of Bangladesh. The primary potential source of pollution in the area is the discharge of oily wastes, and accidental spills affecting mainly the margins of the forest area. Minor spills occur due to poor engine maintenance, careless refueling and occasional sinking of overloaded, informally operated country vessels which have become predominantly mechanised over the past decade. This has typically been done by rudimentary retrofitting of irrigation pump engines without proper regard for efficiency or oil waste containment. Because the engine spaces of such vessels are open to rainwater, spray, and leakage through the caulked wooden hull planking, oily wastes are discharged overboard with bilge water. Since traditional wooden planked country boat designs do not cater to the vibration caused by mechanisation, pollution has increased in recent years, including at village level ports (*hats and bazars*). Studies have commenced to address this issue in Bangladesh as in other countries that have faced the transition to the mechanisation of

informal sector river transport.¹ While such vessels can penetrate the entire recesses of the SRF the main impacts can be most readily addressed at centers of population which rely on the country boat sector for communications. The coastal area is also used by fishing and coastal cargo vessels of 100-200 dwt of the trawler 'bay crossing' type. These vessels usually have deck mounted fuel tanks and spare fuel in drums. There are frequent reports of their sinking during storms in the coastal margins and outer estuary areas of the Bay of Bengal. Minor spillage during refueling is considered normal.

The risks of larger spills may result from grounding or collision involving international trade cargo vessels transiting the Pussar River and its entrance, or in some cases, passing offshore between Calcutta and Chittagong along the exposed, shallow and navigationally dangerous coastline which is poorly marked with navigational aids. The average size of general cargo vessels visiting Mongla Port is about 8,000 dwt. Forty percent of these vessels are container feeder ships which are normally less than 10,000 dwt and the remainder are break-bulk cargo vessels, mainly in the range of 10,000 dwt to 17,500 dwt. These vessels are assumed to carry an average of about 750 tons of fuel oil in double bottom tanks. On average, about 170 such vessels per year which visit Mongla Port pass through the Sundarbans both inward and outward. As mentioned earlier, a total of about 250,000 tons of oil is estimated to be carried as fuel or IWT cargo throughout near the SRF each year and additional amounts are carried by vessels passing offshore en-route between Chittagong and Calcutta. Vessels visiting Mongla Port occasionally refuel from barges and accidental minor spillage is reported to occur from this source.

While grounding on hard sand shoals is a risk, rocky outcrops are not a hazard in this recent sedimentary delta area. The main risk would result from mechanical breakdown or serious navigational error and stranding on a coastal sand shoal, followed by wave damage during monsoon storms that prevail from June to November. These latter risks are greatest for international vessels approaching Mongla Port via the Pussar River entrance at the outer bar area. While crossing the bar in monsoon conditions, there is a risk of a vessel being set down heavily onto hard sand, especially if losing control at a critical juncture or if the tidal state or wave height had been miscalculated. The vessels' deeper draft stern is the main risk area in these circumstances rather than the mid-area double bottom tanks. However, pilotage is compulsory for international vessels entering the Pussar River and there is no record of any serious grounding or major estuarine oil spillage to date. The risk can be reduced by the enhancement of shore based navigational aids at the river entrance and improved ship-to-shore communication systems, and these are planned under the proposed *Ports Efficiency and Access Project*. However, the main rationale for such investment would be to allow hitherto prohibited night navigation by international vessels in the river, which carries its own set of risks. Accordingly, enhanced pilot training would also be needed.

Similar pollution risks exist for the Indian portion of the SRF which lies within India which is increasingly affected by industrial and urban pollution from the Calcutta area which by themselves increasingly threaten the SRF (Mukherjee, 1998). This also results from the heavier shipping traffic that enters the Hoogly River about 120 km

¹ For example, NOAMI (1994) *Experimental Project for Improving the Efficiency and Profitability of Country Boat Operation*. The study recommendations are being taken up under the World Bank's ongoing *Third Inland Water Transport Project* and may be taken further under the *Fourth Inland Water Transport Project*, in 1999.

west of the Bangladesh border, and relates to shipping at Haldia and Calcutta ports. The Indian government's pollution contingency planning for shipping should be examined in design of any mitigation measures for Bangladesh, particularly for joint efforts in dealing with a serious offshore collision and major oil spill. Because of the prevailing south-west winds during the monsoon season, a major oil spill off the Hoogley River entrance probably carries a greater risk to the Bangladesh area of the Sundarbans than from a collision involving Chittagong bound oil tankers from the Gulf ports. This could provide the rationale for a memorandum of understanding (MOU) between the two countries for mutual assistance on major oil spills such as exists between Australia and New Zealand.

C. Institutional and Legal Framework

The ports, shipping and IWT sectors are administered by the Ministry of Shipping (MOS). The coordination of sector development strategy has, to the limited extent that this has actually taken place, has been exercised by the Infrastructure Division of the Planning Commission. The two international ports of Bangladesh are also administered under MOS, namely by the Chittagong Port Authority (CPA) and Mongla Port Authority (MPA). Private sector involvement in shipping activity is extensive. However, the Government owned Bangladesh Shipping Corporation (BSC) manages a total of about 30 international trade vessels in the transport of about 20 percent of Bangladesh's foreign trade goods, including container, general cargo and oil tanker services. Also, the Government owned BIWTC operates a fleet of over 400 IWT and coastal cargo and passenger vessels, and river ferries at 3 major river crossings. The RHD also has a fleet of 70 smaller river ferries.

Since 1976, seafarer training, pollution and safety measures have been regulated by the Department of Shipping (DOS) under the MOS. For IWT, pollution and safety matters have been delegated under the MOS controlled BIWTA, which maintains all IWT infrastructure and channels, to the Inland Shipping Safety Administration (ISSA) which was established in 1997. At present, ISSA exists in name only and the necessary legislation and recruitment of staff remains delayed for nearly two years since the ISSA arrangements were recommended by the World Bank under its IWT3 project.

There are no apparent planning controls on port extensions and the issuance of permits for development generally is uncoordinated and weakly monitored among different agencies such as the Department of Environment (DOE), Ministry of Industry, Board of Investment and local planning departments. While there is a wide range of enacted environmental protection legislation for Bangladesh, much of it is archaic and inappropriate to the control of impacts from port operations and shipping. Overall protection of the environment is governed by the Environment Protection Act (EPA) (1995b) which superseded the Environment Pollution Control Ordinance (1977). The DOE under the Ministry of Environment and Forest is the regulatory authority. The legal framework in Bangladesh has been progressively updated. Legal and regulatory instruments and standards are either in place or being drafted for dealing with oil spills and other port and shipping related environmental management. These include the Protection of the Marine Environment of Bangladesh Act (1990), Environment Conservation Act (1995), the Environment Conservation Rules (1997), and Draft Rules for the Environmental Control of Inland Water Transport (1998).

The Environment Conservation Rules (1997) have been introduced as wastewater effluent and air emission standards for industry (see Table 15). A number of

schedules under the Rules apply to port activity such as air quality (Schedule 2), noise quality for mechanised vessels (Schedule 5) and quality standards for mechanised vessel exhaust (Schedule 7). However, while these could provide a useful starting point for improved management, the schedules are incorrectly gazetted and poorly administered.

Table 15: Environmental Conservation Rules Applicable to Ports and IWT

A: Schedule 2: Air Quality Standards (micrograms per cu m)

	Suspended particulate matter	Sulphur dioxide	Carbon monoxide	Nitrogen oxide
Industrial & mixed	500	120	5000	100
Commercial & mixed	400	100	5000	100
Residential & rural	200	80	2000	80
Sensitive	100	30	1000	30

B: Schedule 5: Noise Quality Standard for Mechanised Vessel

Standard limit (dBa)	Comment
85	Measured at rest and empty at 2/3 of maximum rotation speed at 7.5 m. from vessel.
100	Measured in same position at 0.5 m from vessel.

C: Schedule 7: Quality Standard for Mechanised Vessel Exhaust

Parameter	Unit	Standard limit
Black smoke	Hartage smoke unit (HSU)	65

Source: Syed (1998).

D. Oil Pollution Mitigation Measures

1. The International Framework and Bangladesh

Bangladesh is a member state of the International Maritime Organization (IMO) (see Section B1) which was established by the United Nations to set appropriate standards of maritime safety and responsiveness by maritime countries in dealing with environmental risks by shipping. Member countries of the IMO adopt international conventions on these matters in accordance with their need and capacity to administer and implement them effectively. Implementation is the weakest aspect, especially where financial investment is required, such as for the construction and management of waste oil reception facilities at oil tanker terminals. Conventions of safety management, such as the Safety of Life at Sea (SOLAS) Convention, 1974, STCW 1978 and STCW 1995, other conventions dealing with load lines and communications, and the agreement on Port State Control (PSC, 1990), also provide a framework for the reduction of maritime environmental risks.

Some conventions address pollution more specifically. The most important of these are the International Convention for the Prevention of Pollution from Ships (1973) and Protocol (1978) (MARPOL, 73/78)¹ and the International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC, 1990). Neither of these have been adopted by Bangladesh. While MARPOL 73/78 requires major investment in onshore reception facilities for oil tank residues, the OPRC (1990) could be regarded as a lower cost intermediate step. Bangladesh has also not adopted the conventions on Civil Liability for Oil Pollution Damage (1969), the Establishment of a Fund for Compensation of Oil Pollution Damage (1971) and Protocols to 1992, Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972) [usually referred to as the London Dumping Convention], and Intervention on the High Seas in Cases of Oil Pollution Casualties and Protocol (1973). These are important conventions that most countries have ratified. However, many countries that have formally adopted MARPOL 73/78 have failed to make the necessary investments to comply fully with its provisions. These especially relating to the provision of waste oil reception facilities in ports, for which a cost-benefit analysis is warranted. The conventions so far adopted by Bangladesh are as follows:

- IMO Convention (1948);
- Marine Pollution (1954);
- International Load Lines (ILL), (1966);
- Intervention on the High Seas in Cases of Oil Pollution Casualties (1969).
- International Regulations for Preventing Collisions at Sea (COLREG), (1972);
- Special Trade Passenger Ships (STP) Agreement and Protocol (1971/3);
- Safety of life at Sea (SOLAS), (1974);
- International Maritime Satellite Organization (INMARSAT), (1976); and
- Standards of Training, Certification and Watch-keeping (STCW), (1978);

Various entities in Bangladesh have developed or have proposed institutional arrangements to deal with marine and river pollution. However, these need to be evaluated and coordinated for an effective contribution to port, coastal or river oil spill response capacity under a *National Oil Spill Contingency Plan*. The initiatives taken by Bangladesh include the following:

- The CPA has prepared a policy statement for an oil spill response plan and a Technical Assistance Project Proposal (TAPP) for port environmental management, although minor spills are dealt with on an *ad hoc* basis, and permanent reception facilities for ship solid waste have not yet been introduced. Moreover, CPA has no remit to undertake environmental monitoring, either before or after oil spills occur, and virtually all spills are unreported and un-quantified;
- The MPA has also prepared a policy statement on oil spill response but has no facilities to implement a response, or for dealing with ship solid wastes;
- The BIWTA has completed a broadly based audit of key inland port environmental management and has completed a Project Concept Paper

¹ MARPOL 73/78 contains 5 annexes. These deal with oil pollution, bulk noxious liquid substances, harmful packaged substances, sewage, and marine generated garbage.

(PCP) for the adoption of inland shipping waste reception facilities at 11 inland ports;

- The DOE accumulates water quality reports from 40 sites throughout Bangladesh. However, these are published infrequently as fairly meaningless data. The publications do not report on spillages that may have occurred in the vicinity of monitoring sites. Air quality impairment data at sea or river port areas is not quantified and is entirely anecdotal;
- The Bangladesh University of Engineering and Technology (BUET) has established laboratory testing facilities and a dredge testing facility is available at Narayanganj and there is an oil finger printing and identification of oily wastes and noxious substances at Chittagong University;
- The Surface Water Monitoring Center (SWMC) has made a proposal for an oil spill risk assessment and an associated geographical information system for the SRF under the proposed ADB financed *Bio-diversity Conservation in the Sundarbans Reserved Forest Project*;
- While the Department of Forests has responsibility for coastal protection, including the mangrove areas, it is clear from the degradation taking place that this responsibility is not being effectively implemented. The ADB has programmed a *Coastal Resources Management Project* to help address this problem;
- The Bangladesh Coastguard takes responsibility for combating oil discharges in coastal areas. However, the arrangements are understood to be rudimentary and uncoordinated with the port authorities; and
- Although a Disaster Management Bureau (DMB) has been established to deal at a national level with typhoon risks to coastal communities, it does not have the capacity to coordinate any major coastal pollution incident, such as resulting from the stranding or nearshore collision of an oil tanker.

2. National Oil Spill Contingency Plan

Environmental audits were carried out under the World Bank's Third Inland Water Transport Project (IWT3) on CPA, MPA and Dhaka and Narayanganj river ports (Nuttall, 1997). They confirm the lacking facilities and frequent occurrence of oil spills, particularly at the sole oil importing port of Chittagong. The national instruments also need to be examined carefully in relation to needed CPA and MPA strengthening for effective mitigation, monitoring and possible enforcement of appropriate regulations as well as the formulation and implementation of a *National Oil Spill Contingency Plan*. Oil spills may occur at any time and serious accidents may occur under the best operational practices. It is therefore essential that all countries have well understood and practiced arrangements to deal with such incidents. Shipping companies, port authorities and oil companies are the best organisations to deploy emergency measures for small spills. To help contain serious spills beyond the capacity of the port, polluting entities should be responsible under polluter pay principles. It is also necessary to adopt an effective nationally based arrangement to deal with spillage outside of the port limits, especially where ecologically sensitive coastal areas are at risk.

This concept of national planning is also vital in making timely decisions to seek the assistance of international efforts such as through MOU with neighbouring countries and/or the IMO. It is imperative that a national oil spill contingency plan be prepared urgently by Bangladesh. A tiered approach should be introduced for port level

arrangements and investments to deal rapidly with small, Tier One spills. Reporting and decision making arrangements should accompany this for effective response to major, Tier Two spills and those occurring beyond the port authorities' areas of jurisdiction requiring possible Tier Three, international cooperation. This is the approach adopted internationally under IMO leadership, in the interests of international integration and operational cooperation. An example is New Zealand and its MOU with Australia in dealing with major spills (Maritime Safety Authority of New Zealand (1996)).

In Bangladesh, while this could be administered under the existing DMB, this entity does not yet have the necessary capacity. The most effective agency would be the Bangladesh Coastguard provided experienced commercial marine operations staff are added to the on-scene command and provided there is also a strong linkage to the MOS to ensure that IWT risks and spillage are given due importance. In general, navigational prudence, emphasis on preventive measures and concern for maritime safety management would be the primary mitigation measure, including assurances on crew and on shore capabilities to deal immediately with accidental oil spills. The main deficiency is the lack of effective national oil spill contingency planning, oil spill equipment, or effective salvage facility to take the necessary first steps before any international measures, if needed, can be alerted and provided in the event of a major spill. In India, oil spill contingency planning is handled by the Coastguard and effective linkages to Bangladesh could be adopted readily in dealing with internationally important oil spills.

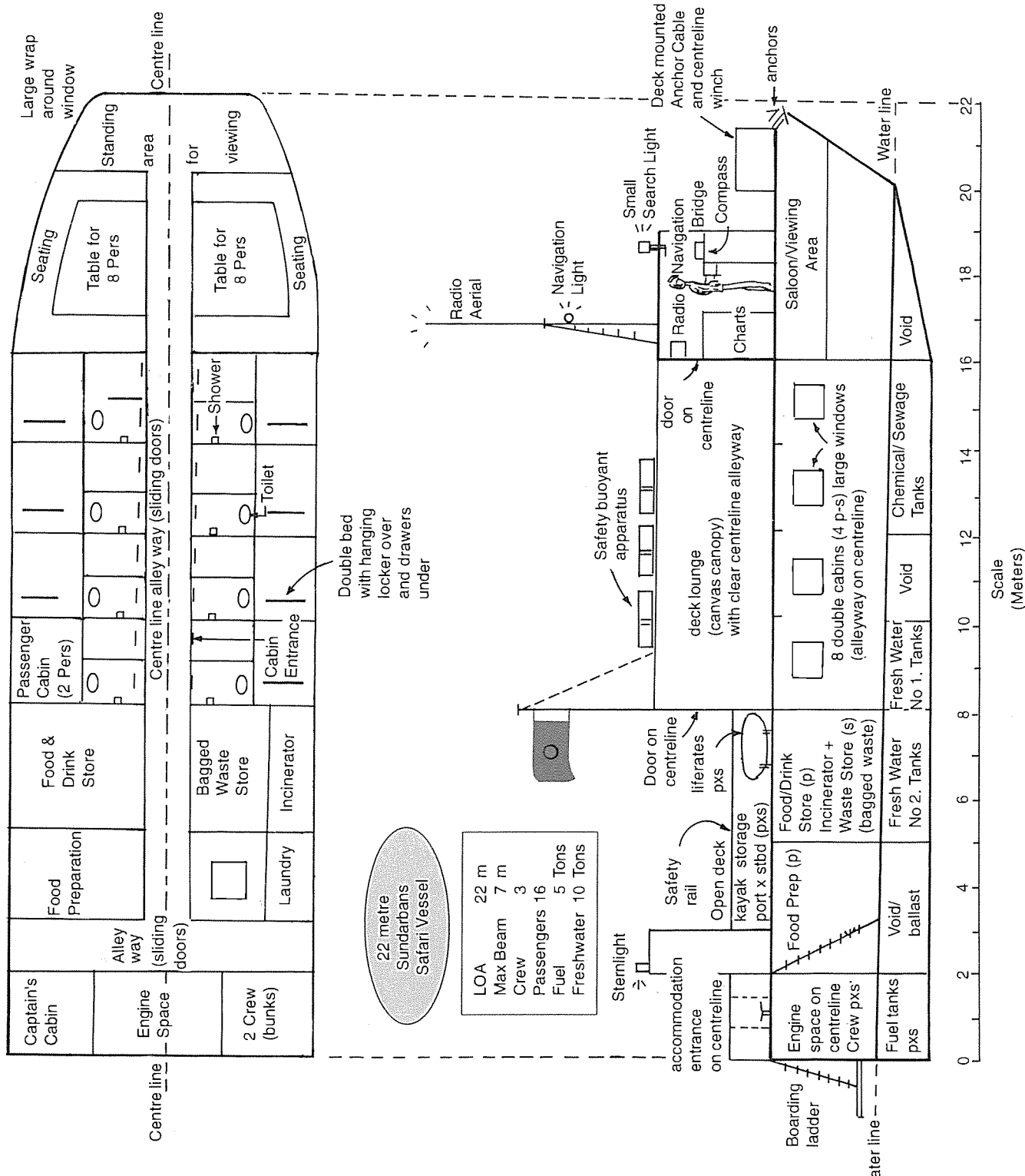
E. Proposal for Inland Water Transport Based Eco-Tourism

The conservation of ecological bio-diversity in the SRF, while facilitating participatory economic development, contains an implicit requirement that any threats of pollution by ports and shipping activities in the area should be assessed conservatively. At the same time, a water transport approach offers an opportunity for the least environmental impact of eco-tourism development. Further, because the focal objectives of the project are biodiversity conservation while promoting sustainable economic livelihood, including eco-tourism, a strategy needs to be adopted which balances these objectives while minimising pollution and human impact. A water based approach to the eco-tourism component, based on a fleet of standard design vessels which minimise pollution risks and waste disposal, has the potential of self contained and supervised movement and education of visitors to the SRF.

The proposed focus of this approach is a series of 22 meter *Sundarbans Safari* vessels for which a conceptual design is proposed in Figure 3. The vessel would be capable of transporting 16 passengers on a draft of about 1 meter anywhere in the Sundarbans and could cater to special interest, study, or general interest groups. A limited range of designs could be developed to include adequate space and arrangements for all supply items needed for a round voyage, and on board waste storage and treatment. The designs could be subject to approval and construction supervision by the Department of Shipping (DOS) or ISSA once the latter becomes properly established. Boatyards in Bangladesh could be accredited under prequalification criteria, and fuel and other pollution risks and crew training and responsibility could be standardised and also assured by examination and independent surveys by DOS/ISSA surveyors. If based at one or two accredited bases, then between voyage surveys could be invoked. Voyage plans could be subject to approval by a 'port captain prior to sailing and the vessels would be small and low cost enough to attract private investment and efficient servicing industries, in line with acceptable operational controls. Local boatmen and engine servicemen could find

employment and there would be no requirement to construct overnight servicing and recreation facilities within the SRF. A key element would be to ensure that engine selection, installation, and maintenance meet well defined criteria. In general, careless discharge of waste oil, un-silenced engines, exhaust emissions and overuse of sirens and sound systems are the main issues concerning the suitability and current management practices of traditional IWT vessels in Bangladesh. To maximise the ecological awareness of crews and operators, and to optimise inspection and survey needs, it is suggested that no more than about two fleet bases should be established. These could be at Mongla Port and at Barisal or Patuakhali, or possibly elsewhere in the buffer zone if regular servicing and supply can be assured without encroaching into the SRF.

Figure 2: DESIGN CONCEPT FOR SUNDRARBANS SAFARI VESSEL



The ADB's feasibility study for the Biodiversity Conservation in the *Sundarbans Reserved Forest Project* overestimated the potential market for international eco-tourists wishing to visit the Sundarbans. The estimated 120,000 visitors per year would fill approximately two jumbo jets per day for the approximately 200 day season. This is not realistic, especially considering the constraints in travelling from Dhaka airport to Khulna, even if visits to Bangladesh could be marketed on a package basis with Nepal or Bhutan. Accordingly, for a market of about 15,000 international visitors, assuming a 200 days per year operational season and, a three day voyage and a one day servicing layover, 20 vessels each carrying about 15 passengers would be capable of 50 voyages and carry about 750 passengers per year ($200/4 \times 15 = 750$), ($15,000 \div 750 = 20$). The estimated 15,000 passengers per year could experience the SRF with minimal impact on the environment, provided standard design vessels and their management ensure that fuel waste is eliminated, noise and use of obtrusive lighting is minimised, and proper training and inspection services are provided. One-day voyages could also be introduced for vessels designed without overnight accommodation. Some vessels could also be restricted to operate only in the main rivers. These could offer lower cost trips to those not willing or able to pay first class overnight accommodation tariffs. Accordingly, the number of visitors could be increased by this second option and allow more local people to experience the national SRF heritage area. To ensure that the environmental objectives are met, accredited vessels should be required to carry special markings, such as subdued coloring and clear identification.

Vessels could be introduced gradually and the environmental impact and institutional capacity for responsible operations could be monitored to ensure that fleet size is optimised in line with the market, effective management capacity, crew training and environmental impact. A cost-benefit analysis of the proposed conceptual designs would also need to be carried out and adjustments to the designs adopted. While setting design criteria and allowing proposes to submit alternative designs for approval should be conceptually allowed, every effort should be made to standardise their operations as far as possible. Voyage planning to avoid the bunching of vessels should be considered and strict rules adopted which prohibit the use of sirens except in a definite emergency, requiring a written report by the vessel's master. Such issues could be minimised by requiring one direction passage through narrow waterways and crew training to curtail current overuse of sirens and noise, exhaust and waste fuel discharge practices of existing IWT vessels.

F. Proposal for Ports Environmental Management

1. Objectives

An advisory technical assistance (TA) for *Ports Environmental Management* is proposed and is being considered for ADB financing with the following objectives:

(i) Provide CPA and MPA with the institutional capacity and other resources to mitigate, respond to and regulate minor and potential major oil spills, and other adverse environment impacts resulting from port and shipping operations within the areas of their jurisdiction;

(ii) Link this capacity with an effective *National Oil Spill Contingency Plan*; and

(iii) Contribute towards the establishment of effective environmental monitoring of environmental impacts in the port areas by other industries and urban activities.

2. Scope

The proposed scope includes:

(i) Develop effective oil response teams at Chittagong and Mongla ports to deal effectively with Tier One and Tier Two oil spills, and potential major, Tier Three spills which may require international resources;

(ii) Develop a *National Oil Spill Contingency Plan* and pollution reporting system, together with cost recovery and sustainable management measures which comply with the requirements of the OPRC (1990) Convention, to ensure that oil spill response measures are extended in an integrated fashion beyond the port limits;

(iii) Identify and prepare a computerised inventory of all entities, including international resources. These may include the East Asia Response Ltd. (EARL) in Singapore, the United States Coastguard (USCG), the IMO, possible internet resources and a possible memorandum of agreement with India to ensure coordinated decisions in dealing with minor and major oil spills;

(iv) Conduct suitable training of oil spill response teams possibly assisted by expert professional teams from overseas, and assist MOS in providing suitable short term fellowships to ensure effective and sustainable response mechanisms at each tier under the proposed *National Oil Spill Contingency Plan*;

(v) Recommend appropriate oil spill combat equipment and its deployment, storage and inventory control at Chittagong and Mongla ports and examine possible contributions by the oil industry to inventory maintenance;

(vi) Assist MOS in the adoption of an appropriate time frame for the implementation of other international conventions on port and shipping environmental management, including MARPOL (73/78), the London Dumping Convention 1972, OPRC (1990) and PSC 1996;

(vii) Review existing legal and regulatory instruments and standards in Bangladesh which deal with maritime, port and river pollution to reveal any necessary refinements to integrate these with the proposed international conventions, and to reveal areas for CPA and MPA institutional strengthening to comply and participate in the enforcement of these instruments;

(viii) Using existing hydrographic and environmental survey facilities in Bangladesh, supervise an environmental survey of the CPA and MPA port areas. The surveys should include the identification by laboratory analysis of waste streams and other sources, follow up measures and their management, and environmentally effective disposal, including dredge spoils;

(ix) Using the port surveys as an opportunity for further training, assist CPA and MPA in developing an effective pollution monitoring unit for areas under their jurisdiction. This should include full cost recovery and appropriate enforcement

mechanisms for the identification and mitigation of pollution resulting from port operations and dredging, and a reporting procedure for other industries and municipalities to take their own mitigating action;

(x) Effectively train CPA and MPA port operations staff in the mitigation and response measures needed to effectively handle and store bulk, general and other cargo recognised as hazardous under the International Maritime Dangerous Goods (IMDG) Convention, including due regard for port worker safety. Training should also extend to the proper handling of other cargo that may adversely affect water quality. Measures to deal with other port and ship wastes and their disposal should also be considered; and

(xi) Prepare and arrange for translation into Bangla, of a *Marine Oil Spill Response Strategy Report*, and *Oil Spill Training Manual* for sustainable implementation of the proposed *National Oil Spill Contingency Plan*, and *Port Environmental Management Manuals* for CPA and MPA.

3. Cost Estimates

(i) The total cost of the TA is estimated at \$545,000 equivalent, of which \$400,000 is the foreign exchange cost and \$145,000 equivalent is the local cost. A breakdown of the cost estimates is in Appendix 5.

4. Implementation Arrangements

A Steering Committee chaired by the Secretary MOS would meet quarterly to provide guidance on the formation and conduct of stakeholder participation and communications for effective implementation of the TA objectives. Members of the Steering Committee will include Chairman CPA, Chairman MPA, senior representatives of the DOS and its concerned authorities, representatives of the oil industries, Bangladesh Coastguard and Bangladesh Defense Forces, Chittagong and Khulna municipalities, representatives of the Ministry of Environment and Forest (MOEF), the oil companies, and a proposed SRF Authority. The ADB, the World Bank and the Consultant team leader recruited under the TA could be accorded observer status on the Steering Committee. The CPA would appoint a senior port conservation officer as Project Director with a senior MPA port conservation officer designated as Project Manager.

A firm of consultants would be recruited for a total of 25 person months under the Bank's *Guidelines on the Use of Consultants* to implement the TA under the executing agency directives. An international consultant Ports Environmental Manager (14 person months) would act as the consultant team leader and be assisted by a domestic consultant Training Specialist (6 person months) and a domestic consultant Environmental Law and Regulatory Expert (5 person months).

The proposed implementation schedule is also in Appendix 5. After formation by the Government of the Steering Committee and appointment of the Project Director and Project Managers, the fielding of consultants is expected to commence in early April 1999. The TA should be implemented in 4 phases over a total period of 3 years, comprising (i) a strategy and planning phase, and (ii) an implementation phase.

5. Reports

The Ports Environmental Manager will submit an Inception Report 4 weeks after the commencement of his services containing an outline strategy and schedule for implementation of the TA. As the main element of strategy and planning phase, he will produce a *Draft Oil Spill Response Strategy and Contingency Plan* and a *Draft Guidebook on Port Environmental Management in Bangladesh* within 5 months of commencing the TA. He will also arrange for these documents to be translated into Bangla after they are finalised.

In cooperation with the Port Environmental Manager, the Environmental lawyer and Regulatory Expert will incorporate into the draft strategy and draft guidebook a proposed strategy, procedure and schedule for the adoption of relevant international conventions by Bangladesh. He/she will also broadly define proposals for legislation and regulation changes and refinements, while taking into account the additional investments needed.

Comments on the draft documents will be sought by the government and the Bank. Subsequently, the strategy and guidebook will be finalised about 9 months after commencement of the TA. The Port Environmental Manager will also cooperate closely with the consultants for construction supervision under the *Port Efficiency and Access Project* to finalise the scope and specifications of oil spill and environmental management equipment to be procured under the latter project and additionally for the TA training.

In the implementation phase, the Port Environmental Manager assisted by the Training Specialist will prepare *Draft Training Manuals* in Bangla and for Bangladesh conditions on oil spill contingency and port environmental management. These draft manuals will be produced within 3 months of commencing the Training Specialist services and will be tested during the first training workshops, following which comments will be sought from the Government, the Steering Committee and the Bank.

Training workshops will also be conducted on oil spill response and port environmental management in which a team of trainers identified to sustain the TA into the future will participate as observers. The training program will be sustained using finalised *Training Manuals* which will incorporate refinements made after completion of the consultant-based training, with a follow-up visit by the consultant Team Leader.

G. Conclusions and Recommendations on Water Transport Pollution

1. Conclusions

The main conclusions on water transport pollution are as follows:

- The main pollution risks from shipping in the SRF are from the approximately 160 international general cargo vessels per year which visit Mongla Port. It is estimated that each carries an average of about 750 tons of oil fuel. The SRF is also by similar vessels on passage between Chittagong and Calcutta. The risks of a collision involving bulk oil tankers about 200,000 dwt passing within about 150 km of the Sundarbans and transferring about 3.5 million tons of oil cargo annually from offshore anchorages at Chittagong for discharge at the oil terminal, should also be

recognised. However, in spite of compulsory pilotage in the Karnafuli River and Pussar River, the risks are significant due to navigational difficulties, especially during the June to October monsoon season which is typified by prevailing onshore winds, typhoons affecting coastal areas disastrously, and reduced visibility due to heavy rain.

- During the cooler months, fog in the hydraulically dynamic river channels is a significant navigational hazard anywhere in Bangladesh. Night navigation in the Pussar River by international cargo vessels averaging 8,000 dwt is expected to commence in the year 2000, following anticipated improved navigational aids. Improved communication aids and other pilotage resources are proposed under the proposed ADB financed *Ports Efficiency and Access Project*.
- At Chittagong Port, the main oil pollution risk centers on the oil refinery. After refining, fuel oil is distributed countrywide by IWT vessels from the Port. Accordingly, risks of spillage due to rehandling, collision and grounding are high, for which inadequate mitigation facilities exist in the port.
- The second main source of potential pollution is from spills of about 10 tons of fuel oil involving collision between and/or the sinking of IWT general cargo vessels throughout Bangladesh, many of these vessels pass north of the Sundarbans, and higher in the interconnected drainage system of the delta on the main IWT route between Khulna and Dhaka, via Mongla Port.
- Minor oil pollution risks exist widely in Bangladesh, as well as within the Sundarbans, from the careless discharge of small quantities of waste oils by rapidly mechanising informally operated country boats which penetrate the minor and interconnected waterways of the country. A country boat component of the World Bank financed IWT3 and potentially the IWT4 project could gradually improve this situation.
- Other shipping pollution risks relate to dredging, shipwaste disposal, and shipbreaking near Chittagong. These can be more easily mitigated than the main risk which is unforeseen oil spills resulting from collision grounding or sinking of vessels. A proposed maintenance dredging program in the future appears to be the most significant of these risks. Because of low industrial activity in the past, environmental risks due to the eutrainment of contaminated sediments are insignificant in the SRF, but are important in the Karnafuli River estuary at Chittagong and at Dhaka Port where sediments are more polluted due to uncontrolled industrial and urban waste disposal.
- A further potential risk involves suggestions by the government to establish a new port in the coastal area, possibly at the mouth of the Pussar River in the Sundarbans. There is no obvious economic advantages for such development and the ecological risks are significant.

- The institutional and regulatory framework for monitoring and controlling pollution by port and shipping operations in Bangladesh is weak. Particularly lacking is a national oil spill contingency plan and suitable linkages to natural disaster preparedness and management and formal arrangements for the efficient introduction of international assistance in the event of a major oil spill. Pollution risks by IWT vessels could be progressively addressed by the recently formed ISSA. However, this entity currently exists virtually in name only and is currently ineffective.
- Similarly lacking is the adoption by Bangladesh of the MARPOL 1973/78 and OPRC 1990 international conventions affecting marine pollution. Neither has Bangladesh adopted the London Dumping Convention (1972), or the PSC 1996 under which sub-standard shipping visiting its ports can be detained.
- The ongoing MPTFS, IWT3 and proposed IWT4 projects, the *Ports Efficiency and Access Project* which includes provision of about \$2.0 million in navigational and pollution equipment investments, and the *proposed Ports Environmental Management Project* as designed under this research, will address the institutional weaknesses comprehensively.
- Further research is needed to develop and sustain pollution risk models, especially for Chittagong, Dhaka and Mongla ports. Nevertheless, the present lack of GIS based models should not delay the immediate adoption of a National Oil Spill Contingency Plan and the proposed investments. The further research should quantify the risks in economic terms under a cost benefit analysis for further investment in mitigating measures, especially regarding the provision of oil spill reception facilities in line with MARPOL 73/78.

2. Recommendations

The main recommendations on water transport pollution are as follows:

- The apparent infrequent occurrence absence of major oil spills in the past from international shipping should be regarded as fortunate rather than a rationale for further delay by the government in adopting a nationally based oil spill contingency plan. While this could be linked to natural disaster management generally, the DMB is not equipped to deal with this. Neither is it appropriate in terms of the industrial experience, network of communication, responsibilities and commercial interests of the port and shipping sector to clean-up its own affairs.
- Many minor oil spills by IWT vessels go unreported and cause locally significant environmental damage, especially in river port areas. Accordingly, there should be no further loss of time in advancing oil spill preparedness for international and IWT port and shipping operations. The most suitable institution to coordinate these activities could be the Bangladesh Coastguard, provided MOS and IWT interests are adequately represented in the on-scene command arrangements. Unfortunately, the

coast guard has inadequate resources. For Tier One (minor oil spill) responses, the two part authorities would be appropriate and should be suitably equipped and trained in the short term.

- The emphasis must be on pollution prevention, especially considering the strong tidal regime in Bangladesh rivers and the seasonal dangerous coastal area. It is also important that oil spill preparedness be adopted nationally, and with due linkages to natural disaster preparedness and international mechanisms for dealing promptly with major oil spills in ecologically sensitive areas. In this regard, the adoption of MARPOL 1973/78 and OPRC 1990 conventions, and the PSC 1996 agreement are important steps and are recommended for urgent consideration by the government, together with the necessary legislation instruments.
- A possible MOU should also be considered between India and Bangladesh for mutual assistance relating to offshore and coastal oil spills in the northern part of the Bay of Bengal.
- A proposed maintenance and capital, or rather, deferred maintenance dredging campaign by the government, to facilitate navigation, should be designed to minimise turbidity and sediment blanketing risks and monitored carefully, especially with regard to the disposal of dredge spoil in the SRF vicinity.
- The systematic collection of shipping solid wastes from vessels at the mid-stream mooring buoys and alongside berths at Mongla Port and Chittagong Port should be initiated as soon as possible.
- The government's proposal for a new port, possibly at the entrance of the Pussar River, is unnecessary and should be resisted strongly as it has potential for adverse ecological impacts.
- The main area for useful involvement of NGOs and SRF communities in marine oil pollution prevention, would be in the proper management of country boats, especially in adopting currently difficult measures to separate oily wastes from bilge water and to properly dispose of or use such wastes. The collection and use of minor oil wastes as cooking in lieu of timber, fuel, should be examined.
- A DOS/ISSA accredited *Sundarbans Safari* standard design and licensed operated fleet of vessels is recommended to minimise the pollution and human impact of proposed eco-tourism in the SRF, while maximising opportunities for local employment and exposure to the natural heritage of the SRF. A cost-benefit analysis would be necessary to optimise the designs, capacity and number. A coordinated safety management and inspection apparatus for such an approach to eco-tourism would be vital. Some of the technical, crew training and operational management features for such a vessel could also be taken up for IWT traffic generally in Bangladesh.

CHAPTER VII

ENVIRONMENTAL POLICY ASPECTS OF INLAND WATER TRANSPORT

A. Policy Objectives for Water Resources and Inland Water Transport

Under the commitment of Bangladesh to gradual privatisation of the economy, water resources management in dealing with the twin problems of flooding and drought can be expected to move away from centralised planning, towards policy development. This will include a regulatory component to protect the environment, particularly fisheries, forests and aquatic biodiversity, to maintain water quality and monitor saline intrusions. At the same time, the objective will need to be the creation of an enabling environment in which farmers can obtain sufficient water for crop production while maintaining sufficient supplies for other essential uses, such as drinking water, industry and navigation.

National level objectives, which provide a framework for water resources policy, are set out in the Draft FFYP as:

- alleviation of poverty through accelerated growth;
- employment generation;
- excess sufficiency in food production;
- high value export promotion ;
- improved human resources through education and training;
- developing infrastructure;
- reducing population growth and improved nutrition;
- environmental protection; and
- reducing inequalities in income distribution.

The water resources sector can contribute to these objectives by facilitating agriculture through sustainable groundwater irrigation, appropriate flood control, maintaining navigation routes, providing and monitoring water supply and drainage, monitoring and regulating pollution, and ensuring that water is available to all at reasonable cost. For navigation, this involves ensuring year-round reliability and eliminating restricting shoals on classified routes, improving coastal and inland port access, and providing access through flood protection embankments for fishpasses and the informal country boat sector. For sustainable transport, sector emphasis needs to be given to IWT route dredging programs, the beneficial use of dredged material to provide economic benefits in flood protection for villages. This can be combined with constructing industrially productive platforms and homestead gardens, and introducing cost recovery measures and an efficient institutional framework to facilitate the relative energy use savings of IWT. This may further ensure that classified routes are not only reliable but enable efficient modal exchanges to IWT at ports and at road and rail terminals, especially for roads in the vicinity of urban areas, allowing door-to-door mobility demands to be met efficiently.

B. Background to Transport Policy in Development

User expenditure cost and time savings, and maintenance savings are the principal economic benefits in transport development projects. While quantification of the environmental impacts in Bangladesh of transport requires comprehensive research for adoption in the cost benefit analysis, the related issue is how to apply this in the policy and regulatory context. Transport is an unavoidable cost, which can be offset by cost efficient network expansion and maintenance, providing access and distribution benefits associated with economic resources and trade which optimises local comparative advantages to yield economic benefits. These can be applied to growth led sustainable development with efforts to internalise and regulate adverse environmental impacts.

Internalising costs for optimal efficiency is difficult where subsidies exist, where marketing and management is weak and pricing mechanisms distorted. In the application of environmental economics to the transport policy framework, the primary concerns are to: (i) internalise the externalities; (ii) minimise the depletion of non-renewable energy sources; (iii) cost-effectively reduce air and noise pollution; (iv) promote safety and health; (v) provide positive welfare impacts for the equitable distribution of transport user savings; (vi) ensure sustainable maintenance of transport infrastructure; (vii) ensure property rights; (viii) encourage energy efficiency; and (ix) reduce adverse global impacts. The key issues focus on energy efficiency and optimal infrastructure replacement and improvement, which also minimise pollution and user costs under market oriented pricing and regulatory mechanisms.

Energy efficiency and pollution prevention must be recognised by transport users and operators as profitable and qualitatively beneficial. Emphasising economic efficiency, financial profitability and the privatisation of transport services which also internalise pollution and other environmental degradation costs should therefore underlie technical decisions and the policy framework (Aldrich, 1996: xiv). The key issue to the consumer is the marginal cost, where the benefit of avoiding environmental pollution, such as by reduced fuel usage and emission, and where infrastructure replacement and maintenance instruments are balanced against the additional costs of the technology and enforcement.

Energy efficiency and safety measures can be internalised in transport decisions by appropriate engineering in the design. This may include road and river alignment, gradient reduction, removing or installing barriers, route marking and navigational aids, and provision for safe and cost efficient passenger and freight exchanges where a change of transport mode is viable within the transport chain. Improving road surface roughness and reducing waiting and travel times, ensuring intermodal exchange efficiencies and an adequate O&M budget also help to achieve optimal benefits. This needs to be accompanied by allowing for optimal modal choices, ideally through the price mechanism in the policy framework. The achievement of engineering and policy objectives are also assisted by the adoption and enforcement of appropriate regulations. The investment, replacement and efficient operation of transport infrastructure therefore requires careful planning and execution to meet overall economic development strategies at the national level, and policy measures which encourage minimal user costs and maximum freedom for operator investment and modal choices. These are governed by informed public monitoring of investments. Where, as in Bangladesh, basic modal investments in roads, railways, ports and IWT route development are currently in the public domain, it is imperative that maintenance is

improved to maintain road roughness criteria, that bridge, ferry, road and rail capacities are upgraded to avoid congestion, and that adequate and timely dredging of ports and waterways is carried out efficiently. Avoiding costly bottlenecks, ensuring that entry and exit barriers to private operators are kept low, while ensuring that safety criteria are adhered to, avoiding operating monopolies, and ensuring that user charges allow for rational choice between modes, are all essential features of an economically efficient transport network.

It has been shown that IWT is cost efficient for longer route transport of bulky commodities, based mainly on user cost savings which result in lower energy and lower pollution costs. However, unless IWT routes of adequate depth and year round reliability are provided, then these advantages will be eroded because the additional time and added investment costs will result in further investment in less economically viable alternative transport. It is in this perspective that the cost-benefit analysis of projects, such as the *Kalni-Kushiyara River Management Project*, have a public duty to optimise the contribution to efficient national economic growth by not only pursuing agriculture and fisheries improvement through flood protection but also promoting the full transport benefits.

Since water resources and transport investments have not been well integrated in the past, these broader aspects of policy need to be explored in the Bangladesh context. This is particularly relevant since transport policy efforts to orient the pricing of rail and to some extent IWT towards the open market in Bangladesh are incomplete (see Chapter III). Monitoring and enforcement measures to minimise the pollution costs of transport are also weak.

C. Strategies for Transport Policy

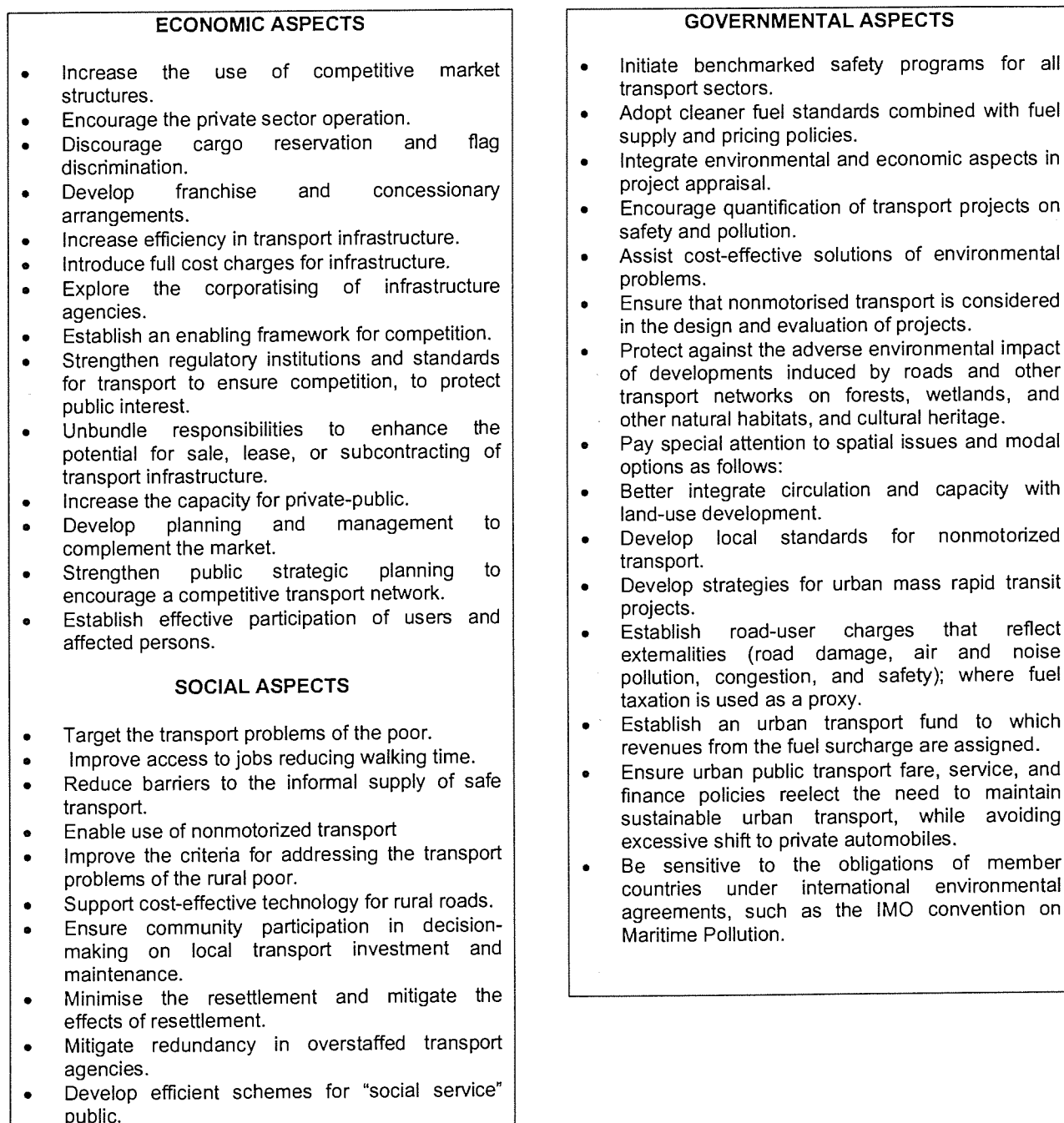
1. Background

Appropriate policy and strategies are essential for encouraging competition, efficiency and minimising environmental impacts of the various transport modes. A framework for sustainable transport based on World Bank (1996): 4-9 is shown in Figure 4. The primary economic and financial objective is to make transport more cost-effective and responsive to demand. Competition must be facilitated by regulatory reform to enable private firms to enter and exit easily. Strategic action is also required through land use planning, management of demand, transport engineering and pricing, and regulations to encourage environmental sustainability and improved safety. This can be complemented in terms of enhancing rural livelihood by facilitating transport access, by giving greater attention to informal and non-motorised transport, and mitigating the effects of dislocation caused by transport projects.

Decisions regarding the construction of transport connections which require the diversion of productive land or encroach on ecologically sensitive areas is a question of overall development policy, rather than transport policy. Accordingly, transport policy must be determined by overall development goals and priorities. Refinement of this principle at the project level can be assisted by incorporating environmental impacts into the cost benefit analysis of investment options. However, geography, the overall transport network access and distribution considerations and earlier development decisions which may be regarded as sunk costs in development decisions may all make modal or route changes difficult. For this reason, it is very important, for example, that the early dialogue

regarding the proposed construction of the Ganges River barrage in Bangladesh is pursued from a basin wide perspective. Location of the barrage, if and when decided, possibly near the existing ferry crossing at Mawa between Khulna and Dhaka, will be an obvious transport crossing site. This will not only need to take account of environmental concerns related to the hydrology and ecology of the area, but will significantly determine routing and construction of future highways alignment and IWT development.

Figure 4: Policy Framework for Sustainable Transport



Similar considerations affect decisions on the Dhaka by-pass alignment where the dual needs of flood protection while catering to local urban ring road traffic as well as through traffic to Chittagong. Clearly, the closer the by-pass alignment to the present eastern fringes of Dhaka then the more it will encourage usage by intra-urban traffic and increase the economic benefits of the road. On the other hand, an alignment on top of an embankment further east, close to the river, then the lower the costs of achieving both flood protection while catering to through traffic. The trade offs involved include recent Government policy guidelines for private sector BOT type investment in roads. The closer to Dhaka city then the greater the revenue potential since intra-urban traffic would also be attracted to use the by-pass. These options have been studied comprehensively and confirm the near-city option (Halcrow Fox, 1997). A further option would be a flood embankment close to the river and an initial ring road close to the urban fringe without embankment costs. However, well prepared and controlled planning of future urban expansion within the embankment protected area will also be necessary, accompanied by engineering and management decisions to ensure that access to the initial ring road is controlled to avoid mixed traffic and resultant severe congestion. These all involve policy considerations and an institutional sophistication that ensures policy implementation, and on a timely basis. The Jamuna Bridge siting and decisions on whether or not to include a rail and pedestrian crossings on the bridge included similar issues relating to meeting transport demands for growth of the north west region of Bangladesh. Also, ensuring year round flows in the Gorai River off-take of the Ganges River under a proposed World Bank project would improve agriculture, ecological sustainability and rural livelihood prospects in south-west Bangladesh. It would also improve natural flushing of the Pussar River, assisting both international and IWT shipping access to Mongla Port. Since this is a potentially important IWT route then it is vital to ensure a complementary basis to water resources and transport policy.

Demand for transport in Bangladesh, will continue to increase rapidly. While decisions taken earlier and elsewhere in the economy will govern many transport decisions, every transport and water resources project should focus positively on improving the environment and the economic efficiency of transport energy and avoiding alienation of the over populated land. Another major consideration is to provide for energy saving modal choices with the transfer of goods and people between modes made as efficient as possible. Policy instruments should be oriented to encourage transport investors, operators and users to make environmentally supportive and economically sustainable choices. The difficulties concern not only the valuation of environmental costs and how to internalise the degradation of common resources, especially from air and noise pollution, and the reduction of aesthetic and other qualitative values, but also the broader economic returns among multiple choice scenarios.

In summary, the policy strategies should include overall development, transport and environmental planning objectives, incorporate quantifiable and non-quantifiable environmental measures in the cost-benefit analysis, and the application of management and pricing instruments aimed at internalising transport user costs. Setting priorities and ensuring the quality of statistics and the reliability of mechanisms to enforce regulations are critical in applying these principles. In this context, national and municipal planning and effective management authorities are vital in avoiding transport bottlenecks being manifested in the urban environment.

2. The Demand for Mobility and Environment Impacts

As noted by Kraan and in't Veld (1991): 91-110, transport is an element of (i) production processes where movement of goods or labor is required (freight, business and commuting), and (ii) consumption activities related to leisure and shopping. Transport is also an important industry and contributes, for example, 7 percent to the GDP of the European Community. In the relationship between population and economic growth on one hand and total mobility on the other, demand for mobility grows at a faster rate. In Bangladesh, GDP grew at an average of 5.5 percent between 1974/5 and 1992/3 while passenger and freight transport demand grew at 8.4 and 8.2 percent respectively (GOB, 1997: vi). The latter reference also indicates that freight transport demand may grow to 30 billion ton km by the year 2015/6 compared to 10 billion ton km in 1996/7, and that the modal share of roads will remain the highest (GOB, 1997b: vii). This is due to economic diversification while production becomes more specialised, resulting in increased household demand. Merely advocating IWT as a more environmentally friendly mode is therefore only one dimension of the transport problem. For example, air polluting, noisy and dangerous driven trucks are a major contributor to government revenues through registration fees and fuel tax, while truck damage to roads is high. Diversion of heavy traffic to IWT would therefore require a review of government transport revenue sources as a whole.

Large investments in roads have facilitated meeting mobility demand, while increased disposable income has led to rapid growth in private car ownership, which in view of currently low levels will continue rapid increase. Accordingly, there are prospects of further increased demand for mobility oriented road transport in Bangladesh, considering the current relatively low level of GDP and moderately high GDP growth forecasts of over 5 percent per annum needed for the economy to expand significantly (GOB, 1997a).

Increased demand for mobility favors road rather than rail or IWT investment because of its door-to-door facility. The negative impacts are urban sprawl, creation of artificial barriers for pedestrians and animals, and visual and noise pollution. The major perceived use of public space is for motorised transport at the expense of non-motorised users. Demand for parking facilities for cars is one such impact. As far as noise is concerned, 50 dB is the usual acceptable level for industry. However, casual observation (in the absence of published data) leads to the conclusion that 65 dB is usually exceeded close to roads in Bangladesh. The use of vehicle horns is unconstrained and an evident cultural norm, and air horns are normal for aggressively driven trucks and buses, with the latter competing with other buses for kerb space and the attention of potential fares.

Road accidents, as a consequence of demand for mobility, are a function of road design, traffic intensity, speed, weather and driving habits. While engineering solutions take current precedence in Bangladesh, although weakly applied, the improvement of driver education is at least as important and needs to be addressed comprehensively.¹ Atmospheric pollution by transport is also a consequence of increased

¹ As noted in Chapter III, Bangladesh have one of the worst road safety records in the world. This matter will be taken up in 1998-2000 under a Nordic Development Fund component of the ADB-OECF financed *Jamuna Bridge Access Roads Project* in cooperation with United Kingdom financing of safety data management and monitoring.

mobility related to fuel quality and content, and engine maintenance; causing acid rain, lung diseases, the degradation of architecture and degrading the former tranquillity characterised by parklands, boulevards waterways and environmentally benign non-motorised transport for which Dhaka was formerly renowned. There has been no comprehensive research on the environmental impacts of these developments in Bangladesh, rather the emphasis is still, necessarily, on building the necessary institutional capacity to examine, analyse, regulate and enforce the outcome of any research findings. A key issue, in spite of a large 1997 increase leading to a one-day general strike (*hartal*), is that gasoline is still priced below international levels. There has also been no effort to introduce unleaded gasoline due to the cost of adding catalytic converters to vehicles and modern cars imported with converters are obliged to remove them. Moreover, recommendations to increase the acquisition costs of small two stroke vehicles to curb carbon dioxide emissions (see the ALGAS recommendations in Chapter V, Section A3) may be disadvantageous to the poor in meeting their mobility demand. While these instruments affect mainly urban passenger traffic, the ALGAS study suggests that diesel is also priced very low, reducing the energy efficiency advantages of IWT, discouraging its optimal usage for freight traffic, and adding to growing road congestion.

Fundamentally, however, Bangladesh is a deltaic country where navigable or potentially navigable waterways penetrate the hinterland in a dense network of channels. By 2015, transport demand originating from internationally traded goods may reach 29 million tons compared with 19 million tons in 1995/6 (GOB, 1997b: x). Since most of this traffic is channeled through the two seaports, policy instruments may be applied to encourage the distribution of international trade goods by IWT, for inter-modal exchange points to have facilities for IWT, and for manufacturing and other industries to locate close to the rivers. This also has implications for proper attention to industrial effluent control as much as to the environmental impacts of IWT, as well as currently lacking land use planning policies and instruments to ensure the optimal siting of public and private sector inter-modal exchange infrastructure.

D. Transport Policy Instruments

1. Introduction

In transport, pollution up to an economically optimal level can be tolerated both in terms of the atmosphere's capacity to assimilate the pollution and in human health. The diversion of traffic to IWT can help avoid exceeding local levels of tolerance, especially for roads. However, while minimised by the internalisation of energy usage under fuel pricing and vehicle acquisition policies, transport pollution is complicated by the externality of its effects, where one transport operator's actions depend on the actions of other and is beyond the control of the individual. Holding polluters accountable under a regulatory or willingness to pay regime for the transgression of defined emission levels is therefore essential where a 'polluter pays' principle can be defined and implemented. Both of these options are difficult in Bangladesh. The many private sector operators of public road services, such as buses and trucks, are the greatest polluters and controlled by highly politicised unions that impose their will by organised violence. This is compounded by corrupt police units. These encourage bribery, allowing private vehicle owners to openly flaunt legal emission and safety regulations. Diversion of heavy traffic to IWT may help to minimise the impacts but the policy implementation process for stricter vehicle and vessel emission control requires careful handling.

Transport also damages the global environment. Pollution from motor vehicles produces one-fifth of the incremental carbon dioxide in the atmosphere world wide. This contributes to global warming which is a particular threat to Bangladesh where about 20 million people would be seriously affected and 20 percent of the country inundated by a one-meter rise in sea level by the year 2070 (ADB, 1994: 62). As demonstrated in the ALGAS Study, Bangladesh is a very small contributor to global warming in overall terms. However, present high levels of vehicular pollution in the country are consistent with policies which ignore the external costs of impacts on common environmental resources, making it morally difficult for Bangladesh to demand that countries which make higher emissions should curb their actions. Valuing and internalising these costs through the adoption of international agreements to deal with adverse consequence of degraded universally exploitable air and water resources is one of the most difficult issues affecting development, and transport policy in particular. The affordability of this in Bangladesh, in meeting the standards of other countries, also requires research. Also, the database on actual emissions is very poor. This will also make it difficult for developed countries with high levels of total emission to purchase pollution rights from Bangladesh and to thereby provide revenue for investment in low polluting transport and industry. The most practical and desirable option is to adopt policies which encourage lower cost, low emission solutions, such as IWT, and to improve the database to quantify the emissions. This will encourage revenue from tradable pollution rights.

2. Transport Infrastructure Instruments

The planning and provision of transport infrastructure is a public matter, which gives central and municipal governments a powerful tool for transport control. An important criteria for infrastructure policy is its integration into general land use planning policy at national, regional and municipal levels. Where there is a lack of strong planning tradition, as in Bangladesh, then the effectiveness of infrastructure policy is hampered. Many road sector instruments applied in other countries are virtually non-existent in Bangladesh. These include network planning, lane segregation, one way roads, parking policies which may be priced or located to encourage or discourage private car usage and traffic engineering, such as signal optimisation and road design for speed reduction and provision of noise screens, or effective controls on, use of horns, speeding, lane hopping and dangerously intimidating behaviour during overtaking, etc., or road user infringement penalties. In the ports sector, containerisation although increasing rapidly, is about 15 years behind most other countries in its development. The ports handle mainly cargo in break bulk form and lack of planning and investment has resulted in extreme congestion and inefficient linkages with land transport infrastructure. One of the issues here is lack of adequate bridges to handle container laden trucks for efficient inland distribution, which together with entrenched labor practices and outdated customs controls, determine that containerized cargo is almost entirely unloaded in the port onto ancient trucks suited only to break-bulk handling. However, since the BTSS in 1994 network planning has improved but a major issue is the weak and corrupt institutional capacity to implement transport plans and policy objectives efficiently. Overall network planning in recent projects include integrated corridors and feeder routes with adequate bridges and by passes to allow future development of container traffic (Chapter III).

The DOE has adopted in its 1992 Environment Policy a set of objectives that include ensuring environmentally sound transport development. However, not only does DOE lack the capacity to examine, define or monitor this objective, but suitable

regulations and integration with overall transport planning are lacking, including environmental impact assessment procedures for the sector, for which development agencies apply their own criteria in project design and implementation. Regulatory standards are being introduced but there is only a weak linkage with the enforcement of transport user adherence.

Infrastructure taxation is another policy instrument. Land pricing and property taxes may be used to encourage land purchase and rental close to public transport facilities, while IWT development raises the further complexity of allotting non-existent water use rights and their tradability. Parking taxation may be used to discourage the use of vacant lots for private parking. None of these instruments appear to have been applied in Bangladesh, and parking everywhere is virtually free where sidewalk hawkers and accumulated rubbish permit roadside access. Everywhere, buses allow passengers to alight and step down in the middle of the road. Trucks park wherever their operations and overnight stopovers conveniently allow. Animals and beggars also range freely on city thoroughfares.

Public intervention on the supply side of the automotive or IWT vessel market could be an effective way of reducing environmental damage. This can be achieved by limiting the number and selective type of cars and vessel acquisitions and their fuel control standards, engine volume etc. Setting speed limits is another way of discouraging the use of high speed, high fuel consumption road vehicles. However, there is little evidence in Bangladesh of attention to these instruments. Most countries, excluding Bangladesh, also adopt lead control regulations in fuel usage and many encourage the use of LPG or CNG through preferential taxation and tax deductible retrofitting. It is encouraging that that government announced recently that it would allow the private sector to provide LPG outlets. In expanding the perspectives for IWT, noted by Bombis et al. (1991) for Europe, scrap and build policies may be adopted to encourage fuel and technology efficiency, and economies of scale, particularly towards the construction of low draft, fuel efficient container barges. However, vessel safety surveys are weakly enforced and there is total absence of requirement for insurance. However, the social impacts of adopting the latter instrument deserve careful consideration. Small private operators with small profit margins, where even superannuation may be threatened as they strive to stay in business, are likely to be affected seriously, as mentioned in Bombis et al. (1991) with regard to Europe, and by Brooks (1995b) with regard to IWT privatisation in the PRC.

A range of transport policy instruments have been noted which may be applied to reduce external environmental effects. It is noteworthy that demands for mobility determine the political acceptability of policy instruments. Most are applied by governments only indirectly or in a limited fashion, reducing their potential effectiveness in emission, land acquisition and other environmental aspects. Bangladesh is a prime example of this issue. The matter is complicated by the possibility of substitution between transport modes. In land based transport, the construction of shopping malls and industry outside of existing urban areas where land price tend to be lower, may increase trip-distance, increase fuel emission, and contribute to urban sprawl, as much as discouraging effects on transport network expansion. Policies may also encourage high income earner mobility while discouraging low income earner movement. Political parties with a strong electoral base in high income areas may oppose measures aimed at reducing car usage versus non-polluting non-motorised transport or public transport. It is noteworthy, in Bangladesh, that many newspaper articles, presumably contributed by

educated higher income earners, are often biased against non-motorised transport as being a cause of urban congestion, ignoring that increased use of private cars, lack of vehicle segregation and aggressive driving are the primary culprits. Similar concerns must also be kept in mind for the country boat sector, where in spite of rapid mechanisation in the past 15 years, sail and oar propelled vessels remain cost efficient, environmentally benign and appropriate for some cargoes. However, the application of unsilenced motors and total disregard of the even weak regulations, including IWT for passenger vessels is noted. It is especially noteworthy that industries in Chittagong, Dhaka and Khulna close to rivers use the river for unsupervised discharge of industrial waste as much as for the handling of river traffic. In promoting IWT, this prevailing noise pollution aspect as well as unregulated emissions and the discharge of oily wastes must be looked into. If it is not, then pollution by IWT will quickly reach the damaging levels already apparent for land transport. Loss of life from accidents is also frequently reported involving IWT vessels in Bangladesh. According to Ekelof (1997): 14, the official statistics on IWT loss-of-life accidents in 1991 were 7 times lower than reported in the newspapers. The official loss of life in IWT accidents from 1984 to 1992 was 992, including one accident where 426 lives were lost. The 1991 newspaper review also includes 10 lives lost due to piracy.¹

3. Policy Formulation and Implementation Efforts in Bangladesh

Table 16 outlines some 1992 recommendations on road user instruments, which have so far been largely rejected by the government as being too costly, while Table 17 summarizes the uphill tasks associated with rail policies, and Table 18 the less well-formulated and proposed IWT policy objectives, outputs and activities. The key common thread is the weak existing commitment to policies and consequent slow policy implementation.

Table 16: Proposed Action Plan for Road Vehicle Tax Changes

- | |
|--|
| <ul style="list-style-type: none"> • Import duty on spare parts of vehicles should be reduced to 20 percent to improve safety and increase utilization of the vehicle fleet. • Annual road taxes should be doubled for all vehicles to encourage efficient use of vehicles. • Import duties on bus body building materials should be reduced to 20 percent to encourage use of better materials. • Import duties, sales taxes and excise duties on motor cycles and auto rickshaws should be doubled to make the taxation of these vehicles comparable with taxes on cars and taxis. • Ex-refinery prices of diesel and petrol should be reduced by Tk. 1.00 per litre and simultaneously excise duties should be increased by Tk. 1.00 per litre; the objective of this policy change is to make the 'concealed tax' on fuels visible taxes. • Excise duty on diesel should be increased by Tk. 2.00 per litre in addition to the increase noted above; this will reduce the disparity in tax paid per kilometer between diesel and petrol-engine vehicles. • 4-wheel drive passenger vehicles should be taxed at the top rate for passenger cars. • Diesel-engine cars should be taxed at the same rate as equivalent petrol-engined cars; this downward revision of import duties on diesel-engine cars is expected to lead to fuel efficiency by encouraging the use of diesel-engine vehicles which are more fuel-efficient compared to petrol-engine vehicles. |
|--|

Source: Kampsax (1994)

¹ The Independent (1998): 6, in reporting one of the frequent IWT accidents in Bangladesh involving serious loss of life, refers to the poor design and maintenance of IWT vessels. These are compounded by the effects of storm and opposing current induced waves in the wide estuaries, tendencies to chronic and unsupervised overloading and inadequate safety surveys, lack of shipowner interest in safety matters, and poor training of IWT crews.

Table 17: Rail Policy Implementation

Over the past two decades, the development of bus services in Bangladesh and large investments in its road network have eroded the market position of Bangladesh Railways (BR). Other factors such as inadequate tariffs, revenue leakages, rising costs, open-ended Government subsidies, and a weak administrative and organisational setting, contributed to its worsening performance. By the early 1990s, BR was one of the largest loss-incurring state-owned public enterprises.

In 1994, with ADB assistance, the Government launched a comprehensive Railway Recovery Program that focuses on long distance inter-city passenger traffic and the transport of bulk freight. The modest achievements of BR in the past few years are as follows.

- Deficit Reduction achieved through (a) improved ticket collection, (b) commercial use of land and sales of assets, (c) some exercise of autonomy in adjusting fares and freight rates, and (d) reduction of staff through retrenchment.
- Termination of open-ended subsidies towards a more transparent contractual relationship between the Government and BR for providing financially unfavorable but socially desirable railway services. Since 1992/93, the obligation has declined by 5 percent annually.
- Labor rationalization by a reduction in BR staff from about 57,000 in 1990 to 40,000 by the end of 1997 based on voluntary separation, natural attrition, and staff retrenchment, including retraining.
- A separate body, the Bangladesh Railway Authority, was set up with a new organization structure. The private sector was engaged to operate passenger ticket outlets, containers in Dhaka and Chittagong, communications systems, and the BR telecommunications section.
- Adoption of a rational investment program with investment concentrated on replacing and rehabilitating worn out assets rather than purchasing new facilities.
- A Five-Year Action Program was prepared in 1997 to establish interim steps for the reforms. It was envisaged that BR will be transformed into a separate corporate entity under the Companies Act of 1994. A new Staff Rationalization Plan is planned to reduce the total staff of BR from the current 40,000 to 30,000 by 2001. The Action Program is already falling behind schedule.

Source: ADB (1997e): 5

Table 18: IWT Policy Formation**A. Objectives**

- retrenchment of the state from service delivery, and enhancement of the private sector investment,
- enable cost covering revenue collection and, where required for social reasons, introduction of explicit government subsidy,
- the set-up of regulatory powers to improve the efficiency, safety and environmental mitigation of IWT.

B. Outputs

- the establishment of new regulatory authorities,
- amendments to the legal framework to facilitate and sustain private sector participation,
- a new policy framework to facilitate full cost recovery basis,
- the initiation of full or partial privatisation, dredging, ferry routes and salvage,
- compulsory insurance and classification of vessels to ensure resources for salvage, and minimum safety maintenance and operation,
- restructuring of the parastatal sector, with offloading of redundant capital items and staff, to attain cost effectiveness and financial sustainability.

C. Activities

- a draft policy framework, including the definition of the new institutions,
- Financial and Institutional Action Plans for the rationalisation of parastatals,
- establishment of the relevant capacity for the regulatory and planning body, and
- the establishment of the sector regulatory and planning authority, and
- privatisation of key parastatals.

Source: Based on DANIDA (1997): 42-43

E. Environmental Policy Proposals for Inland Water Transport

1. Present Policies and Options

The 1995 Environment Protection Act (EPA) provides a legal framework for action. However, current policies and guidelines are incomplete, and do not yet allow the DOE to fulfill the mandate and scope of the EPA and have a very low chance of success (see Table 19). Also, the DOE is a young agency and resource management issues are beyond its capacity, and need to be addressed through other agencies for which institutional responsibilities lack integration adequate guidelines or commitment.

Table 19: Overview of Environmental Management in Bangladesh

Pollution Management Issues:	
- Industrial pollution	Responsibility lies with DOE rather than the industries themselves and overall regulations and guidelines are only partially drafted.
- Energy-related pollution	Responsibility lies with DOE, but no guidelines or regulations have been written.
Resource Management issues: Including water resource management, soil degradation, forests, bio-diversity and loss of wetlands	All of these issues are addressed and are the responsibility of ministries and departments other than the DOE. Accordingly, there is little to unify the separate approaches.

Source: World Bank (1997a): 3

Moreover, the basic approach to control transport pollution in Bangladesh is 'command-and-control,' where the government sets, monitors, and enforces standards, while the DOE must rely on legal action by the court system to enforce the standards. Worldwide experience shows that the ability of governments to complete all of these tasks is usually weak. It is also subject to corruption. Bangladesh is no exception and the DOS Marine Court system is hopelessly enmeshed in 2,500 backlogged cases of violations against safety construction and operational regulations by IWT operators (DANIDA, 1997: A4).

In addition to the weakness of the DOE, communication between government and the private sector regarding environmental issues and concerns has not been constructive. World Bank (1997a) cites that new legislation has generally not been preceded by consultation with the private sector to build awareness and acceptance. As a result, environmental regulations have been perceived as government interference without concern for the financial and business conditions.

On the basis that current policy is inadequate, World Bank, 1992 proposed measures that could be taken (see Table 20). Three policy groups are shown: incentive-based policies, regulatory or command and control policies, and public awareness policies. While there is increasing public awareness on environmental issues it has not led to adequate response by the government, while increasing population and poverty contribute to worsening environmental conditions. This reinforces views that government actions lack commitment and are generally flouted. The policy options used by DOE to address pollution fall under the regulatory approach, as opposed to the more incentive-based or public awareness approaches. The greater involvement of the public through disclosure of environmental information and public awareness campaigns are only recently being attempted in Bangladesh.

Table 20: Environmental Policy Options

Type of policy	Price	Quantity	Technology
Incentive-based			
Direct	-Effluent charges	-Tradable emission	-Technology taxes
Indirect	-Fuel taxes -Taxes -Performance bonds	-Tradable input or production permits	-Subsidies for R&D and fuel efficiency
Regulatory or "Command-and Control"			
Direct		-Emission standards	-Mandated technical standards -Efficiency standards
Indirect		-Land zoning -Bans and quotas	
Public awareness		-Public disclosure of pollution impacts	

Source: World Bank, 1992: 73.

The government's emphasis on regulation through emission standards is appropriate when pollution is caused by a few public enterprises or non-competitive firms, and when the technology for controlling pollution can be easily specified by regulators and applied uniformly by firms. The IWT sector is partly within this category. However, more price incentive-based policies or quantity restriction policies, need to be explored for the private sector which is now dominantly represented among IWT users. Incentive-based approaches are more cost-effective than regulatory approaches, since they allow each firm to do its own cost-benefit calculations, and encourages operators able to clean up for the least cost to do so, while allowing the others to pay government for the environmental cost of its pollution. By setting pollution charges or taxes at appropriate levels, enough operators will decide that it is cheaper to abate their pollution than to pay the tax or fines.

In addition, it has also been confirmed that local communities and NGOs affect environmental performance significantly. This especially applies where formal

regulations are absent or ineffective as in Bangladesh.¹ Community pressure and negotiated agreements for clean up and compensation are common when polluters are identifiable and employment alternatives are available (Huq and Wheeler, 1992). In all cases, the availability to the public of basic information on pollution damage plays a key role.

Good environmental policy is a combination of incentive-based policies, monitoring, targeted regulation and public awareness. The World Bank (1997a) identified five essential conditions if policies are to be effective, of which only the second and third conditions have been partly met in Bangladesh:

- an understood framework for negotiations between parties;
- a clear statement of standards and agreements;
- an available means of monitoring pollution;
- defaulters must be penalised; and
- the application of regulations must be fair and equitable.

2. Initiatives to Encourage the Private Sector

(a) Policies and Guidelines

While a national Environmental Management Action Plan (NEMAP) was adopted in 1996, it makes little reference to the private sector. A review of this omission is vital to the environmental aspects of IWT since the objective for diversion of heavy road freight traffic from road to IWT by improved policy instruments would be governed by the response of the dominantly private sector road and IWT users. The World Bank (1997a) has outlined three main areas where private and public sector collaboration in pollution management is desirable: policies and guidelines, support programs, and privatisation strategies.

The measures to bring pollution under control should be based on policy initiatives which combine improved standards, improved monitoring and enforcement of those standards, and improved market-based policies, such as changes in relative prices, tax swaps, and tradable emission rights. The private sector, through consultations, should play an active role in the shaping these standards and policies. This would require depoliticising owner organisations and the establishment of self-regulating professional bodies, of which virtually none exist in Bangladesh. An encouraging recent event, however, is the establishment in Bangladesh, in May 1998, of the Chartered Institute of Transport. This is an international body with strong professional standards.

(b) Privatisation

The World Bank has noted that where the state is the chief provider of transport infrastructure such as in Bangladesh, then institutions are typically weak and the policy framework is inadequate (World Bank, 1996: 2). State-owned enterprises (SOEs) are also typically more pollution intensive (that is, pollutants emitted per unit of output) than private companies, for institutional, financial, and technological reasons. The

¹ To capitalise on this process, the ADB, for example, is cooperating with the government on a possible project to encourage the involvement of NGOs in road safety improvements. This initiative includes public education campaigns on the health impacts of transport pollution.

commercialisation of SOEs should provide opportunities for increased managerial and technical efficiencies and increased environmental accountability to the public. These changes all provide incentives for SOEs to lower pollution intensities. In the IWT sector, both BIWTC and BIWTA are significant SOEs, and BIWTC ferry and shipping services and the dredging operations of BIWTA and BWDB could be privatised. The same approach could be adopted for the 70 ferries operated or owned by RHD and for water transport based eco-tourism.

3. Information needs

In addition to inadequate government policies, the limited adoption of environmentally sound business practices in Bangladesh is linked to insufficient environmental information and technical knowledge. Transport managers seldom know the environmental impact they cause. However, neither the DOE, the Department of Trade and Industry, nor the Federated Chamber of Commerce have yet established information centers on such topics, and none have links to international networks and databases. This task is left usually to occasional newspaper articles by academics or journalists summarising the results of aid-agency studies in Bangladesh.

The role of both the public and private sectors in environmental information collection and distribution therefore needs to be improved. The public sector should take the lead through data collections to analyse the costs and benefits of alternative public policy measures and to ensure basic information is available for public and private choices (World Bank, 1992: Chapter 4). However, the public sector should not have to take responsibility for providing information to private companies on technology-specific cleaner production options and equipment-specific pollution abatement options. This kind of information can be provided to private firms through non-profit international information sources. Environmental service firms that provide information are emerging in Bangladesh through various NGOs. The environmental service industry can be developed to provide technology information and carry out environmental audits, certifications and site assessments. The public sector can help support and stimulate private environmental service firms, but it should not have to provide information services that would undercut the private capital services. Moreover, the ISO has promoted both international quality assurance and environmental standards. These need to be established in Bangladesh.

Dissemination of new technology to private enterprises can be better achieved through private and public sector collaboration. This may involve programs to promote clean technologies and improve energy efficiency through access to information, training and credit. International quality standards, such as the International Standards Organisation (ISO) 9000 and 14000 may be appropriate for polluting industries and the transport sector alike, particularly since these standards would increase pressure to comply, since export companies that do not meet environmental standards in their production and transport systems could be excluded from large export markets. To facilitate the change to market solutions of pollution abatement, it may be necessary to cushion the adoption with concessionary credit, requiring short-term use of public funds, aid donor financing, or use of tradable pollution emissions. In the domestic transport sector international standards can be adopted gradually. It could be questioned whether the adoption of international standards is valid in developing countries with relatively low global pollution impacts such as Bangladesh. However, the perspective to consider is that of putting the global environment at the moral centre of development (Adams, 1995: 312),

while maximising the application of tradable emission revenues to meet acceptable global limits (see Chapter 5.A.3 regarding the ALGAS)

In those cases where the polluter pays principle falls hard on existing operators some public sector easing of the financing constraint can help. Mature IWT operators with an old technology and facing a one-time adjustment cost to become cleaner are the prime example. Another situation relates to small and medium shipping companies that may not generate enough cash flow to cushion investments in cleaner technology. To help these operators meet national environmental standards, the government could consider a variety of incentives, including: (i) a temporary tax holiday through immediate or increased depreciation of low emission ship engines¹ and ship designs suited to low draft carriage of containers and other cargo. (ii) reduced tariffs or import duties on environment-related performance equipment including engines and generators; (iii) tax swaps between profit-tax and energy or pollution taxes; or (iv) access to financing for environmental technology.

Operators typically demand that such financing for environmental technology be at below-market rates. 'Green funds' do exist in numerous countries and are often financed through either donor support, or through the collection of pollution taxes or charges. These and other alternatives should be considered for the Bangladesh IWT sector, especially for low-pollution, low-noise emission propulsion systems. In all cases, the financial incentive must be focused, time-bound and recognised as designed to enable the operator to become profitable after the new investment.

4. Commercialising State Owned Enterprises

In Bangladesh, SOEs are being targeted for reform. For example, Bangladesh Railways, under the Five-Year Plan covenanted to the ADB loan for the *Jamuna Bridge Rail-Link Project* requires a process of commercialisation and possible privatisation in the longer term. A similar approach is also expected for ports under the proposed ADB-financed *Ports Efficiency and Access Project*. While road usage is dominated by the private sector, government operations are still in practice. However, road maintenance and ferry operations are firmly and inefficiently embodied the public domain and are being targeted as an area for private sector involvement. In addition, BOT options are being considered for high-density road network expansion, the proposed Dhaka by-pass being the prime example. Guidelines were produced in early 1998 and introduction of a privatisation cell in RHD is being considered (GOB, 1998d). For IWT, the removal of dredging operations from BIWTA and the curtailment of passenger services by BIWTC are the key services being considered for privatisation. This should be linked to removal of BWDB dredging operations from the public domain for optimal effect. The commercialisation of SOEs typically opens up opportunities for increased managerial and production efficiency, the introduction of new capital and technologies, and increased environmental accountability to both local communities and to government regulators, all of which should lead to lower pollution. To date, the GOB's overall privatisation program has been restricted in scope and slow moving, although it is part of Bangladesh's reform objectives.

¹ Currently, many IWT operators now rely on engines designed for low lift irrigation pumps and attach these to wooden vessels built for sail which was omnipresent in Bangladesh until the mid 1980s. Not only is this inefficient, the vibration shortens the life of vessels which are not designed for motor.

5. Regulatory and Legal Framework

These benefits would not, however, be realised unless the environmental regulatory regime is sufficiently effective to enforce the regulations. Also, policies to facilitate investments by the new private owners in cleaner technologies may be appropriate. Also, the legal system may need strengthening to address issues concerning liability of the new owners, often as a condition of sale. Thus, while privatisation may be a necessary condition to lessen the pollution loads generated by state-owned transport operators, it is not sufficient. Attention must also be brought to bear on the regulatory and legal environment for private sector operations as discussed in Chapter VI.

6. Problems in IWT to be addressed in the Policy Implementation

Each of the IWT subsectors face particular problems in the implementation of the proposed policy areas (see Figure 5). The Country boat subsector is constrained by lack of affordable credit facilities. According to DANIDA 1997: A4, an average boat of 12 m length will cost TK 120,000. Current credit resources are informal with very high interest rates being charged of about 10 percent per month. The owners' organisations also lack official recognition, while craft development resources are informal, landings are rudimentary and boat owner training is lacking.

In the ferry subsector, BIWTC lacks cost control measures, revenues are not adequate for asset replacement and is over-dominant, leaving little potential for the private sector. Moreover, the government policy in transport is towards the reduction of ferries in favor of bridge crossings, such as the recently completed Jamuna Bridge. While BIWTC has gradually reduced its cargo-passenger services on the river routes, the remaining over 200 vessels, most of which are obsolete, also need to be taken out of service in favor of the private sector. Another constraint is that little of the river port revenues are retained for port development, and many of the facilities could be privatised.

The main policy implementation constraints are the institutional weaknesses and lack of coordination within the IWT sector, with other transport modes, or with the water resources sector. Training syllabi are too general, trainers are often incompetent and, as noted, the Marine Court has a massive backlog of cases. The Marine Court also lacks institutional separation from the DOS. Apart from safety design considerations, insurance, registration and survey standards are weak, navigation aids are inadequate and radio communications, insurance or salvage services hardly exist. The environmental management of the sector is equally lacking and improved management will be slow, and will need to be focussed on the main ports of Chittagong, Dhaka and Mongla for any hope of tangible results, especially for oil spill management, environmental impact assessment of investments, dredge disposal management, survey and regulatory enforcement and the establishment of waste reception facilities.

7. Policies for Linking IWT and Water Resources Management

The principal lessons from the literature review are that water resources policy need to adopt a river basin, multi-sectoral and integrated user approach. Incorporating IWT development and management into this perspective needs more than the current lip service. The integrated policy framework and strategies need to be prepared, probably under the guidance of a strengthened Planning Commission. Recourse to MOS guidance perhaps can be limited initially to the technical and

operational standards of IWT vessels, with gradual development of a River Management and Planning Authority having responsibility for IWT, flood control and river infrastructure generally. The focal need is to facilitate realisation of the environmental and economic value of IWT through the management and cost recovery measures for flood control, channel dredging and beneficial use of dredged material, development of agriculture, rural infrastructure, including enhancement of the country boat sector, and inland port development at urban centers. Under the NWMP, there is an opportunity to establish greater integration of planning, management, cost-recovery mechanisms and public recognition of these needs. These policy objectives can be applied in the project proposals outlined in Chapter V.

CHAPTER VIII

CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

The research explores the evaluation, policy and operational issues of IWT development potential in Bangladesh where natural conditions determine that rivers must be reckoned with in terms of life threatening flooding risks and the dominate use of water resources for irrigation. Bangladesh is the lower riparian recipient of its river resources and actions and policies applicable higher in the international river basins are at least as important as those within Bangladesh.

The improvement of IWT conditions offers an opportunity for least cost transport in meeting development objectives. Adverse environmental and social impacts can be less for IWT than for other transport modes, especially road transport which has received the major share of investment in meeting economic growth objectives.

While water resources management has catered mainly to irrigation, it has severely depleted available water for IWT. It has also neglected efficient and comprehensive dredging as a potentially cost recoverable means to maintain channel depths, and improve drainage and reduce flood risks. The water resources strategy has favoured embankment construction, which restricts drainage, neglects land building of the delta in the face of tectonic subsidence, impedes groundwater recharge, and impedes IWT route flexibility, and the social benefits of IWT.

If these development conflicts are to be avoided, it is apparent from the example of the *Kalni-Kushiyara River Management Project*, that both the cost-benefit analysis, which incorporates environmental and social benefits, and the institutional and policy perspectives of IWT, must be more purposefully integrated with water resources, and policies and plans. These must encourage least cost, economically efficient transport modal investment. It is not sufficient to merely demonstrate positive NPV/EIRRs for water resource or transport projects. Rather, the opportunity must be taken to integrate and maximise the benefits of energy efficiency, pollution reduction and avoided land acquisition of IWT vis-à-vis other transport modes as a contribution to the sustainable cost recovery of water resources investment. This may also help create least cost transport modal choices.

While IWT may divert heavy and bulky traffic from roads and compete cost effectively with railways, what is more at stake is the entire development policy context of transport in Bangladesh. The sunk costs of inappropriate investment in road network expansion while meeting the demand for mobility of road and urban sector transport policy and planning must also be considered. The policy implementation process is also vital in this context for which political commitment, public awareness, appropriate regulation and enforcement requires strengthening. Without this overall perspective on integrated water resources and overall transport planning and management, and with prevailing policies which distort market prices, and regulations which are not enforced, efficient transport modal choices are constrained. Under the latter scenario, less time-sensitive traffic than necessary may continue to congest and demand increased road space. Past investment has responded to meeting mobility demand by a too narrow vision of transport options and

policies which disregard environmental quality. The IWT routes and their management must also be improved if the waterways are to meet the needs of other water users and be kept free of pollution.

The main environmental risk of IWT development is that without proper attention, mere diversion of traffic to IWT will be counterproductive in terms of environmental sustainability, particularly regarding oil and noise pollution, for which mitigation measures are recommended. The other environmental risk is that IWT development would encourage industries to locate near the rivers and without the enforcement of affluent controls would add to the reduction of water quality.

The *Kalni-Kushiyara River Management Project* and the ongoing debate regarding management of the lower Ganges River offer the potential to provide the reliable year-round depths needed for IWT. Increased opportunity for IWT through channel deepening and water storage schemes should offer a lower cost alternative for IWT to capture more long distance traffic and allow IWT user revenues to contribute to cost recovery for developments which also improve traditional water resources usage in Bangladesh. This also applies to avoiding the alienation of productive land resources, catering to a rapidly growing population and rapidly growing demand for transport in the GBM basin, for which the international dialogue needs to be improved.

B. Recommendations

There is a need for more research to quantify the economic savings and reduced environmental impacts of IWT in Bangladesh vis-à-vis other transport modes. This should contribute to sustainable development through the cost benefit analysis of projects, and overall development planning and the transport policy and regulatory framework, particularly to ensure that sunk costs which tend to perpetuate sub-optimal policies and development decisions of the past. This should be accompanied by ensuring that operation and maintenance costs of each mode are reflected in user charges, and that preventive of overloading and pollution emission by transport units is strengthened. This approach will allow more rational, least cost transport investment decisions to be made for the financial benefit of transport operators, water resource users, and the recovery of water resource investments.

More effort must also be given to private sector transport operations, through appropriate policies, regulations, public awareness, and improvement of institutional frameworks. This will help to address the environmental impacts of all transport modes. There is a particular opportunity to improve water resources management by policies which encourage private sector investment in cost efficient dredging to improve and maintain adequate channel depths, to add usable land resources and mitigate flooding.

It is also recommended that under a strengthened Planning Commission and the ongoing NWMP, a policy framework aimed at coherent integration of water resources and IWT development opportunities. Consideration should also be given to the separation of BIWTA from the MOS and creation of a River Planning and Management Authority.

Special attention should also be given to continued dialogue between all of the riparian countries of the GBM basin, seeking and demonstrating win-win solutions for

cost-efficient international IWT network improvements. This approach will help to gradually improve political mistrust. Demonstrating the benefits to IWT users should also benefit poverty constrained farmers for whom substantial cost-recovery contributions for flood protection may be impractical and socially undesirable. In this regard, a detailed feasibility study is proposed for improving the entire IWT route between eastern Assam and Calcutta, and Assam to Chittagong, which were important IWT transport routes prior to the partition of India and East Pakistan (now Bangladesh) in 1948. This should be accompanied by cost recovery measures where the formal sector IWT users, and efficient ICT may facilitate efficient multimodal transport. The construction of ICTs in north west Bangladesh, allowing for competition between road, rail and IWT, accompanied by a similar terminal in Dhaka, improvement of IWT facilities at the two seaports of Chittagong and Dhaka, and a *Greater Dhaka IWT Route Development Project* are also recommended for detailed investment evaluation for private sector participation.

The study further recommends the use of environmentally friendly *Sundarbans Safari* vessels in the eco-tourism development of the SRF, a World Heritage Site.

The study notes the risks of increased oil pollution in advocating the energy saving and other benefits of IWT. To mitigate these risks, a *Ports Environmental Management Project* is recommended, the scope, cost estimates and implementation arrangements and schedule for which are described, including measures for the adoption of a National Oil Spill Contingency Plan. To be successful, a contingency plan should be linked closely with international efforts and development in a tiered fashion from main port resources at Chittagong, Mongla and Dhaka.

BIBLIOGRAPHY

- Abu Abdullah (1991), *Modernization at Bay: Structure and Change in Bangladesh*, Dhaka, University Press Ltd.
- Adnan, S. (1991), *Floods, People and Environment*, Dhaka, Research and Advisory Services.
- Ahmad, Q.K. (1994), *Integrated River Basins Management for Socio Economic Development of a Region*.
- Ahmed Kamal (1997), Mass Movements and Our Political Culture, Dhaka, *Holiday*, (26 March), Proceedings, Management of International River Basins and Environmental Challenges, Dhaka, Academic Publishers.
- Ahmed Kamal and H. Mahabub (1990), *Development Impact of Rural Infrastructure in Bangladesh*, Washington, International Food Policy Research Institute.
- Akatsuka, Y., T.Asaeda, and J.F. Brooks (1994), *The Outlook for Research in Asian Inland Water Transport*, Unpublished.
- Andruskiewicz, et al (1996), *The Challenges of Maritime Economy in Present Stage of Transitions in Poland*, in Mazurkewicz B, Ed Proc. International Conference on Inland and Maritime Navigation and Coastal Problems of East European Countries, Vol. 1, 19-28, G'dansk, Technical University of G'dansk.
- Asafudoula, M. (1995), *Proceedings of the Third Conference on the Flood Action Plan*, Dhaka, Flood Action Plan Coordination Organization.
- Ashraf Ali et al. (1996), *Development Issues of Bangladesh*, Dhaka, University Press Ltd.
- Asaeda. T., Akastsuka, Y., Pham H. S. and Vu, T.C., *Bed Topography and Vessels Payload. South-East Asia Case Study*, Proceedings of the International Conference on Environmentally Sound Water Resources Utilization, Bangkok, UNESCAP.
- Asaeda. T., Akastsuka, Y., Pham H. S. (1992), *Perspectives for the Navigation of Rivers in South-South Asia*, Research Report, 22, Tokyo, Saitama University.
- Asian Development Bank (1980), *Appraisal of the Outports Project in Burma (Myanmar)*, Loan No. 456 - MYA, Manila, ADB.
- _____. (1989), *Review of the Scope for Bank Assistance to Urban Transport*, Manila, ADB.
- _____. (1991a), *Appraisal of the Inland Waterways Project in Indonesia*, Loan No. 1089-INO, Manila, ADB.
- _____. (1991b), *Dhaka Integrated Flood Protection Project*, Loan No. 1124-BAN(SF), Manila, ADB
- _____. *Vehicular Emissions Control Planning in Metro Manila: Final Report*, TA No. 1414-PHI, Manila, ADB.
- _____. (1994a), *Economic Cooperation in the Greater Mekong Sub-region*. Manila, ADB.
- _____. (1994b), *Road Overlay and Improvement Project*, Loan No. 1287-BAN (SF), Manila, ADB.
- _____. (1995), *Jamuna Bridge Access Roads Project: Loan No. 1478-BAN (SF)*, Manila, ADB.
- _____. (1996a), *Urban Poverty Study: Final Report*, TA No. 2246-BAN, Dhaka, ADB.
- _____. (1996a), *Toward Effective Water Policy*, Vol. I-II, Manila, ADB.

- _____. (1996b), *Economic Evaluation of Environmental Impacts: A Work Book* Manila, ADB.
- _____. (1996c), *The Jamuna Bridge Access Roads Project*, Loan No. 1478 BAN (SF), Manila, ADB.
- _____. (1997a), *The Jamuna Bridge Rail Link Project*, Manila, ADB.
- _____. (1997b), *Regional Cooperation in South Asia*, Dhaka, BRM (Bangladesh Resident Mission), ADB.
- _____. (1997c), *Summary Initial Environmental Impact Assessment: Jamuna Bridge Rail Link Project*, Manila, ADB.
- _____. (1997d), *Key Indicators of Developing Asian and Pacific Countries*, XXVIII, Manila, ADB.
- _____. (1997e), *Bangladesh: Country Economic Review*, Manila, ADB.
- Atiur Rahman (1985), *Political Economy of SARC*, Dhaka, University Press Ltd.
- Bayes, Abdul (1995), *Battle of the Sexes*, Dhaka, *Daily Star*.
- Balduck, J (1995), *Recent Experiences in Flanders During the Floods of 1993/4 and 1995*, Brussels, PIANC.
- Banerjee, P. (1996), *Towards a Shared Vision for Binational Development*, WSRC, Calcutta University.
- Bhadra, L. J. and D. Bhadra (1997), *Red and Green: A Bangladesh Collage*, Dhaka, University Press Ltd.
- Balloffet and Assoc. (1996), *Summary Initial Environmental Examination: Jamuna Bridge Access Roads Project*, Fort Collins, Balloffet and Associates.
- Bangladesh Times (26 October 1996), *Ganges Water Sharing to be Resolved Before January*, Dhaka.
- Bombis, R. et al. (1991), *Towards a European Policy For the Inland Water Transport Industry*, Rijswijk, NEA Transport Research and Training.
- Bolton, F. (1992), *Environmental and Health Aspects of Irrigation*, in ODA (Overseas Development Agency), *Priorities for Water Resources Allocation and Management*, Southampton, ODA: 117-148.
- Borrows P. (1995), *Managing Flood Risk for the River Thames navigation*, Brussels, PIANC.
- Brooks, J. F (1995a), *Inland Water Transport Development in Asia*, Report of Expert Group Meeting on IWT Information Systems and Training, Bangkok, UNESCAP (United Nations Economic and Social Commission for Asia and the Pacific).
- _____. (1995b), *Perspectives for Inland Water Transport Development for the People's Republic of China*, Proceedings: Inland Waterways Transport Development Seminar, Wuhan, Ministry of Communications, ADB.
- _____. (1997a), *Transit for Nepal Trade Goods*, Dhaka, ADB.
- _____. (1997b), *Sustainable Development is not a Contradiction in Terms*, *Asia Pacific Journal of Environment and Development*, 4,2, Dhaka, Bangladesh Unnayan Parishad.
- _____. (1998), *Port and Shipping Pollution Risks in the Sundarbans Reserved Forest*, Dhaka, ADB.
- CBRB (1998), *Containers Barge Ahead*, Rotterdam, Netherlands Rhine and Inland Shipowners' Association.

CIDA (Canadian International Development Agency) (1994), *The Kalni-Kushiyara River Improvement Project : Pre-feasibility Study*, Dhaka, BWDB (Bangladesh Water Development Board).

_____. (1998), *The Kalni-Kushiyara River Management Project : Feasibility Study Final Report*, Dhaka, BWDB.

Crowe, B. (1995), *Sharing the Ganges*, Dhaka, University Press Ltd.

Danida (1997), *Inland Water Transport Sector Policy and Strategy Study*, Draft Final Report, Copenhagen, Cowi Consult.

De Hann (1995), *The 1993 and 1995 Floods as Motive to Renew Policies*, Brussels, PIANC.

Della Luna, G. et al. (1995) *La Regularisation du Lit Permet La Navigation a 'Grand Gabarit, Reduit le Risque pour les Diques et Maintenant L'Environnement Naturel*, Brussels, PIANC.

Dixon, J.A. et al. (1986), *Economic Analysis of the Environmental Impacts of Development Projects*, ADB, Economic/Staff Paper No.31, Manila, ADB.

Ekelof, P.J. (1997) *Safety, Aids to Navigation and Human Resource Development*, in DANIDA, op.cit.

Emajuddin Ahamad (1985) SAARC: *Seeds of Harmony*, Dhaka, University Press Ltd.

Elskens, F. (1995), *Protecting Overflow Dikes for Controlled Flood Areas in Belgium*, Brussels, PIANC.

Engel, H. (1995), *Floods in the River Rhine Basin*, Brussels, PIANC.

Evidence (1996), *Water Diplomacy Caught in a Whirlpool*, Dhaka, XIV-29: 16-17

Fingas, M. F., W. S. Duval and G. B. Stevenson (1979), *The Basics of Oil Spill Clean-Up*, Environmental Protection Service, Ministry of Supply and Services, Canada.

Fischer, J. (1995), *Les Grandes Crues du Rhone de 1993 et 1994*, Brussels, PIANC.

Fukasaku, K. Ed. (1995), *Regional Cooperation and Integration in Asia*, Manila, Asian Development Bank.

Galloway, G.E. and J.D. Manous (1994), *Balancing the Environment, Navigation and Flood Control on the Lower Mississippi River: A Challenge for the Twenty First Century*, Proc. 28th International Navigation Congress, Seville. PIANC.

GOB (Government of Bangladesh) (1989), *Bangladesh Inland Water Management Action Plan*, (BIWTMAS), (1988) *National Flood Protection Policies*, Dhaka, Ministry of Irrigation, Water Development and Flood Control, Dhaka, BIWTA (Bangladesh Inland Water Transport Authority).

_____. (1994a), *Bangladesh Transport Sector Study*, Dhaka, UNDP/World Bank.

_____. (1994b), *Bangladesh Transport Sector Study: Water Transport Sector Final Report*, Dhaka, National Planning Committee.

_____. (1995a), *Inland Container River-Port Dhaka (Final Report)*, Dhaka, BIWTA.

_____. (1995b), *National Environment Management Action Plan (NEMAP)*, Dhaka, Ministry of Environment and Forest (MOEF).

_____. (1996a), *Bangladesh Integrated Transport System Study (Draft)*, Dhaka, Planning Commission.

- _____. (1996b), *National Water Management Plan*, Dhaka, WARPO (Water Resources Planning Organization), Ministry of Water Resources.
- _____. (1997a), *Draft Fifth Five-Year Plan*, Dhaka, Ministry of Planning.
- _____. (1998a), *Bangladesh Integrated Transport System Study*, Dhaka, Planning Commission.
- _____. (1998b), *Overview of Water Resources Management and Development in Bangladesh*, Dhaka.
- _____. (1998c), *The Ganges Water Sharing, Treaty and the Resulting Opportunities*, Dhaka, Ministry of Water Resources (MWR).
- _____. (1998d), *Overviewing of Water Resources, Management and Development in Bangladesh*, Dhaka, Ministry of Water Resources.
- GOB and World Bank (1992), *Proceedings of the Second Conference on the Flood Action Plan*, Dhaka, GOB.
- Halcrow Fox (1997), *Dhaka Eastern Bypass Study*, Dhaka, Halcrow Fox Consultants.
- Hansson, L. (1996), *Towards Sustainable Transportation-Going From Mere Words to Practice*, Stockholm.
- Hasan Zaheer (1994), *The Separation of East Pakistan*, Dhaka, University Press Ltd.
- Henderson, H. (1995a), *Redefining Wealth, Our Planet*, 7.1. Lund, International Institute for Industrial Environmental Economics.
- _____. (1995), *New Horizons: The Economic, Social and Environmental Impacts of Participatory Watershed Development*, International Institute for Environment and Development, London, IEED, Gatekeeper Series : 50.
- Hiver, J. M. (1995), *Voices Navigables en Region Wallonne: Amenagements Hydrauliques et Gestion des Episodes des Crues*, Brussels, PIANC.
- Hochstein, A. (1990), *Inland Waterway System in Asia*, Proceedings 27th Navigation Congress, Osaka, PIANC.
- Hofer, T. and B. Messerli (1997), *Floods in Bangladesh*, Berne, Institute of Geography, University of Berne.
- Howe, C.W. et al; (1969), *Inland Waterway Transportation in Public and Private Management and Investment Decisions*, Baltimore, Johns Hopkins Press.
- Hughes, R. S., Adnan and D. Clayton (1994), *Flood Plains or Flood Plans ?* IED (International Institute for Environmental Development), London.
- Huq and Wheeler (1992), *Pollution Reduction Without Formal Regulation: Evidence from Bangladesh*, Washington, World Bank.
- Huq, S. (1998), *New Paradigm for Water Sector Planning in Bangladesh*, Dhaka, The Independent (30 March: 6).
- IMO (International Maritime Organisation) (1995a), *Contingency Planning: Section II, Manual on Oil Pollution*, London, IMO.
- _____. (1995b), *IMO News*, London, IMO, 3:XII.

- Independent (1998a), *Country Will Have 1,700 People Per Square Km in 30 Years*, Dhaka, The Independent (24 January).
- _____. (1998b), *Container Terminals by Private Agencies Favoured*, Dhaka, The Independent (12 August).
- _____. (1998c), *Launch Capsize*, Dhaka, The Independent (16 March).
- Islam, M.A. (1996) (International Union on the Conservation of Nature), (1996), *An Inventory on International Conventions*, Dhaka, IUCN.
- Jansen, E.G. et al. , (1989), *The Country Boats of Bangladesh*, London, Intermediate Technology Publications,
- Jeffrey, R. (1981), *India: Independence and the Rich Peasant*, in Jeffrey, R (Ed), *Asia: The Winning of Independence*, London, Macmillan.
- Khan, M. A. (1962), *Muslims a Struggle for Freedom in Bengal, 1757-1947*, in Sajjad Hussain (Ed), *East Pakistan: A Profile*, Dhaka, Orient Longman.
- Khan, M. H. and M. Choudhury (1985), *Improved Sail Propulsion for the Country Boats of Bangladesh*, in Brooks, J. F. (Ed), *Proceedings of Regional Conference on Sail-Motor Propulsion*, Manila, ADB.
- Khan, Shamsul et al. (1996), *Political Culture, Political Parties and the Democratic Transition in Bangladesh*, Dhaka.
- Lalaut, Y. (1995), *Le Role de Canal à Grand Gabarit*, Brussels, PIANC.
- Lloyds of London (1990), *Environment, Shipping Economist*, Lloyds of London Press.
- Majumder, M.K. (1997), *Arsenic Project in Limbo*, the Independent, Dhaka (27 October).
- Martin, S. and S. Maynard (1994), *Quantification of Navigation-Induced Forces and Their Impact on the Environment*, Proc. 28th International Navigation Congress, Seville, PIANC.
- MOST (1995), *Pocket Book of Transport Statistics in India*, Delhi, Government of India.
- Moudud Ahmed (1991), *Bangladesh: Constitutional Quest of a Nation*, Dhaka, University Press Ltd.
- Mukherjee, S (1998), *Calcutta Effluents Hasten Sundarban's Doom*, *Independent*, Dhaka (20 May).
- Muhith, A. M. A. (1992), *Bangladesh: Emergence of a Nation*, Dhaka, University Press Ltd.
- Munasinghe, M. and W. Shearer (Eds.), (1994), *Defining and Measuring Sustainability: The Biophysical Foundations*, Tokyo, United Nations University and World Bank.
- Muskatirovic, D.(1996), *Yugoslavia Inland Waterways: Possibilities of Extension by Construction of the Danube-Aegean Sea-Link*, *Dream or Reality*, in Mazurkiewicz, Ed.(1996) Ibid:347-360.
- Netherlands Rhine and Inland Association (CBRB), (1995), *Containers Barge Ahead*, Riskwijk, NEA Transport Research and Planning.
- New Zealand Government (1995), *Resource Management Act (1991)*, Wellington, New Zealand Government.
- _____. (1996), *New Zealand Marine Oil Spill Response Strategy*, Wellington, Maritime Safety Authority.

- NOAMI (1994), *Experimental Project for Improving the Efficiency and Profitability of Country Boat Operations*, Dhaka, BIWTA (Bangladesh Inland Water Transport Authority).
- Novak, J. J. (1994), *Bangladesh: Reflections on the Water*, Dhaka, University Press Ltd.
- Nuttall, P. (1997), *Environmental Audit of Inland Water Ports, Seaports and Ship-Related Facilities in Bangladesh*, Dhaka, Mott MacDonald Consultants.
- PIANC, (1992a), *Guidelines to Inland Water Transport Development*, Brussels, PIANC.
- _____. (1992b), *Container Transport with Inland Vessels*, Brussels, PIANC.
- Rahman A. and Saleemul Huq (1989), *The Greenhouse Effect and Coastal Area of Bangladesh*, Dhaka, Academic Publishers: 25-36.
- Rahman, M.A. (1963), *The Country Boats of East Pakistan: An Economic Analysis*, in Jansen et al. (op.cit.).
- Rahmatullah, M. (1997) *Asian Land Transport Development*, Background Paper Presented to Dhaka Seminar on Asian Land Transport Development, UNESCAP, Bangkok.
- Rao, P. and M. Kumar (1996), *Management of Inland Water Transport*, Mumbai, Proceedings, National Conference on Transport Systems Studies.
- Rasheed, K.B.S. (1994), *International River Basins Development - Environmental Challenges*, Dhaka, Academic Publishers: 25-36.
- _____. (1995), Potentials and Constraint of Inland Water Transport Development in Bangladesh, Dhaka, *Asia Pacific Journal on Environment and Development*, 2, 1: 40-50
- Research Advisory Services (1995a), *The UNDP Independent FAP Review Mission, Dhaka*, Monitor, 1.2.
- _____. (1995b), *A Second Version of the FAP Strategy Report*, Dhaka, Monitor, 1.3.
- Rezaul Karim, M. M. (1997), *South Asian Growth Quadrangle: Ties of a Gordian Knot? Viewpoint*, Dhaka. *Chronicle* (11 April).
- Rizzoli, J. L. (1995), *L'Action des Grands Lacs de Seine Impact des Ouvrages de Navigation*, Brussels, PIANC.
- Rydzowski, W. and Wojewodzka-Krol(1994), *The Influence of Financial Limitations on the Development of Waterways Infrastructure*, Proc. International Navigation Congress, Seville PIANC, SI-3:23-27.
- SCTP (1988), *Report of the Steering Committee on Transport Planning*, New Delhi, Government of India.
- Salahuddin Ahmed (1987), *Bangladesh: Tradition and Transformation*, Dhaka University Press Ltd.
- Sayeed, K. B. (1960), *Pakistan: The Formative Years*, Karachi, Pakistan Publishing House.
- Sen, B. (1998), *An Assessment of Poverty Reduction Objectives of the Asian Development Bank's Operations in Bangladesh*, Dhaka BIDS (Bangladesh Institute of Development Studies).
- Sriraman, S (1998), Inland Water Transport in India : Issues and Prospects, *Asian Transport Journal*, June, 101-119.

Steinberger, K (1998), Bangladesh: *The Poison that Lurks in UNICEF's Wells*, Manila, Manila Bulletin (24 October).

Tabarak Hussain (1997), SAARC, Sub Regional Grouping and Bangladesh Position, Dhaka, *The Independent* (8 April).

_____. *The Influence of Transportation Policy on the Development of Waterways and Inland Navigation in Poland*, in Mozurkewicz, B.(Ed). Ibid.

UNDP (1993), *Transport Sector Needs Assessment in India*, New York, UNDP.

_____. (1996), *World Population Prospects*, New York (UNDP), United Nations Development Programme.

UNESCAP (1980), *Maintenance and Development of Inland Waterways, Seminar Proceedings*, Dhaka, UNESCAP.

_____. (1985), *Report of the Inland Water Transport Programming Mission*, Bangkok, UNESCAP.

_____. (1989), Report on the Study of the Viability and Cost-Effectiveness of Establishing a Regional Inland Water Transport Center in Bangladesh, and of the Alternatives of Strengthening the Secretariat or Using a Network Approach, Bangkok, UNESCAP.

_____. (1992), Summary of Meetings Under Project FAS 186/142: *Development of Inland Water Transport*, Bangkok, UNESCAP.

_____. (1997), *Seminar on Asian Land Transport Development*, Dhaka, UNESCAP.

UNICEF (1997), *The Dancing Horizon*, Dhaka (UNICEF), United Nations Children's Fund.

USAID (1990), *Disaster History: Significant Data on Major Disasters Worldwide*, Washington, Office of US Foreign Disaster Assistance Agencies for International Development.

WARPO (1996), *Terms of Reference: National Water Management Plan (NWMP)*, Dhaka, Ministry of Water Resources.

Wilbur Smith Associates (1991), *Inland Waterways Traffic Survey. Additional Surveys to Transport Efficiency Study (TES)*, Papua New Guinea, Washington, World Bank.

World Bank (1977), *Bangladesh, Second Inland Water Transport Project*, Staff Appraisal Report No. 1570-BD, Washington, World Bank.

_____. (1979), *Burma: Inland Water Transport Project*, Credit 413-BA, Project Performance Audit Report, Sec. M79, Washington, World Bank.

_____. (1987), *China Water Transport Sector Study*, Report No. 6383-CHA, Washington, World Bank.

_____. (1991), *Third Inland Water Transport Project, Staff Appraisal Report*, Report No. 8815-BD, Washington, World Bank.

_____. (1992), *Development and the Environment*. Washington, World Bank.

_____. (1995), *China: Inland Waterways Project*, Staff Appraisal Report No. 13934-CHA, Washington, World Bank.

_____. (1996), *Sustainable Transport*, Washington, World Bank.

_____. (1997a), *Water Resources Management in Bangladesh*, Dhaka, World Bank Resident Mission.

_____. (1997b) *Private/Public Sector Roles in Improving Pollution Management in Bangladesh*, Washington, World Bank.

_____. (1997c), *Port Master Plan and Trade Facilitation Study*, Washington, World Bank.

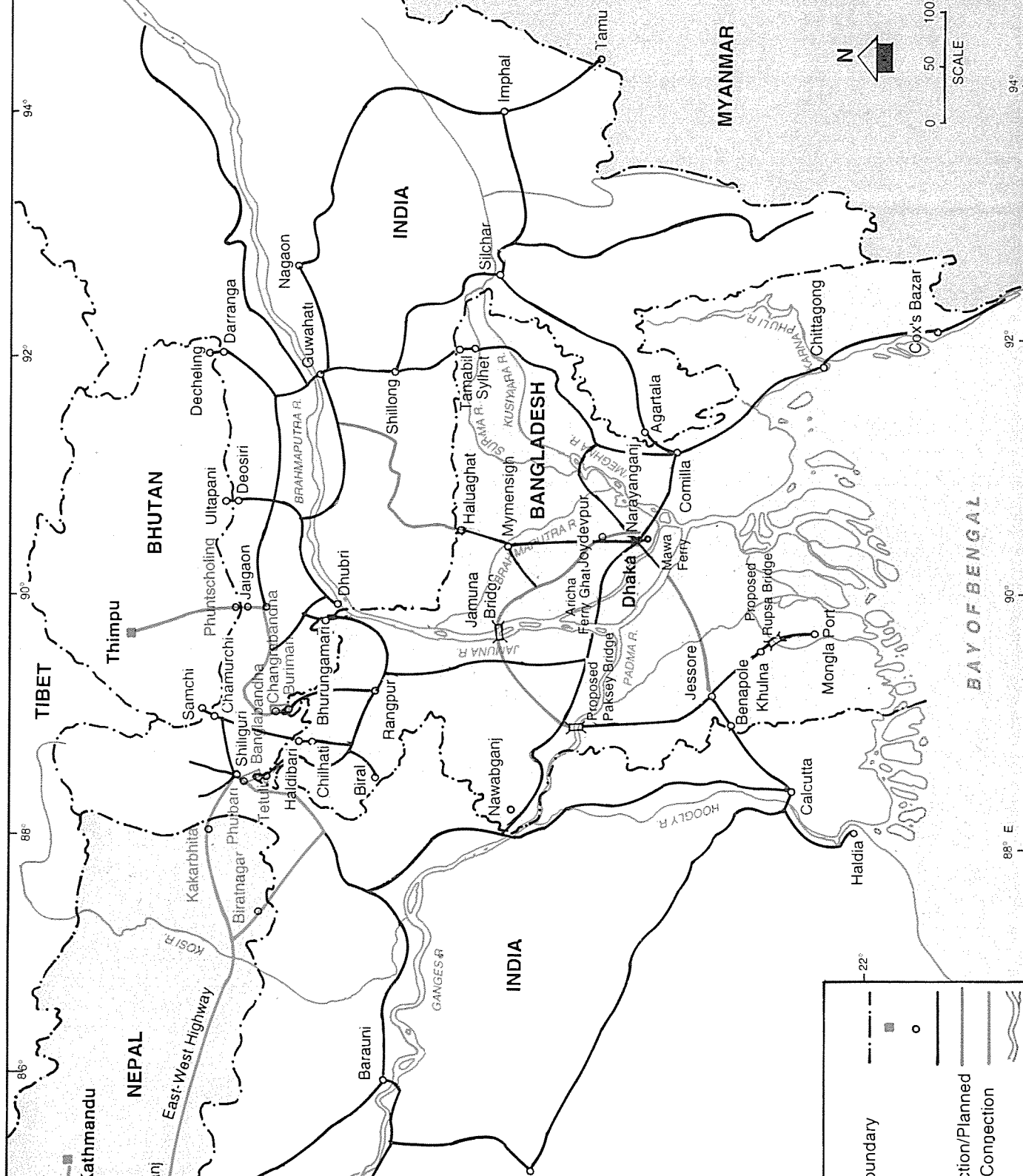
_____. (1997d), *Towards an Environmental Strategy for Asia*, Washington, World Bank.

_____. (1997b), *Priority Framework for NEMAP Implementation*, Dhaka, MOEF-World Bank.

Zaman, M.Q. (1993), *Rivers of Life: Living with Floods in Bangladesh*, *Asian Survey*, XXXIII, 10:985-996.

_____. (1996), *Development and Displacement in Bangladesh*, *Asian Survey*, XXXVI, 8:691-703.

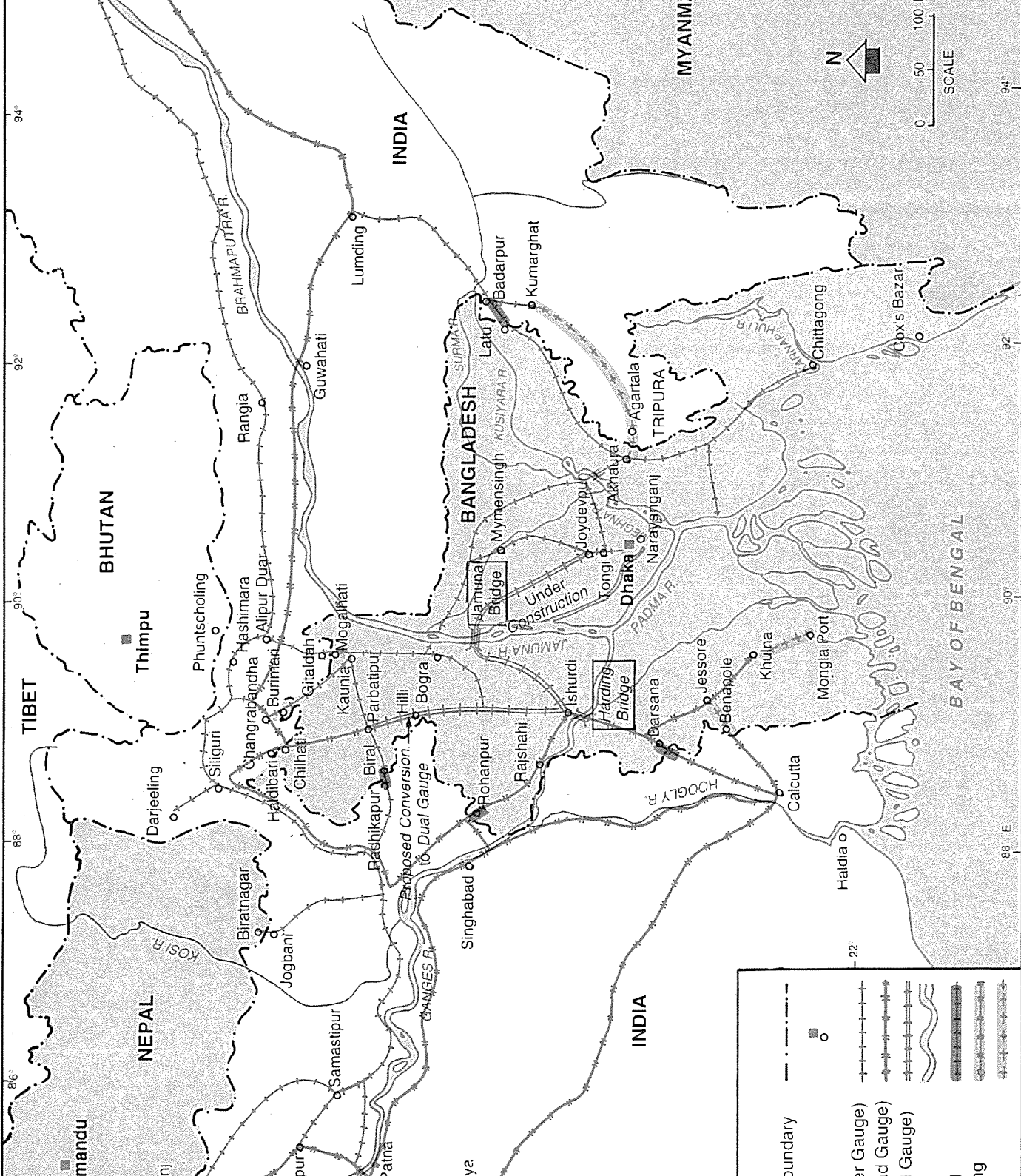
MAP : MAJOR ROAD TRANSPORT ROUTES



	boundary
	Existing/Planned
	Proposed
	Waterway

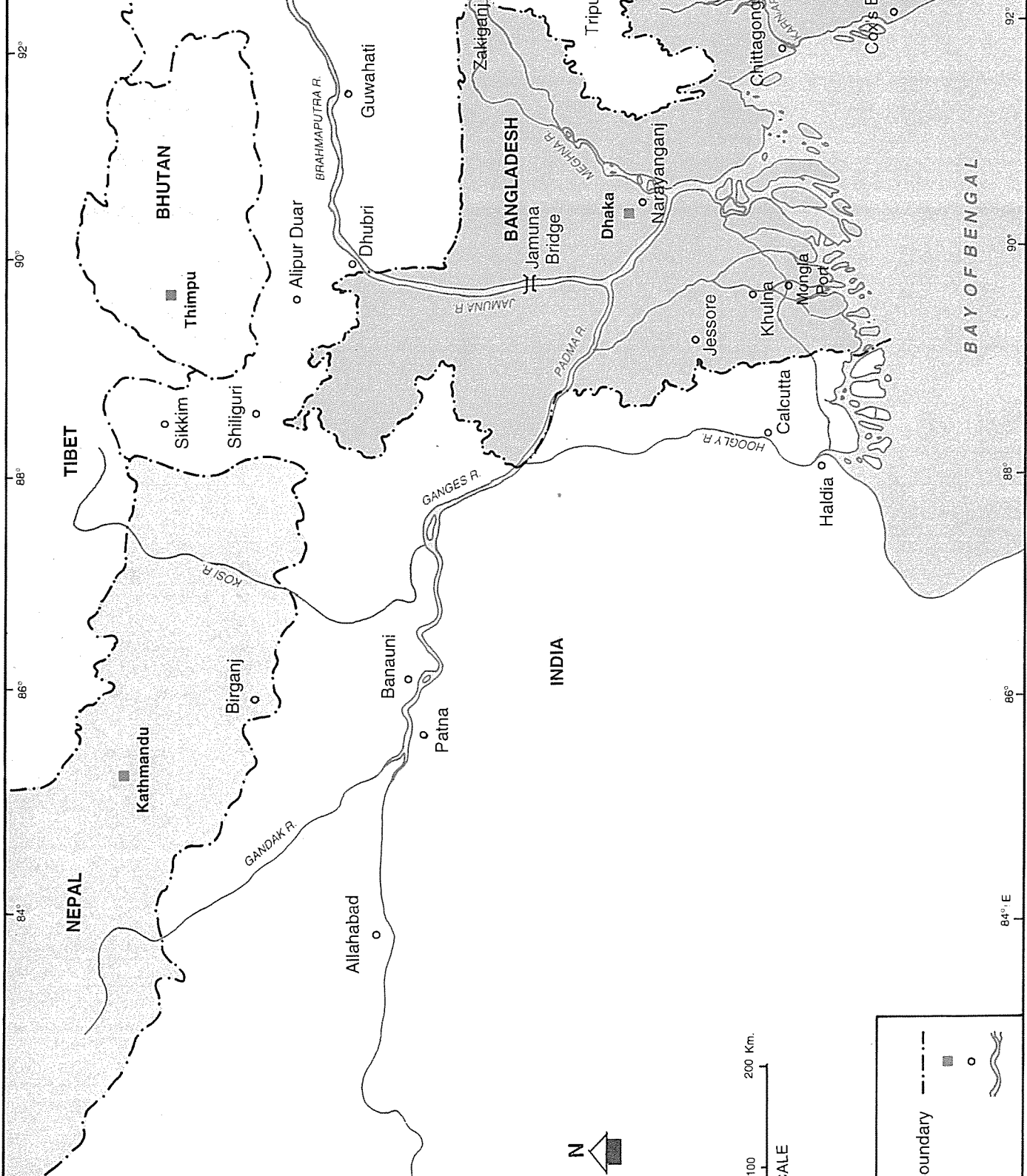
(Not necessarily authoritative)

MAP : MAJOR RAIL TRANSPORT ROUTES

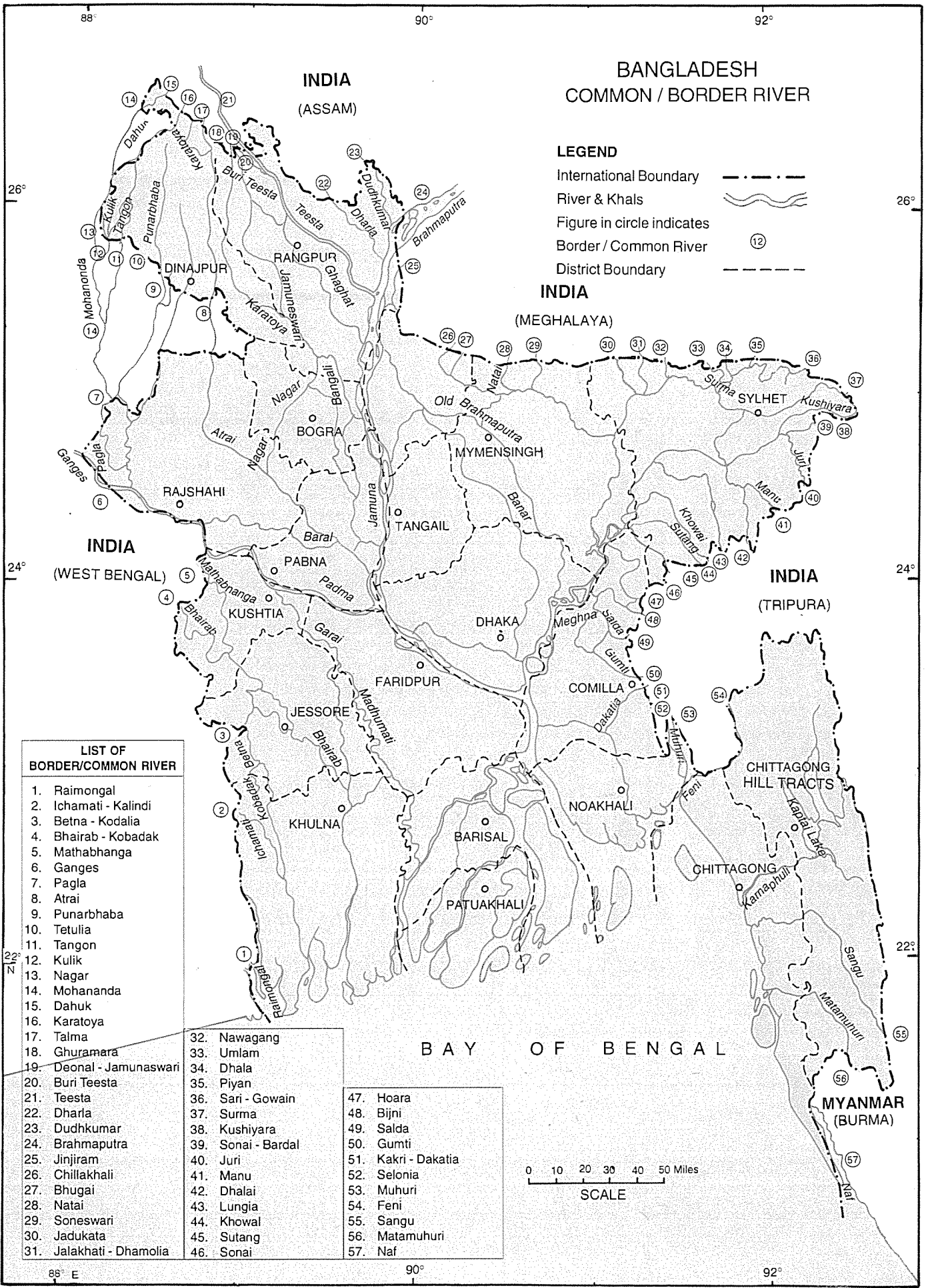


(Slightly authoritative)

MAP : THE GANGES-BRAHMAPUTRA-MEGHNA REGION



Authority authoritative;



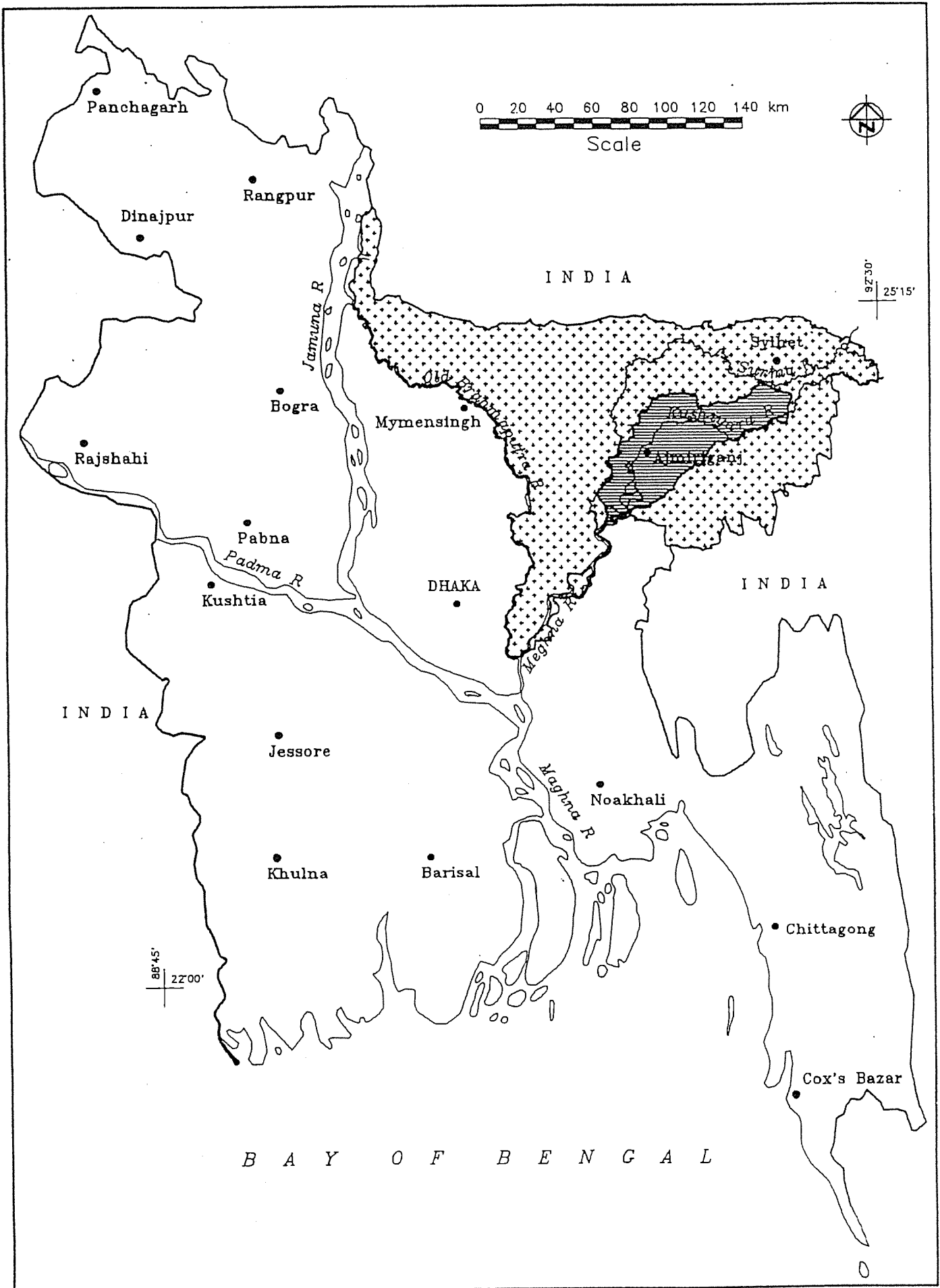
Source : Rasheed, KBS (1994): 55

LIST OF KEY PERSON MET

Name	Position	Organization
Mr. Ahmed, Raguib Uddin	President	Northeast Regional Water Mgnt Proj.
Dr. Engr. Akatsuka, Yuzo	Professor/Dean	Tokyo University
Md. Alam, Shahid	Project Director (Resettlement)	Bangladesh Railway
Mr. M.R. Ali	Chairman	Shippers' Council of Bangladesh
Mr. Aves, J.	Consultant Team Leader	Beca Worley Int'l.
Mr. Bari, Abdul	President	Bangladesh Environment Dev. Org.
Mr. Barua, T.K.	Resittlement Officer	The World Bank, Bangladesh
Mr. Bayes, Abdul	Professor and Chairman (Dept of Economics)	Jahagirnagar University
Mr. Brandon, Carter	Environmental Economist	The World Bank
Mr. Bunschoten, P.	Area Manager, East Asia & Pacific	HAM Dredging and Marine Contractors (Jamuna Bridge Project)
Mr. Cadou, Charly, F.X.	Team Leader, Northeast Regional Project	CIDA
Mr. Chowdhury	Director	QC Container Line Ltd.
Mr. Christensen	Environmental Scientist	GIBB Consulting Engineers
Prof. Dipak, Kanti Das	Mechanical Engineering Dept	Bangladesh Univ. of Eng'g. & Tech.
Mr. Egli, Paul	Engineer-Economist	
Mr. Ellevset, Leif Agnar	Managing Director	World Bank Traffic Safety Consultant
Mr. Fleming, B.J.(Jesz)	Manager, Ports and Harbours	SMEC Consulting
Mr. Finney, Chris	Director	Mott MacDonald
Mr. Foster, Jr	Field Program Manager, Rail II, Program	CIDA Consultant
Mr. Ghani, Abdul	Irrigation Engineer	The World Bank, Bangladesh
Mr. Gillham, Martin	Resident Representative	Motth MacDonald
Mr. Halim Jahangir	Chief of Planning	Mongla Port Authority
Mr. Halim, M.A.	General Manager (Marketing)	Bangladesh Shipping Corp.
Dr. Haque, A.K. Enamul	Associate Professor	Department of Economics
Dr. Haque, Mahfuzul	Senior Assistant Secretary	Min. of Evt & Forest, Bangladesh
Mr. Hossain, Mosharraf	Sr. Social Anthropologist	CIDA

Prof. Howe, John	Dept. Transport Engineering	Delft, Institute of Hydraulics Engineering
Dr. Huda, Shamsul	Secretary	British Council
Capt. Huq, Nurul (Ret)	Former Chief of the Naval Staff	Bangladesh Navy.
Mr. Huq, Saleemul	Executive Director	Bangladesh Centre for Advanced St.
Dr. Hussain, M. Zakir	Head	IUCN, The World Conservaton Union
Mr. Islam, Anwarul	Secretary	Gov't of People's Rep. of Bangladesh
Md. Islam, Nazrul	Joint Secretary (Dev)	Mi. of Water Resources, Bangladesh
Engr. Ali Khan, Meser	Director General, River Research Institute	Min. of Water Resources, Bangladesh
Mr. Khan, Parvez Anwar	Chief Engineer	Bangladesh Inland Water Transport
Mr. Khan, M.A.	Director, Ports & Traffic Dept.	BIWTA
Mr. Kvam, Reidar	Anthropologist	The world Bank
Mr. Laitalainen, Rauno	Community Dev. Adviser, Stage II Leader	Bangladesh Water Dev Board
Mr. Legassick, Roger	Road Safety Eng'g. Advisor	O'Sullivan & Graham
Mr. Leonard. Keith	Natural Resources & Multisectoral Dev Expert	ANZDEC
Mr. Lundebye, Stein	Senior Transport Engineer	The World Bank
Mr. Mahbub, Ali	Water Resources Engr. Northeast Reg. Project	CIDA Consultant
Mr. Mansur, Syed A.	Managing Director	The Ganges Limited
Mr. Matsushima, Masaaki	Dep. Resident Representative	Japan Int'l. Cooperation Agency
Mr. McCarthy	First Secretary Engineering	United Nations Road
Dr. McCauley, David	Sr. Environmental Policy Advisor	International Resources Group
Mr. McCurdy, R.	Contracts Manager	Jamuna Bridge Railway Link Project
Mr. Mobarek, Ismail E.	Principal Port Engr/Maritime Specialist	The World Bank
Mr. Moore, John	Counsellor	Canadian High Commission
Dr. Nishat, Ainun	Professor	Bangladesh Univ of Eng'g. Technology
Mr. Nishizono, K.atshide	Section Chief, Ports & Harbors Bureau	Ministry of Transport, Japan
Mr. Pearce, T.	Vehicle Inspection Specialist, Second Road Rehabilitation & Maintenance Project	DFID Consultant
Mr. Rahman, Nazibor	Managing Director	Rural Mngt Consultants Ltd.

Mr. Rahman M. Fasihur	Secretary	Bangladesh Inland Water T'port Autho.
Mr. Rahman, S.M. Matiur	Secretary General	Shippers' Council of Bangladesh
Mr. Rashid, Haroun Er	Professor	Independent University, Bangladesh
Mr. Md. Rezwanul Haque	Chairman	Chittagong Port Authority
Dr. Rahmatullah, M.	Director, Transport, Communications and tourism Division	United Nations ESCAP, Bangkok
Mr. Rob, Abdur	Minister	Ministry of Shipping, Bangladesh
Dr. Rosenbaun, Kenneth	Environmental Policy Consultant	Washington, USA
Ms. Roxana Ahmed	Deputy Chief	Ministry of Environment and Forest
Mr. Sariatullah	Development Advisor	Canadian High Commission
Mr. Schmuck	Social Anthropologist	Free University Berlin
Mr. Shariff Atiqur Rahman	Chairman	Mongla Port
Mr. Tilus Pertti	Director	NAVIGA Limited
Mr. Weijenberg, Jan	Head, Agriculture & Natural Resources Unit	The World Bank
Mr. Wiebe, H.	Team Leader, Beneficiary Participation and Project Management	Local Government Engineering Dept.
Mr. Wright, Christopher	Senior Shipping Consultant	Acres International Lintied
Dr. Zaman, Mohammad	Anthropologist/Resettlement Specialist	Canada



KALNI-KUSHIYARA PROJECT SCOPE

