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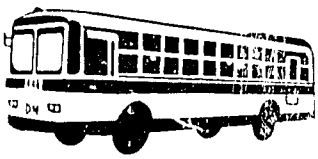

INTERMODAL TRANSPORT STUDY

VOLUME I INTERMODAL ANALYSIS AND TRANSPORT SECTOR PLAN

FINAL REPORT

DECEMBER 1985

PREPARED FOR
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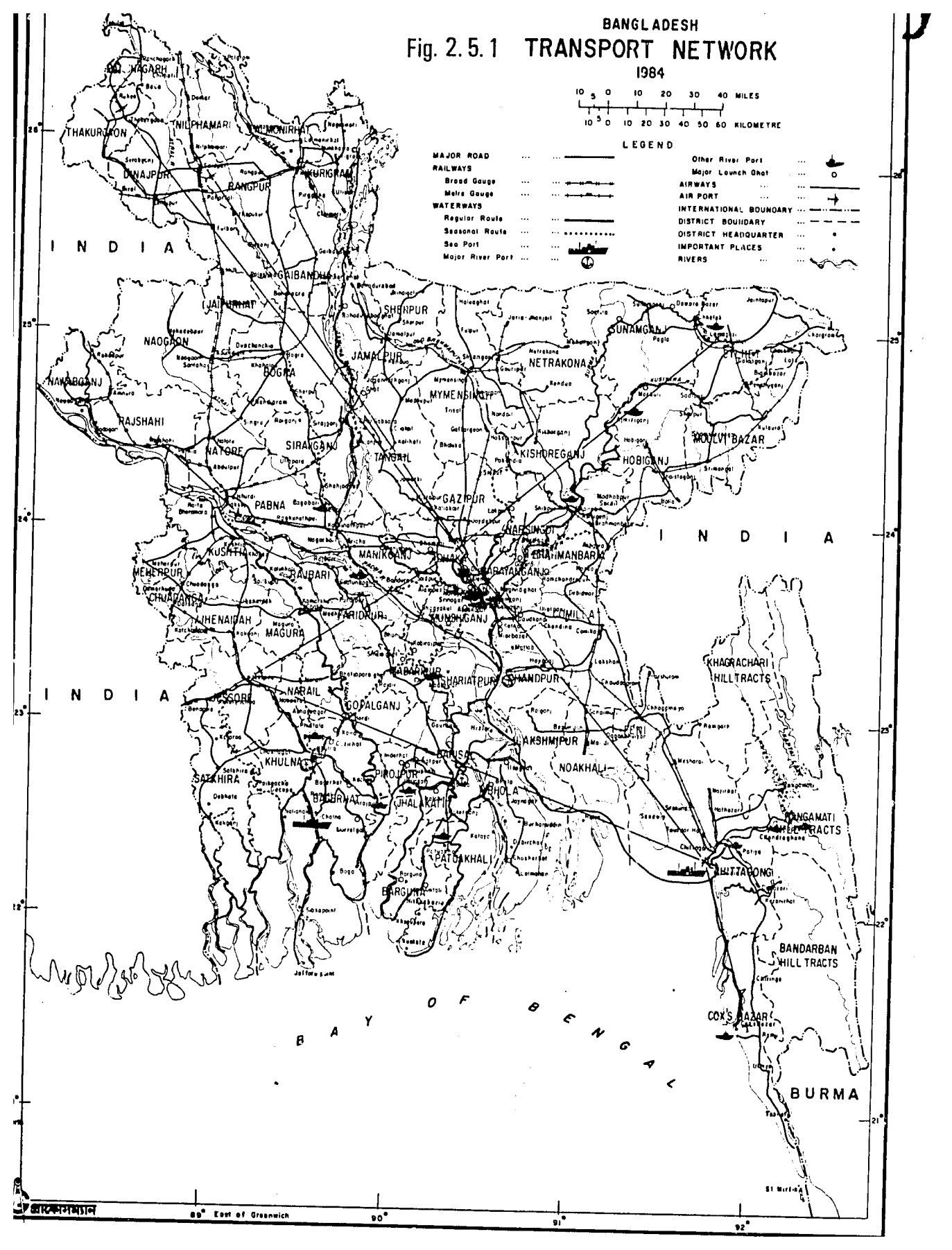
Fig. 2.5.1 TRANSPORT NETWORK

1984



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EXECUTIVE SUMMARY

Study Background

The Government of the People's Republic of Bangladesh recognized the need to study the transport sector as a whole before the formulation of the Third Five Year Plan (TFYP) to facilitate appropriate resource allocation to the transport sector. Technical assistance for the task of carrying out a preparatory study for the Transport Sector of the Third Five Year Plan was provided by the United Nations Development Program with the Asian Development Bank acting as the executing agency.

Study Objectives

The main objective of the Intermodal Transport Study is to assist in the determination of investment requirements for the Third Five Year Plan (1985/86-1989/90) through the provision of a list of prioritized projects based on economic priorities.

The Study is also to recommend policy changes for the desirable development in the transport sector.

General Approach and Methodology

Two interrelated distinct aspects of transport sector planning as specified in the study objectives were differentiated and dealt with as such.

Major study items were; analysis of past trends in the transport sector, assessment of existing situation including field surveys, modal split (distribution of traffic among different modes) analysis, transport demand projections based on macro-economic analysis, assembly and identification of investment project proposals, evaluation of projects and formulation of investment program, and analysis and formulation of recommendations for policy and institutional issues.

Intermodal Analysis

An exhaustive analysis of factors affecting modal choice was made.

The Consultants' user surveys revealed that factors other than the out-of-pocket cost such as travel or transit time is more important to users, particularly those using the road mode, which has been growing the fastest.

Optimum modal split was investigated in terms of the total cost to the naitonal economy including transport operating costs and infrastructure costs of rehabilitation of existing facilities and provision of new facilities.

The inland waterway transport (IWT) mode was found to be the least cost mode for freight and for passengers except in the case of short freight transport. Limiting the share of the IWT mode, optimum combination of the rail mode and the road mode can exist. Generally, however, a higher rail share is less costly to the economy.

Past Trends and Future Projections of Traffic

Past performance and future projection of traffic by each mode are shown below:

Freignt

Year	Rail	Road	IWT	Total
1977	712(23)	1370(44)	1026(33)	3108
1985	748(16)	2460(54)	1381(30)	4589
1990	1087(17)	3111(50)	2097(33)	6295
2000	2465(19)	5270(41)	5230(40)	12965

(in milion ton-km, modal shares in parentheses)

Passengers

Year	Rail	Road	IWT	Total
1977	4874(30)	8380(50)	3412(20)	16666
1985	8428(28)	15460(51)	6203(21)	30091
1990	10055(24)	22905(54)	9328(22)	42288
2000	14812(17)	49959(57)	22489(26)	87260

(in million passenger-km, modal shares in parenthesis)

Major movements in the future will be concentrated in the southern corridors of Chittagong-Dhaka-Khulna. At present unknown but potentially important factor is the industrial and mining development in the north-west.

It needs mentioning that the stagnation of railway transport and the fast growth of road transport in particular in freight transport in the past has been costly to the country in terms of the resource cost. Accelerated growth of railway transport and IWT should be and can be achieved through better management for both and some accompanying investments for IWT. This would result in a slower growth of road transport.

Sector Strategies and Recommended Actions for TFYP

Based on the assessment of existing conditions and desirable future, strategies for transport sector development and recommended actions for each mode have been determined as follows.

Strategies of Transport Sector

101. Rehabilitation and maintenance of existing assets rather than construction or aquisition of new assets to correct existing situation of low utilization of assets.

102. Managerial and operational improvement of transport operators to achieve higher asset utilization and better service quality.

103. Gradual phasing out of public sector operations providing transport services for which the private sector can operate with reasonable return.

104. Rationalization (i.e. selective increase and simplification) of fare, rate and tariff structures to reflect real costs of providing transport services to achieve optimum intersectoral as well as intermodal resource allocation.

105. Establishment of better performance monitoring systems for all modes of transport in order to achieve higher managerial efficiency in operation and planning.

106. Implementation of taxation and credit policies which encourage the better use of existing assets by for example reduced duties on spare parts and the growth of the private sector operators by easier credit.

Actions for Railway Sub-Sector

201. Improvement in rolling stock utilization by means of better operation and beter maintenance.

202. Rehabilitation of existing infrastructure to restore the capacity.

203. Restructuring of management and operational practices toward market-oreinted and market-responsive ones so that potentials of the railway sub-sector can be realized vis-a-vis other competing modes. This would require organizational restructuring at all levels of management with re-defined responsibilities and overhauling of types and levels of services.

204. Implementation of a firm program to eradicate fraud such as ticket-less travel, waste and abuse of railway property.

205. Upward revision of passenger fares and freight rates to reduce government subsidy and subsequent distortion in transport demand market. Passenger fares have to be increased by 100%-200% and freight rates by 20% to become financially self-sufficient under the current conditions. Actual increase should be done in steps while considering the improvement in performance.

206. Improvement in railway operation functions which have direct effects on productivity, such as signalling, communication, and track safety.

207. Involvement of private sector in selected railway manufacturing operations.

208. Upgrading of management information system.

Actions for Road and Road Transport Sub-Sector

301. Rehabilitation and upgrading of arterial national highways which carry substantial long-distance through-traffic. This indicates that highway sections forming a part of the national "H" shaped trunk road network should be given priority.

302. Reconstruction of war-damaged bridges and narrow bridges located within the above trunk road network should be given priority.

303. Gradual and selective phasing out or privatigation of the operations of the Bangladesh Road Transport Corporation.

304. Improvement of major ferry services particularly those forming parts of the trunk road network.

305. Increase (20%-40%) in bus fares to ensure that operators' revenue is sufficient for improving roadworthiness and safety of the bus fleet. Major increase (35%-45%) in freight rates through administrative guidance so that truckers can avoid economically damaging overloading.

306. Establishment of systematic data collection and evaluation systems for infrastructure, vehicle fleet, and traffic.

307. Allocation of development fund to a fewer number of projects to improve the efficiency of implementation.

Actions for Ports and Waterway Transport Sub-Sector

401. Increased share of the IWT sub-sector in the total budget allocation to the transport sector so that the return on the total investment in the transport sector can be increased.

402. Improvement in cargo handling and in vessel repair facilities to increase vessel productivity.

403. Implementation of systematic dredging and river training programs to secure economically viable waterways.

404. Provision of navigational aids and better training of pilots to ensure safety and shorter vessel turn round.

405. Provision of berthing and landing facilities at selected locaitons to ensure better service, shorter vessel turn round, and higher productivity. Planning and implementation of items 404, 405, and 406 should take into account the changing demand pattern and the expanded role of this sub-sector.

406. Periodic review of fares and freight rates to ensure the healthy growth of the waterway transport industry.

407. Gradual phasing out of BIWTC operations except for the maintenance of a minimum fleet and selected unprofitable routes which are considered of national interest.

408. Provision of incentives to private operators to modernize and to raise the efficiency of their operation.

409. Thorough review of the functions of the Chalna Port to determine its future considering the possible shift of cargo from Chittagong.

410. Establishment of reliable data collection system to ensure proper planning.

TRANSPORT SECTOR INVESTMENT PLAN 1986-1990

Subsector	Agency	Subject			Plan Allocation Million Tk.
Rail	BR		Total		6,000
		• System improvement and rehabilitation		30%	
		• Meter gauge rehabilitation		13%	
		• Workshop for diesel locomotive		21%	
		• Loco. carriage purchase		23%	
Road	RHD		Total		8,550
		• Upgrading of natonal highways		69%	
		• War damaged bridges and narrow bridges, Meghna bridge		14%	
		• Other roads		13%	
	BRTC		Total		250
		• Partial replacement of fleet			
IWT	BIWTA		Total		3,448
		• Dredging		37%	
		• Infrastructure		12%	
		• Workshop, navigation aids river work, vessels		22%	
	BIWTC		Total		482
		• Ferry fleet expansion and vessel replacement			
Port	PCA (Chalna)		Total		1,075
		• Permanent port (partial)		68%	
		• Cargo handling equipment		13%	
		• Other		19%	
	CPA	Total (excluding multi-purpose berths)			3,827(1,265)
		• Two multi-purpose berths		67%	
		• Procurement of dredger		13%	
		• Procurement of vessels		6%	
		Total (excluding multi-purpose berths)			21,070

CHAPTER 1

INTRODUCTION

1.1 Background and Objectives

1.1.1 Study Background

The Government of the People's Republic of Bangladesh recognized the need to study the transport sector as a whole before the formulation of the Third Five Year Plan to facilitate appropriate resource allocation to the transport sector. Technical assistance for the task of carrying out a preparatory study for the Transport Sector of the Third Five Year Plan was provided by the United Nations Development Program with the Asian Development Bank acting as the executing agency. Pacific Consultants International of Japan in association with PADECO Co., Ltd. of Japan and Development Design Consultants Ltd. of Bangladesh were contracted to provide consulting services for the study.

The Study commenced in the middle of October, 1984. Draft Final Report was presented in the beginning of July 1985. This report presents findings and recommendations of the Study prepared by the Consultants incorporating comments made by the Government and other concerned agencies.

Acknowledgement

In undertaking this study the Consultants received excellent cooperation and assistance from various government officials. In particular the Consultants are grateful to Mr. Ahmed Farid, Secretary, Dr. A.H. Shaidat Ullah, Member, Mr. Nural Haq, Division Chief, Mr. M.H. Chowdhury, Joint Chief, Mr. A Mannan Talukder, Joint Chief, Mr. Abdul Fattah, Joint Chief, Mr. Md. Altamas Hossain, Deputy Chief, Transport Survey Wing, Mr. Sk. Abdul Malek, Assistant Chief, Transport Survey Wing, of the Planning Commission for their guidance and assistance throughout the study. Many other officials of government and private organizations provided valuable information and insights. The Consultants deeply appreciate their kind cooperation. The Consultants also acknowledge that their macro-economic analysis in this study drew heavily on those prepared in preceeding or concurrent studies for TFYP.

1.1.2 Study Objectives

The main objective of the Intermodal Transport Study is to assist in the determination of investment requirements for the Third Five Year Plan (1985/86-1989/90) through the provision of a list of prioritized projects based on economic priorities. Specific objectives are to:

(1) assist the Government in the foumulation of a coordinated transport sector plan for the Third Five Year Plan (1985/86-1989/90) and to outline in broad terms a perspective plan for the following five years;

(2) identify priorities both intermodally and spatially in the foumulation of a strategy for balanced regional development, taking into consideration the effect of the thrust for rural development and administrative decentralization;

(3) prepare a program of transport investments of national importance based on economic priorities and to identify specific areas of potential investment where further feasibility or pre-investment studies may be required; and

(4) recommend policy changes where existing policies are identified as constraints on efficient allocation and utilization of resources in the transport sector.

1.2 General Approach and Methodology

1.2.1 General Approach

Two interrelated but distinct aspects of transport sector planning should be recognized. They are:

- the identification and the prioritization of transport infrastructure improvement projects and the subsequent formulation of investment programs;

  and,

- the identification and the prioritization of needed policy changes and other institutional improvements.

Both require the identification of various factors affecting the performance of the transport sector, determination of characteristics of each factor, and understanding of interrelationships among them.

It was found in the early stage of the study that the data base, both existing and collectable within the time frame of the Study, was insufficient to support the adoption of a rigorous systems analysis type approach. First, socio-economic data and traffic data for each district were not available to the extent that would make the traffic demand projections by district possible. Secondly, the data from which performance characteristics can be derived were insufficient for determining the relationship between the performance and the loading characteristics.

It was therefore decided to adopt an approach that would allow more flexibility where data are insufficient. The approach basically follows the formal process of transport planning of macro-economic analysis, regional growth assessment, modal split analysis, and modal link loading condition estimations. Evaluation of various proposed and possible projects were made taking into account quantifiable economic benefits and costs wherever possible and other hard-to-quantify factors which were assessed by means of scoring systems.

1.2.2 Methodology

Figure 1.1.1 illustrates the flow of work carried out in this Study. The following briefly describes each of the work items indicated in Figure 1.1.1. Paragraph numbers correspond with numbers shown in the Figure.

(1) Survey and Assessment of Existing Transport Facilities and Operations.

An Inventory of existing infrastructure and facilities of the road, rail, and waterway transport was developed from various sources and their present conditions were evaluated by visual inspection as far as possible. Assessment of the current operation of each mode of transport was carried out by deriving performance measures and critical observation of current practices. Chapters 8-11 describe the results.

(2) Analysis of Past Transport Development

Reports of past studies and other existing data were assembled and the development and changes in the recent past in the transport sector were analyzed for each mode in terms of infrastructure and performance. The results are presented in chapters 8-11.

(3) Traffic Surveys and Other Data Collection

At the outset of the Study it was found that the paucity of actually measured traffic data has long been a serious problem for all modes. A number of sample traffic surveys were conducted for all modes to establish a reference data base. Road side interviews and weight measurements of road traffic, on-board passenger surveys of rail passengers, passenger counts of waterway passenger on-board and at landing, etc. were carried out. Information on traffic was also assembled from relevant agencies. Details of surveys and the results are shown in Chapters 8-11.

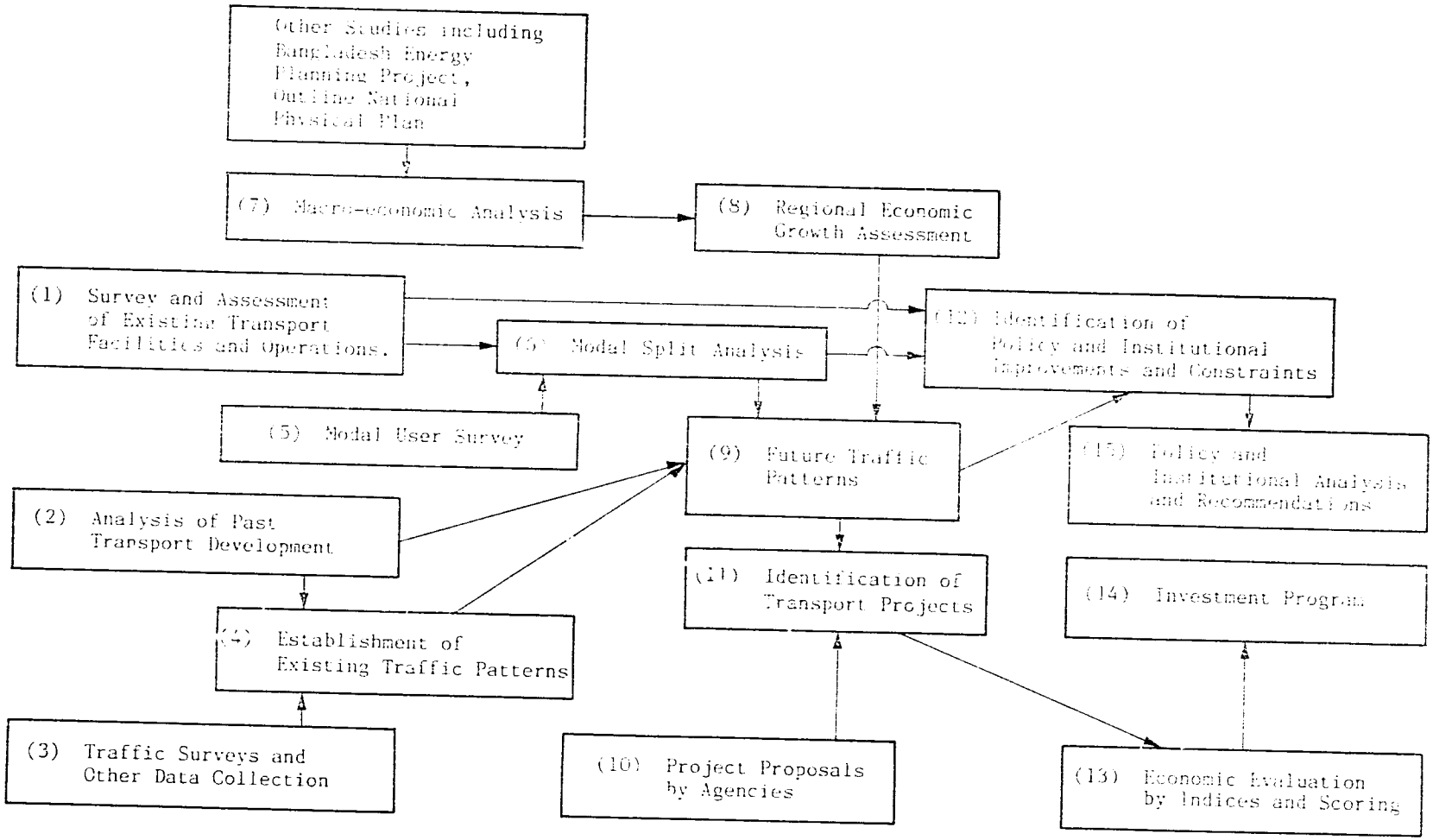

FIGURE 1.1.1 STUDY FLOW CHART

(4) Establishment of Existing Traffic Patterns

Existing traffic patterns of each of the three modes were established by synthesizing the results of items (2) and (3). Global figures such as total passenger-kilometers and the total ton-kilometers of freight were estimated for each mode. Chapters 3, 8-11 present the results.

(5) Modal User Survey

A series of surveys were carried out to find out how users of each mode perceive the services offered by each mode and why they made decisions in choosing particular modes. Passengers of railway, buses and launches were interviewed and freight shippers were surveyed. In chapters 8-10 the survey details and the results are shown. A summary is shown in Chapter 3.

(6) Modal Split Analysis

Analysis was made concerning the shares of each mode in transporting passengers and commodities. Existing modal shares were established and historical trends delineated. The results of the user survey and the assessment of existing transport operating conditions were examined against the exsiting modal split. Likely changes in the future were analyzed. Discussions and results are given in Chapter 3.

(7) Macro-economic Analysis

Changes in the national economy were analyzed and macro-economic projections were made in order to give a general framework for the transport sector planning. The relationship between the transport demand growth and the growth in the national economy was established. Thus macro-transport demand projections were made. The methods and the results are shown in Chapters 2 and 4.

(8) Regional Economic Growth Assessment

District by district GDP and their growth patterns were established. In addition changes in food grain import/export requirements were estimated district by district. Freight and passenger transport demand estimates were made on the basis of the above. Analysis and results are shown in Chapter 2 and Chapter 4.

For steps (7) and (8) concurrent economic studies for the preparation of the Third Five Year Plan were referred and their output were integrated in this study.

(9) Future Traffic Patterns

The existing traffic patterns were modified to yield future traffic patterns taking into account the growth estimates and the likely future modal split. Traffic projections are presented in Chapter 4.

(10) Project Proposals by Agencies

Projects being proposed by various transport agencies to be included in the Third Five Year Plan or in the plans beyond were collected and an exhaustive list was prepared for each mode. They are shown at the end of Chapters 8-11 and in Chapter 6.

(11) Identification of Transport Projects

In addition to the projects identified above, other projects which were found by the Consultants to be promising in light of the projected future traffic patterns and the analysis of existing operational conditions were added to the above list. These projects are presented in Chapters 6-11.

(12) Identification of Policy and Institutional Improvements and Constraints

Based on the analysis of the existing situation and the likely future changes, aspects of the transport sector where changes in policy or institutional improvements are expected to incur substantial increases in the overall efficiency of the sector are identified. At the same time constraints which are likely to limit the range of future changes in the sector were also identified. These points are described in detail in Chapter 5 and in Chapters 8-11.

(13) Economic Evaluation by Indices and Scoring

The projects identified in the (11) above were evaluated regardless of whether they are on-going or new. The projects were divided into two, those for which meaningful quantification of benefits was possible and those for which it was not possible. A set of criteria for evaluating projects were developed for each mode, one of the most important being the Economic Internal Rate of Return (EIRR). Each project was evaluated against each of the criterion in terms of scoring points. Projects were then ranked in accordance with the weighted total points. Ranking of projects was done separately for each of the three modes.

6

(14) Investment Program

An analysis of transport budget allocation was made comparing with the modal performance. A realistic scenario with the margin of changes was formulated for the TFYP and plans beyond. Target budget allocations for each mode were thus determined. Investment programs for each mode for the TFYP period were formulated by basically distributing the projects in accordance wth the priority ranking as determined in (13) above.

(15) Policy and Institutional Analysis

Suggestions on policy and institutional changes were made as a result of the work in (12) above. Not all suggestions show desirable directions in a concrete manner. Some suggestions are intended more to draw attention in particular aspects so that preparations may be initiated for future planning and operational purposes.

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CHAPTER 2

THE NATION AND ITS ECONOMY

2.1 The Nation

2.1.1 Historical Background

The nation of Bangladesh came into being in December 1971 after a nine month war of liberation which was notable for the severity of human loss of life and physical destruction. About 300 railway bridges and 270 road bridges were damaged and rivers, sea and river ports blocked by sunken vessels and debris. There was also considerable damage to rolling stock and facilities for all modes of transport.

Thus the newly independent nation, not only inherited an economy that had stagnated due to under-investment, it also had the problem of restoring its war damaged assests as its first priority. These difficulties, coupled with the world-wide recession and a substantial proportion of resources being used to secure the basic human needs have limited the economic development that could be possible in the fourteen years of Independence, despite substantial foreign assistance. Bangladesh thus remains one of the least developed countries of the world.

An unusal feature of the country is the high degree of homogenity among its cultures and peoples. Although there are people of Indian and Tribals groups, the vast majority (some 98%) have Bangla as their mother tongue and about 86% are Muslims.

The country is predominantly rural, with some 85% of the population dependent on agriculture, the vast majority being subsistence farmers and landless. Some 47% of GDP comes from agriculture. It is estimated that about 80% of the population are living below the poverty line. This results in malnutrition, high infant mortality rates and low productivity.

Life expectancy is one of the lowest in the world, although the improvement in recent years is one of the causes of the accelerating population growth rate because fertility rates have not decreased correspondingly.

The effect of an improverished and increasing rural population has been a rise in the number of the landless. This in turn has resulted in an increasing rural labour force, causing real wages to decrease and a corresponding decrease in the average calories consumed daily. It is now estimated that 60% of the rural population receive less than 85% of the considered minimum level of daily calory intake.

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Jute has been the main exportable product of Bangladesh. Its production, however, has been stagnating under depressed market due to competition with synthetic materials. Progress has been made in food grain production in recent years, giving a hope that the self-sufficiency in food grain supply could be achieved in not too distant future.

High unemployment and underemployment, accentuated by the increasing rate of urbanization have left Bangladesh with social and economic problems that are going to be part of the development scenario well beyond the year 2000. Because of a severe lack of natural resources (apart from gas) the country has had to depend on external help for financing its import requirements as well as for its development programme. This is also likely to be the case for the next 15 years, although it is expected that some of the development assistance already received will begin to show benefits.

The development of Bangladesh has been affected by the international framework in which it operates and the extent to which the richer nations have been prepared to provide assistance. This makes it particularly difficult for the Government to plan with confidence due to the uncertainties surrounding the support from foreign aid.

The legacy of the past history of under-investment and natural and man made disasters will continue to influence the scale and direction of economic development for many years to come.

2.1.2 Geographical Features

Bangladesh is predominantly a deltaic region bounded in the north and west by India, in the east by Burma and India and in the south by the Bay of Bengal. The delta is formed by 3 rivers - the Brahamaputra-Jamuna, the Padma (Ganges) and the Meghna. The alluvial plain formed by these rivers covers most of the country with over half being below the 8 m contour line. The northwest is slightly higher, being typically 10 - 30 metres above sea level whilst in the south-east, the Chittagong Hill Tracts rise to a height of over 1200 m. There are two main areas of upland - the Madhupur tract, between Dhaka and Mymensingh (10 - 20 m) and the Barind tract, mainly in Rajshahi district (upto 40 m). In addition there are several isolated areas of hills, rising to 30 m.

The area of the country is 143,000 sq. km gross, but rivers account for 5-6% of the gross land area leaving 135,000 sq. km of actural land area. About 15% of the land is forest with the main areas being the sunderbans in the south west, the Chittagong Hill Tracts and the Madhupur Tract. Bangladesh's per capita consumption of wood is one of the lowest in the world, yet such is the pressure of the vast rural population that the timber resources are being fast depleted.

The river systems basically flow in a north to south direction, with the country being divided into two areas by the mighty Jamuna. Because of this transport communications from east to west are constrained and road and railways extremely costly to build, because of the presence of a large number of natural waterways and the deltaic nature of the land.

The climate of Bangladesh is governed by the monsoon season. The heavy rainfall (up to 2.5 m annually) falls mainly in the monsoon period, June-October. There is also the heavy runoff of the major rivers from melting snow in the Himalayas. Because of the deltaic nature there are serious flooding over large areas of the country. The dry season from November to February is cool, compared to the March-May period before the commencement of the monsoon.

The flooding caused by the monsoon requires roads and railways to be built on embankments, typically at least 2 m above the land. Unfortunately construction materials are in short supply, particularly stones and gravel whatever is available located in the northeast. The soil is generally highly silty and due to its grain size distribution is not amenable to high consolidation or stability. Although, historically, transport has been predominantly by waterways, water diversion for irrigation in India and in Bangladesh has reduced the dry season flows with a twofold effect. Lower water levels have been combined with increased siltation due to the lower volume and hence velocity of flow. Thus there has been a reduction in the length of dry season navigable rivers in recent years.

The effects of climate and topography have thus contributed to the problems faced by Bangladesh. Unfortunately, these are obstacles that cannot be altered and in fact, could pose greater problems as the pressure for land increases with increasing population.

2.2 Population

2.2.1 Existing Population

The population of Bangladesh has trebled during this century, with the most dramatic increases occuring in the last thirty years resulting in a doubling of the population. In 1981, the census estimated that there were 89.9 million people. The population density of 630 people per square kilometre, makes Bangladesh one of the most densely populated countries in the world.

The reason for the rapid increase in population has been a decrease in the death rate whilst the crude birth rate has remained high. Consequently the average annual growth rate increased to the current level of 2.4% from about 1.7% during 1940s.

The past data of population, density and average annual growth rate are given in Table 2.2.1

Table 2.2.1 Population of Bangladesh 1901 - 1981

Year	Population (million)	Density per sq. km. (net of rivers)	Annual average growth rate (% p.a)
1901	28.9	215	-
1911	31.6	235	0.90
1921	33.3	247	0.53
1931	35.6	265	0.67
1941	42.0	312	1.67
1951	44.2	328	0.51 1/
1961	55.2	410	2.25
1974	76.4	568	2.53
1981	89.9	668	2.35

Note: 1/ Due to emmigration to India.

Source: BBS 1983-84

The size of the labour force depends on the population of working age and participation rates. The data for the last 3 censuses appears to be misleading, however, as it shows that despite an increase in the percentage of the population of working age, there was a decrease in the percentage of those working or seeking it, See Table 2.2.2.

Table 2.2.2 Labour Force 1961 - 1981

Year	Labour Force (million)	Population >10 as % total population	Labour force as % total population	Labour force as % population >10
1961	18.9	62.9	34.3	54.4
1974	21.9	64.8	28.7	44.3
1981	24.3	66.8	27.1	40.5

Source: BBS (1984)

It would appear that the percentages for the labour force in the 1981 census are an underestimate, particularly as the labour force a percentage of the population over 10 years of age declined. It is difficult to define the labour force in a society primarily engaged in subsistence farming. The percentage of population who are able to conduct productive work would have been more stable than indicated by the census statistics.

2.2.2 Existing Regional Population Distribution

In Table 2.2.3 the 1981 population is shown distributed over the 20 districts used in the census, as well as the density and labour force estimates. It can be seen that the population density varies considerably at the extremes between Chittagong Hill Tracts 59 persons per square kilometre to Dhaka with 1491 persons per square kilometre. Despite these extremes though, there is much less variation between the rest of the districts.

2.2.3 Future Population Scenarios and Projections

There have been a number of population projections made by several agencies for Bangladesh upto 2000. Their results vary widely because of different assumptions on fertility and mortality rates. The Out-line National Physical Plan (ONPP) considered the range of assumption that had been used and made its own conclusions for projections. A range of outcomes was considered and three preferred scenarios were chosen, giving a low, middle and high projection for the population growth upto 2000. The assumption and resulting population forecasts are shown in Table 2.2.4. The middle scenario was taken by the ONPP as their prefered projection, and is the basis for this study.

Table 2.2.3 Regional Population Population Distribution 1981

District	No.	1981 Population (Thousands)	Density per sq.km.	1981 Labour Force Thousands	% Pop.
Chittagon	1	5714	870	1644	28.8
Ctg. Hill Tracts	2	781	59	242	31.0
Comilla	3	7079	1112	1821	25.7
Noakhali	4	3933	988	965	24.5
Sylhet	5	5820	475	1605	27.6
Dhaka	6	10457	1491	3090	29.6
Faridpur	7	4880	772	1289	26.4
Jamalpur	8	2552	769	666	26.1
Mymensingh	9	6764	710	1826	27.0
Tangail	10	2512	766	667	26.5
Barisal	11	4808	863	1290	26.8
Jessore	12	4144	631	1099	26.5
Khulna	13	4485	431	1261	28.1
Kushtia	14	2366	698	620	26.2
Patuakhali	15	1897	534	496	26.1
Bogra	16	2806	740	757	27.0
Dinajpur	17	3293	491	893	27.1
Pabna	18	3530	787	919	26.0
Rajshahi	19	5428	582	1465	27.0
Rangpur	20	6707	740	1766	26.3
Bangladesh		89926	668	24381	27.1

Area net of rivers

Source BBS (1984); Outline National Physical (1985)

Table 2.2.4 ONPP Population Scenarios and Projections

Scenario	Assumptions		Population(Millions)	
	Fertility	Life Expectancy	1990	2000
Low	5.6 down to 3.8	Constant 48 years	109.095	131.220
Medium	6.0 down to 4.8	50 years to 56 years	113.304	147.147
High	Constant 6.3	51 years to 60 years	116.849	164.105

Source: ONPP Preliminary Report 1985

2.2.4 Future Regional Population Distribution

Although fertility and mortality rates are assumed to be constant across the country, the natural growth rates of the districts will vary because of different age structure. Further there has been some migration with nine districts showing net inward and eleven net outward migration in the period 1974 - 81. This trend is expected to continue upto 2000, despite changes in investment and decentralization policies. These might have some effect, but as the migration effect is relatively small (less than 10% of total district population for the majority of the districts), it is assumed that the current trends will continue.

The net in-migration districts, apart from Dhaka, Chittagong and Chittagong Hill Tracts, lie predominantly on the western side of Bangladesh. The projected trend population and growth rates for the districts are given in Table 2.2.5, using the ONPP medium projection.

The effect of these growth rates means an increase in population density, with the average density over the country in 2000 being higher than all but two of the districts in 1981, at a level of 1093 persons per square kilometre. The district distributions of population density for 1985 to 2000 are given in Table 2.2.6.

The distribution of the future labour force has been made for each district, using the ONPP medium scenario for population. For the male participation rates, a slight decrease was assumed in the age range upto 1[illegible] and over 65, otherwise the existing rates were assumed to remain constant upto 2000. Some increase in female participation rates was assumed. The national average participation rates were assumed constant in all districts for a given age band. There would thus be some variation in the labour force as percentage of the population depending on the age structure and the sex ratio. The projected labour force by district upto 2000 is shown in Table 2.2.7. Projections made by other agencies are somewhat higher than these, partly due to assumptions about higher female participation rates.

Table 2.2.5 Future Regional Population Distribution 1981 - 2000

District	No.	1981 (Thousands	1985 (Thousands	G.R. % p.a.	1990 (Thousands	G.R. % p.a.	1995 (Thousands	G.R. % p.a.	2000 (Thousands	G.R. % p.a.
Chittagong	1	5712	6454	3.10	7537	3.15	8786	3.11	10204	3.04
Ctg. Hill Tracts	2	779	1061	8.03	1521	7.47	2156	7.23	2989	6.75
Comilla	3	7080	7603	1.80	8327	1.84	9146	1.89	10105	2.01
Noakhali	4	3929	4192	1.63	4556	1.68	4960	1.71	5417	1.78
Sylhet	5	5818	6287	1.96	6877	1.81	7485	1.71	8065	1.50
Dhaka	6	10455	12382	4.32	15241	4.24	18713	4.19	22865	4.09
Faridpur	7	4879	5129	1.26	5479	1.33	5865	1.37	6309	1.46
Jamalpur	8	2524	2741	2.08	3041	2.10	3377	2.12	3757	2.16
Mymensingh	9	6765	7328	2.02	8107	2.04	8975	2.06	9947	2.08
Tangail	10	2514	2701	1.81	2996	2.09	3327	2.12	3704	2.17
Barisal	11	4810	5133	1.54	5538	1.53	5959	1.48	6378	1.37
Jessore	12	4142	4587	2.58	5262	2.78	6031	2.77	6901	2.73
Khulna	13	4486	4931	2.39	5560	2.43	6249	2.36	6978	2.23
Kushtia	14	2367	2638	2.75	3051	2.95	3526	2.94	4067	2.90
Patuakhali	15	1896	2081	2.35	2296	1.99	2511	1.81	2700	1.46
Bogra	16	2805	3156	2.99	3669	3.06	4266	3.06	4961	3.06
Dinajpur	17	3293	3764	3.40	4429	3.31	5203	3.27	6091	3.20
Pabna	18	3531	3933	2.73	4550	2.96	5281	3.02	6171	3.16
Rajshahi	19	5427	6075	2.86	7006	2.89	8034	2.78	9105	2.53
Rangpur	20	6708	7353	2.32	8261	2.36	9285	2.36	10437	2.37
Bangladesh		89920	99529	2.57	113304	2.63	129135	2.65	147147	2.65

[1] Interpolated by Consultants

Source: ONPP (1985)

Table 2.2.6 Future Regional Population Densities, 1981 - 2000

District	No.	Population Density Per Square Kilometer				
		1981	1985	1990	1995[2]	2000
Chittagong	1	870	996	1147	1338	1554
Ctg. Hill Tracts	2	59	80	115	164	227
Comilla	3	1112	1194	1307	1436	1587
Noakhali	4	989	1055	1147	1248	1363
Sylhet	5	475	513	561	611	658
Dhaka	6	1489	1763	2171	2665	3256
Faridpur	7	768	808	863	924	993
Jamalpur	8	769	835	926	1028	1144
Mymensingh	9	710	769	851	942	1044
Tangail	10	766	823	913	1014	1129
Barisal	11	864	922	995	1070	1145
Jessore	12	630	698	801	918	1050
Khulna	13	431	473	534	600	670
Kushtia	14	700	780	902	1042	1202
Patuakhali	15	534	586	646	707	760
Bogra	16	739	832	967	1124	1307
Dinajpur	17	491	561	660	775	908
Pabna	18	788	877	1015	1178	1376
Rajshahi	19	582	652	751	862	977
Rangpur	20	740	811	912	1025	1152
Bangladesh		668	739	841	959	1093

1 Area is net of rivers 2 Interpolated

Source: ONPP (1985) and Consultants

Table 2.2.7 Future Regional Labour Force Distribution 1981 - 2000

District	No.	Labour Force 1981 Thousands	1981 % pop	1985 Thousands	1985 % pop	1990 Thousands	1990 % pop	1995 Thousands	1995 % pop	2000 Thousands	2000 % pop
Chittagong	1	1644	28.8	1877	29.1	2189	29.0	2566	29.2	2995	29.4
Ctg. Hill Tracts	2	242	31.0	341	32.1	506	33.3	756	35.1	1100	36.8
Comilla	3	1821	25.7	1898	25.0	2043	24.5	2222	24.3	2450	24.2
Noakhali	4	965	24.5	997	23.8	1065	23.4	1200	24.2	1254	23.1
Sylhet	5	1605	27.6	1729	27.5	1925	28.0	2148	28.7	2365	29.3
Dhaka	6	3090	29.6	3789	30.6	4755	31.2	5969	31.9	7478	32.7
Faridpur	7	1289	26.4	1334	26.0	1422	26.0	1519	25.9	1623	25.7
Jamalpur	8	666	26.1	722	26.3	810	26.6	919	27.2	1043	27.8
Mymensingh	9	1826	27.0	1991	27.2	2242	27.7	2531	28.2	2867	28.8
Tangail	10	667	26.5	728	27.0	819	27.3	922	27.7	1041	28.1
Barisal	11	1290	26.8	1399	27.3	1563	28.2	1740	29.2	1930	30.3
Jessore	12	1099	26.5	1291	28.1	1584	30.1	1906	31.6	2281	33.1
Khulna	13	1261	28.1	1431	29.0	1655	29.8	1900	30.4	2165	31.0
Kushtia	14	620	26.2	731	27.7	893	29.3	1068	30.3	1274	31.3
Patuakhali	15	496	26.1	543	26.1	618	26.9	708	28.2	796	29.5
Bogra	16	757	27.0	906	28.7	1143	31.2	1446	33.9	1818	36.6
Dinajpur	17	893	27.1	1024	27.2	1234	27.9	1498	28.8	1806	29.7
Pabna	18	919	26.0	1064	27.1	1286	28.3	1537	29.1	1854	30.0
Rajshahi	19	1465	27.0	1739	28.6	2154	30.7	2595	32.3	3092	34.0
Rangpur	20	1766	26.3	1975	26.9	2296	27.8	2674	28.8	3121	29.9
Bangladesh		24381	27.1	27509	27.6	32202	28.4	37824	29.3	44353	30.1

'Interpolated by Consultants

Source: ONPP (1985) and

2.2.5 Urbanization

Bangladesh is predominantly rural and until recently, the level and rate of urbanization remained low. It is not easy to isolate the trend of urbanization from the past census statistics as a large number of Upazilla headquarters were included in the 1981 census as being urban centres. Also there were some changes as to what constituted an urban centre. This, however, had no effect on this study as district population was used as the basis.

Despite these difficulties, it is evident that there has been a rapid increase in urbanization in the last 20 years, to a level of 15.1% of the total population in 1981. Dhaka has shown the highest growth rate of the five major cities (10.9% for 1974 to 1981) a trend which is likely to continue to 2000, although it may slow down slightly, due to overcrouding in the city and improved rural conditions.

The decentralization policies are likely to affect the relative growth rates of some of the larger cities but are unlikely to reduce the overall trend of rapid urbanization. In fact, they may result in an increase in the rate of urbanization as upazilla headquarters grow as a result of decentralized administration and as the pressure on the land in the rural areas intensifies.

Because of the complex factors affecting rates of urbanization, it is considered highly speculative to attempt to make regional projections. Overall, the percentage of the population that is urban is likely to be in the range 22-34% by 1990 and rising to 35-45% by 2000.

The effect of this large increase in urban population on utilities and services will be enormous. Whether failure to provide for the increased demand will result in a reduction in the rate of growth of the urban population or not is difficult to predict. It is, however, certain that there will be an increasing percentage of the population living in urban areas and that this will have an increasing effect on the demand for regional transport.

2.3 National Economy

2.3.1 Gross Domestic Product and Its Components

Bangladesh is predominantly a rural subsistence economy. Agriculture still contributes nearly half of GDP, although its share has steadily declined from some 57 percent in 1972-73 to an estimated 45 percent in 1984-85.

The growth of GDP and its sectoral components has been analysed at constant 1982-83 prices using data from the Bangladesh Energy Planning Project (BEPP). Macro-economic model data base and their projections for 1983/84 and 1984/85 using the reference scenario. This enables the relative performance of the planning periods to be compared. The values of GDP and its components at constant prices are shown in Table 2.3.1., and the percentage share of the sectoral components in Table 2.3.2. From this, growth rates corresponding to the First Five Year Plan, the 2 year plan and the Second Five Year Plan have been calculated and are given in Table 2.3.3.

Agriculture's share of GDP has steadily declined over the period 1972-1984 being matched by an equally steady rise in the service sector. As expansion of the latter is mostly concentrated in urban areas, this implies an increasing level of rural poverty, and migration to urban areas, in search of employment.

Industry showed a sharp increase in the aftermath of the liberation war, due partly, the low base due to the effect of the war and partly because of the efforts to restore and recover the economy. The share of industry rose to 10% in 1974/75 and has fluctuated around that level ever since.

Transport's share also showed a sharp rise immediately after the war, again because of the effort to restore the losses caused by widespread destruction in 1971 and also because of the low level starting base (6.2% GDP in 1972-73). Its share remained fairly constant for the remainder of the period, although there is a slight indication of a decline between 1982-83 and 1984-85.

The share of construction sector did not increase in the First Five Year Plan period. At the beginning of the Second Five Year Plan there was an increase, but since then, the share has remained fairly constant.

The average annual growth rates of GDP and its components, shown in Table 2.3.3, illustrate the sharp increase in all sectors in the First Five Year Plan followed by much slower growth rates in all sectors except energy in subsequent periods. Part of the reason for this slow down can be seen from the way investment was applied. In Table 2.3.4 the average sectoral shares of investment over each plan period are shown as well as the average annual growth rates. It can be seen that the growth in total investment has slowed down considerably since the First Five Year Plan from an average of 22% to

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Table 2.3.1 GDP and Its Sectoral Components, 1972 - 1984

Year	GDP and Its Sectoral Components, Millions Taka, (1982-83 Constant Prices)						
	GDP	Agriculture	Industry	Transport	Construction	Energy	Services
1972/73	167294	95956	10672	10312	7511	463	42381
1973/74	193906	105870	12427	16904	8564	338	49687
1974/75	200480	104971	20063	17333	9214	306	48632
1975/76	224479	117258	21495	18173	8808	480	58364
1976/77	228301	113710	22213	19625	10579	580	61642
1977/78	242849	123408	22642	20465	10684	680	64981
1978/79	255347	121641	25709	22100	16128	687	69099
1979/80	258028	121849	25550	22595	12760	801	74487
1980/81	275594	128361	27676	23219	14462	889	80985
1981/82	277929	129520	28078	23251	15298	1053	80726
1982/83	287132	135530	27563	25048	15122	1078	82791
1983/84 E	302599	138573	30226	25253	16108	1226	91213
1984/85 E	316203	142473	31773	25989	16935	1375	976557

E Estimate BEPP Macro-economic model -referna scenario

Source: BEPP Macro-economic data base.

Table 2.3.2 Sectoral Shares of GDP in Percent 1972 - 1984

Year	Sectoral Share of GDP in Constant 1982-83 Prices, (%)					
	Agriculture	Industry	Transport	Construction	Energy	Services
1972/73	57.4	6.4	6.2	4.5	0.3	25.2
1973/74	54.6	6.4	8.7	4.5	0.2	25.6
1974/75	52.4	10.0	8.6	4.6	0.2	24.2
1975/76	52.2	9.6	8.1	3.9	0.2	26.0
1976/77	49.8	9.7	8.6	4.6	0.3	27.0
1977/78	50.8	9.3	8.4	4.4	0.3	26.8
1978/79	47.6	10.1	8.7	6.3	0.3	27.0
1979/80	47.2	9.9	8.8	4.9	0.3	28.9
1980/81	46.6	10.0	8.4	5.2	0.3	29.5
1981/82	46.6	10.1	8.4	5.5	0.4	29.0
1982/83	47.2	9.6	8.7	5.3	0.4	28.8
1983/84[E]	45.8	10.0	8.3	5.3	0.4	30.2
1984/85	45.1	10.0	8.2	5.4	0.4	30.9

E Estimate BEPP Macro-economic model - reference scenario
Energy sector includes only those in modern sector.

Source: BEPP Macro-economic database.

Table 2.3.3 Growth Rates of GDP and Its Sectoral Components 1972-1984

Period	Average Annual Growth Rates of Value Added % p.a. (Constant 1982-83 Prices)						
	GDP	Agriculture	Industry	Transport	Construction	Energy	Service
1972/73 - 1977/78	7.74	5.16	16.22	14.63	7.30	7.99	8.92
1977/78- 1979/80	3.08	-0.63	6.23	5.23	9.28	8.53	3.83
1979/80- 1984/85	4.15	3.18	4.46	2.84	5.82	11.41	5.57

Source: BEPP Macro-economic Model (1985)

Table 2.3.4 Average Sectoral Shares of Total Investment Over Plan Periods 1973-84

Period	Sectoral Shares of Total Investment (%) and Growth Rate (% p.a.)						
	Total	Agriculture	Industry	Transport	Construction	Energy	Services
1973/74-	100.0	26.5	15.5	18.8	15.3	10.9	13.0
1977/78	(22.0)	(18.2)	(41.8)	(12.5)	(23.6)	(26.4)	(19.5)
1977/78-	100.0	25.3	19.6	17.4	11.9	13.3	12.5
1979/80	(9.4)	(11.0)	(4.6)	(16.9)	(-1.6)	(25.8)	(1.0)
1979/80-	100.0	31.1	14.6	15.2	8.2	14.9	16.0
1984/85	(3.8)	(6.8)	(-1.3)	(-2.8)	(-3.3)	(12.2)	(11.3)

' Average annual growth rate in % p.a. in parentheses.

Source: BEPP Macro-economic Model (1985)

an estimated 3.8% in the last five years in constant prices. There has been considerable variations in the relative shares of the sectors. Of particular note is the way that investment in services grew in the last five years, at the expense of industry, transport and construction.

Because there is no reliable information about GDP before 1972-73, it is not possible to trace the changes in GDP per capita beyond the period 1974-1981, covering the last two population censuses.

Using the population estimates from Table 2.2.1 and the GDP in constant 1982-83 Taka in Table 2.3.1 the GDP per capita for 1974 and 1981 have been calculated, together with the average annual growth rate over the seven year period, and the results given in Table 2.3.5.

Table 2.3.5 GDP Per Capita, 1974 and 1981 (Constant 1982-83 Prices)

Year	Population (Millions)	GDP (Millions) Taka	GDP/capita Taka	Average Growth rate %
1974	76.4	193906	2538	
1981	89.9	275594	3066	2.73

Source: Consultants, Table 2.2.1 and Table 2.3.1

2.3.2 Sectoral Issues

Apart from the detailed composition of GDP as described above, there are a number of sectoral issues that are particularly relevant to the understanding of the Bangladesh economy.

(1) Agriculture : The outstanding feature of the land distribution pattern is the low average size of holding (1.4 hectares) and even this disguises the fact that 45% of total farm holdings were less than 1.0 hectares. Further, about 12% of the rural population have no land and a further 29% have less than 0.2 hectares, effectively also being landless.

The predominant crop is rice production, with 3 growing seasons, although on average only 46% of the cropped area is cultivated more than once a year. Apart from rice, the other main cereal crop is wheat, although its distribution is more limited because of the flooding.

The main cash crop is jute, with Bangladesh producing about 40% of the world's marketed supply. In recent years, however, jute has faced increasing competition from synthetics and other substitutes and Bangladesh has faced increased competition from other jute exporting countries.

Currently Bangladesh does not produce enough cereal crops to feed its population even at low consumption level and food grains have to be imported in the range 1-2 million tons annually. Intensive efforts are being made to increase food production through the introduction of fertilizer and irrigation technology. The stated aim is to be overall self-sufficiency in food grains by 1990, although regionally there will still be deficit areas.

(2) Industry : The industrial sector, accounting for about 10% of GDP employs a similar percentage of the labour force. Slightly more than half of the output is provided by large scale industry although small scale industry is more productive per unit of capital.

In the fourteen years since Independence, Government policy towards industry has been varied. Initially, the nationalization of large scale private enterprises led to the sector being dominated by the public sector. A multitude of problems causing loss of output and inefficiency led the Government in 1982 to return a substantial number of previously nationalized enterprises to private ownership.

The growth of industrial activity in the economy is mainly determined by the availability of resources, particularly, Government investments, which in turn are closely linked to the disbursement of external aid.

(3) Investment : Since Independence, investment has grown threefold in real terms, although this obscures the fact that in the First Five Year Plan it grew at an average annual rate of 22.0%, slowed in the next two years to 9.4% p.a and is estimated to have slowed further to 3.8% p.a in the Second Five Year Plan. This is clearly one of the main contributory reasons for the slow down in the economy (see Table 2.11) Gross national savings have now reached 4.1% of GDP largely due to the increase in net factor income earned by Bangladesh labour overseas and remitted home. There has, however, always been a significant gap between investment and savings which has been filled by external aid.

External aid currently acccounts for over 60% of total investment. The Government is the most important investor in the economy, accounting for nearly two-thirds of the total. In recent years, however, the Government has sought to encourage private investment, both from nationals and foreign investors.

(4) Balance of trade : Bangladesh has always suffered from a structural trade deficit, with exports never covering more than 50% of the import bill. Foreign aid has almost entirely financed the deficit. Exports from Bangladesh have traditionally comprised jute and jute products, tea, leather goods and some fish and food items. Jute however, still accounts for more than hlaf of total export earnings, despite a decline in its market share in recent years. Non-traditional items such as garment have gradually increased and now account for more than 30% of total exports.

The main imports have been food grains and petroleum products. In 1982/83, food grains totalled 23% of the total value of imports, although a sizeable proportion was in the form of grant aid. Petroleum products have grown at a high rate overall throughout the fourteen years since Independence although there have been some extremely large fluctuations on a year by year basis. Despite the existence of natural gas, the balance of trade effect of large petroleum products imports is likely to be felt for many years to come.

2.3.3 GDP Growth Scenarios

The forecasting of future GDP depends largely an understanding of the existing framework of those indicators that express the development of the economy. Whilst theoretical analysis can establish the relationship equations, such is the complexity of the factors that a macro-economic model linking the indicators and validated against historic data is required. Such an exercise has been carried out by the consultants on the Bangladesh Energy Planning Project, using a data base from 1972 to 1982. Using their macro-economic model the consultants used as inputs the exogenous variables either agreed by the Planning Commission or provided by them. Thus it is proposed to use the results of their macro-economic model as inputs into this study.

Assuming that economic growth is led by capital accumulation, the BEPP produced three scenarios based on different annual growth rates of investment for the period upto 1999-2000. The high and reference scenarios were based on investment growth rates proposed by the Planning Commission, whilst the low scenario was added by the BEPP to check the effects of a less favourable economic future. The assumptions used for total investment growth rates per annum for each scenario for each planning period are shown in Table 2.3.6.

The allocation of investment by sector is the critical factor in determining sectoral growth.

Table 2.3.6 Future Total Investment Growth Rate Assumptions

Plan Period	Average annual growth rates, % p.a.		
	Low Scenario	Reference Scenario	High Scenario
1985-86 1989-90	7	7	10
1990-91 1994-95	7	10	10
1995-96 1999-2000	7	9	10

Source: B.E.P.P. Macro-economic model (1985)

Table 2.3.7 Future Sectoral Investment Allocation Assumptions

Period	Sectoral investment allocations assumption, %						
	Total	Agri-culture	Industry	Trans-port	Construc-tion	Energy	Services
1985/86-1989/90	100	27	15	15	8	20	15
1990/91-1994/95	100	25	18	15	8	18	16
1995/96-1999/2000	100	20	20	15	10	18	17

Source: BEPP Macro-economic model (1985)

In order to determine what these allocations should be, certain policy criteria were established, viz:

- Agriculture should grow to achieve minimum food grain requirement within 10 years

- The shares of the other sectors should reflect an acceleration of the creation of urban industrial jobs and rural investment in services and infrastructure in an attempt to keep people from migrating to urban centres. With these policies in mind, the Planning Commission proposed the sectoral investment allocation in percentages as shown in Table 2.3.7. It was assumed that these allocations would be the same for each of the investment growth scenerios.

Using these assumptions, as well as assumptions about marginal productivity of labour, terms of trade, net factor income etc, the three scenarios were developed to give forecasts for the economy in the future. The projected sectoral values added and GDP in constant 1982-83 Taka are shown in Table 2.3.8 and the precentage sectoral distributions in Table 2.3.9 for all three scenarios.

The average annual growth rates for each of the five year plan periods to 1999-2000 for each sector and GDP are given in Table 2.3.10 for each scenarios.

Using the population forcasts in Table 2.2. and the GDP from Table 2.3.8, the GDP percapita and its growth rate for each scenario are shown in Table 2.3.11. It can be seen that, for all three scenarios, the GDP per capita is increasing at an accelerating rate, due to the growth rate of GDP being higher than the population growth rate.

Table 2.3.8 Future GDP and Sectoral Values Added, 1985 - 2000

A. Low Scenario

Year	GDP Million Tk.	Sectoral Values Added (Millions Tk)					
		Agriculture	Industry	Transport	Construction	Energy	Services
1984/85	316211	142440	31805	25996	16935	1376	97659
1989/90	395621	162012	42411	31692	22317	2261	134929
1994/95	505996	186733	60590	40066	30159	3414	185034
1999/2000	663035	211499	88484	51993	44646	5163	261250

B. Reference Scenario

Year	GDP Million Tk.	Sectoral Values Added (Million Tk)					
		Agriculture	Industry	Transport	Construction	Energy	Services
1984/85	316203	142473	31773	25989	16935	1376	97657
1989/90	411310	162141	42293	31665	22317	2261	134927
1994/95	548093	192125	65137	41727	31583	3590	193026
1999/2000	770885	228901	103228	58386	50885	5895	294039

C. High Scenario

Year	GDP Million Tk.	Sectoral Values Added (Million Tk)					
		Agriculture	Industry	Transport	Construction	Energy	Services
1984/85	318826	143161	32464	26159	17093	1394	98555
1989/90	421699	169185	47046	33738	24117	2489	145124
1994/95	591667	209032	75521	47028	36238	4191	219657
1999/2000	872057	258390	125641	69009	61308	7172	250537

Source: BEPP Macro-economic model (1985)

Table 2.3.9 Future Sectoral Shares of GDP, 1985 - 2000

A. Low Scenario

Year	GDP	Sectoral Share of GDP in Constant 1982-83 Prices (%)					
	%	Agriculture	Industry	Transport	Construction	Energy	Services
1984/85	100	45.0	10.1	8.2	5.4	0.4	30.9
1989/90	100	41.0	10.7	8.0	5.6	0.6	34.1
1994/95	100	36.9	12.0	7.9	6.0	0.7	36.5
1999/2000	100	31.9	13.4	7.8	6.7	0.8	39.4

B. Reference

Year	GDP	Sectoral Share of GDP in Constant 1982-83 Prices (%)					
	%	Agriculture	Industry	Transport	Construction	Energy	Services
1984/85	100	45.0	10.1	8.2	5.4	0.4	30.9
1989/90	100	41.0	10.7	8.0	5.6	0.6	34.1
1994/95	100	36.4	12.4	7.9	6.0	0.7	36.6
1999/2000	100	30.9	13.9	7.9	4.9	0.8	39.6

C. High Scenario

Year	GDP	Sectoral Share of GDP in Constant 1982-83 Prices (%)					
	%	Agriculture	Industry	Transport	Construction	Energy	Services
1984/85	100	44.9	10.2	8.2	5.4	0.4	30.9
1989/90	100	40.1	11.2	8.0	5.7	0.6	34.4
1994/95	100	35.3	12.8	8.0	6.1	0.7	37.1
1999/2000	100	29.7	14.4	7.9	7.0	0.8	40.2

Source: BEPP Macro-economic Model (1985)

Table 2.3.10 Future GDP and Values Added Average Annual Growth Rates

Period	Scenario	Average Annual Growth Rates (% p.a.)						
		GDP	Agriculture	Industry	Transport	Construction	Energy	Services
1984/85-1989/90	Low	4.58	2.61	5.92	4.04	5.50	10.44	6.68
	Ref.	4.58	2.62	5.89	4.01	5.67	10.44	6.68
	High	5.75	3.40	7.70	5.22	7.13	12.29	8.05
1989/90-1994/95	Low	5.04	2.88	7.40	4.80	6.38	8.59	6.52
	Ref.	5.91	3.45	9.02	5.67	7.19	9.69	7.42
	High	7.01	4.32	9.93	6.87	8.48	10.98	8.64
1994/95-1999/2000	Low	5.55	2.52	7.87	5.35	8.16	8.62	7.14
	Ref.	7.06	3.56	9.65	6.95	10.01	10.43	8.78
	High	8.07	4.33	10.72	7.97	11.09	11.34	9.80

Source: BEPP Macro-economic Model (1985)

Table 2.3.11 Future GDP Per Capita in Constant 1982-83 Prices

Scenario	Year	Population (Millions)	GDP (Millions) Taka	GDP/Capita Taka	Average Growth Rate (% p.a.)
Low	1984/85	99.5	316211	3178	
	1989/90	113.3	395621	3492	1.90
	1994/95	129.1	505996	3919	2.34
	1999/2000	147.1	663035	4507	2.84
Reference	1984/85	99.5	316203	3178	
	1989/90	113.3	395604	3492	1.90
	1994/95	129.1	527188	4084	3.18
	1999/2000	147.1	741334	5040	4.29
High	1984/85	99.5	318826	3204	
	1989/90	113.3	421699	3722	3.04
	1994/95	129.1	591667	4583	4.25
	1999/2000	147.1	872057	5928	5.28

Source: Consultants, Table 2.5 and 2.15

In each scenario, the percentage share of agriculture has decreased over the 15 years period to 2000, whilst the other sectors have increased. The implications of this are that as the country modernizes and the economy grows, agriculture is likely to fall in relative importance. The implication though, is that the service sector will largely take up the reduction in agriculture's share. Since most of the service sector's activities are concentrated in the urban areas, this may imply an increase in rural poverty and in urban attractiveness.

In all scenarios, the percentage share of transport sector also shows a decline over the period to 2000. This is contrary to the common phenomenon of transport sector growing faster than overall GDP when the economy is underdeveloped. The descripancy is probably a result of the BEPP model having been calibrated against the transport sector performance measured in artificially depressed fares and rates. Had the value added in transport sector been measured in real terms,the transport sector growth many have been estimated higher. In any case, minor difference in the transport sector estimates do not significantly alter the GDP growth estimates.

By September 1985, the Planning Commission decided that a rate of 5.4% per annum should be adopted as the target GDP growth rate for the Third Five Year Plan. This report is based on the target GDP growth rate of 5.4% p.a. in the TFTP period. For the subsequent periods rates assumed for the reference scenario were adopted in this study.

2.4 Regional Development

2.4.1 Existing Regional Distribution of GDP

The distribution of the total GDP by district gives an indication of regional variations in the economy. This reflects a combination of factors such as natural resources, location of industry, availability of agricultural land, and Government policies on regional development and investment. In order to estimate existing and future regional distribution of GDP, two data sources were used. Firstly, the national GDP at constant 1982-83 prices, which is describe in 2.3.1 for 1981-82 is taken from Table 2.3.1. Then the regional percentage distribution implied in the ONPP report, volume 2 (1985), was applied to the total GDP.

In this latter report, the percentage distribution of the incremental increase in total GDP for the period 1981 - 84 was used to calculate the regional GDP. However, the actual amount of the total increment of GDP in the ONPP report was considerably higher than that implied in Table 2.3.1 for the same period. For consistency, this increment has been taken and distributed according to the regional percentage distribution, and the results given in Table 2.4.1 (The old system of 20 districts has been retained for this analysis.)

It can be seen that there were considerable variations in both the absolute amounts and in the growth rates in the period 1981-82 to 1984-85. The highest growth rates in regional GDP were in Pabna and Bogra on the west bank of the Jamuna River. Noakhali also showed a very high growth rate. In contrast, low rates were found in Faridpur, Mymensingh and Tangail.

The per capita GDP for the districts was calculated using the regional population estimates in Table 2.2.5, and are given in Table 2.4.2. It can be seen that three districts experienced a reduction in percapita GDP, Chittagong Hill Tracts (which also had the highest level of percapita GDP), Mymensingh and Tangail. The highest growth rates were experienced by Pabna, Bogra and Noakhali.

The sectoral percentage shares of values added are given for 1981-82 in Table 2.4.3. The importance of industry in Dhaka and Chittagong compared with the very low level in all the other districts can be seen. The reverse is true for agriculture, however with Dhaka and Chittagong's share being well below the rest of the country.

2.4.2 Existing Regional Economic Features

From the analysis of the sectoral distribution of regional values added it can be seend that there are variations between regions. The dominance of Dhaka and Chittagong in industry and the resulting heavy traffic movement between them is expected to continue. A brief description of the industrial sector by district is given in Table 2.4.4 and the location of the principal industries in Figure 2.4.1 and 2.4.2.

Table 2.4.1 Existing GDP distribution by district 1981 - 84

(in constant 1982/83 prices)

District	No.	GDP 1981-82		GDP Increment 1981-84		GDP 1984-85	Growth Rate 1981-84 % p.a.
		M. Taka	%	%	M. Taka	Million Tk	
Chittagong	1	25653	9.23	7.81	2989	28642	3.74
Ctg. Hill Tracts	2	7393	2.66	3.26	1248	8641	5.34
Comilla	3	20928	7.53	5.89	2254	23182	3.47
Noakhali	4	10506	3.78	7.39	2828	13334	8.27
Sylhet	5	18593	6.69	4.80	1837	20430	3.19
Dhaka	6	35214	12.67	16.68	6384	41598	5.71
Faridpur	7	13257	4.77	1.88	720	13977	1.78
Jamalpur	8	6365	2.29	3.04	1164	7529	5.76
Mymensingh	9	19372	6.97	2.67	1022	20394	1.73
Tangail	10	7476	2.69	0.89	341	7817	1.50
Barisal	11	12924	4.65	2.80	1072	13996	2.69
Jessore	12	11478	4.13	3.88	1485	12963	4.14
Khulna	13	15592	5.61	3.40	1799	17391	3.71
Kushtia	14	6281	2.26	2.20	842	7123	4.28
Patuakhali	15	5892	2.12	1.15	440	6332	2.43
Bogra	16	8143	2.93	6.77	2591	10734	9.65
Dinajpur	17	9811	3.53	2.95	1129	10940	3.70
Pabna	18	9700	3.49	10.18	3896	13596	11.91
Rajshai	19	14758	5.31	5.75	2201	16959	4.74
Rangpur	20	18593	6.69	5.38	2059	20652	3.56
Bangladesh		277929	100.00	100.00	38274	316203	4.39

Source: 1. BEPP Macro-economic data base (1985)
2. ONPP Vol. 2 (1985)
3. Consultants calculations

Table 2.4.2 Existing Regional Per Capita GDP 1981-84

(in constant 1982/83 prices)

District	No.	GDP Per Capita		Growth Rate
		1981 - 82	1984 - 85	% p.a.
Chittagong	1	4356	4438	0.62
Ctg. Hill Tracts	2	8785	8144	-2.49
Comilla	3	2904	3049	1.64
Noakhali	4	2631	3180	6.52
Sylhet	5	3134	3250	1.22
Dhaka	6	3229	3360	1.33
Faridpur	7	2683	2725	0.52
Jamalpur	8	2470	2747	3.60
Mymensingh	9	2807	2783	-0.28
Tangail	10	2921	2894	-1.31
Barisal	11	2644	2727	1.04
Jessore	12	2701	2826	1.51
Khulna	13	3395	3527	1.28
Kushtia	14	2583	2700	1.50
Patuakhali	15	3036	3043	0.07
Bogra	16	2819	3401	6.46
Dinajpur	17	2881	2906	1.03
Pabna	18	2674	3457	8.94
Rajshahi	19	2644	2792	1.83
Rangpur	20	2709	2809	1.21
Bangladesh		3013	3177	1.78

Source: Tables 2.2.5 and 2.4.1

Table 2.4.3 Sectoral Percentage Distribution of Regional Values Added, 1981/82

District	No.	Sectoral Distribution of Regional Values Added, 1981/82,%				
		Agriculture	Industries	Transport	Construction	Services & Other
Chittagong	1	30.0	32.0	7.7	4.2	26.1
Ctg. Hill Tracts	2	64.3	8.9	7.8	1.7	17.3
Comilla	3	44.4	7.1	9.7	6.4	32.4
Noakhali	4	45.6	5.2	8.9	7.5	32.8
Sylhet	5	49.0	6.8	8.3	6.1	29.8
Dhaka	6	24.9	25.8	14.3	4.9	30.1
Faridpur	7	51.3	2.0	9.6	7.0	30.1
Jamalpur	8	53.3	1.6	6.7	7.6	30.8
Mymensingh	9	56.0	2.1	5.3	6.7	29.9
Tangail	10	53.4	3.4	8.4	6.0	28.8
Barisal	11	47.1	1.3	9.8	7.5	34.3
Jessore	12	50.1	4.4	8.5	6.2	30.8
Khulna	13	46.2	9.7	10.5	5.4	28.2
Kushtia	14	49.3	6.7	5.3	6.4	32.3
Patuakhali	15	57.0	1.0	5.3	6.3	30.4
Bogra	16	54.6	1.9	6.3	1.9	35.3
Dinajpur	17	54.3	4.4	5.2	6.5	29.6
Pabna	18	50.6	5.6	7.0	6.3	30.5
Rajshahi	19	52.9	2.6	7.5	6.5	30.5
Rangpur	20	54.8	2.9	6.3	6.7	29.3
Bangladesh		46.6	10.1	8.4	5.5	29.4

Source: ONPP Vol. 2 (1985)

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For the most part, industrial activity is small scale, and apart from one or two places, scattered. At the present, the only major mineralogical activity relates to the exploitation of the gas fields in the eastern part of the country, predominantly in Sylhet, Comilla, Noakhali and Chittagong.

Stone, cement, fertilizer, paper, jute and jute products, cereals, sugarcane and petroleum products account for the bulk of goods moved in Bangladesh - apart from imports. Some of these are described in more detail:

(1) Stones : Apart from the use of river washed stones and gravel, mainly in Sylhet, and Dinajpur, there is a deposit of boulder and gravels at Banda Tilla, Chittagong. Also calcarious sand stone is supplied from Chittagong Hill Tracts.

(2) Fertilizer : The demand for urea fertilizer is currently just about macched by supply, with an estimated demand of 708,000 tons and a production of 760,000 tons in 1982-83. However, whilst existing production will peak at about 840,000 tons in 1985/86, the demand will grow at a faster rate, outstripping supply. Because there is currently no natural gas in the northwest, no urea fertilizer can be produced there, although the existing demand is estimated to be 217,000 tons in 1983-84.

(3) Cement : The current level of demand is about 1 million tones annually. The supply from factories in Bangladesh is about 300,000 tons, leaving a shortfall of about 700,000 tons to be imported.

(4) Paper : The current demand for newsprint of about 35,000 tons is just met by the supply, although there is no supply of security paper, to meet an estimated current demand of 900 tons.

(5) Jute : The current production of 6.7 million bales comes principally of five districts, Dinajpur (18%), Mymensingh (14%) Jessore (10%), Faridpur (10%) and Dhaka (8%), accounting for some 60% of the total. The rest is scattered through out the country, although Chittagong, CHT and Patuakhali produce virtually nothing.

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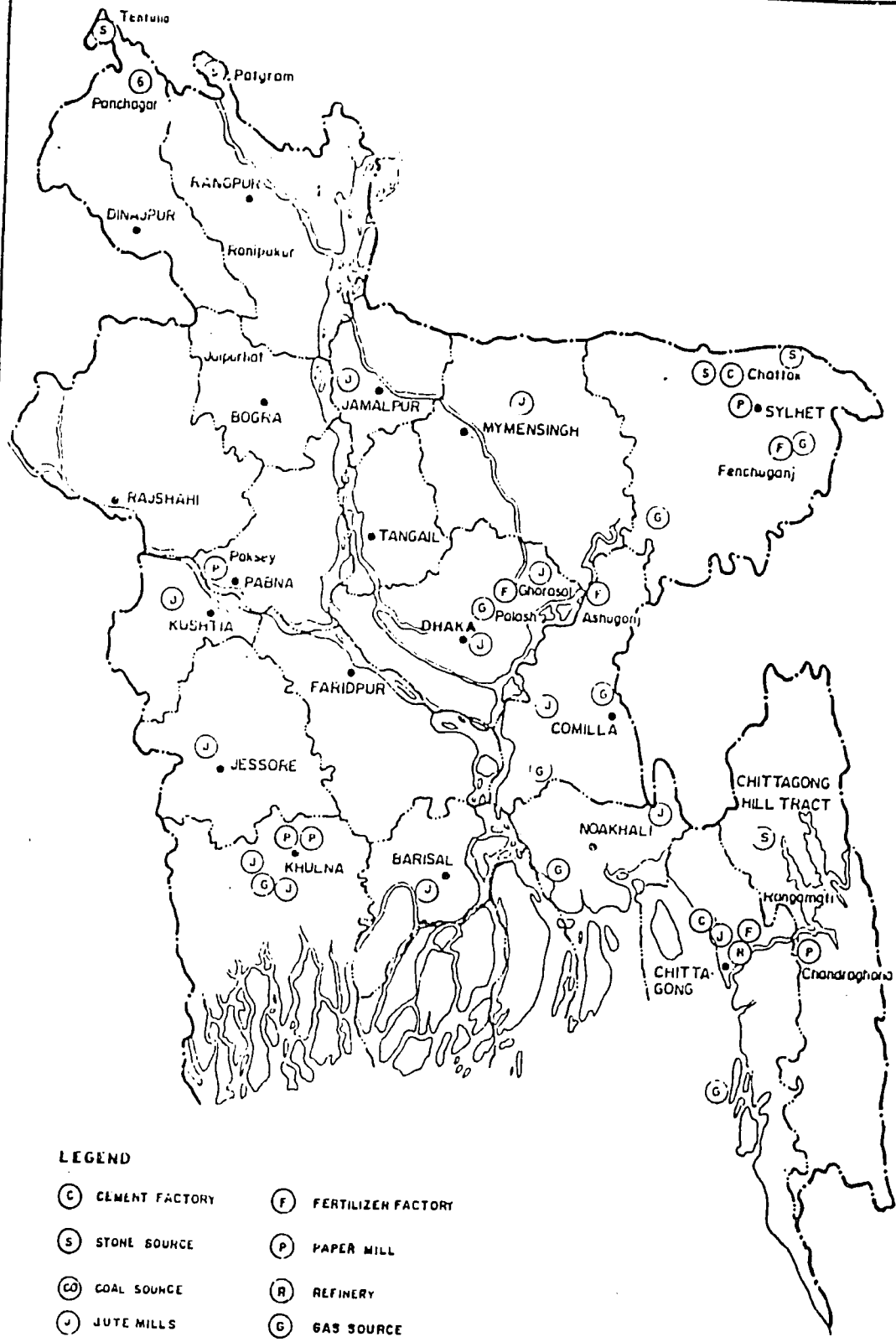

FIG. 2.4.1 LOCATION OF EXISTING MAJOR INDUSTRIES

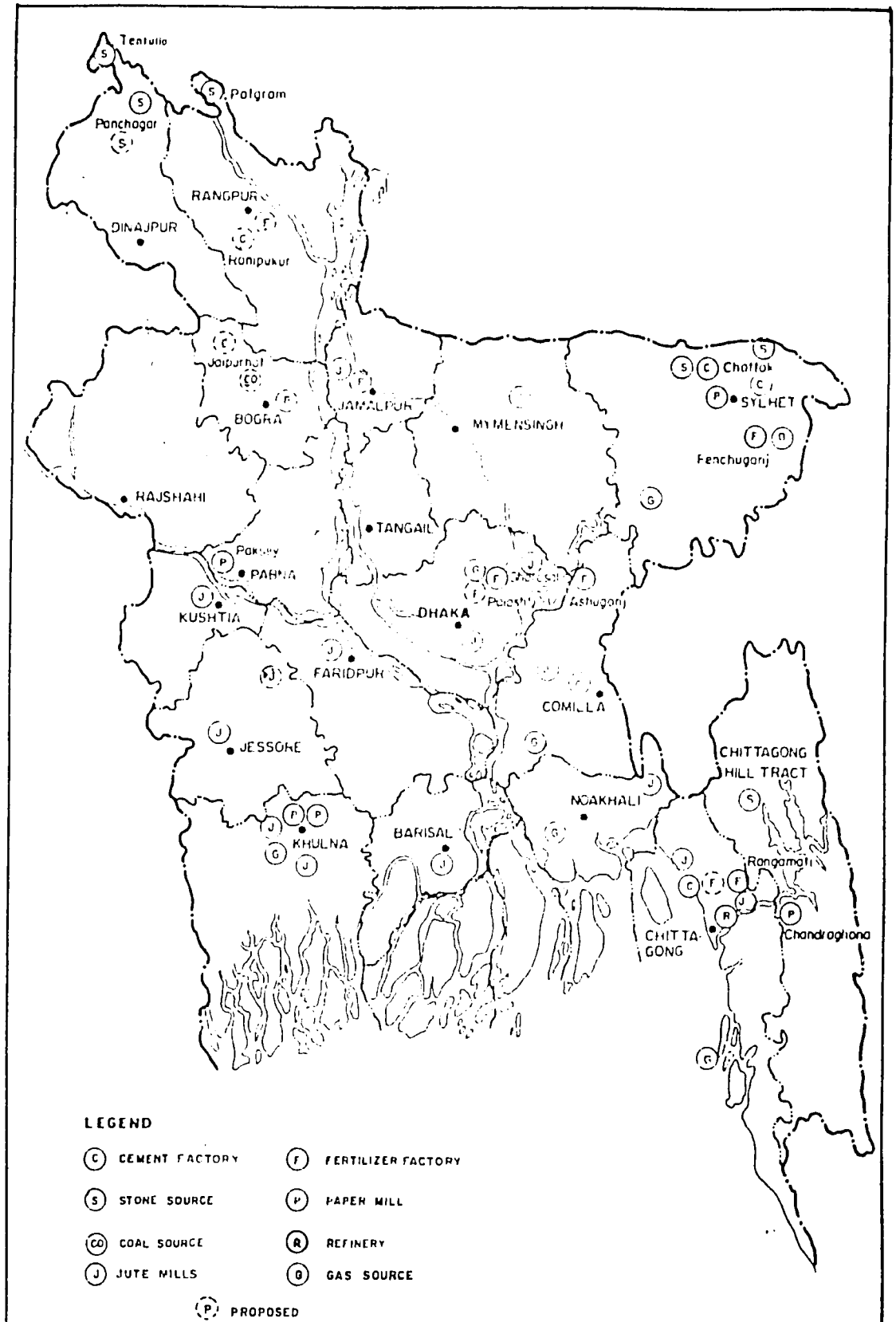

FIG. 2.4.2 LOCATION OF EXISTING AND PROPOSED MAJOR INDUSTRIES

(6) Rice and cereals : Food grains are the most important single commodity produced in Bangladesh, with national production estimated at around 15-17 million tonnes. Because food self-sufficiency has an important bearing a both the absolute volumes of cerals being moved and the regigonal distribution of much movements it has been analyzed in detail in the section 2.4.6.

Table 2.4.4 Brief Description of Industrial Activities by District

District	No.	Brief description of industrial activities
Chittagong	1	Principal centre for heavy and medium industry, mainly because of its port. Important industries are jute, cottton engineering, chemicals, cement, timber mills and tannaries. The only oil refinery and steel mill in Bangladesh are in Chittagong.
Ctg. Hill Tracts	2	The significance of industry is in the exploitation of the natural resources. The Karnafuli Hydro electric project at Kaptai produced 23000 KWH in 1981-82. There are paper mills, timber and plywood factories and a rubber project which produced some 180 tons of latex in 1981-82. There are also chemical factories and a number of small scale and cottage industrial units in the region.
Comilla	3	The Principal industrial activities are textiles jute, food manufacturing, chemicals and pharmaceuticals and tobacco. There is also a large number of cottage industries.
Noakhali	4	The level of industrial activity is low, being mainly cottage industries and hand weaving. There are some engineering works and jute mills.
Sylhet	5	One of the two cement factories of Bangladesh is located in Sylhet, using limestone mainly imported from India. There are a number of small scale and cottage industries. Sylhet is a major producer of gas from its gas fields and stones and gravel from rivers and flood areas. Tea processing industry is also located in this district.

Dhaka	6	Dhaka is famous for its weaving industry. It has a very significant proportion of the countries handlooms, jute and textile mills. Fertilizer production from natural gas and other industrial units reinforce the dominance of Dhaka in the industrial sector, overall other districts.
Faridpur	7	The industrial sector is quite small, being predominantly cottage and small scale industries. There are some food manufacturing plants as well as textiles and pharmaceutical products.
Jamalpur	8	There is very little industrial activity other than cottage and small scale units
Mymensingh	9	A jute mill and a cotton textile mill and a few small factories are all that constitutes the industrial sector apart from the cottage industries.
Tangail	10	Famous for its weaving industry. There are cotton weaving mills as well as jute mills.
Barisal	11	There is no major industry. Small scale and cottage industries only, comprise the industrial sector.
Jessore	12	Handlooms and weaving are principal activities, although the sugar mill produces about 8% of the total output for Bangladesh.
Khulna	13	Principal industries are textiles, newsprint, hardboard, iron re-rolling, ship building, wood processing, engineering workshops and some fish processing.
Kushtia	14	Principal industrial activities are textiles, weaving, (Particularly handlooms) some engineering and sugar mills which produce nearly 20% of the total output of Bangladesh.
Patuakhali	15	There are no major industries. A few small factories are the only industry in the district.
Bogra	16	There are textile plants, sugar and rice and other processing plants.
Dinajpur	17	Principal industries are textiles and sugar and a silk factory
Pabna	18	Jute, sugar and cotton mills are the principal industrial activities with a considerable number of small scale and cottage industries.

Rajshahi	19	There is not much industrial effort, apart from sugar mills, a jute mill, two textile mills and a silk factory.
Rangpur	20	There are three sugar mills and a spinning mill. For the rest there are a variety of small scale and cottage industries. A tobacco processing plant also exists.

2.4.3 Rural Development and Decentralization

The dominant factor that has influenced regional disparities has been that of the large urban centres, such as Dhaka, Chittagong, Rajshahi, Khulna, etc. These cities have attracted investment and as a consequence have become growth centres. Although there have been attempts at rural development in the past, they have not been particularly successful at raising the living standard of the rural poor. During the sixties, Thana Training and Development Centres (TTDC) were established for farmers, co-operators, etc, to augment the development activities at the grass root level. The TTDC represented a structure for the decentralization of the resource allocation and management of projects like Rural Works Programme, Thana (now Upazila) irrigation Programme, re-excavation of derelict tanks, input distribution marketing and training. The Integrated Rural Development Programme (IRDP) was launched in 1971 on the Comilla Co-operative model to co-ordinate rural development activities. The emphasis of these programmes was on building infrastructure and on some production programmes. The creation of jobs for rural unemployed and the provision of basic necessities was given lesser importance. There was little involvement of people at the grass roots level in the development process. This led to the realization that administrative decentralization would be a necessary first step towards achieving rural development.

In 1976, four Divisional Development Boards were created in each administrative divisional headquarter at Dhaka, Chittagong, Rajshahi and Khulna. The main functions of these Boards were:

(a) to prepare schemes for the concerned Division;
(b) to approve of the projects upto certain costs;
(c) to execute and supervise the approved projects;
(d) to grant loans for setting up of cottage industries;

It was subsequently realized that these Boards were having limited success, partly due to the physical size of the regions. This has led to the present Government policy of decentralization down to the Upazila level. This has led to the creation of 64 districts, sub divided into 460 Upazilas.

Under the reorganized set up, Upazila becomes the main centre of administrative and development activities. The Upazila authority is entrusted with all development activities including repairs, renovations and maintenance of public institutions and infrastructural

facilities. The Central Government will perform the regulatory functions and provide technical guidance and supervision as and when needed by Upazila administration.

Initially, the priorities for development have been set by the Government as follows:

(a) Agriculture, irrigation, cottage industry
(b) Physical infrastructure;
(c) Socio-economic infrastructure;
(d) Sports and culture;
(e) Miscellaneous.

Funds have been provided by the Government to initiate the programmes and revenue sources identified for future income. The main source of future revenue are:

(a) Lease of money on inland fisheries;
(b) Taxes on profession, trade, etc;
(c) Lease money from markets, feries, etc.;
(d) Tax on dramatic and theatrical shows, exhibitions, etc.;
(e) Fees for licence and permits by Upazila Parishad;
(f) Tools on services and facilities;
(g) Arrangement of sharing revenue with Upazila by national Government;
(h) Development grant by Central Planning Body.

As a result of this move to decentralize administration and development programmes, there is likely to be a greater emphasis on regional balance, with those areas that have traditionally received less investment experiencing higher economic growth rates, albeit from a lower base.

Although this process has only just commenced, the effect of a more equitable distribution of investment was assumed by the ONPP report (1985) for the period of the Third Five Year Plan, in its estimate of the percentage distribution of the increment in GDP. For the purposes of this study, it is assumed that this trend will continue in the future.

2.4.4 Future Regional Distribution of GDP

The estimates of national GDP for the future have been made in section 2.3.3. In the ONPP project the study team made estimates for the distribution of the incremental growth in GDP upto 1990, on the basis of a policy of increasing decentralization. In order to see the effect of continuing this trend upto 2000, it has been assumed that the percentage distributions of future increments (based on the estimates in Table 2.3.8) will be the same as predicted for the period 1984-1985 to 1989-1990. The results are shown as Alternative A in Table 2.4.5. This scenario would result in a declining GDP per capita for Dhaka and Ctg. Hill Tracts making Dhaka the lowest in the country by 1994-1995 see Table 2.4.6.

Table 2.4.5 Future Regional Distribution GDP 1985 - 2000, Alternative-A

District	No.	1985 GDP Millions Tk.	1990 GDP Millions Tk.	G.R. %p.a.	1995 GDP Millions Tk.	G.R. %p.a.	2000 GDP Millions Tk	G.R. %p.a.
Chittagong	1	28642	33667	3.29	41996	4.52	55551	5.75
Ctg. Hill Tracts	2	8641	9181	1.22	10076	1.88	11532	2.74
Comilla	3	23182	29176	4.71	39111	6.04	55279	7.16
Noakhali	4	13334	16819	4.75	22596	6.08	31997	7.21
Sylhet	5	20430	24399	3.62	30978	4.89	41685	6.12
Dhaka	6	41598	49704	3.63	63138	4.90	85002	6.13
Faridpur	7	13977	16453	3.32	20558	4.56	27239	5.79
Jamalpur	8	7529	9331	4.39	12318	5.71	17179	6.88
Mymensingh	9	20394	24337	3.61	30877	4.88	41520	6.10
Tangail	10	7817	9365	3.68	11931	4.96	16107	6.19
Barisal	11	13996	17369	4.41	22961	5.74	32062	6.91
Jessore	12	12963	17400	6.08	24756	7.31	36727	8.21
Khulna	13	17391	20185	3.03	24817	4.22	32355	5.45
Kushtia	14	7123	10639	8.36	16468	9.13	25955	9.53
Patuakhali	15	6332	7586	3.68	9665	4.96	13049	6.19
Bogra	16	10734	14615	6.37	21049	7.57	31521	8.41
Dinajpur	17	10940	14869	6.33	21382	7.54	31982	8.39
Pabna	18	13596	18976	6.91	27897	8.01	42416	8.74
Rajshai	19	16959	22849	6.15	32613	7.38	48503	8.26
Rangpur	20	20652	28685	6.80	42001	7.92	63673	8.68
Bangladesh		316230	395604	4.58	527188	5.91	741334	7.06

Source: ONPP Volume 2 (1985)
Consultants, Table 2.3.8 and 2.4

Table 2.4.6 Future Regional Per Capita GDP, 1980-2000, Alternative A

District	No.	GDP Per Capita Taka (Constant 1982-83 Prices)				
		1980-81	1984-85	1989-90	1994-95	1999-2000
Chittagong	1	4356	4438	4467	4780	5444
Ctg. Hill Tracts	2	8785	8144	6036	4673	3858
Comilla	3	2904	3049	3504	4276	5470
Noakhali	4	2631	3180	3692	4556	5907
Sylhet	5	3134	3250	3548	4139	5169
Dhaka	6	3229	3360	3261	3374	3718
Faridpur	7	2683	2725	3003	3505	4001
Jamalpur	8	2470	2747	3068	3648	4573
Mymensingh	9	2807	2783	3002	3440	4174
Tangail	10	2921	2894	3126	3586	4349
Barisal	11	2644	2727	3136	3853	5027
Jessore	12	2701	2826	3307	4105	5322
Khulna	13	3395	3527	3630	3971	4637
Kushtia	14	2583	2700	3487	4670	6382
Patuakhali	15	3036	3043	3304	3849	4833
Bogra	16	2819	3401	3983	4934	6354
Dinajpur	17	2881	2906	3357	4110	5251
Pabna	18	2674	3457	4171	5283	6873
Rajshahi	19	2644	2792	3261	4059	5327
Rangpur	20	2709	2809	3472	4524	6101
Bangladesh		3013	3177	3492	4082	5038

Source: Consultants Table 2.2.5 and 2.4.5

This scenario is considered to be highly unlikely, as it would either provoke an increase in investment in Dhaka (with a corresponding reduction elsewhere) or the attractiveness of Dhaka for net in-migration would diminish, giving a lower growth rate of population.

An alternative scenario, has also been considered, based on the same population forecasts. Assuming the worst effects of regional imbalance have been eliminated by 1989-90, and that the per capita GDP in Dhaka and Chittagong Hill Tracts will not continue to decline and that all districts will remain at their level relative to the national average in 1989-90 upto 2000, an alternative scenario has been projected, as Alternative B and is shown in Table 2.4.7. This gives a more equitable distribution of GDP per capita. See table 2.4.8.

2.4.5 Future Regional Economic Developments

There are three main factors that will effect and possibly alter the existing regional development pattern:

- Administrative decentralization
- Agricultural development, and in particular, overall food self-sufficiency,
- Mineralogical exploitation.

With decentralization, there will come a more equitable distribution of resources and, hopefully, a more balanced demand for transport. The development of more regionally based facilities and services should mean that people have to travel less than at present, in order to use them. On the other hand the rising income would induce people to make more trips. The net effect may well be more trips.

The thrust for overall food self sufficiency will have major impact on regional development. The plan to be self-sufficient in food by 1990 hides the fact that some areas, such as Dhaka, Chittagong and Khulna will still be very much in deficit, whereas the surplus areas will lie in the north and northwest. Because of the significance of these changes, a more detailed study has been made in Section 2.4.6.

There are several mining projects that could also significantly alter the regional development pattern and have an impact on the transport system. In some cases, proposals for the transport of the outputs have been included in the projects feasibility study. Thus, it is proposed to canalize the Korotaya river from Madhyapara in Dinajpur to the port of Baghabari and to canalize the Atrai-Jamuna river from Jamalgonj, Joypurhat also to the port of Baghabari. These are intended to provide for the shipment of coal and limestone to the other ares of Bangladesh by Inland Water Transport. It is worth mentioning, however, that existing rail facilities provide access to these mining projects and the Baghabari port.

Table 2.4.7 Future Regional Distribution GDP 1985 - 2000, Alternative-B

District	No.	1985 GDP Millions Tk.	1990 GDP Millions Tk.	G.R. %p.a.	1995 GDP Millions Tk.	G.R. %p.a.	2000 GDP Millions Tk	G.R. %p.a.
Chittagong	1	28642	33667	3.29	45595	6.25	65143	7.40
Ctg. Hill Tracts	2	8641	9181	1.22	15285	10.73	25782	11.02
Comilla	3	23182	29176	4.71	37431	5.11	50598	6.21
Noakhali	4	13334	16819	4.75	21370	4.91	28583	5.99
Sylhet	5	20430	24399	3.62	30798	4.77	40894	5.83
Dhaka	6	41598	49704	3.63	71005	7.39	106562	8.46
Faridpur	7	13977	16453	3.32	21352	5.35	29220	6.48
Jamalpur	8	7529	9331	4.39	12074	5.29	16471	6.41
Mymensingh	9	20394	24337	3.61	31389	5.22	42672	6.33
Tangail	10	7817	9365	3.68	12124	5.30	16547	6.42
Barisal	11	13996	17369	4.41	21736	4.59	28581	5.63
Jessore	12	12963	17400	6.08	23188	5.91	32607	7.06
Khulna	13	17391	20185	3.03	26320	5.45	36198	6.58
Kushtia	14	7123	10639	8.36	14295	6.09	20267	7.23
Patuakhali	15	6332	7586	3.68	9588	4.80	12749	5.86
Bogra	16	10734	14615	6.37	19778	6.24	28236	7.38
Dinajpur	17	10940	14869	6.33	20297	6.42	29220	7.56
Pabna	18	13596	18976	6.91	25724	6.27	36786	7.42
Rajshai	19	16959	22849	6.15	30313	6.82	42434	6.96
Rangpur	20	20652	28685	6.80	37526	5.52	51784	6.65
Bangladesh		316230	395604	4.58	527188	5.91	741334	7.06

Source: Consultants.

Table 2.4.8 Future Regional Per Capita GDP, 1980-2000, Alternative B

District	No.	GDP Per Capita Taka (Constant 1982-83 Prices)				
		1980-81	1984-85	1989-90	1994-95	1999-2000
Chittagong	1	4356	4438	4467	5190	6384
Ctg. Hill Tracts	2	8785	8144	6036	7090	8626
Comilla	3	2904	3049	3504	4093	5007
Noakhali	4	2631	3180	3692	4308	5277
Sylhet	5	3134	3250	3548	4115	5071
Dhaka	6	3229	3360	3261	3794	4660
Faridpur	7	2683	2725	3003	3641	4292
Jamalpur	8	2470	2747	3068	3575	4384
Mymensingh	9	2807	2783	3002	3497	4290
Tangail	10	2921	2894	3126	3644	4467
Barisal	11	2644	2727	3136	3648	4481
Jessore	12	2701	2826	3307	3845	4725
Khulna	13	3395	3527	3630	4212	5187
Kushtia	14	2583	2700	3487	4054	4983
Patuakhali	15	3036	3043	3304	3818	4722
Bogra	16	2819	3401	3983	4636	5692
Dinajpur	17	2881	2906	3357	3901	4797
Pabna	18	2674	3457	4171	4871	5961
Rajshahi	19	2644	2792	3261	3773	4661
Rangpur	20	2709	2809	3472	4042	4962
Bangladesh		3013	3177	3492	4082	5038

Source: Consultants. Table 2.2.5 and 2.5.7

Other developments in the same region are the Bahi Maddharpur Hardrock and Bangalibazar Maddharpur limestone projects, as well as a newly discovered, but significant, coal field in Dinajpur. As these natural resources are developed, they will place a demand on the transport system even before there is any production as construction equipment and other goods will be needed in the development phase.

These projects in the northwest further emphasise the necessity of developing an adequate transport system in that region.

The limestone deposit in Joypurhat is intended to be the basis for a cement complex to provide for the needs of the northwest, and possibly for other areas.

With such an increase projected in commodity outputs in the northwest, it is possible that a more detailed regional development study will need to be undertaken in order to coordinate what may be competing demands for resources, particularly transport.

At present no gas has been found on the west bank of the Jamuna river, necessitating fertilizer being moved from the Urea plants in Dhaka, or even imported. If gas is found, or if a gas pipe line is constructed, the construction of urea fertilizer plant in the north-west would meet the growing demand of the region.

Such is the existing distribution of the industrial base of the country, it is unlikely that major changes will occur, at least within the next five years. Although food self-sufficiency will enable resources to be channeled into other sectors, this will not happen before 1990.

Most of the scenarios of economic growth and population growth and distribution are based on existing trends and past developments. For this study these scenarios have been accepted with some allowances for those effects already described. This will set the broad framework within which national transport planning can take place. The locations of planned and proposed developments are shown in Figure 2.4.2.

2.4.6 Existing and Future Regional Food Production and Consumption

The existing production of food grains is not sufficient for the population, even at a low level of consumption and consequently up to a million tonnes a year are imported, mostly through the port of Chittagong. The overall picture, however, hides a more serious problem, that of regional deficit. Even if the total production can be raised to national food self-sufficienty, there will still be areas that are considerably in deficit, notably Dhaka, Chittagong and Khulna due to the large urban populations.

Because of the volume, and the likely changes in distribution patterns as a result of reduced imports as national self-sufficiency is attained (target date is 1990), the estimated food production and consumption has been calculated for each district, based on existing and projected populations and assumptions on consumption rates, as well as predicted future production.

A slight rise in the average daily consumption per capita from 15 oz (426 gm) in 1981 to 16.6 oz (470 gm) has been assumed. The population forecasts, based on the ONPP preferred scenario have been used (from Table 2.2.5). Estimates of existing and future cereal production by district have been made by the BEPP Rural Energy Analysis, and have been used for this analysis (allowing 10% for losses and seed). The estimated existing and future cereal consumption by district are in Table 2.4.9. and production in Table 2.4.10 and the deficit or surplus in Table 2.4.11.

It can be seen that with few exceptions, all the districts demonstrate a consistency in the direction of the balance, i.e those with a surplus increase their surplus over time (eg Rangpur) those with a deficit either reduce and go into surplus (eg Pabna) or increase in deficit (eg Dhaka). The only exceptions to this are Noakhali, which slowly reduced its surplus and becomes a slight deficit by 2000, Faridpur, which although declining in deficit, remains in deficit by 2000, Sylhet Patuakhali and Bogra, which fluctuate in surplus and Barisal which dips into deficit before increasing substantially.

Although there is not much change in the pattern of the balance, deficit or surplus, the way in which the deficit areas can be fed will change significantly. At the moment, the food imports that substantially supply Dhaka, Chittagong and Khulna, move from south northwards. Chittagong, Chittagong Hill Tracts and Comilla all large deficit areas can currently be supplied from the imported food. In the future, Dhaka is likely to be supp'ied from a different direction to the existing situation, that is, from north and particularly northwest. Khulna, (and Kushtia) should be supplied from the growing surplus from Barisal and Patuakhali.

Although overall there may be self-sufficiency in food, not all the theoretical surplus will be marketable. However, the patterns of movement are unlikely to be affected by this and Table 2.4.11 can be used as a guide to future food grain movements.

Table 2.4.9 Estimated Existing and Future Cereal Consumption 1981-2000

District	No.	Estimated Cereal Consumption				
		1981 (1000T)	1985 (1000T)	1990 (1000T)	1995 (1000T)	2000 (1000T)
Chittagong	1	886	1029	1232	1475	1750
Ctg. Hill Tracts	2	121	169	249	362	513
Comilla	3	1098	1213	1362	1536	1734
Noakhali	4	609	669	745	833	929
Sylhet	5	903	1003	1125	1257	1384
Dhaka	6	1622	1975	2492	3142	3922
Faridpur	7	757	818	896	985	1082
Jamalpur	8	392	437	497	567	645
Mymensingh	9	1049	1169	1326	1507	1706
Tangail	10	390	431	490	559	635
Barisal	11	746	819	906	1001	1094
Jessore	12	643	732	860	1013	1184
Khulna	13	696	787	909	1049	1197
Kushtia	14	367	421	499	592	698
Patuakhali	15	294	332	375	422	463
Bogra	16	435	503	600	716	851
Dinajpur	17	511	600	724	874	1045
Pabna	18	548	627	744	887	1059
Rajshahi	19	842	969	1146	1349	1562
Rangpur	20	1041	1173	1351	1559	1790
Bangladesh		13950	15876	18528	21685	25243
Per capita consumption/Day	Oz	15.0	15.4	15.8	16.2	16.6
	gm	426	437	448	460	470

Source: Consultants, and Table 2.2.5

Table 2.4.10 Estimated Existing and Future Cereal Production 1981-2000

District	No.	Total Cereal Production								
		1981	1985		1990		1995		2000	
		Actual (1000T)	Est-imated	%p.a.	Est-imated	%p.a.	Est-imated	%p.a.	Est-imated	%p.a.
Chittagong	1	836	903	1.95	1011	2.29	1153	2.66	1316	2.68
Ctg. Hill Tracts	2	114	124	2.12	150	3.88	181	3.83	198	1.81
Comilla	3	1097	1212	2.52	1361	2.35	1507	2.06	1653	1.87
Noakhali	4	718	760	1.43	842	2.07	933	2.07	996	1.32
Sylhet	5	1282	1347	1.24	1465	1.69	1640	2.28	1844	2.37
Dhaka	6	830	1031	5.57	1259	4.08	1484	3.34	1737	3.20
Faridpur	7	489	543	2.65	709	5.48	917	5.28	1129	4.25
Jamalpur	8	471	592	5.88	723	4.08	877	3.94	1036	3.39
Mymensignh	9	1558	1737	2.76	1986	2.72	2257	2.59	2563	2.58
Tangail	10	496	650	6.99	772	3.50	902	3.16	1010	2.29
Barisal	11	842	885	1.25	1084	4.14	1440	5.84	1909	5.80
Jessore	12	625	780	5.69	982	4.71	1207	4.21	1347	2.22
Khulna	13	632	706	2.81	775	1.88	853	1.94	933	1.81
Kushtia	14	347	430	5.51	491	2.69	557	2.55	621	2.20
Patuakhali	15	418	447	1.69	555	4.42	749	6.18	1017	6.31
Bogra	16	654	899	8.28	1007	2.29	1110	1.97	1187	1.35
Dinajpur	17	853	961	3.03	1114	3.00	1310	3.29	1541	3.30
Pabna	18	470	683	9.79	918	6.09	1143	4.48	1342	3.26
Rajshahi	19	864	1114	6.56	1391	4.54	1665	3.66	1984	3.57
Rangpur	20	1414	1676	4.34	1983	3.42	2366	3.59	2848	3.78
Bangladesh		15010	17479	3.88	20578	3.32	24251	3.34	28211	3.07

Source: BEPP - Rural Energy Analysis

N,B These figures are gross production

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Table 2.4.11 Estimated Existing and Future Cereal Surplus or Deficit 1981-2000

District	No.	1981 1000T	1985 1000T	1990 1000T	1995 1000T	2000 1000T
Chittagong	1	-134	-216	-322	-437	-566
Ctg. Hill Tracts	2	- 18	- 57	-114	-199	-335
Comilla	3	-111	-122	-137	-180	-246
Noakhali	4	37	15	13	7	- 33
Sylhet	5	251	209	194	219	276
Dhaka	6	-875	-1047	-1359	-1806	-2359
Faridpur	7	-317	-329	-258	-160	- 66
Jamalpur	8	32	96	154	222	287
Mymensingh	9	353	394	461	524	601
Tangail	10	56	154	205	253	274
Barisal	11	12	- 23	70	295	624
Jessore	12	-81	- 30	24	73	28
Khulna	13	-127	-152	-212	-281	-357
Kushtia	14	-55	- 34	- 57	- 91	-139
Patuakhali	15	82	70	125	252	452
Bogra	16	154	306	306	283	217
Dinajpur	17	257	265	279	305	342
Pabna	18	-125	-12	82	142	149
Rajshahi	19	-64	34	106	150	224
Rangpur	20	232	335	434	570	773
Bangladesh		-441	-144	- 6	141	146

Source: Consultants, Table 2.4.9 and 2.4.10

N.B. Cereal balance = Gross production - 10% gross production for losses and seeds - consumption.

2.5 Transport Overview

2.5.1 Historical Background

Before 1947 and partition, the transport system of the region west of Jamuna River was basically oriented to serve the port of Calcutta. The Northeast was tied to Assam in terms of transport, and the Southeast to the port of Chittagong. There were few paved roads. Although there was a well developed rail system, it was not designed to serve the needs of the region without Calcutta.

After the partition Chittagong was the only port and was a major terminal run by the railways. After partition, a second port, Chalna on the Pusur river was selected. There were long delays in planning and construction and because of siltation of the river, it is only just becoming fully operational, although midstream unloading and loading of vessels has been carried out for some time.

Railways became isolated after the partition. Linkages to India were lost. Subsequent neglect of maintenance and proper investment have contributed to its decline.

Apart from the railway, transport was also handled by inland water transport. Because of the dominance of the Railway Board, (they even ran their own fleet of barges) for many years IWT was not very well organized or equipped.

The rivers were used, however, for Indian transit traffic between Calcutta and Assam, upto 1965 and the war with Pakistan. Thereafter the border was closed until the liberation of Bangladesh, by which time India had built a broad gauge rail link and had found alternatives that did not involve a transit in Bangladesh.

In the 1950s and 60s, considerable efforts were made to develop the road network, despite the difficulties posed by numerous rivers and lack of suitable material for the embankment. Necessary to keep the road above flood levels. Bridges were built and major river crossing were served by ferries.

In this period, the road network increased from some 460 km of paved road to 3200 km. Inland river ports were built and new railway stations and sidings were added to the rail system.

The war of liberation, however, undid much of what had been developed through the destruction of bridges, rail track, rolling stock, ships and ports. Enormous efforts were made to restore the transport systems in the aftermath of the war with massive investments in construction and rolling stock. In this period, most of the transport operators were nationalized. More recently, however, privatization has been encouraged, and the state owned operators are now facing commercial competition.

2.5.2 Existing Situation

As a result of the massive investment in the early 1970's the basic network is substantially complete, apart from a few notable exceptions. The railways and the waterway transport, however, have had investments focused on rolling stock or vessell acquisition with little improvements in infrastructure, which leaves the road network to meet the increasing demand of an expanding population and economy.

As the rivers flow north to south, the land transport systems have tended to follow the same line. Thus it is much easier to travel on a north south axis than east-west, whatever mode is used. The Jamuna River virtually cuts the country in two, and although there are both rail and road ferries, delays are often severe, apart from the time for making the crossing. Variations in water level between dry season and flood season and the river's tendency to throwup sand bars and move its bed, make river crossings difficult and costly to maintain.

The major road network in Bangladesh consists of some 5 700 km of paved road and 4 800 km of gravel and unpaved road under responsible of the Roads and Highways Department. Poor construction materials and inadequate compaction have resulted in a deteriorating network. Insufficient money is being spent on routine and periodic maintenance and there is a need for urgent rehabilitation of some sections.

Both private and public companies operate freight and passenger services. Because of the difficulty of getting return loads, trucks are often overloaded when transporting freight, in order to compensate for the empty return, a major cause of road deterioration. Bus operators provide a reasonable service, but buses are susceptible to breakdown through inadequate maintenance.

The rail system consists of two gauges, broad gauge west of the Jamuna (970 km) and metre gauge predominantly on the east although there are also some links in the west as well; (total 1900 km). Because the original network has been disrupted by the border with India and the change in orientation to Chittagong and Chalna, there has been a change in line usage, with some lines, originally branch lines taking much heavier traffic than they were designed.

It is worth mentioning that during severe flooding the railways often become the only communication means as well as provide shelterfro affected people.

Passenger traffic has substantially increased since Independence, although the uncertainty surrounding the volume of ticketless passengers obscures the actual volume. On the other hand, in recent years there has been a steady decline in the volume of freight carried.

The river network is vast and complicated, varying with the season in length from 8300 km to 5120 km (including Bay crossing). In recent years there has been an increasing loss of dry season routes

due to siltation. Between 1973 and 1984, the length of primary and secondary routes with a draft in excess of 6 feet declined from 3640 km to 2853 km.

Because river transport is the oldest means of travel and for some areas, the best suited to the riverine nature of the country, it carries a significant amount of freight and passenger traffic. The bulk of the freight traffic moves between the ports of Chittagong and Chalna and the towns of Dhaka, Narayanganj and Khulna.

River transport is sometimes dangerous, particularly during the monsoon season, due to poor maintenance of vessels, poor navigational aids, and poor preparedness for sudden changes in weather.

There is a considerable imbalance between imports and exports through the ports, with Chittagong handling the bulk of import traffic and Chalna the export, particularly jute and jute products.

Thus there is now a basic transport system to serve the needs of Bangladesh, although for various reasons, the level of service is generally low. Travel times are long because of low speeds and ferries cause long delays on the road. Also, because of the sparseness of the network, some journeys are difficult, particularly for east-west movement.

Figure 2.5.1 shows the railway system, the main arterial roads and the primary inland waterway routes.

CHAPTER 3

INTERMODAL ANALYSIS

3.1 Objectives and Factors Considered

3.1.1 Analysis Objectives and Approaches

Transport systems are rarely independent. Different modes of transport often compete or complement each other. Figure 3.1.1 shows a schematic diagram of major links of rail, road and waterway systems in Bangladesh. It can be seen that many parts of the country are served by the three modes. It is, therefore, essential to analyze the system including all three modes as a whole. This chapter presents an analysis of the transport sector as a whole focusing on intermodal and supramodal aspects.

Two separate objectives should be recognized for intermodal study. The first one is to find an optimum combination of transport modes which minimizes the total cost of absorbing a certain level of transport demand in the context of national economy.

The second one is to find ways and means to guide the transport development, demand an supply, toward the optimum.

This recognition of different objectives is important since they require different approaches. On the one hand, the former is concerned with the performance characteristics of the transport sector of the economy in terms of absolute economic costs. On the other hand the latter is concerned with the characteristics of the transport sector as perceived by users and operators of transport services, which are normally not based on economic costs.

In order to pursue the first objective economic resource costs of each of the three transport modes, i.e. rail, road and waterway, were analyzed and the optimum combinations were sought. For this purpose a set of computer models which calculate the total economic cost of each mode for any distance and traffic volume were developed for the prevailing factor prices and conditions in Bangladesh. Economic resource costs of each mode under assumed improved conditions were also obtained by means of the models. Another computerized model was developed which seeks the optimum modal split under the given resource cost characteristics of the three mode. A technique called dynamic programming was utilized for the latter model. Five major transport corridors of Bangladesh were analyzed by applying the results of the computer modeling analysis.

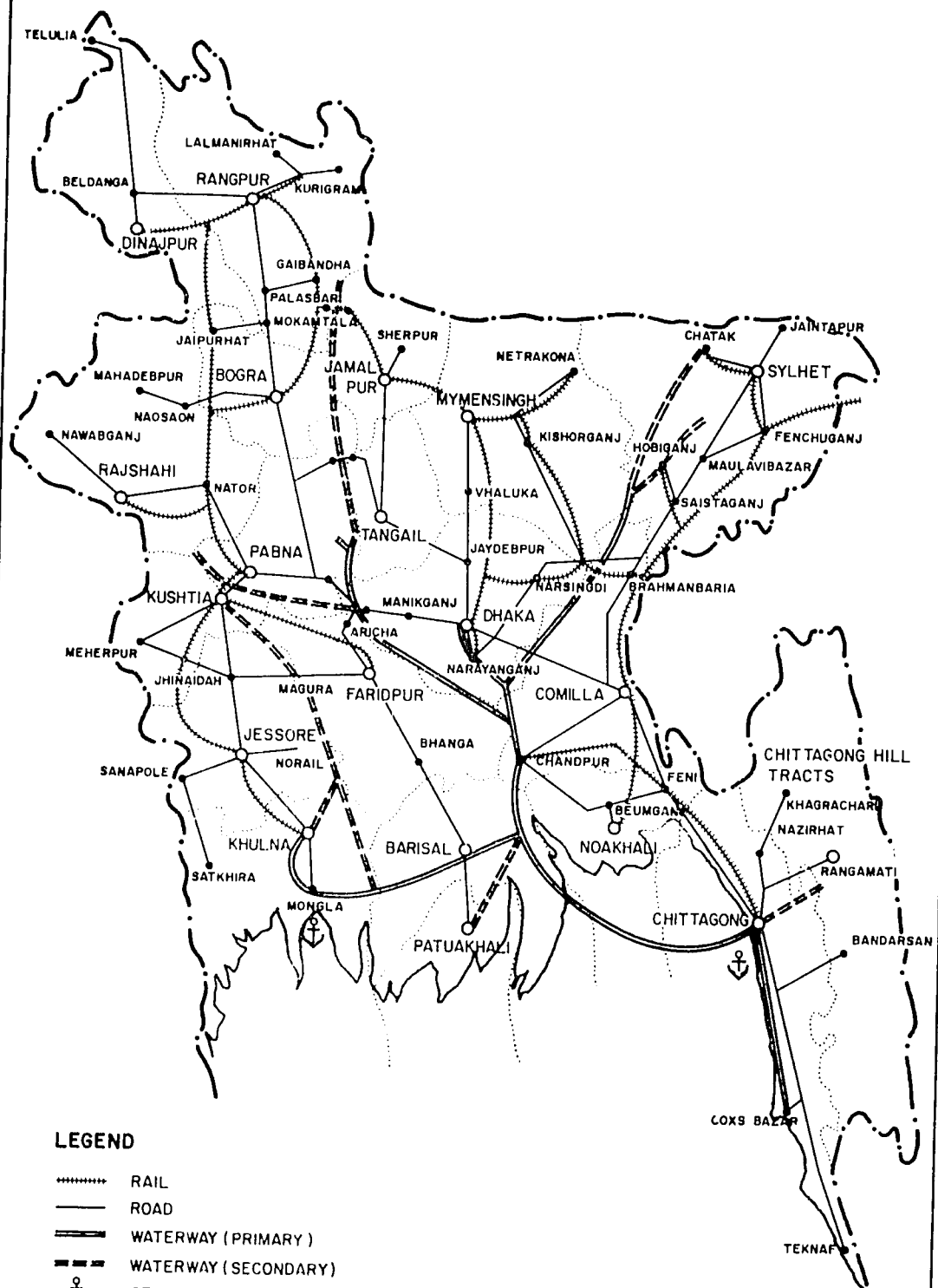

FIG. 3.1.1 BANGLADESH ARTERIAL TRANSPORT NETWORK SCHEMATIC DIAGRAM

For the second objective the results of the Consultants' user surveys were analyzed to determine the behavior of users. Factors affecting users' choice of transport mode were identified and their importance and extent of influence were clarified. Factors affecting the transport supply were identified and their roles in Bangladesh were examined.

Existing situation in terms of modal split was assessed in light of the results of the intermodal analysis. Implications for future policy changes were identified and discussed.

3.1.2 Factors Affecting Economic Optimum Modal Split

When shifting of any amount of traffic, passenger or goods, from one mode to any other mode results in an increase in the total amount of resource spent in the transport sector, the transport sector can be said to be in the economically optimum situation concerning the modal split. The optimality is defined in terms of resource cost to the national economy, not to individual users, not to transport service operators, nor to the Government.

Such optimality, i.e. the least cost solution, depends on many factors. It depends on type and volume of traffic demand, cost of transport service supply, and cost of keeping passengers or goods in transit. Appendix 3.1 Table 3.1.1 lists factors affecting the total resource cost of transport.

Type and volume of traffic demand determine transport service requirements. If there is an excess capacity in a mode, increase of traffic in that mode would not increase the total cost much. If a mode is operated at capacity, any increase in traffic would require capital investment. Such investment may not be necessary at this time but may have to be done in a few years time because of cumulative effect of traffic growth. The total economic cost, therefore, must be compared in terms of the total amount over a certain time period. In this study, discounted present value was used for the comparison of cost streams over time.

The cost of transport supply comprises three broad categories, capital and operating costs of rolling stock/vehicle/vessel, capital and maintenance costs of infrastructure, and the cost of cargo handling. The last category applies only to freight transport. Determinants of transport supply costs are listed in Appendix 3.1 Table 3.1.1 for each mode. An important factor determining the capital cost of rolling stock/vehicle/vessel is the utilization level. The effect of improvement in utilization level in Bangladesh seems to be large. The cost of operation depends in part on the existing conditions of facilities. Poor conditions make the operating cost high. It should also be noted that operational practices determined by the management can have a large diffference in the cost of operation.

In addition to the cost of maintaining the existing infrastructure, the cost of providing new infrastructure facilities or improving the existing infrastructure should be included in the total cost where applicable. As stated earlier, taking into account only existing limitations and conditions of the transport system may lead to erroneous conclusions even for the short run, when some changes in infrastructure are in order in the near future.

The analysis and costing of cargo handling should include the feeder services connecting the point of initial origin or final destination with the point of boarding or loading onto linehaul service.

Passengers in transit loose their time which could have been used elsewhere for productive purposes. Similarly, as long as goods are in transit they can not be sold or used or consumed for their original purposes. loosing an amount of value attributable to the time period in transit. For the majority of passengers in Bangladesh, however, the value of time in transit is insignificant. The majority of goods transported in Bangladesh are low value bulk commodities and the effect of transit time on their final value should not be significant. In this study, therefore, the value of time for passengers and goods were not included in the quantitative analysis.

3.1.3 Factors of Modal Choice

As many as 14 or 18 factors can be involved when a passenger or a shipper select a particular mode over other modes for a particular trip or a shipment. This is illustrated in Appendix 3.1 Figure 3.1.2 and Figure 3.1.3. All factors shown below the dotted line affect passengers' or shippers' decision as perceived by them. Some of the factors are never perceived in quantifiable terms.

Not many factors are under the Government control. It should be recognized, therefore, that guiding the modal split is not an easy task. What Government can do most, however, is to influence the long term development of physical availability of transport services while exerting non-physical means of incentives and discouragement.

Financial viability of transport operators, governmental or private, affects the modal choice of users insofaras it affects the operators' ability and direction to develop the transport system. Inproperly priced and controled fares and rates may distort development strategies and operational practices of the operator away from the path toward the economic optimum.

Factors as perceived by users can be classified into four categories; 1) out of-pocket cost, 2) time and reliability, 3) comfort and safety for passengers and probability of damage and pilferage for goods, and 4) non tangible as shown in Figure 3.1.2 and Figure 3.1.3. Evaluation of these factors by shipper or passenger varies depending on type and consignment size of goods to be shipped, or trip purpose of the passenger.

Analysis on these factors are presented in Section 3.4.

3.1.4 Factors Affecting Modal Supply

Transport service suppliers are affected by many factors, internal decision making, external market force, and government actions. Table 3.1.2 lists such factors in general terms. All factors are interrelated to varying degrees.

As oppose to the process of modal choice by users, Government can affect, intentionally or unintentionally, the development of transport supply to a large extent. Some of the prominent means available to the Government are listed in Table 3.1.2.

Table 3.1.2 Factors Affecting Modal Supply

- o Traffic Demand
- o Planning
  - Governmental Planning
    - * Planning at Various Levels
      - - Central, i.e. Planning Commission
      - - Ministrial
      - - Departmental or by agency
  - Private Planning
- o Profitability of Operation and Cost Recovery
  - Revenue Factors
    - * Fares and Rates
      - - Governmental controls
      - - Market conditions
      - - Marketing
      - - Revenue leakage e.g. ticketless passengers, underrecording
  - Earmarked User Charges
    - * Availability of user charges earmarked for use in transport sector.
- o Infrastructure
  - Investment Decision
    - * Governmental budget allocation
    - * Foreign aid availability
    - * Private investment, e.g. private jetties
  - Construction
    - * Capability of local contractors
    - * Capability of agencies for supervision
    - * Design standards
  - Maintenance
    - * Governmental budget allocation
    - * Foreign aid availability
    - * Private sector maintenance

- Rolling stock/Vehicl/Vessel Fleet
  - Investment Decision
    - Governmental budget allocation
    - Foreign aid availability
    - Private investment
    - Price
      - Import duty including for parts
      - Import quota
      - Local manufacturing/assembly protection policy
      - Excise tax
    - Credit availability and terms
    - Regulatory and design limits on vehicle/vessel size
  - Aquisition timing
    - Governmental import regulations, e.g. licensing, approval
  - Maintenance
    - Governmental budget allocation
    - Ease in spare parts aquisition
      - Government approval
      - Import duties and taxes

- Operation
  - Public sector involvement
    - Government policy on direct involvement, defined objectives
      - extent
      - types of services
    - Privatization policy
  - Direct Operation Controls
    - Route licensing
  - Indirect Usage Controls
    - Taxes
      - fuel tax
      - tolls
    - Fees
      - Registration fees
  - Managereal Conditions
    - Functional efficiencies

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3.2 Historical Changes in Modal Shares

Shares of each mode in transporting passengers and goods, called modal split, were determined by comparing the total ton-km and passenger-km figures developed for each mode as described in Chapters 8, 9, and 10. Methods used in establishing existing as well as past performance indicators of passenger-km and ton-km are presented in these chapters.

As noted in these chapters, these estimates contain a margin of error which may not be insignificant due to the lack of a solid data base. Estimates for the road mode are probably slightly over-estimated to some extent because of the likely proximity of some traffic count locations to urban areas. However, road mode ton-km and passenger-km estimates in this report do not include those made inside urban areas as oppose to estimates in previous studies which were based on fleet size and necessarily included urban travel.

Ticketless passengers on the rail mode were taken into consideration. Freight ton-km by rail presented in this report, however, are those published by the Bangladesh Railway. These recorded freight tonnages may well be lower than the actual considering the practice of under-recording, which is prevalent in other modes.

Nevertheless, the total ton-km and total passenger-km estimates developed in this study should give a fair picture of trends in inland transportation in Bangladesh.

1) Freight Transport

Figure 3.2.1 shows past trends in freight transport in terms of the total ton-km by each mode, and Figure 3.2.2 shows changes in the shares of each mode in freight transport.

While the performance of the railways has been stagnating or showing decline in recent years and the performance of IWT has been steadily but slowly growing, the growth of the total ton-km by road has been remarkable. Since 1976 the total freight ton-km by all three modes has increased by almost 50%, of which 74% were taken up by road, 24% by IWT, and only 2% by the railways.

The difference in the ability to capture the growing freight transport market has made the relative shares of each mode to change. This is illustrated in Figure 3.2.2. The road mode has increased its share from 44% in 1976 to 54% in 1985, whereas the rail mode has lost its share from 23% to 16% in the same time period. The IWT mode has held its share fairly well, loosing 3% from 33% to 30%.

Ton-km estimates are shown in Appendix 3.2 Table 3.2.1.

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Fig. 3.2.1

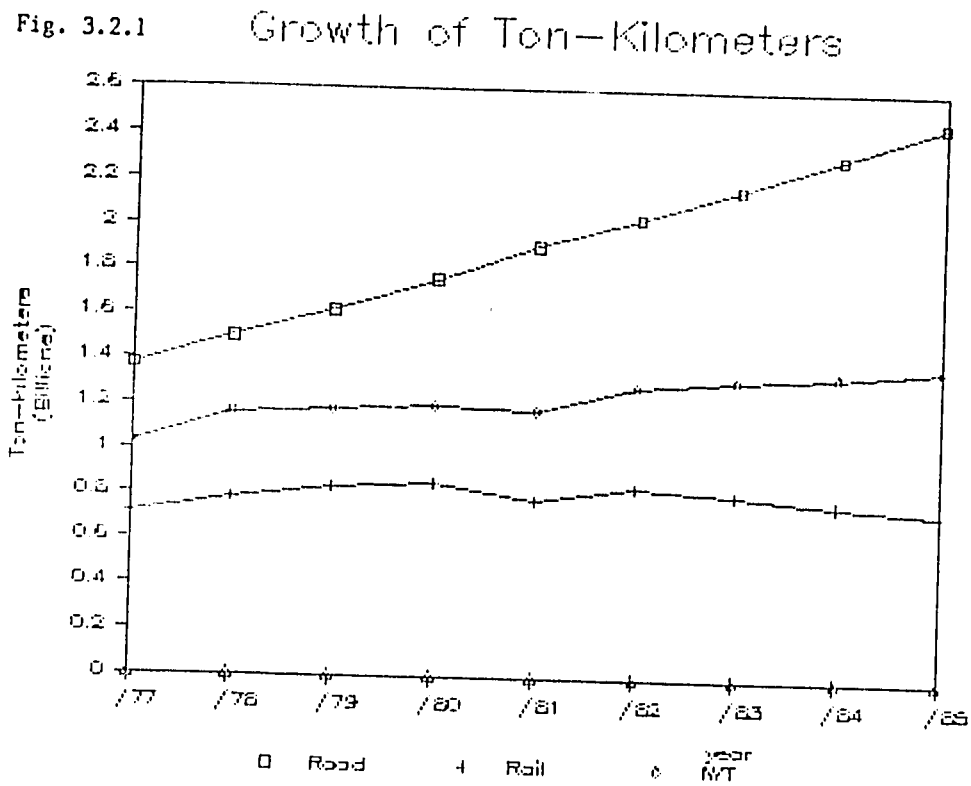

Fig. 3.2.2

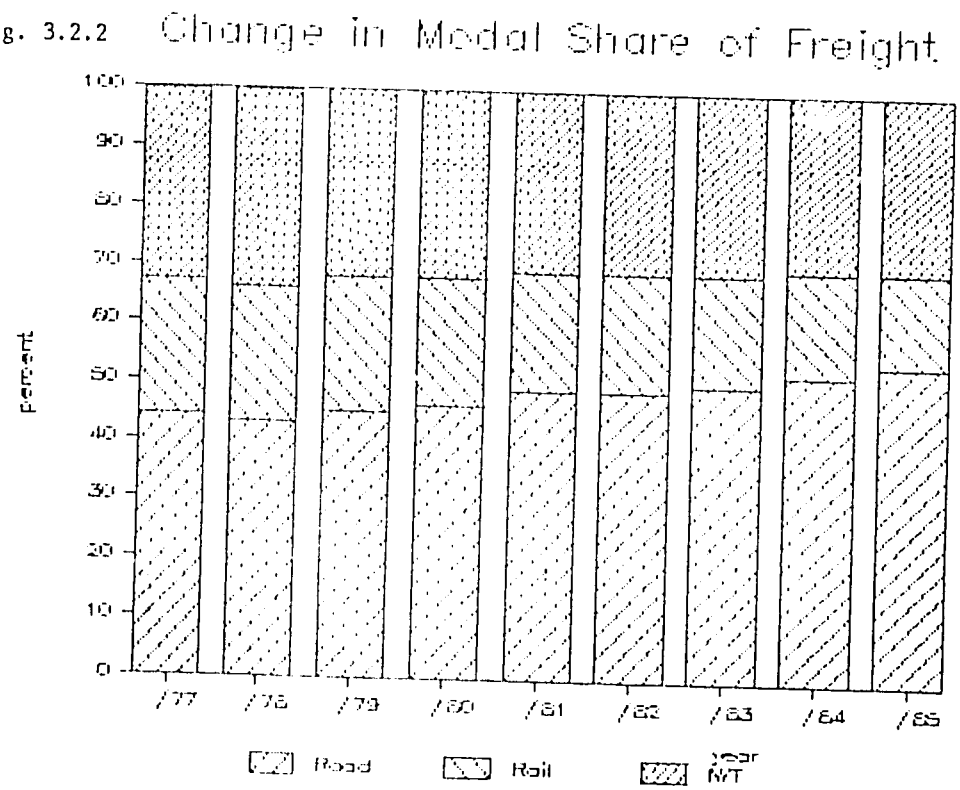

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Table 3.2.1. Growth of Freight in tons by Mode 1976/77 to 1984/85

Year	Tons (million)				Modal Percentage			
	Road	Rail	IWT	Total	Road	Rail	IWT	Total
1976/77	8.06	3.16	4.26	15.48	52	20	28	100
1977/78	8.76	3.57	4.83	17.16	51	21	28	100
1978/79	9.52	3.24	4.89	17.65	54	18	28	100
1979/80	10.35	3.18	4.98	18.51	56	17	28	100
1980/81	11.24	2.98	4.90	19.12	59	16	25	100
1981/82	11.98	3.23	5.36	20.57	58	16	26	100
1982/83	12.76	3.00	5.47	21.23	60	14	26	100
1983/84	13/59	2.94	5.58	22.11	61	14	25	100
1984/85	14.47	2.82	5.73	23.2	63	12	25	100
G.R. 1976/77 to 1980/81	8.7	-1.5	3.6	5.4 % p.a.				
G.R. 1980/81 to 1984/85	6.5	-1.4	4.0	4.8 % p.a.				

Source: 1. Appendix Table 3.2.1 assuming road average lead of 170 km and IWT average lead of 241 km

2. B.R. 1984 Year book

3. Consultants calculations

Because of the shorter average lead of the road freight transport, the share of the road mode is higher in terms of total tonnage hauled than in terms of total ton-km. Details are shown in Table 3.2.1. It was estimated that the shares of each mode in terms of total tonnage are 63% for road, 12% for rail, and 25% for IWT. The drop of the railways in its share in the total tonnage hauled is partly due to the increase in the average lead from 225 km in 1976 to 265 km in 1984.

2) Passenger Transport

The picture is somewhat different for the passenger transport as shown in Figure 3.2.3 and Figure 3.2.4. Although the total amount by the road mode has been increasing, traffic by other two modes have also increased as illustrated in Figure 3.2.3.

As a result modal shares of each mode have not significantly changed in the last 10 years. The road mode has taken 50%, the railways 30%, and the IWT mode remaining 20%.

In terms of the number of passengers carried, however, the share of the railways has decreased. Increasingly rail passengers have been traveling longer distances but relatively less in number, although the total passenger-km has been increasing. The share of railways in the total number of passengers carried declined from 38% in 1975 to 30% in 1984. The difference of 8% has been taken up equally by the road mode and the IWT mode.

Estimated number of passengers by mode by year are shown in Table 3.2.2.

Pasenger-km estimates are shown in Appendix 3.2 Table 3.2.2.

Fig. 3.2.3 Growth of Passenger—Kilometers

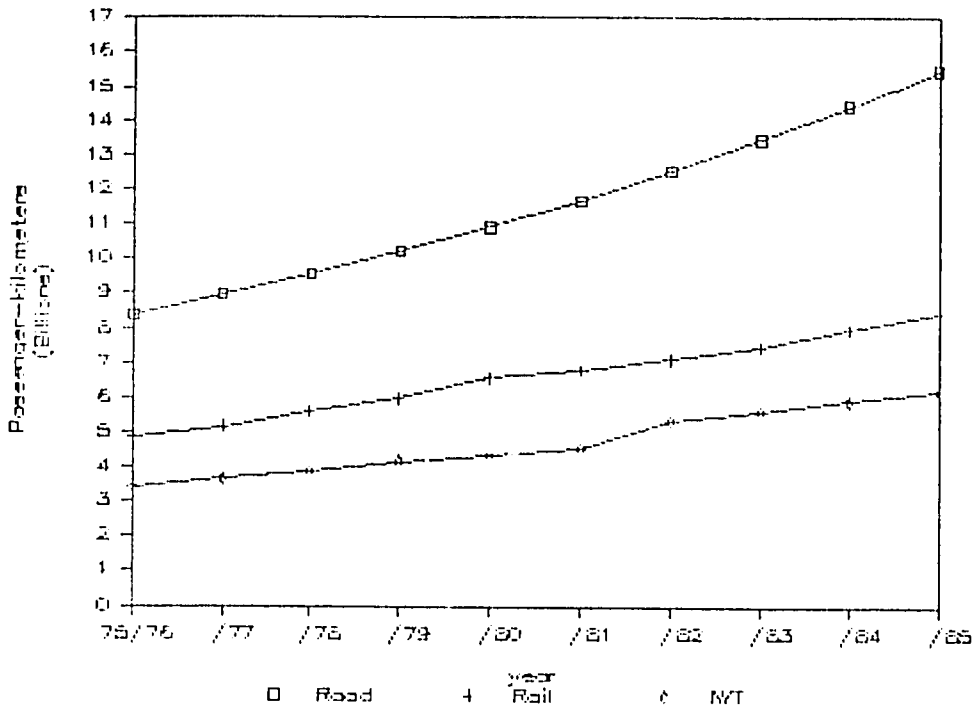


Fig. 3.2.4 Change in Modal Share of Passenger

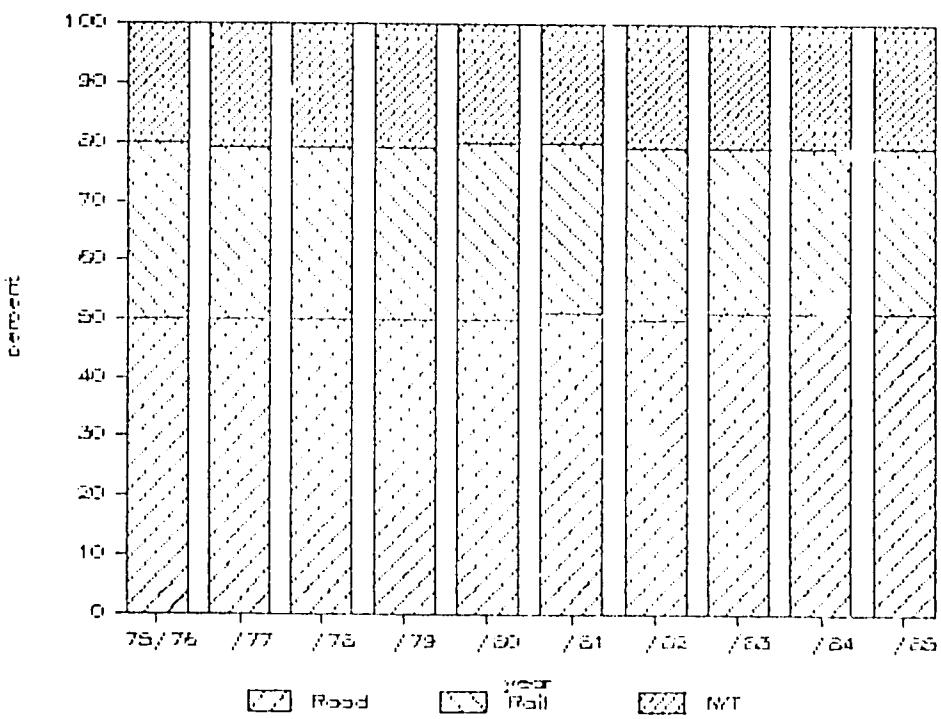


Table 3.2.2. Growth of Passengers by Mode 1975/76 to 1984/85

Year	Passenger (million)				Modal Percentage			
	Road	Rail	IWT	Total	Road	Rail	IWT	Total
1975/76	93.1	102.4	77.5	273.0	34	38	28	100
1976/77	99.5	105.1	82.9	287.5	35	36	29	100
1977/78	106.3	107.8	88.5	302.6	35	36	29	100
1978/79	113.6	110.5	94.6	318.7	36	35	29	100
1979/80	121.3	113.4	98.0	332.7	36	34	30	100
1980/81	129.6	116.3	102.9	348.8	37	33	30	100
1981/82	139.1	119.3	120.8	379.2	37	31	32	100
1982/83	149.2	122.3	127.4	398.9	37	31	32	100
1983/84	160.1	125.5	134.0	419.6	38	30	32	100
1984/85	171.8	132.5	141.0	445.3	38	30	32	100
G.R. 1975 to 1980	6.8	6	5.8	5.0	% p.a.			
G.R. 1980 to 1984	7.3	3.3	8.2	6.3	% p.a.			

Source: 1. Appexdix Table 3.2.2 assuming road average lead of 90 km,
2. Appendix Table 3.2.2 and assuming IWT average lead of 44 km,
3. Consultants calculations

3.3 Factors Affecting Modal Choice

3.3.1 Users Criteria for Modal Choice

An interview survey was carried out by the Consultants to passengers and shippers to obtain information concerning why they had chosen a particular mode over other modes.

Table 3.3.1 shows percentage distribution of shippers with regard to reasons for choosing a particular mode. Although the sample size is small, the resulting table clearly indicates a general tendency. While a majority of road users cited the time saving as the reason for choosing the mode, a greater majority of IWT users cited the cost saving as the primary reason. Users of the rail mode perceive its advantage in neither time saving nor cost saving but in convenience. This may seem surprising when considering the nature of the rail transport which is not a door-to-door service like trucking. What has probably been taking place is the loss of customers of the rail mode to other modes when they see other modes more convenient. Those who locate themselves convenient to the railways have stayed with the mode. Because of the once dominant position of the railways in Bangladesh, many freight generating entities, i.e. industrial plants, godowns, agricultural product depots, etc., are located near the railways. There must still be a pool of potential customers which the railways should exploit by making those shippers realize the convenience of railway services. Such historical advantage, however, may be lost by poor management. Despite the apparent excess supply of wagons, 3% of road users and 11% of IWT users cited the unavailability of rail wagons as the reason to choose the mode.

Although cost is not the primary concern of shippers except for the IWT mode, it is not insignificant for the rail and road modes. It was cited as the reason by 20% and 10% of shippers respectively. Non-availability of any competing mode is the reason for a sizable portion of shippers choosing the road mode, reflecting the limited coverage of the rail and IWT modes.

Table 3.3.1 Reasons for Choosing the Mode (Freight)

(in percent)

Reason for Choosing the Mode	Rail	Road	IWT
Save time	0	63	0
Save cost	20	10	77
Not available on others	0	24	6
No railway wagons	0	3	11
Safer	13	0	0
Convenience	67	0	6
Total	100	100	100

Table 3.3.2 summarizes the results of the Consultants user survey for passengers concerning their reason for modal choice. Subject samples were all passengers departing Dhaka on inter-district trips. One should imaging the majority of them returning to their home in districts.

An overwhelming majority chose IWT because of its low fare, whereas the time saving was the most important factor in choosing the road mode. Convenience seems to be the most important factor for the rail passengers.

The current actual, not nominal, level of IWT fares is about the same as the road mode and almost twice as much as the rail mode. However, in order to reach a place well served by the IWT such as Chandpur, Barisal, and Khulna, one has to take a long circutious route by the other mode. It is only for such routes that the IWT fare is the least expensive.

Table 3.3.2 Reasons for Choosing the Mode (Passengers)

(in percent)

Reasons	Rail	Road	IWT
Save cost	29	-	69
Save time	-	42	-
Near home or work	35	16	19
Easier	6	11	-
Comfort	6	18	12
Safer	18	7	-
No other mode	6	6	-
Total	100	100	100

Note: Third class passengers only for rail and IWT

Source: Consultants' survey

3.3.2 Freight Rates and Passenger Tariffs

1) Freight Rates

Going freight rates were surveyed by the Consultants as described in Chapters 8, 9, and 10. Table 3.3.3 summarizes typical freight rates for the three modes at various hauling distances. For distances longer than 100 km the road mode is the most expensive followed by the rail and the IWT in this order. At the distance of 300 km the typical freight rate of the road mode is 30% higher than the rail mode and 150% higher than the IWT. Typical freight charges of the three modes are illustrated in Figure 3.3.1. IWT is the cheapest at virtually any distance under the prevailing rates. The rail mode becomes less expensive to shippers for distance over 75 km as long as the linehaul operation is concerned.

However, costs other than the linehaul cost often incur to shippers during transporting their consignment from the initial origin to the final destination. If the points of initial origin or final destination are different from the loading and unloading points of the linehaul operation, the cost of feeder services connecting the initial origin or final destination with the points of loading or unloading of the linehaul service should also be added. Such feeder services are often required when using railways or IWT.

In the survey of freight shippers, data were collected on loading and unloading charges. Table 3.3.4 summarizes these charges for the three modes. There seem to be some anomalies in the reported charges as there are large variations. Some of the variations can be explained by regional differences or by available facilities. Some also depend on whether the data came from a private shipper or a public sector operator, with the latter reporting lower costs. Unfortunately the samples were not sufficiently large enough to allow for a rigorous analysis of the variation although there does not appear to be any difference between the modes.

It was estimated that for a feeder service by trucks for a distance of 10 km would cost Tk 4.0/tons km to the shipper on average, and loading and unloading operations Tk. 25/ton.

Since loading and unloading take place at both ends in any case, the cost of feeder service and transshipment were added to the rail mode rates and the IWT mode rates. For the case of one feeder service the additional cost of Tk.65/ton and for the case of two feeder services Tk.130/ton were applied. Resulting ton-km rates are shown in Table 3.3.3.

Because of the additonal charges to the rail mode and the IWT mode, intermodal advantage to shippers in terms of the total cost of freight transport changes. Table 3.3.5 summarizes the changes in relative advantage by including the cost of feeder operations. The distance under which the road mode command the cost advantage over other modes becomes longer. Under the prevailing rates the road mode can offer lower rates only under 80 km against the railways and under

Fig. 3.3.1

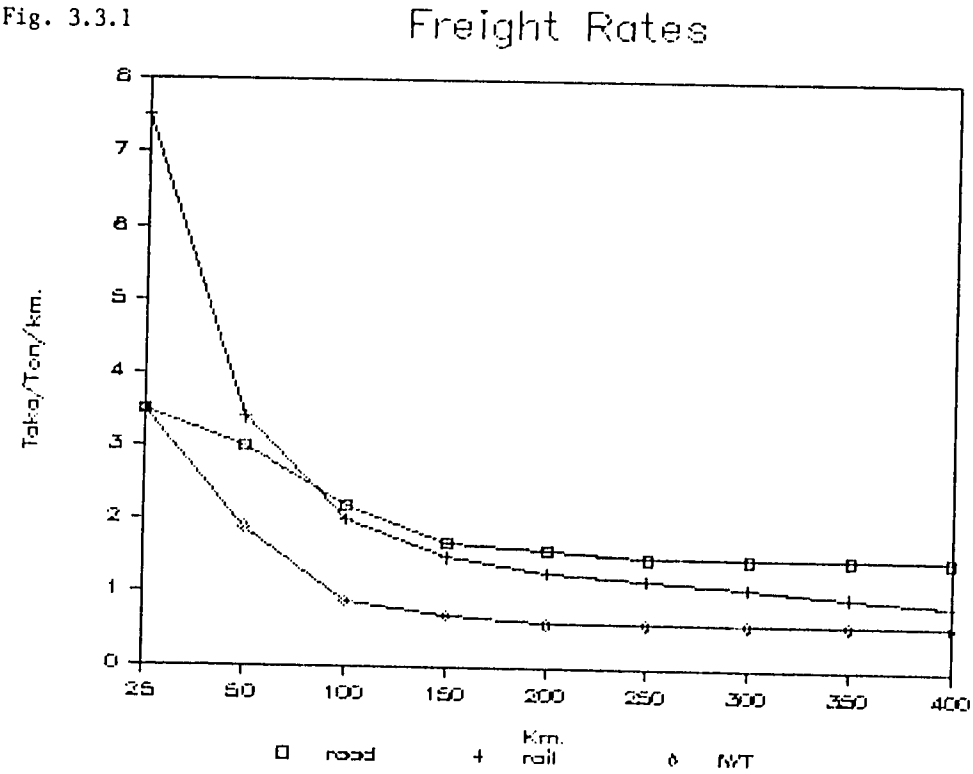


Fig. 3.3.2

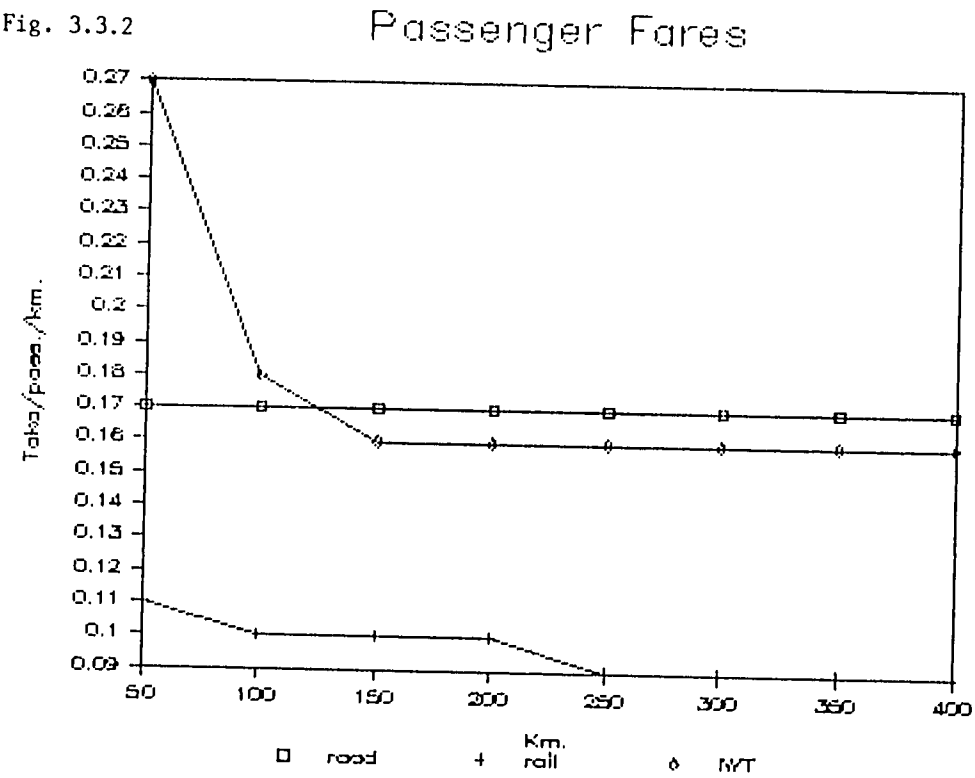


Table 3.3.3 Modal Freight Rates with Transshipment and Feeder Services

(1985 prices)

Distance km	Road Taka/T.km.	Rail Taka/T.km Line-haul	Rail Taka/T.km +1 Feeder	Rail Taka/T.km +2 Feeder	IWT Taka/T.km Line-haul	IWT Taka/T.km +1 Feeder	IWT Taka/T.km +2 Feeder
25	3.5	7.5	10.1	12.7	3.5	6.4	9.0
50	3.0	3.4	4.7	6.0	1.9	3.2	4.5
100	2.2	2.0	2.7	3.3	0.9	1.6	2.2
150	1.7	1.5	1.9	2.4	0.7	1.1	1.6
200	1.6	1.3	1.6	2.0	0.6	0.9	1.3
250	1.5	1.2	1.5	1.7	0.6	0.9	1.1
300	1.5	1.1	1.3	1.5	0.6	0.8	1.0
350	1.5	1.0	1.2	1.4	0.6	0.8	1.0
400	1.5	0.9	1.1	1.2	0.6	0.8	0.9

Source: Consultants surveys

Table 3.3.4 Freight Loading and Unloading Costs

(1985 prices)

Commodity	Road Loading Tk/Ton	Road Unloading Tk/Ton	Rail Loading Tk/Ton	Rail Unloading Tk/Ton	IWT Loading Tk/Ton	IWT Unloading Tk/Ton
Jute etc.	6-20	6-14	13-17	13-14	6-20	6-14
Fertilizer	8-10	10-12	8-30	8-35	8	9-10
Wheat	12-25	10-20	8-11	8-11	8-10	8-9
Rice	12-30	11-30	8-11	8-11	8-10	8-9
Iron etc.	23	23	13	13	-	-
Cement	20	20	8	8	40-48	12

Table 3.3.5 Break-even Distance of Freight Transport

(in km)

	Road-Rail	Road-IWT	Rail-IWT
Linehaul	80	30	0
Plus One Feeder	200	60	0
Plus Two Feeders	300	100	0
Rail One Feeder/IWT Two Feeders	-	-	0

Note: Figures show the distance beyond which the total transport charge uring the former mode is higher than the latter.

Source: Table 3.4.3

Table 3.3.6 Passenger Transport Rates by Mode

(in Taka/km)

Distance km	Road		Rail	IWT	
	With Jamuna	Without Jamuna		Coastal	Inland
25	-	0.17	0.11	0.22	
50	-	0.17	0.11	0.22	0.27
100	0.30	0.17	0.10	0.22	0.18
150	0.26	0.17	0.10	0.22	0.16
200	0.25	0.17	0.10	0.22	0.16
250	0.24	0.17	0.09	0.22	0.16
300	0.24	0.17	0.09	0.22	0.16
350	0.23	0.17	0.09	0.22	0.16
400	0.23	0.17	0.09	0.22	0.16

Source: Consultants survey

30 km against the IWT. With the inclusion of one feeder service and transshipment, this distance becomes 200 km against the railways and 100 km against the IWT. Railway rates, however, are higher against the IWT at any distance in any case, including the case of the rail mode with one feeder and the IWT with two feeders.

In actual cases, feeder service and transshipment costs are often not as important as the linehaul rates to shippers. Some shippers own and use private pettiers and no further external transport takes place. Some shippers provide own vehicles and gangs for feeder and transshipment work, internalizing the cost. A detailed study examining the structure of transport market is necessary to determine the price competitiveness of each of the three mode. The overall tendency, however, can be seen through the analysis presented in this subsection.

2) Passenger Tariffs

Passenger tariffs for the three modes have been analyzed in Chapter 8, 9 and 10 for rail, road and IWT. These fares are average or typical values, obtained from the passenger surveys and published fare schedules. The effect of the Jamuna crossing is noticeable for road fares as there is a distinct difference between those with a Jamuna crossing and those without. The fares are given in Table 3.3.6 and are plotted in Figure 3.3.2. Only third class rail fares are shown, as some 95% of rail passengers travel in this class, for which the fares are considerably less than other modes. Road fares without a Jamuna crossing are less than IWT for distances upto 120 km, although IWT coastal fares (BIWTC rates) are considerably higher than road.

The extent of cost advantage of a mode over others varies a great deal depending on particular trip ends because of large difference in route distance by mode. Table 3.3.7 shows fares for trips from Dhaka to selected destinations as well as associated route distances and travel times. It can be seen that the cost disadvantage of the road mode is not as high as the rate curve suggests because of shorter route distance over the rail mode in many cases. IWT's cost advantage over road for the Dhaka-Chandpur and Dhaka-Barisal routes is apparent.

3.3.3 Other Factors

1) Freight

Transit Time

Overall average travel speed of freight by the railways was found to be a little slower than IWT, 9.3 km/hr for rail freight against 10.4 km/hr for IWT. For some O&D pairs for which IWT is competitive in terms of route length, IWT commands a time advantage.

Table 3.3.7 Intermodal Comparison by Trip Ends

Destination	IWT Dist. km	IWT Time Hr.	IWT Fare by Class I	IWT Fare by Class II	IWT Fare by Class III	Rail Dist. km	Rail Time Hr.	Rail Fare by Class I	Rail Fare by Class II	Rail Fare by Class III	Road Dist. km	Road Time Hr.	Road Fare by Class Bus	Road Fare by Class Minibus
Bhairab						85	2.0			9	88	2.0	20	
Comilla						187	3.5	163		18	90	2.3	18	
Faridpur	134	10.5	25		18						105	3.5	30	
Mymensingl						116	3.8	106	25	12	124	2.0	20	23
Chand pur	66	4.5	25		15						156	4.0		35
Kistoregong						133	6.0		30	13	186	4.0	32	
Jessore						570	11.5	341		49	218	6.5	55	
Barisal	169	11.5	152		25						229	8.0	50	
Chittagong						343	6.5	284	70	44	240	7.3	43	
Sylhet						311	8.5	249	64	28	264	7.0	65	
Khulna	363	27.0	200		65	623	14.0	360		54	278	7.5	60	
Rangpur						414	14.5	285		36	304	10.5	75	
Dinajpur						481	16.7	309		42	385	12.0	88	

Source: Consultants survey

The results of the Consultants' user survey show that the road mode maintains a commanding time advantage in freight transport in all cases.

Other Factors

The problem of pilferage exists. Its severity is in the order of IWT, road and rail.

It is interesting to note that railway users responded most by giving "convenience" as the reason for choosing the mode. This susgests the existence of special relationships between the railways and users which users feel convenient. Special relationships are not limited to physical ones such as exclusive sidings. Institutional relationships may be important.

2) Passengers

Travel Time

The average travel speed of rail passenger trains does not significantly differ from that of buses under the prevailing conditions in Bangladesh as shown in Table 3.3.8. The average speed of IWT launches is almost one third of land transportation.

In terms of travel time to reach a desired destination, however, the road mode enjoys a clear advantage over the rail mode for most destinations as shown in Table 3.3.7. This is because the road network provides shorter routes than the circuitous rail routes for most destinations.

Despite much slower speed, IWT is competitive for certain destinations, such as to Chandpur and Basisal as shown in Table 3.3.7. because of the directness of waterway routes compared with other modes.

For many short distance routes served by IWT, access roads to landing stations are often long or unsuitable for mechanized vehicular traffic, leaving IWT as the virtual monopoly of passenger transport there.

Other factors

Other factors affecting passenger modal choice such as service reliability, comfort, and safety are not known in quantitative terms. Nevertheless, they are important factors as confirmed by Table 3.3.2.

Table 3.3.8. Average Travel Speed by Mode

	Mode		
	Rail	Road	IWT
User Survey			
Average speed (km/hr)	38.9	37.8	13.9
Standard deviation (km/hr)	11.2	8.8	0.8
Other sources			
Average speed (km/hr)	30.0	28.0	11.4

Source· Consultants' surveys

3.4 Economically Optimum Modal Split

3.4.1 Cost Characteristics of Transport Modes

When th only overall average costs such as cost/ton-km or cost/passenger-km for different modes are known, there can not be any question of optimum modal split. The mode with the least average cost should be allocated 100% of traffic to achieve the least total cost. This solution, however, is not only unrealistic but also incorrect. For a given transport system and its condition the total cost of accommodating traffic depends on the level of traffic volume. It is only when different transport modes show different cost characteristics with regard to traffic level that distributing traffic among different modes may produce a lower level of the total cost than allocating all traffic to a single mode. It is therefore essential to examine the characteristics of each mode as a function of traffic volume.

1) Key features and parameters

Detailed computerized cost models were developed for each of the three modes. Descriptions of model structures are presented in Appendix 3.4.1 as well as values of model parameters. Key features and parameters of each model are briefly described below.

Rail Model

a. Rolling stock loading and utilization: Loading per train, train speed, turn round, average train trip length, etc., were determined by estimates for 1985 as shown in Chapter 8.

b. Operating and rolling stock capital costs: They were developed as shown in Chapter 8.

c. Track capacity: Two types of track are differentiated, single and double. Nominal tra k capacity for typical BR track was determined at 35 trains (two way) per day for single track and 70 trains per day for double track.

d. Number of trains per day: This is determined by traffic volume by the model. When calculating freight traffic cost, the number of passenger trains on the same track is set not to exceed 15. When calculating passenger traffic cost, the number of freight trains on the same track is set not to exceed 5 per day.

e. Signalling; When the number of trains per day exceeds 80% of the single track capacity, a signalling improvement is assumed to take place. The cost was taken from the project of replacing equipment in the Mymensingh-Jamalapur-

Dewangonj section. When the number of trains per day exceeds the nominal capacity of double track section, another major improvement in control equipment is assumed at a cost 50% higher than the above.

f. Double tracking: When the number of trains exceeds 110% of the nominal single track capacity, double tracking is assumed. The cost of double tracking was taken from a project proposal for double tracking the Aliswar-Laksam-Naoti section.

g. Rehabilitation: Rehabilitation is assemed to take place in every X years which is a linear decreasing function of the number of trains per day and the track capacity, changing from 50 years at the ratio of 0.0 to 10 years at the ratio of 1.0 or more. Unit rehabilitation cost was determined from the data for the Jessore-Banapole section and other sections. The minimum rehabilitation interval of 10 years was determined considering the actual needs of Bangladesh Railway. After proper rehabilitation is done, track renewal interval should be 25 to 30 years.

Road Model

a. Vehicle loading and utilization: Average tonnage per truck, vehicle occupancy, average standard axles, annual utilization, etc., were mainly based on the Consultants traffic survey as shown in Chapter 9.

b. Vehicle operating cost: As described in Chapter 9. In addition the effect of road surface condition is included as a function of surface roughness.

c. Pavement rehabilitation: When the cumulative number of standard axles exceeds the remaining life, rehabilitation is assumed to take place. The remaining life is dertermined by the existing pavement deflection and the existing cumulative number of standard axles.

d. Road type: Three types of road are considered. Type A is the high standard 2-lane road, type C is the low standard single lane road and type B is the in-between. Each has different capacity.

e. Total traffic: In calculating the total traffic the percentage of truck traffic is held constant at 44%.

f. Road widening: When the total traffic exceeds the capacity, widening of the road is assumed to take place. From type B and C type A is assumed after the widening. From type A an additional type A road is assumed.

g. Road surface deterioration: Road surface condition expressed in the roughness measure is assumed to deteriorate in proportion to the cumulative number of standard axles between the maximum roughness of 8000 mm/km and the minimum roughness of 2000 mm/km. Maximum roughness is assumed to occur just before rehabilitation and minimum after a rehabilitation or widening (widening is assumed to be done with resurfacing at the same time). Pavement design of rehabilitation or widening is assumed to be done with the design pavement life of ten years. No road maintenance cost is considered as it is closer to reality in Bangladesh. VOC increase due to road deterioration, however, has a far greater impact on the total cost.

IWT Model

a. Vessel loading and utilization: Average load, average speed, turn round, non-steaming days per trip, down time ratio, etc. are as developed in Chapter 10. Average time in landing station per trip for passenger launches and steamers is assumed to be a function of sailing time, varying from a minimum of 1 hour for sailing of less than 4 hours and to a maximum of 6 hours for sailing of more than 24 hours. It is also assumed that passenger vessel departures are limited within the period of 6 am to 6 pm following actual practice.

b. Vessel operating cost: Basic cost parameters are those shown in Chapter 10.

c. Cargo handling cost: A flat economic cost of Tk. 9.4/ton is included in IWT cost model taking into account IWT's propensity of extra cargo handling.

d. Dredging: Maintenance dredging is assumed. The amout was determined from the amount claimed by BIWTA as desirable. Actual expenditure by BIWTA for maintenance dredging in recent years is 30% of this amount.

e. Berthing facility: Berthing facility requirements depend on cargo handling rate, i.e. tons/hour. Average jetty construction cost was obtained from BIWTA.

f. Landing station: Passenger landing station construction cost was also obtained from BIWTA.

All models are structured to take the hauling distance as a variable. Because of the descreteness of infrastructure investment, all costs are calculated for 10 years with a traffic growth rate of 6% per year, and the discounted present value summed over the 10 year period at a discount rate of 15% per year is calculated as the measure of cost comparison.

Fig. 3.4.1 Total Cost of Freight Transport/km

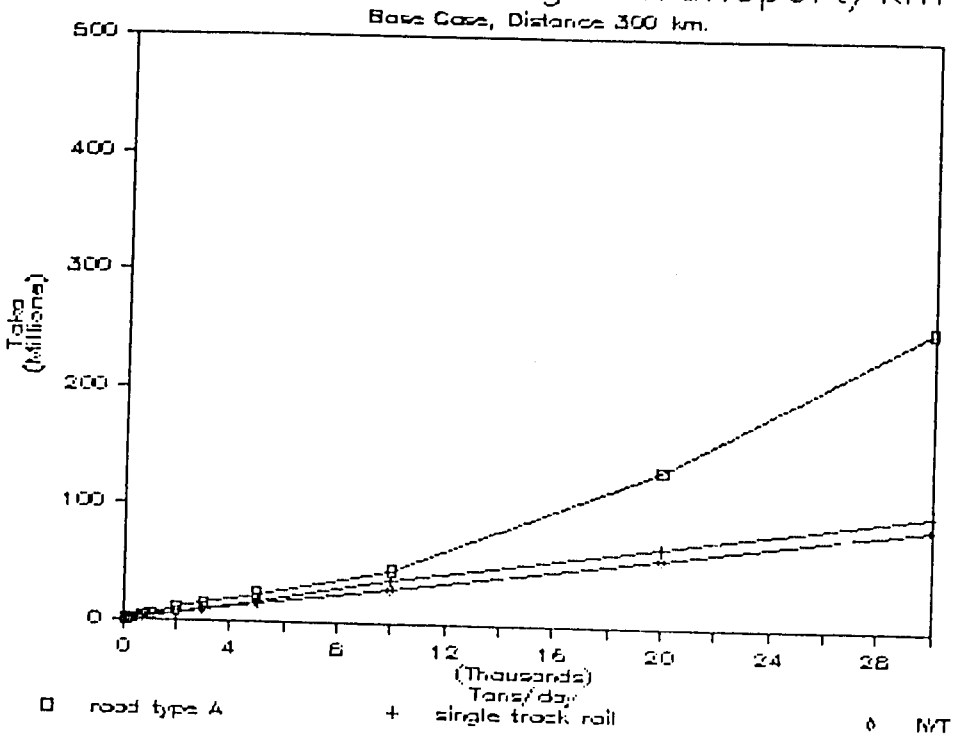
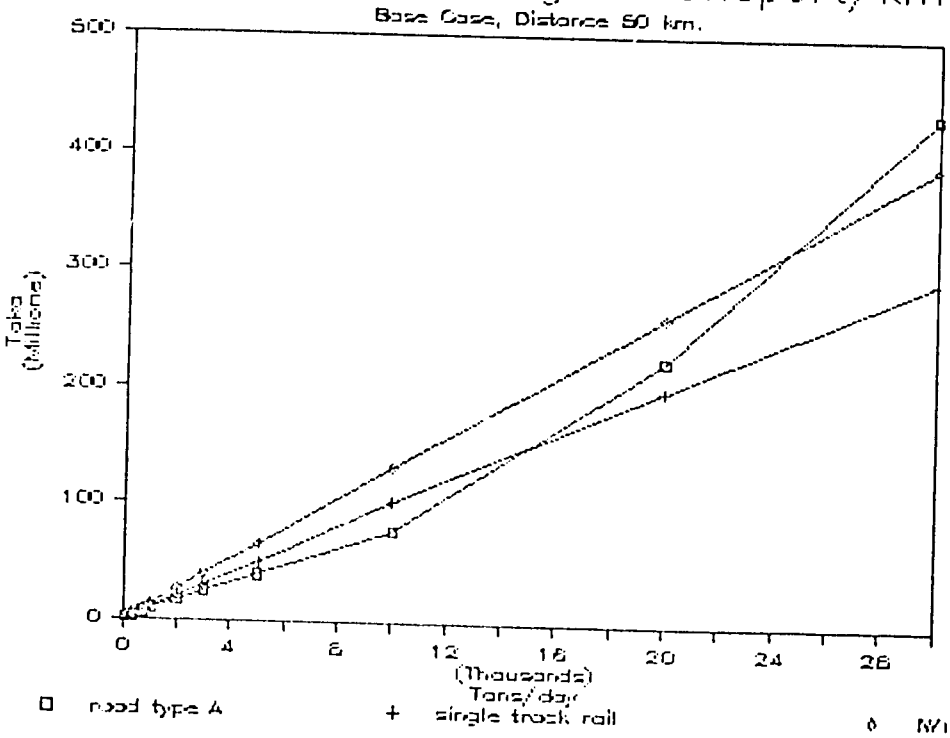


Fig. 3.4.2 Total Cost of Freight Transport/km



2) Cost Characteristics Under Existing Conditions

Freight Transport

The total combined cost of transport operation and infrastructure provision for freight is illustrated in Figure 3.4.1 for the distance of 300 km and in Figure 3.4.2 for the distance of 50 km up to the traffic volume of 30 thousand tons per day, which is equivalent of 6,400 trucks (two ways) or 70 trains per day. All total costs are expressed in terms of discounted 10 year cumulative cost per km. At the hauling distance of 300 km the road mode is the most expensive in the range over 400 tons a day (about 85 trucks a day) followed by the railways and the IWT mode, in this order. However, at the distance of 50 km the order is reversed for the traffic range less than 16,000 tons a day. In this range the road mode is the least expensive. Because of the need for constructing additional 2-lane road when traffic is more than 16,000 tons a day, even for the distance of 50 km the road mode is more expensive than the rail mode for the traffic level of 20,000 tons or more. Double tracking is needed for freight traffic more than 9,400 tons a day. Additional cost, however, does not make the rail mode more expansive than the road mode.

Figure 3.4.3 and Figure 3.4.4 show the cost characteristics of the three modes for the traffic level up to 5,000 tons a day. In the very low traffic range, less than 300 tons a day, the railway mode is the most expensive. The IWT mode maintains the lowest mode status at any traffic volume. For the distance of 50 km, the IWT, the railway and the road modes are ranked in this order in terms of cost in the range below 5,000 tons a day.

Absolute levels of the total cost are significantly lower in the case of 300 km than in the case of 50 km for all modes.

Passenger Transport

For passenger transport the relative cost advantage of modes differ from that for freight in that the IWT mode is the least cost mode at any distance as shown in Figures 3.4.5, 3.4.6, and 3.4.7 for the distances of 300 km, 50 km and 25 km respectively. At 300 km the road mode is the most expensive. At 50 km and 25 km, however, the rail mode is slightly more expensive than the road mode up to a certain traffic level, 120,000 passengers per day for 50 km and 350,000 passengers for 25 km, beyond which the road mode becomes the most expensive one because of needed construction of additional carriageways and increasingly higher rate of pavement deterioration as traffic load increases. For the distance of 50 km costs by railways and by roads are very close in the low traffic range as shown in Figure 3.4.8.

The clear cost advantage of the IWT mode is noteworthy.

Fig. 3.4.5 Total Cost of Passenger Transport/km

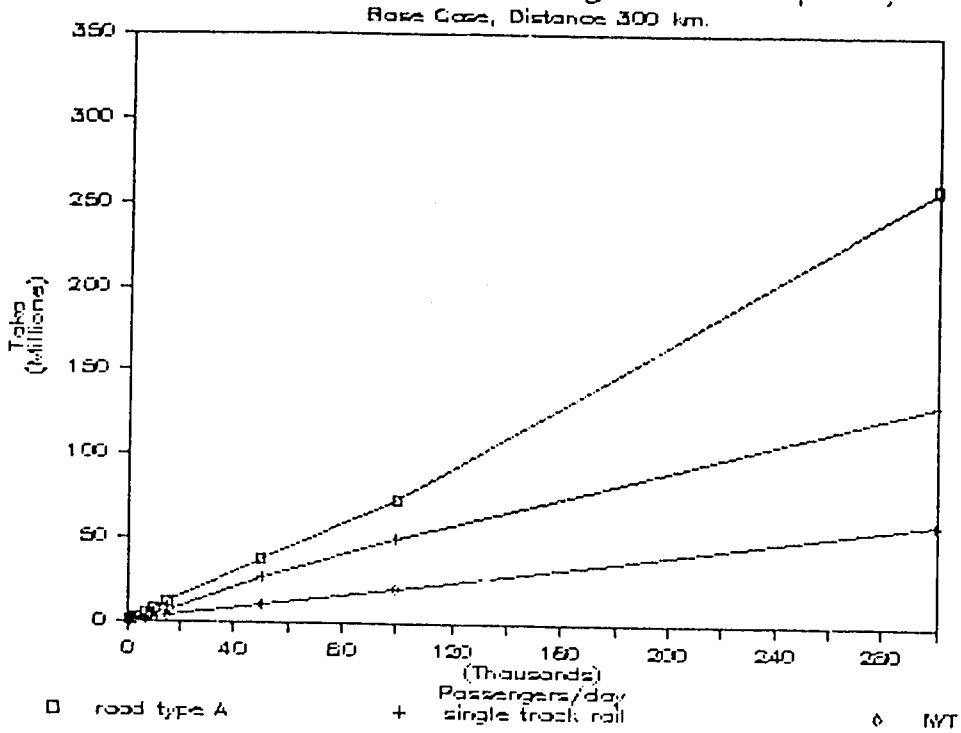


Fig. 3.4.6 Total Cost of Passenger Transport/km

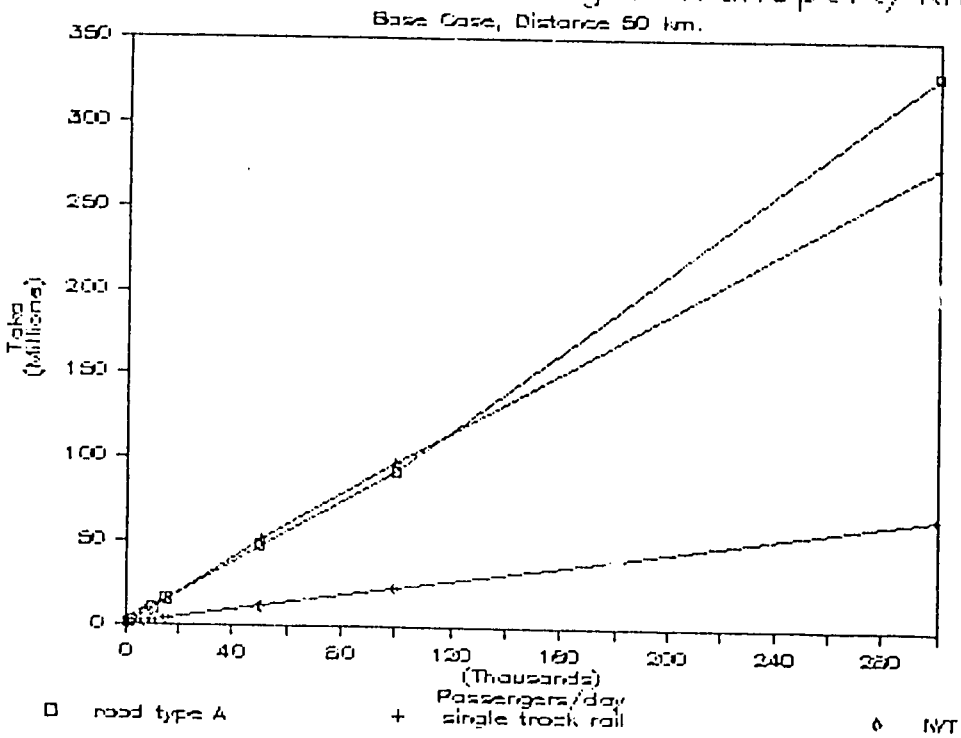


Fig. 3.4.7 Total Cost of Passenger Transport/km

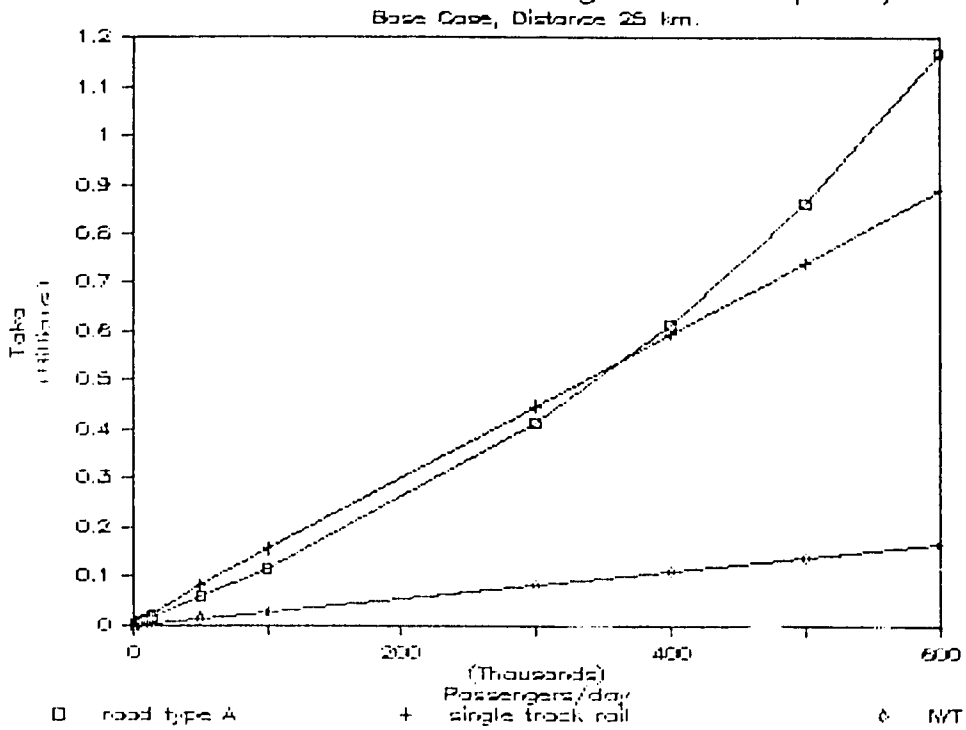


Fig. 3.4.8 Total Cost of Passenger Transport/km

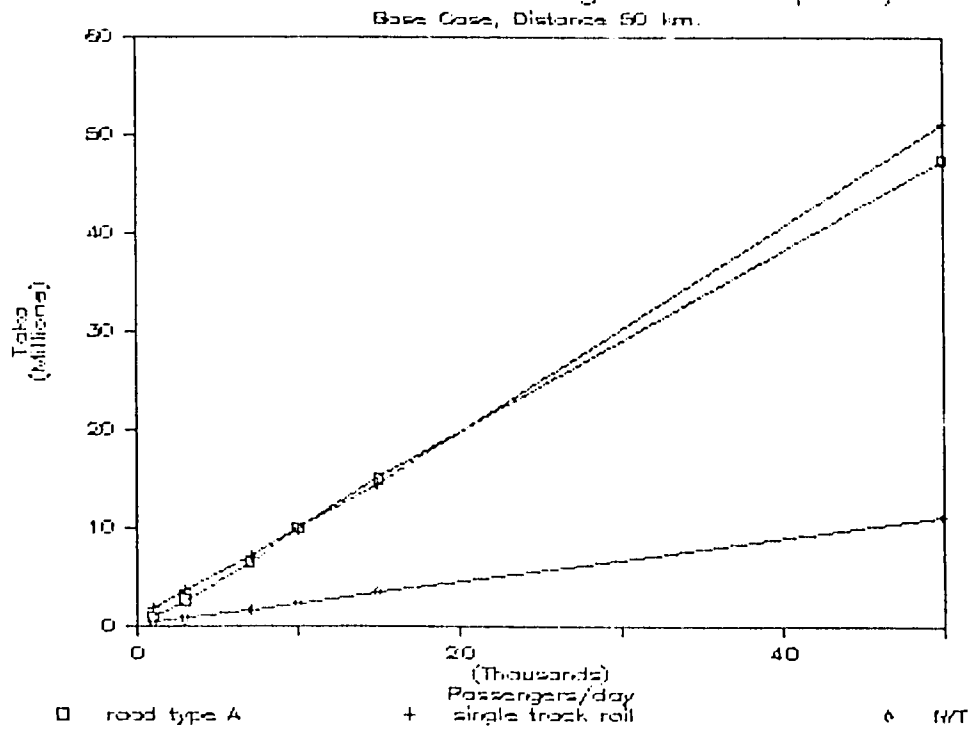


Fig. 3.4.9 Total Cost of Freight by Rail/km

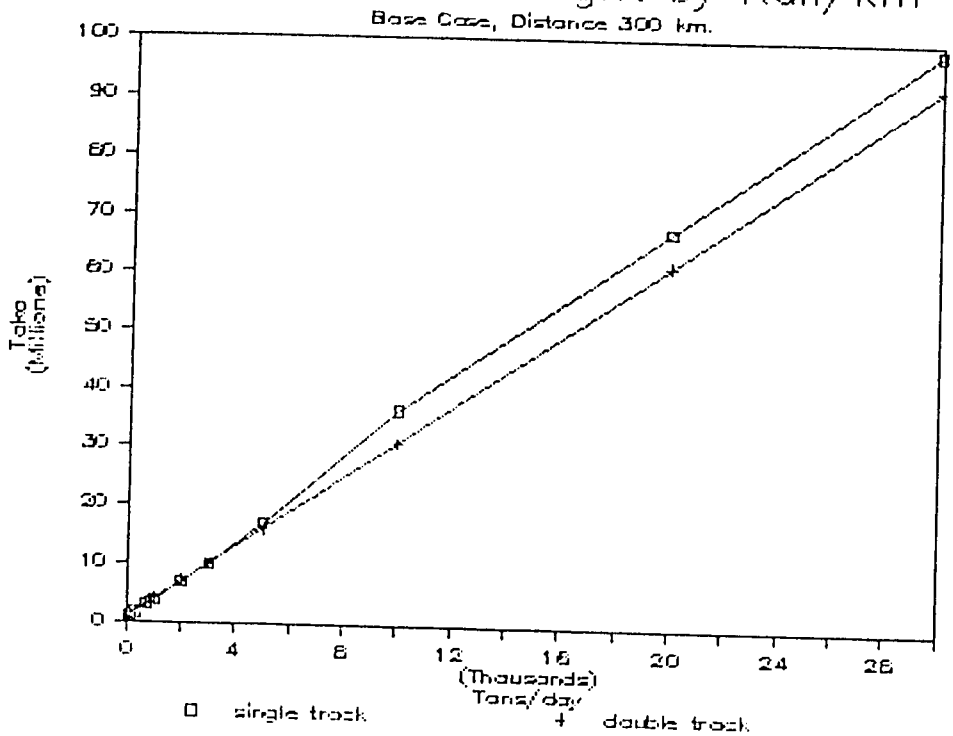


Fig. 3.4.10 Total Cost of Freight by Road/km

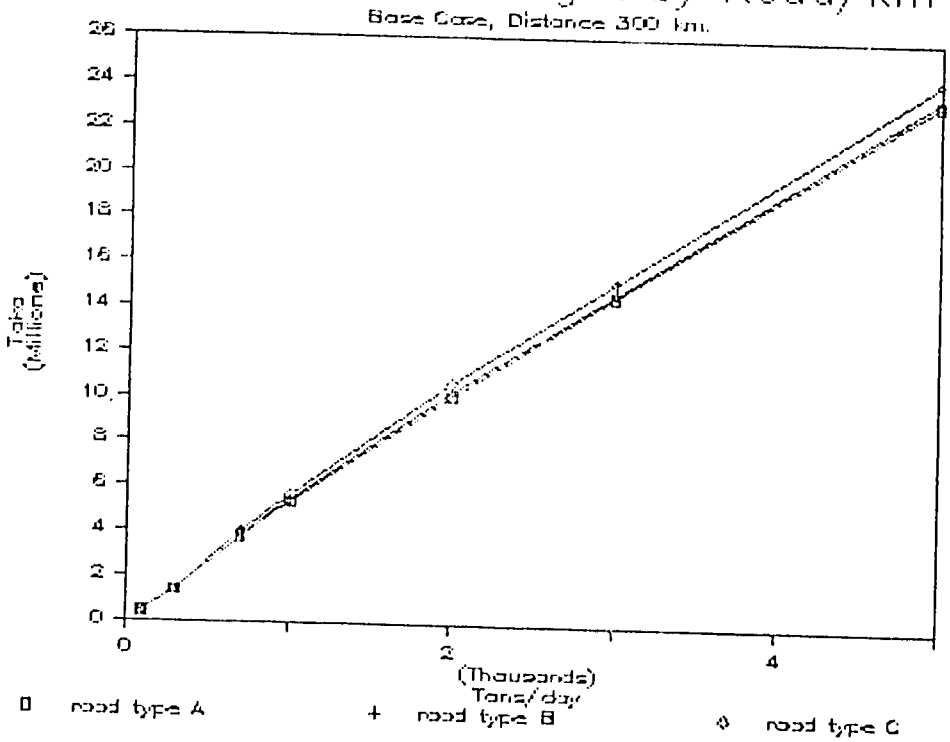


Fig. 3.4.11 Total Cost of Passenger by Rail/km

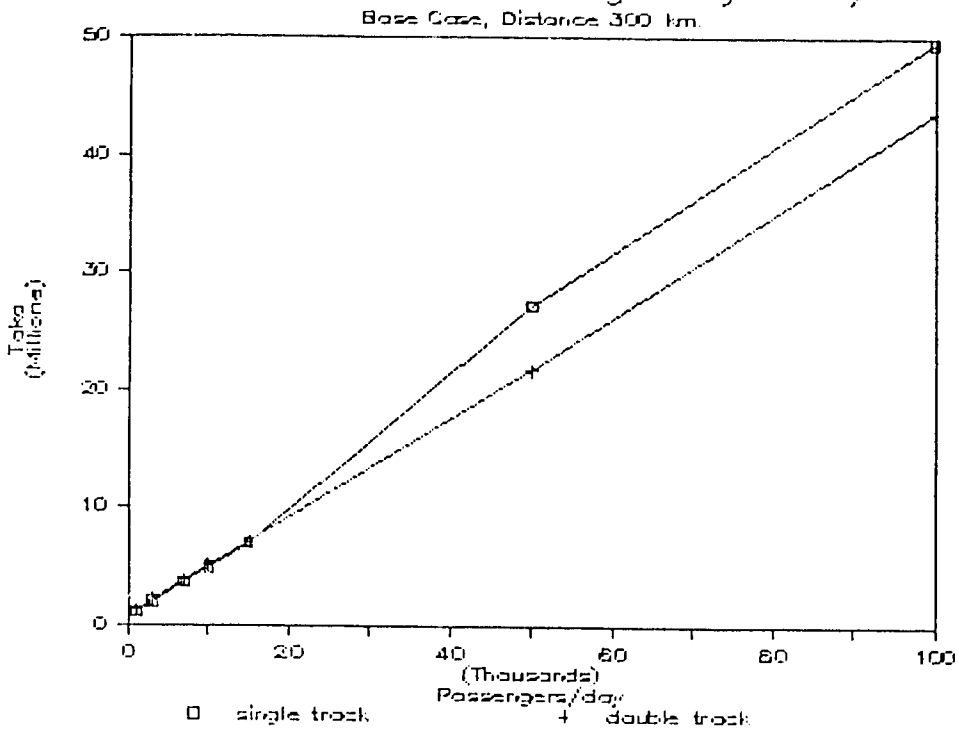
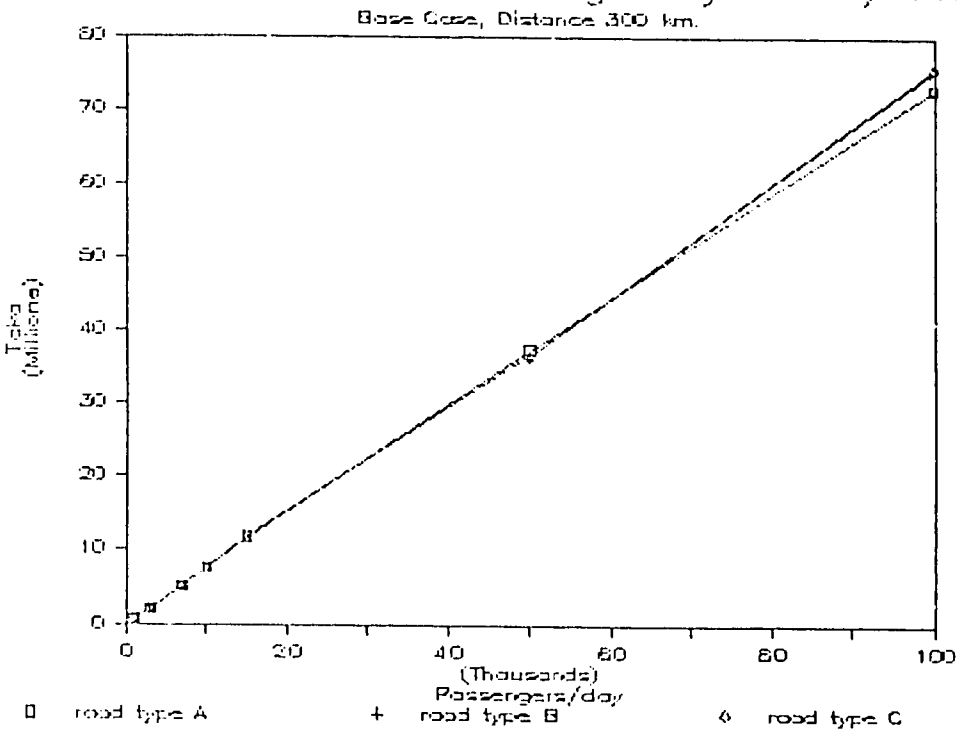


Fig. 3.4.12 Total Cost of Passenger by Road/km



Difference by Type of Facility

Figures explained in the foregoing paragraphs show the cases with single track railway and type A standard 2-lane road. Difference in the total cost for double track railway and type B and C roads are shown in Figures 3.4.9 through 3.4.12.

Under the assumption that 15 passenger trains per day be already on the track, single track sections would require double tracking for the traffic level over 9,400 tons a day. The difference in the total cost with double track sections on the per km basis remain constant for traffic beyond that level. As traffic grows higher, the percentage of the double tracking cost to the total cost becomes smaller. For passenger train services a similar characteristics is observed. Under the assumption of 5 freight trains per day a passenger volume of 42,600 per day would require double tracking. Cost differential as the percentage to the total cost, however, is higher than in the case of freight traffic because of the lower percentage of operating cost.

Difference among type A, B and C roads in terms of overall long term total cost is small as shown in Figures 3.4.10 and 3.4.12 provided that proper actions such as pavement strengthening and widening be carried out as assumed in the model. This is primarily because of the fact that road improvement costs, pavement strengthening or widening, are small relative to vehicle operating costs except for extremely low traffic level. When pavement is weak and road deteriortion fast, vehicle operating component dominates the total road transport cost.

Table 3.4.1 shows breakdown of total costs of the three modes estimated by the models for selected combinations of distance and traffic level.

Economy of Scale

Transport cost models developed in this study do not take the possible changes in technology into consideration. In particular, the models assume that the average capacity per unit train, vehicle or vessel be constant regardless traffic level (see Appendix 3.4.1). In other words the models are designed to give the total cost of transport by the existing transport equipment. The cost curves shown above are intended to give current costs, not costs in the future when traffic level is high. In actual situation in the future, wherever a high traffic volume is assured, investments will be made to utilize larger and more cost effective transport equipment, longer trains, larger trucks, and larger vessels. In such cases cost curves in high traffic ranges would show down-ward bending shapes rather than the quasi-straight line or upward bending shape.

Table 3.4.1 Typical Present Value of Total Cost Per Km.

(in thousand Tk. per year per km, percentage to total in parentheses)

Mode	F/P	Distance	Traffic Volume	Cost Components					
Rail		km	per day	Operating	Loco.	Coach	Signal	Rehab.	Additional Track	Total
(Single)	F	300	1000	1770	287	1126	0	658	0	3842
				(46)	(8)	(29)	(0)	(17)	(0)	(100)
	F	300	5000	8852	1276	5016	1077	742	0	16963
				(52)	(8)	(30)	(6)	(4)	(0)	(100)
	P	300	10000	2563	556	1080	0	659	0	4859
				(53)	(11)	(22)	(0)	14	0	(100)
	P	300	100000	25634	5309	10314	3257	867	4230	49610
				(52)	(11)	(21)	(7)	(2)	(9)	(100)
	F	50	1000	4816	387	5071	0	658	0	10932
				(44)	(4)	(46)	(0)	(6)	(0)	(100)
	F	50	5000	24079	1722	22582	1077	742	0	50202
				(48)	(4)	(45)	(2)	(1)	(0)	(100)
	P	50	10000	3376	2009	3807	0	659	0	9850
				(34)	(20)	(39)	(0)	(7)	(0)	(100)
	P	50	100000	33759	19175	36346	3257	867	4230	97633
				(35)	(20)	(37)	(3)	(1)	(4)	(100)

Note: F for freight, P for passengers.

Traffic volumes in tons/day for freight and passengers/day for passenger.

Table 3.4.1 Typical Present Value of Total Cost Per Km. (Continued)
(in thousand Tk. per year per km, percentage to total in parentheses)

Mode Road	F/P	Distance km	Traffic Volume	Cost Components: Improvement	Widening	VOC	Total
Type A	F	300	1000	791	0	4512	5303
				(15)		(85)	(100)
	F	300	5000	1788	0	21590	23377
				(8)		(92)	(100)
	P	300	10000	0	0	7730	7730
						(100)	(100)
	P	300	100000	1495	3593	67808	72896
				(2)	(5)	(93)	(1-0)
	F	50	1000	791	0	7821	8612
				(9)		(91)	(100)
	F	50	5000	1788	0	37424	39211
				(5)		(95)	(100)
	P	50	10000	0	0	9908	9908
						(100)	(100)
	P	50	100000	1495	3593	86910	91998
				(2)	(4)	(94)	(100)

Table 3.4.1 Typical Present Value of Total Cost Per Km. (Continued)
(in thousand Tk. per year per km, percentage to total in parentheses)

Mode	F/P	Dist-ance	Traffic Volume	Cost Components			Total
Road		km		Improvement	Widening	VOC	
Type C	F	300	1000	1126	0	4512	5638
				(20)		(80)	(100)
	F	300	5000	0	2545	21801	24347
					(10)	(90)	(100)
	P	300	10000	0	186	7436	7622
					(2)	(98)	(100)
	P	300	100000	0	6139	69783	75922
					(8)	(92)	(100)
	F	50	1000	1126	0	7821	8947
				(13)		(87)	(100)
	F	50	5000	0	2546	37791	40337
					(6)	(94)	(100)
	P	50	10000	0	186	9531	9717
					(2)	(98)	(100)
	P	50	100000	0	6138	89442	95580
					(6)	(94)	(100)

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Table 3.4.1 Typical Present Value of Total Cost Per Km. (Continued)
(in thousand Tk. per year per km, percentage to total in parentheses)

Mode	F/P	Dist-ance	Traffic Volume	Cost Components					Total
IWT		km		Fixed	Variable	Handling	Dredging	Infra	
	F	300	1000	1992	495	81	46	344	2957
				(67)	(17)	(3)	(2)	(12)	(100)
	F	300	5000	9958	2474	407	46	1695	14580
				(68)	(17)	(3)	(0)	(12)	(100)
	P	300	10000	884	1132	-	46	11	2072
				(43)	(55)	-	(2)	(1)	(100)
	P	300	100000	8767	11228	-	46	75	20115
				(44)	(56)	-	(0)	(0)	(100)
	F	50	1000	10064	495	489	46	2062	13156
				(76)	(4)	(0)		(16)	(100)
	F	50	5000	50324	2474	2443	46	10173	65460
				(77)	(4)	(4)	(0)	(16)	(100)
	P	50	10000	1056	1132	-	46	65	2299
				(46)	(49)	-	(2)	(3)	(100)
	P	50	100000	10478	11228	-	86	445	22201
				(47)	(51)	-	(0)	(2)	(100)

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3.4.2 Optimum Modal Split

Optimum modal split can be defined as the distribution pattern of traffic among different modes at which the total combined cost of all modes is the least. For such an optimum condition to take place a necessary condition is that the ranking in terms of the total modal cost changes as the total traffic volume changes. In other words, cost curves of each mode such as those shown in Figure 3.4.1 through 3.4.8 must cross each other. Otherwise, the least cost solution is always for the least cost mode to take all traffic. The optimum split also depends on the rate of increase in cost or the slope of cost curve relative to other modes. The rate of increase in cost is called marginal cost in economics.

A computer program was developed for this study capable of searching and determining the least cost traffic distribution among modes for a given set of cost curves, using a technique called dynamic programming.

The results of cost analysis by models show that the IWT mode offers the least cost solution for any combination of distance and traffic volume, freight or passengers, except for the case of freight transport at 50 km. In such a case, a 100 % assignment to IWT results in the least total cost.

However, it is not only unrealistic but also misleading to consider the case of complete monopoly by a mode. The economic total cost is often different by specific commodity type or passenger type. Certain high value commodities may have significant time value, which are ignored in the models, for example. It was therefore decided to carry out the optimum modal split analysis setting the maximum modal share of the least cost mode at a certain level.

Freight

For the distance of 300 km cost curves of each mode with respect to traffic volume do not intersect each other except in the very low traffic range as shown in Figures 3.4.1 through 3.4.3. Slopes of cost curves do not change much relative to each other. Therefore, optimum modal split curves with respect to traffic level show all-or-nothing patterns as shown in Figures 3.4.13 and 3.4.14. When 30% of the total tonnage are taken up by IWT, the road mode takes all of the remaining volume up to the traffic volume of 600 tons per day. Beyond that level, the rail mode takes all, leaving nothing to the road mode at any traffic level. This is because of the slope of the road mode cost curve being consistently higher or steeper than the rail mode. In other words the rail mode should be given all the remaining traffic left by the IWT mode for the distance of 300 km except for the very low traffic level. When the maximum IWT share is set at 60% of the total, the traffic level at which the rail mode replaces the road mode becomes 1000 tons per day.

For the distance of 50 km optimum shares are different from cases with the distance of 300 km, and are illustrated in Figure 3.4.15. In this case, the least cost mode for the low traffic range, the road

Fig. 3.4.13

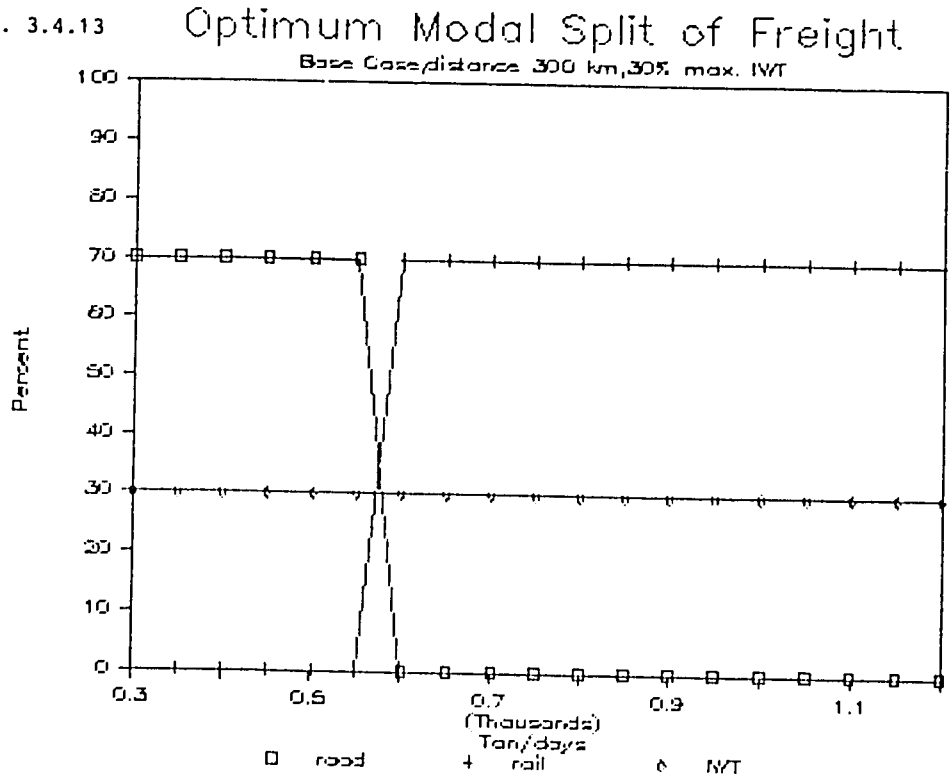


Fig. 3.4.14

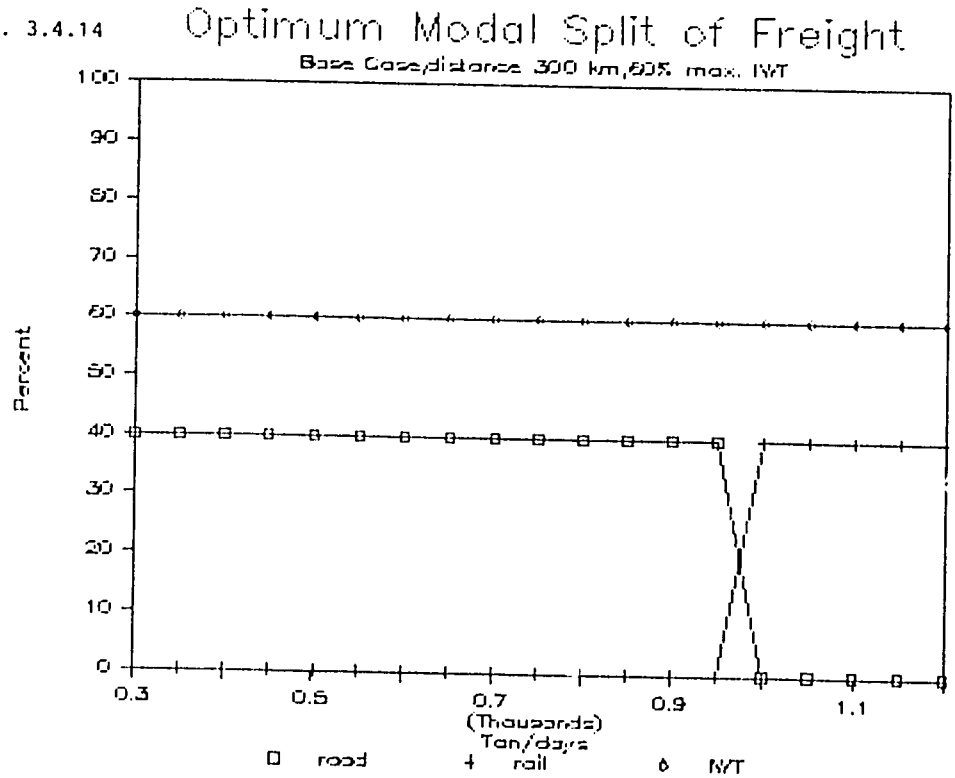


Fig. 3.4.15 Optimum Modal Split of Freight

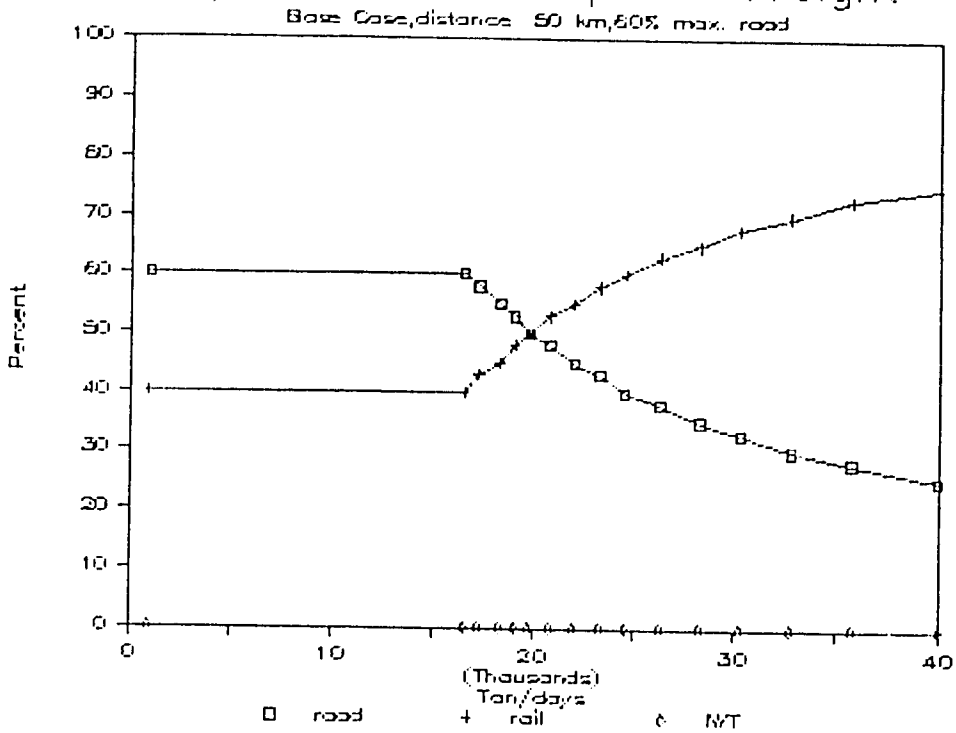
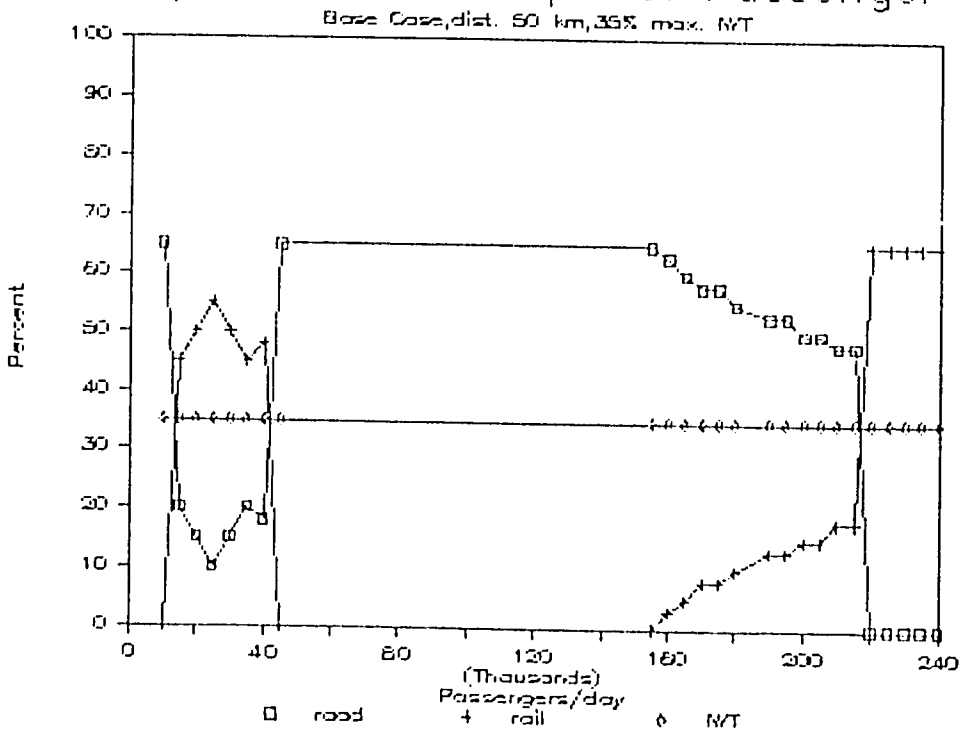


Fig. 3.4.16 Optimum Modal Split of Passenger



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mode, is allowed to have its maximum share of 60 percent. IWT is uncompetitive and was assumed out of the market. In the high traffic range of beyond 17,000 tons a day the rail gradually takes share from the road because of the cost of additional carriageways for the road mode.

Passenger

For the long distance passenger transport there seems to be no optimum combination as cost curves of three modes never intersect each other as shown in Figure 3.4.5. The more traffic in IWT and the more in railways, the less the total cost would become. For the short distance of 50 km the cost curves of the road mode and the rail mode are similar and intersect each other several times up to the traffic level of 120 thousand per day as shown in Figres 3.4.6 and 3.4.8. The theoretical modal split under the assumption of 35% to IWT, therefore, shows a complex pattern as shown in Figure 3.4.16. In the range between 42-220 thousand passengers per day the road mode should be the dominant mode.

Summary

In general the more traffic on IWT the less the total cost of transport including operation and infrastructure would become except for the case of short distance freight transport for which the road mode is best suited. In all cases the rail mode should be used in the high traffic level instead of additional 2-lane road in order to achieve the least cost.

3.4.3 Improved Conditions

Foregoing discussions are applicable under the existing low level of operating efficiency, particularly in the rail mode and in the freight transport by the IWT mode. It is possible to improve the operating conditions without large investments. For the road mode, costs are calculated with an assumption of pavement deflection of 1.0 mm under 4,100 kg, which is in the poor side in Bangladesh. Better pavement in Bangladesh would be with a deflection value in the order of 0.8 mm.

Cost characteristics and optimum modal split were examined for improved conditions. Difference with the conditions used in the base case is listed in Table 3.4.2. All values assumed for the improved cases are considered within the feasible range.

Improved Rail Total Cost

Appendix 3.4.3 Figures 3.4.17 and 3.4.18 show the difference between the base case and the improved case for freight and passenger transport by rail. The difference is about 15% of the total for freight transport and 8% for passenger transport.

Table 3.4.2 Assumptions on Improved Conditions

	Existing	Improved
Rail Mode		
* Freight		
- Average freight train speed (km/h)	9.93	11.7
- Average locomotive turn round (days)	0.293	0.241
- Average wagon turn round (days)	17.6	8.8
* Passenger		
- Average passenger train speed (km/h)	30	35
- Average locomotive turn round (days)	0.587	0.499
- Average carriage turn round (days)	0.556	0.439
Road Mode		
* Freight and passenger		
- Pavement deflection under 4100 by (mm)	1.0	0.8
Water Mode		
* Freight		
- Non-steaming days per round trip	10.3	4.3
- Handling rate per vessel (tons/hr)	17.4	36
* Passenger		
- Non-steaming hours/steaming hours	0.217	0.10

Road Total Cost with Stronger Pavement

Appendix 3.4.3 Figures 3.4.19 and 3.4.20 show the difference for the road mode. Substantial difference appears after the traffic level of 2,000 trucks per day or 3,700 passenger vehicles per day. The difference is negligible below that traffic level. Main reason for the substantial and increasing difference in the high traffic range is not the pavement strengthening cost but the increased vehicle operating cost due to the rapid pavement deterioration. Total cost curves for the three types of roads under the better pavement strength are shown in Figure 3.4.21. In comparison with the base case curves shown in Figure 3.4.10, it can be seen that the cost difference between the low type road (type C) appears at lower traffic range in the improved case than in the base case because of delayed pavement strengthening.

Improved IWT Total Cost

Appendix 3.4.3 Figures 3.4.22 and 3.4.23 show the difference in the total cost for freight and passenger transport by IWT. Potential cost reduction in freight transport by IWT is larger than cost reduction in other modes within feasible range. Because of the current low utilization rate of vessels and the low efficiency in cargo handling which is also a decisive facror for vessel and jetty requirements. IWT freight cost can be cut by as much as 40%. In contrast margin for cost reduction in IWT passenger transport is not large. The system is reasonably efficient as it is now.

Intermodal Cost Comparison Under Improved Conditions

Total cost curves of the three modes under improved conditions are shown in Figure 3.4.24, which can be compared with Figure 3.4.1 of the base case. For the distance of 300 km the relative positions of the total costs by each mode are basically similar to the base case although absolute values are lower in the improved case. However, the picture is different for the distance of 50 km as a comparison of Figure 3.4.25 with Figure 3.4.2 would reveal. Under the improved conditions the IWT mode would become the least cost mode even for this short distance.

For passenger transport the relative positions of the total cost curves of the three modes are similar to those of the base case shown in Figure 3.4.5 for the distance of 300 km. For the distance of 50 km Figure 3.4.26 of the improved case can be compared with Figure 3.4.6 of the base case. The distance at which the rail mode cost becomes less expensive than the road mode is much shorter than the base case as shown in Figure 3.4.27.

Optimum Modal Split Under Improved Conditions

For freight transport IWT becomes the least cost mode for short distance as well as for long distance. For the distance of 300 km the optimum modal split between the rail and the road modes takes a similar form as shown in Figure 3.4.13 and 3.4.14 except that the traffic volume beyond which the road mode completely loses its share

is lower by 20%. For the distance of 50 km the optimum modal split for the improved case markedly differs from that for the base case of existing conditions as a comparison of Figure 3.4.28 with Figure 3.4.15 would reveal. Aside from the least cost mode IWT which is assigned of 60% of the total, the shares of the road mode and the rail mode alternate.

For passenger transport no optimum modal split exists for the distance of 300 km as is the case for the base case because of unchanging relative cost advantage among the modes at any traffic level. For the distance of 50 km, however, the road and the rail modes shares the remainder of IWT traffic at varying percentages in a certain traffic range as shown in Figure 3.4.29. Unlike the base case in which the optimum share of the road mode is higher than the rail mode in the most of middle traffic range, the rail mode takes a larger share in all ranges except in the extremely low traffic range. The minimum traffic level beyond which the road mode loses its share in the optimum modal split is less than half of the base case.

Fig. 3.4.21 Total Cost of Freight by Road/km

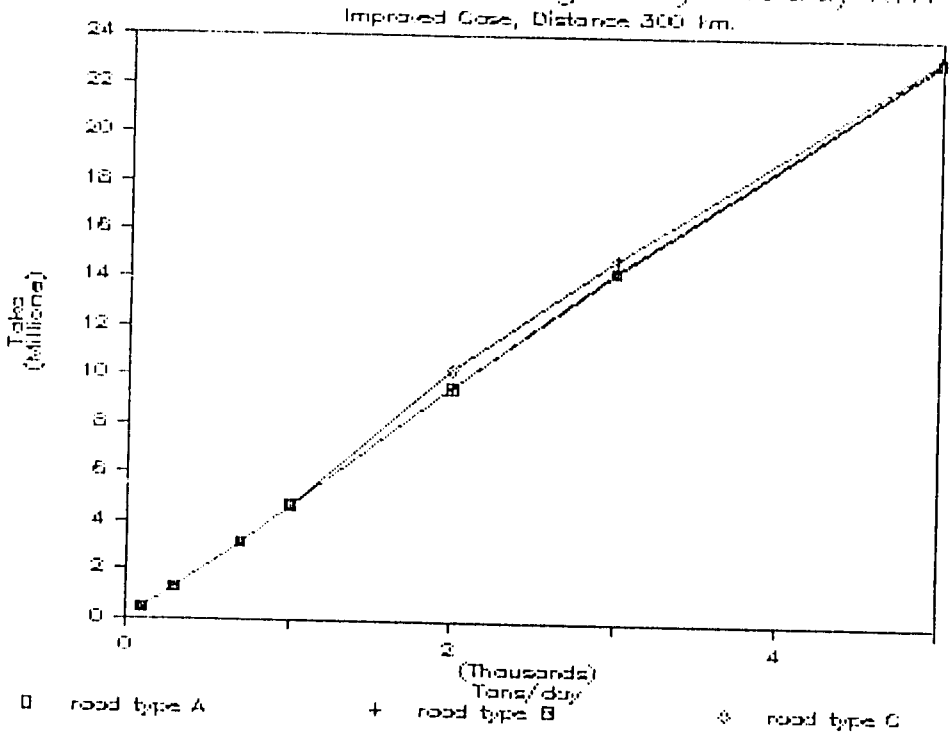

Fig. 3.4.24 Total Cost of Freight Transport/km

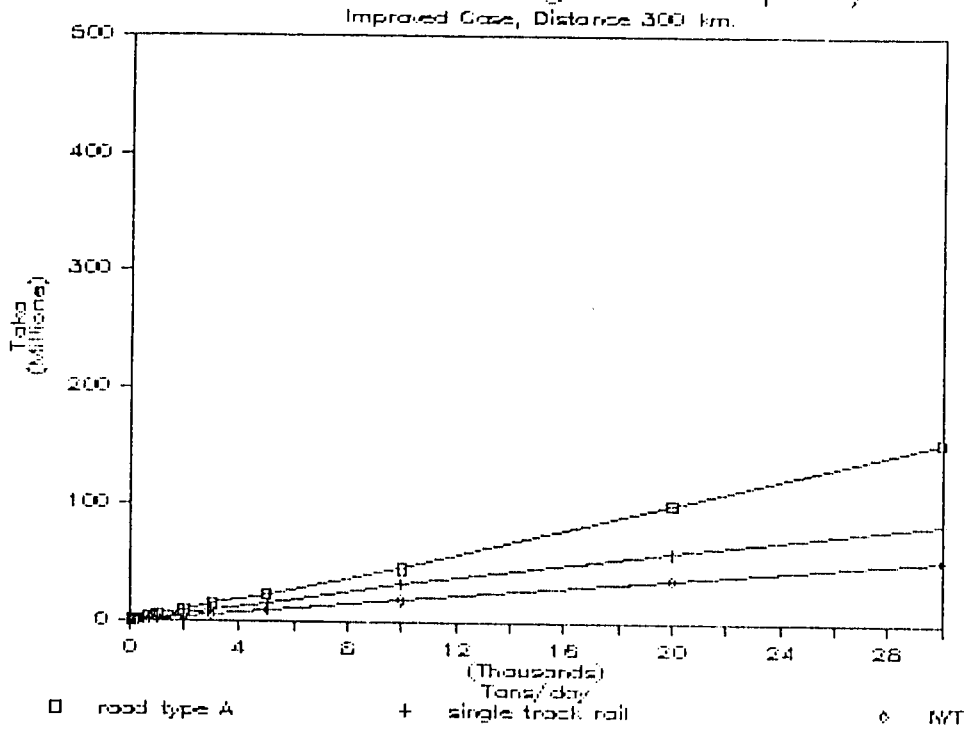

Fig. 3.4.25 Total Cost of Freight Transport/km

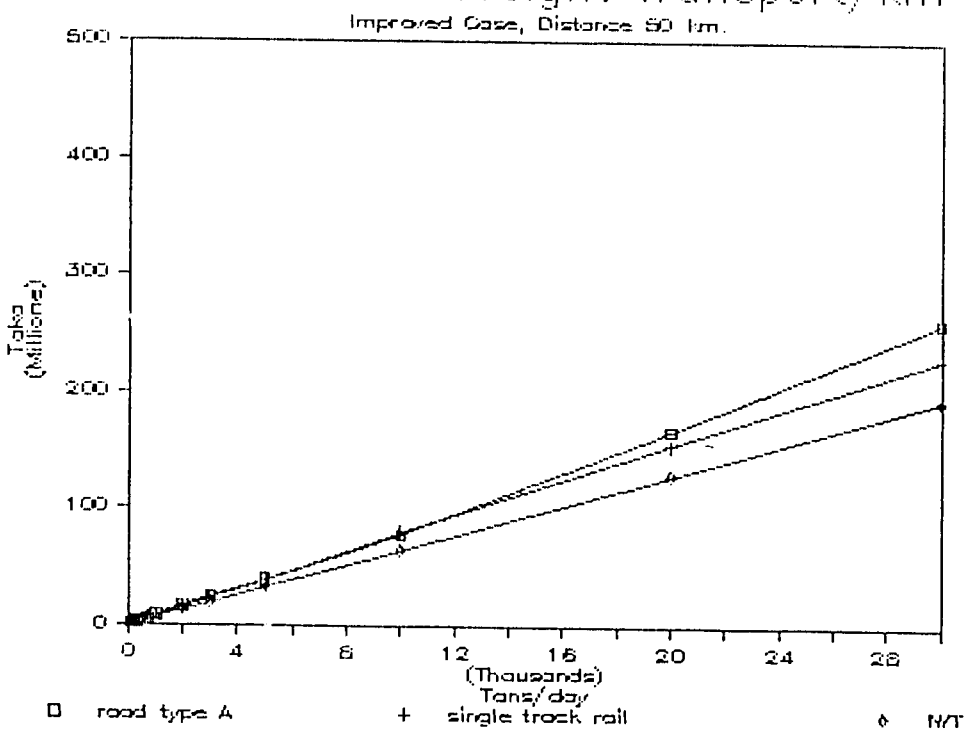

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Fig. 3.4.26 Total Cost of Passenger Transport/km

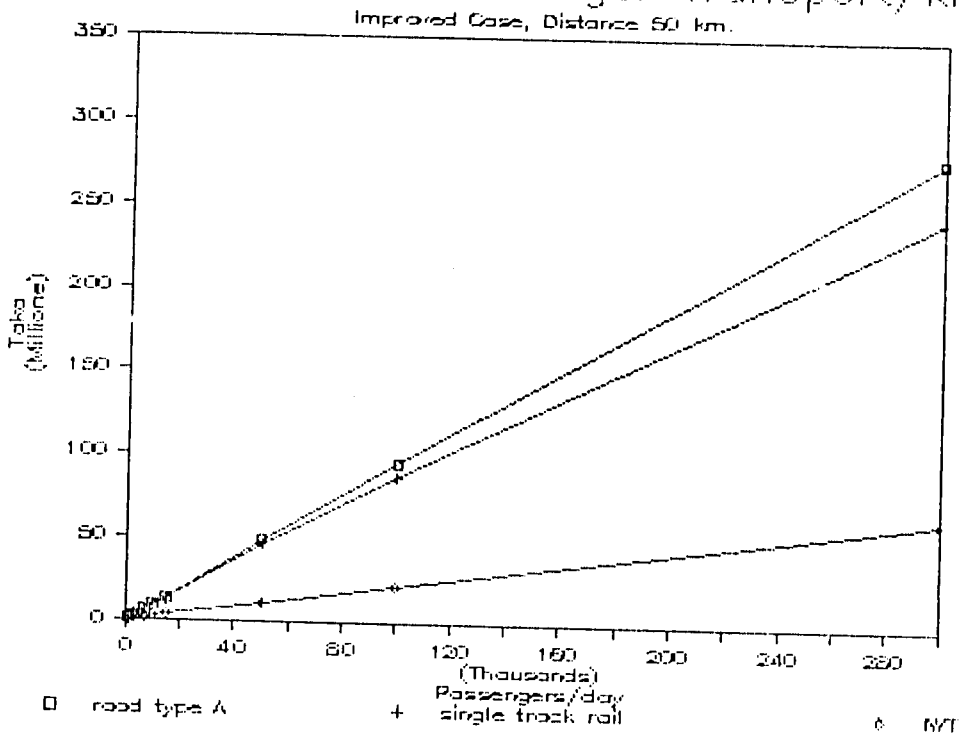

Fig. 3.4.27 Total Cost of Passenger Transport/km

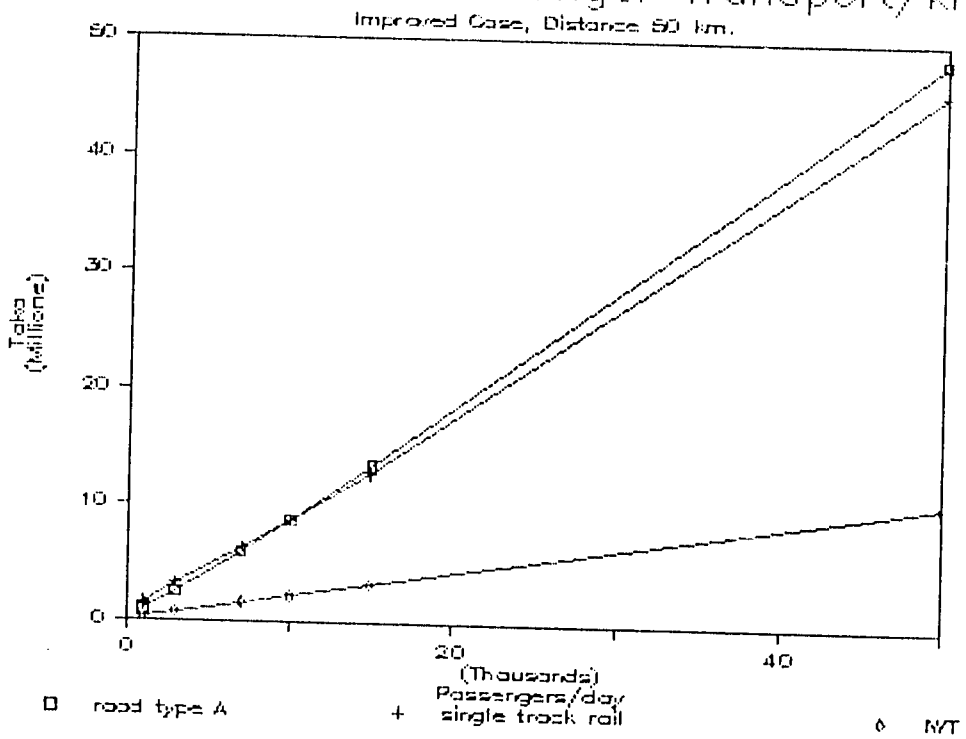

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Fig. 3.4.28 Optimum Modal Split of Freight

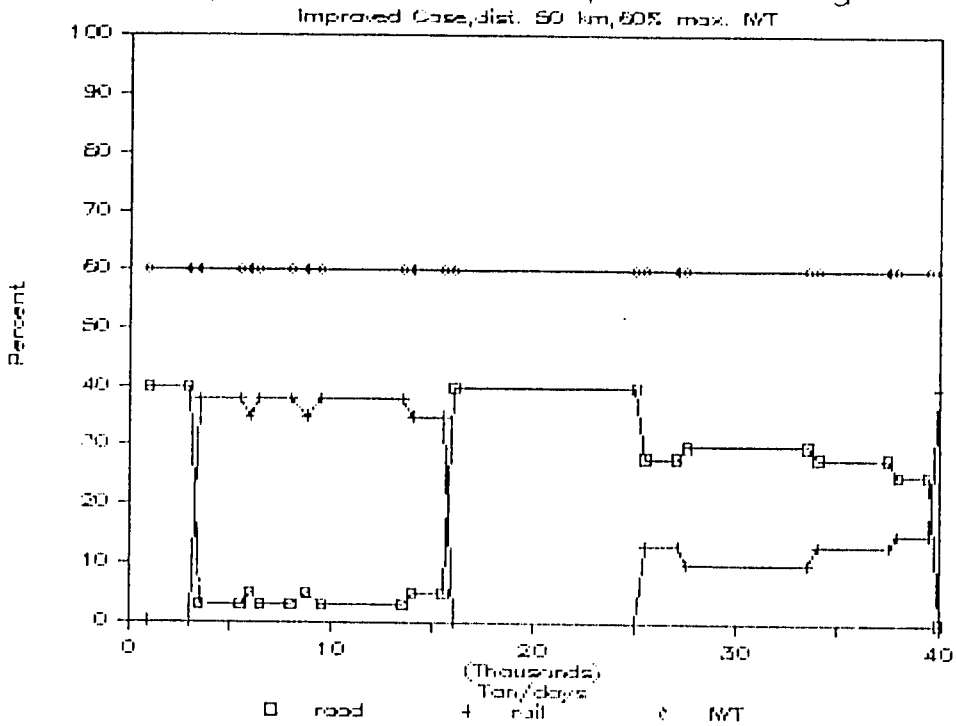
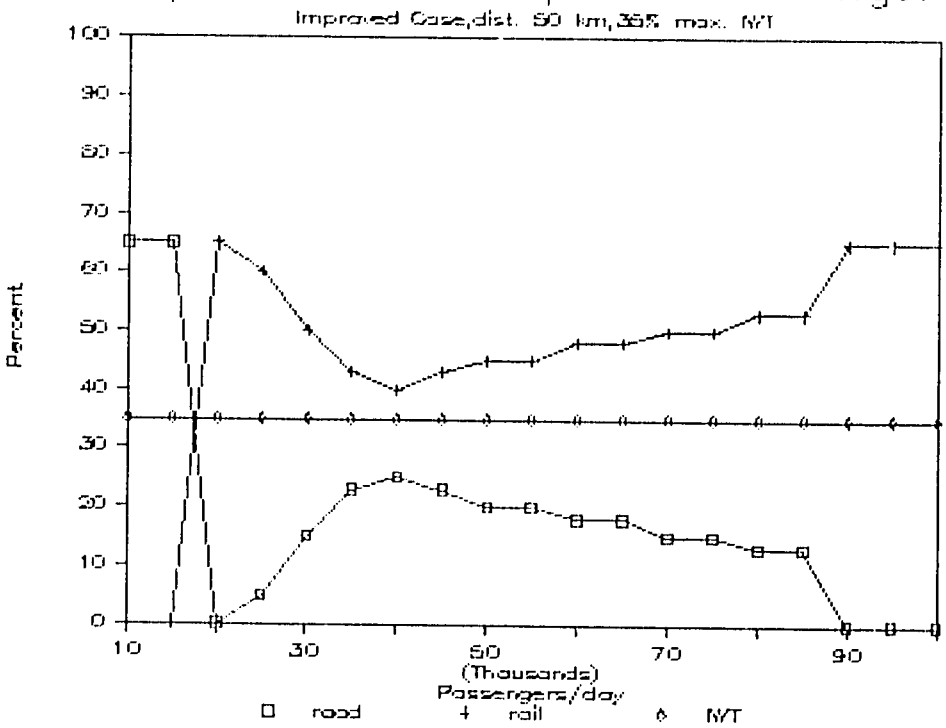


Fig. 3.4.29 Optimum Modal Split of Passenger



3.4.4 Gain by Optimum Split

The difference in the total cost between th case with the existing modal split and the case with the optimum split can be substantial. Table 3.4.3 shows the cases tested to see the difference. Modal shares under the optimum condition vary depending on traffic level. Existing m dal shares are fixed at overall average level. For comparison purposes a case with the second least cost mode being given the remainder of share after IWT is also shown.

Figure 3.4.30 through Figure 3.4.33 show the difference. For the distance of 300 km the difference between the optimum and the existing is significant for both freight and passengers. For the distance of 50 km, however, the difference is almost non-existance for paassenger traffic, indicating that the passenger modal split for short distance is not a crucial matter. As shown in Table 3.4.3, the total cost saving could be as much as 30% of the total cost under the existing modal split.

Table 3.4.3 Total Cost Saving By Optimum Split

Freight

Distance(km)	Condition	Modal Shares(%) Road	Rail	IWT	Total Cost Index 500 Tons/day	20,000 Tons/day
300	Existing	63	12	25	100	100
	2nd Best	-	40	60	80	70
	Optimum	*	*	60	65	70
50	Existing	63	12	25	100	100
	2nd Best	-	40	60	118	117
	Optimum	*	*	60	98	88

Passenger

Distance(km)	Condition	Modal Shares(%) Road	Rail	IWT	Total Cost Index 50,000 Pass./day	120,000 Pass./day
300	Existing	52	28	20	100	100
	2nd Best	65	-	35	99	101
	Optimum	-	65	35	72	70
50	Existing	33.5	31.5	35	100	100
	2nd Best	-	65	35	103	100
	Optimum	*	*	35	99	95

Note: * indicates varying share depending on volume.

Source: Consultants

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Fig. 3.4.30

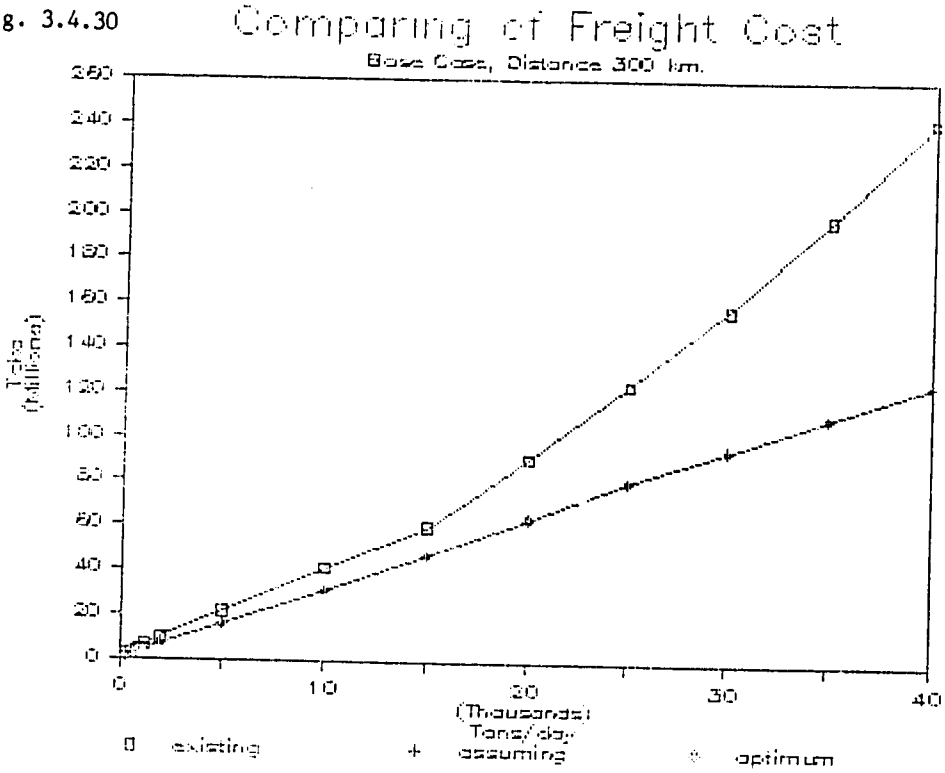


Fig. 3.4.31

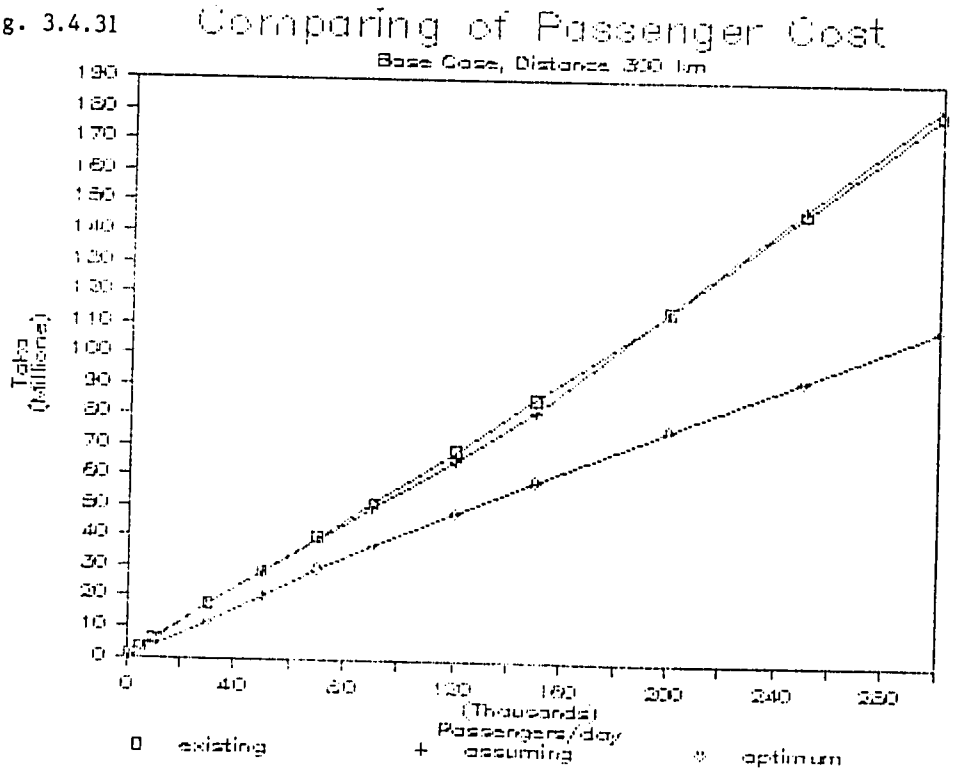


Fig. 3.4.32

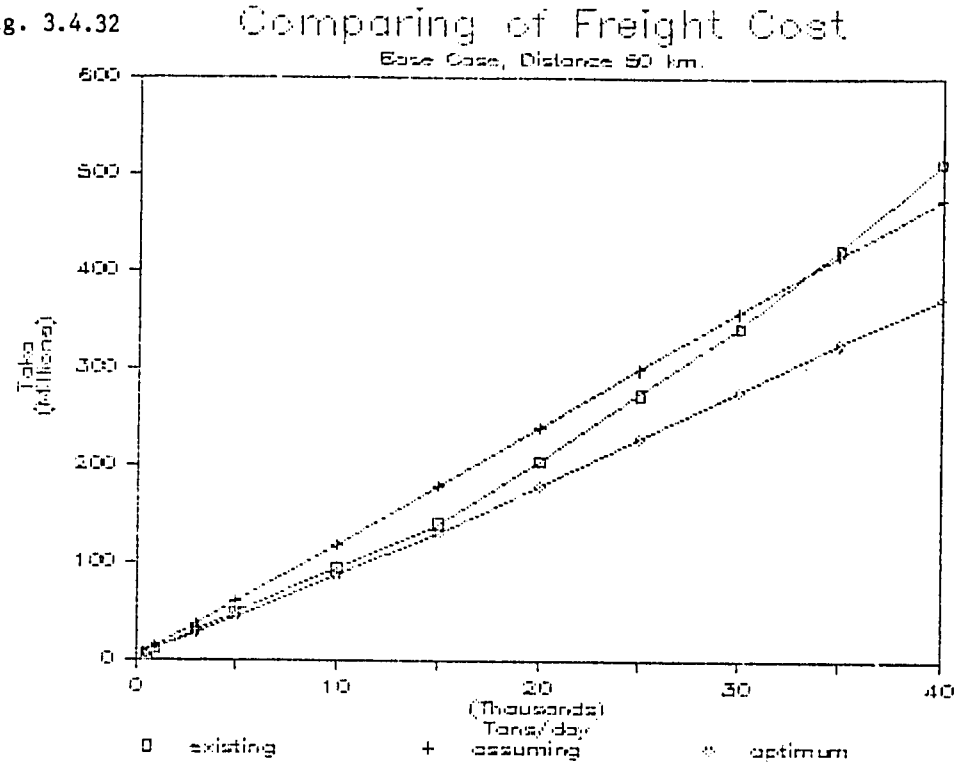
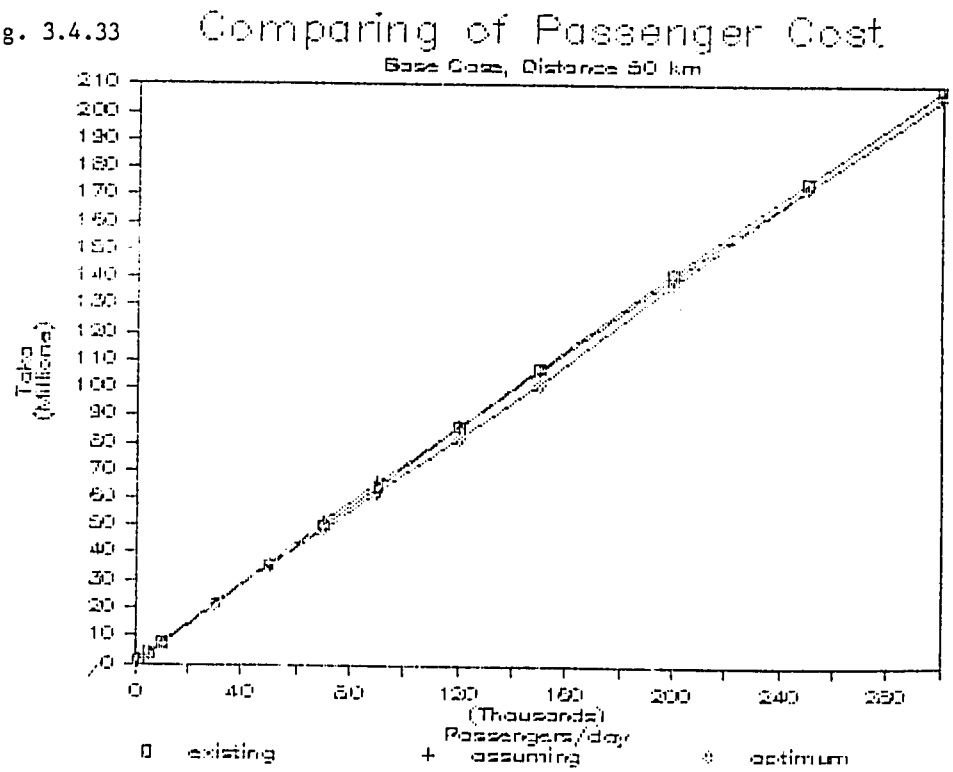


Fig. 3.4.33



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3.5 Corridor Analysis

3.5.1 Introduction

The foregoing discussions on economically optimum modal split are based on cost characteristics of transport modes for the same distance. In the actual transport network in Bangladesh, however, point to point destances are sometimes considerably different by mode. An analysis was made taking into account actual mode specific distances in Bangladesh.

Five major corridors were selected for the anaysis; Dhaka-Chittagong, Dhaka-Khulna, Dhaka-Sylhet, Dhaka-Rangpur, and Dhaka-Mymensingh. Distances by each mode are shown in Table 3.5.1.

Cost curves of each mode with regard to traffic volume were developed for each corridor and are presented in Appendix 6.5. Because of the difference in route distance cost curve relationships among modes are significantly different for some corridors than in the case of equal distance. For the Dhaka-Khulna corridor, for example, the rail mode is the most expensive for a wide range of traffic level due to its long route distance.

The effect of the Jamuna River crossing was not explicitly included as it similarly affects the rail and the road mode.

3.5.2 Existing Situation

A transport corridor includes trips of many origins and destinations, not only those originating or terminating both ends of the corridor. Some are longer and others are shorter than the corridor length. The factor determining the requirements for transport equipment and infrastructure is not the volume of trips with a certain origin and destination. It is the total traffic volume through the section in question. Therefore, typical traffic volumes were estimated for each corridor for each mode.

For freight traffic the freight O&D tables developed in this study as described in Section 4.1.4 were used to estimate mid-corridor traffic volumes as local traffic at mid-corridor points were found minimal.

Road passenger traffic volumes and rail passenger traffic volumes were primarily taken from ADT (Average Daily Traffic) estimates for mid-sections of each corridor. If multiple road routes exist within a corridor their traffic volumes were added to give the corridor volume. For the IWT mode its share in the inter-district passenger traffic was estimated at about 20% as shown in Section 3.6.2. Assuming 20% share for IWT for the Dhaka-Khulna corridor, IWT shares in other corridors were assumed in proportion to passenger

vessel fleet size relative to the passenger vessel fleet size for Khulna. Resultant IWT passenger estimates were compared with the total estimated IWT passengers and were found reasonable.

Table 3.5.2 shows estimated corridor traffic volumes for the five corridors. Volumes shown are primarily traffic volumes estimated to be in the mid-section of each corridor on each mode, not traffic travelling from Dhaka to each of the five corridor destinations.

In all corridors, for freight or passengers, the road mode occupies the higest share, often more than 50%. The Dhaka-Rangpur corridor is the only one in which the rail mode occupies more than one third of freight or passenger transport. In the Dhaka-Chittagong and the Dhaka-Khulna corridors it was estimated that the IWT carries about one third of the total freight flow in the mid-points of the corridors.

3.5.3 Optimum Modal Split for Each Corridor

Optimum modal split ratios were calculated for each corridor for thier total traffic flow levels, existing and projected, using the dynamic programming model. As IWT turned out to be the least cost mode at any traffic level in many cases, optimum ratios were calculated under assumed maximum IWT shares. Table 3.5.3 shows the results comparing the calculated optimum modal split percentages with the existing percentages.

Dhaka-Chittagong

Existing freight modal split is 51% for road, 13% for rail and the rest for IWT. The relation between the rail and the road should be reversed for the total corridor freight volume upto the year 1990. However, if the existing operational efficiency of the railways is not improved, the required investment to expand the capacity of the railways would make the road transport less expensive. This is another reason for the urgent task of improving the railway operation.

For the passenger transport the existing distribution of 63% for road, 22% for rail, and 15% for IWT is a costlier split than the case with less road traffic.

Dhaka-Khulna

For this corridor the rail mode should have no share for freight and passenger traffic travelling the entire length. A large part of the existing railway share, however, should be of trips within the west zone. In this corridor the IWT mode has a clear edge.

Dhaka-Rangpur

The existing freight modal split of 37% for rail and 63% for road can be compared with the optimum combination of rail and IWT with no road transport. For passengers, however, the road mode can have a share in the optimum combination although the existing split of 38% for rail and 62% road should be reversed.

Dhaka-Sylhet

The existing modal split for freight is 20% for rail, 52% for road, and 28% for IWT, and for passengers 39% for rail, 48% for road, and 13% for IWT. Corridor volumes of both freight and passengers are small. It is cheaper to transport all of the freight traffic by the railways than splitting it between rail and IWT under the condition of the maximum IWT share of 30% although IWT cost is lower than the rail cost at any traffic level. This is due to the higher marginal cost of IWT in the low traffic range for this corridor. For passengers the rail mode should take more thar the road mode.

Dhaka-Mymensingh

The existing modal split is heavily in favor of the road mode. From the view point of economic cost the railways shoudl occupy much higher share although by the year 2000 the total freight volume would be large enough to make a small share to the road mode optimum.

Table 3.5.1 Corridor Distances By Mode

Corridor	Rail	Road	IWT
Dhaka - Chittagong	343	261	334
- Khulna	623	312	364
- Sylhet	311	287	308[1/]
- Rangpur	414	321	449[1/]
- Mymensingh	116	121	-

Note: Upto the nearest point on waterways

Source: Consultants

Table 3.5.2 Estimated Existing Corridor Traffic Volumes

Corridor		Rail	Road	IWT	Total
Dhaka					
- Chittagong	Freight	1340	5330	3780	10450
	Passenger	15900	45600	(10900)	72400
- Khulna	Freight	1280	2100	1940	5310
	Passenger	17300	31900	(12300)	61500
- Rangpur	Freight	670	1120	2	1790
	Passenger	8900	14900	-	23800
- Sylhet	Freight	280	730	400	1410
	Passenger	8500	10400	(2800)	21700
- Mymensingh	Freight	290	2290	80	2670
	Passenger	12200	22300	-	34500

Note: In tons/day for freight and in persons/day for passengers.

Source: Consultants

Table 3.5.3 Existing and Optimum Modal Split

(in percent)

Corridor	Type	Year	Rail	Road	IWT	Conditions
Dhaka						
- Chittagond	Freight	Existing	13	51	36	Existing
		1985 Optimum	57	3	40	IWT Max. 40%
		1985 Optimum	37	3	60	IWT Max. 60%
		1990 Optimum	37	3	60	IWT Max. 60%
		2000 Optimum	15	45	40	IWT Max. 40%
		2000 Optimum	-	40	60	IWT Max. 60%
	Pass.		22	63	15	
		1985 Optimum	80	-	20	IWT Max. 20%
		2000 Optimum	80	-	20	IWT Max. 20%
- Khulna	Freight	Existing	24	40	36	Existing
		1985 Optimum	-	40	60	IWT Max. 60%
		2000 Optimum	-	40	60	IWT Max.60%
	Pass.	Existing	28	52	20	Existing
		1985 Optimum	-	80	20	IWT Max. 20%
		2000 Optimum	-	80	20	IWT Max. 20%
- Rangpur	Freight	Existing	37	63	-	Existing
		1985 Optimum	100	-	-	No IWT
		1985 Optimum	40	-	60	IWT Max. 60%
		2000 Optimum	40	-	60	IWT Max. 60%
	Pass.	Existing	38	62	-	Existing
		1985 Optimum	87	13	-	No IWT
		1985 Optimum	67	13	20	IWT Max. 20%
		1990 Optimum	72	8	20	IWT Max. 20%
- Sylhet	Freight	Existing	20	52	28	Existing
		1985 Optimum	40	-	60	IWT Max. 60%
		1985 Optimum	100	-	-	IWT Max. 30%
		2000 Optimum	40	-	60	IWT Max. 60%
	Pass.	Existing	39	48	13	Existing
		1985 Optimum	80	-	20	IWT Max. 20%
		2000 Optimum	80	-	20	IWT Max. 20%
- Mymensingh	Freight	Existing	11	86	3	Existing
		1985 Optimum	90	-	10	IWT Max. 10%
		1990 Optimum	90	-	10	IWT Max. 10%
		2000 Optimum	87	3	10	IWT Max. 10%
	Pass.	Existing	35	65	-	Existing
		1985 Optimum	100	-	-	No IWT
		2000 Optimum	100	-	-	No IWT

3.6 Assessment of Existing Modal Split

3.6.1 Freight

Existing modal split in freight transport is summarized in Table 3.6.1. Trend in the last ten years can be characterized by the rapid growth of the road freight transport, which accounts for more than half of the total ton-km in 1984-85. While IWT showed a modest growth, the rail freight transport stagnated or even declined in the total volume.

The situation is uneconomical in terms of direct economic resource cost. For long distance hauling the road transport is significantly more costly than other modes when taking infrastructure cost into account. Optimum modal split depends on hauling distance and traffic volume. The road mode, however, can occupy a significant share only in the very low traffic range or for a short distance of 50 km or less. For long distance IWT has a decisive cost advantage.

Table 3.4.3 shows the difference in the total cost between the existing modal split and examples of desirable modal split. Cost savings would be in the order of 10-30% if the rail and the IWT modes can take higher market shares in freight transport.

The rapid growth of the road mode can partly be attributable to the failure of other modes in providing services satisfactory to customers. A majority of users cited the time saving as the main reason for choosing the mode even though the Jamuna crossing can impose a full day waiting for trucks.

Table 3.6.1 Existing Freight Modal Split

	Rail	Road	IWT
Average Lead (km)	265	170	241
Share in Total Ton-km (%)	16	54	30
Share in Total Tonnage (%)	12	63	25

Source: Table 3.2.1 and Appendix Table 3.2.1

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3.6.2 Passenger

The existing market shares of each mode in passenger transport are 38% for rail, and 32% for IWT in terms of number of passengers, and 51% for road, 28% for rail, and 21% for IWT in terms of passenger-km. The large discrepancy between figures for shares in the total number of passengers and share in the total passenger-km is due to the difference in average lead by each mode, which were estimated at 90 km for road, 64 km for rail and [illegible] km for IWT. These short average lead figures indicate that the majority of passenger trips are intra-district trips rather than inter-district trips.

When the market is divided into the intra-district trip market and inter-district trip market, modal split in each of the two is considerably different from the overall one. It was necessary to estimate average lead of passengers in each of the two distinctive market.

For the road passengers average lead of both categories were obtained from the Consultants passenger O&D surveys as reported in Chapter 9.

No passenger O&D information was available for the rail and the IWT mode. BIWTA estimated the average lead by private sector at 26.1 km and by public sector at 106.8 km as shown in Table 3.6.2. Sector average would be close to private sector average as the private sector dominates the market, more so than shown in the Table.

Two alternatives were tested for average lead of inter-district passengers by rail and by IWT. Alternative A was set at the average lead of inter-district freight as calculated from freight O&D tables. Alternative B was set at one half of average lead of freight. Given overall average lead and number of passengers and passenger-km figures for each mode numbers of passengers and passenger-km of intra-district and inter-district passengers for each mode can be calculated and the results are shown in Table 3.6.3. It is apparent that the share of road mode in inter-district passenger transport is much higher than the overall share. Short distance intra-district passenger market is roughly equally shared by the three modes.

Given the sparse network of motorable roads in Bangladesh, it is likely that the fairly equal distribution of passengers among the three modes reflects the un-overlapping area of influence of each mode. People utilize a mode which can be reached without excessive walking.

The dominance of the road mode in long distance inter-district passenger transport market is uneconomical in terms of direct resource cost to the economy. This situatiohn, however, would be difficult to change as passengers choose the road mode on the grounds of non-monetary values as shown in Section 3.3.

Table 3.6.2 IWT Passenger Traffic

Service	Length of Water Routes (km)	Number of Passengers Carried (Millions)	Passenger (km) Performed (Millions)	Average Lead (km)
Private Sector (Vessels & Launches)	5350	45.87	1193.1	26.01
Public Sector (BIWTC)	1091	2.81	300.2	106.8
Total	-	48.68	1493.3	30.7

Source: BIWTA, Ports and Traffic Report 1982/83

Table 3.6.3 Modal Shares in Intra and Inter-District Passenger Trips

	Road		Rail		IWT		Total	
Overall								
Average trip distance (km)	90		64		44		-	
No. of passengers (million/yr)	172		133		141		445	
Modal shares (%)	38		30		32		100	
Total pass.-km (million/yr)	15460		8428		6203		30091	
Modal shares (%)	51		28		21		100	
Intra-District			A	B	A	B	A	B
Average trip distance (km)	35		30	35	26	20	-	-
No.of passengers (million/yr)	106		115	98	131	115	353	319
Modal shares (%)	30	33	33	31	37	36	100	100
Total pass.-km (million/yr)	3710		3480	3430	3406	2300	10600	9440
Modal shares	35	39	33	36	32	25	100	100
Inter-District			A	B	A	B	A	B
Average trip distance (km)	177		290	145	296	148	-	-
No. of passengers (million/yr)	66		18	35	10	26	94	127
Modal shares (%)	70	52	19	28	11	20	100	100
Total pass.km (million/yr)	11750		4948	4998	2797	3903	19495	20651
Modal shares (%)	60	57	25	24	15	19	100	100

Note: A,B for rail and for IWT indicate alternate assumptions concerning average trip distances for intra-district trips and inter-district trips.

Source: Consultants.

CHAPTER 4

TRANSPORT DEMAND PROJECTIONS

4.1 Overall Transport Demand Growth

4.1.1 GDP Elasticities of Transport Demand

The growth of transport demand is usually closely associated with the growth of economic activities. Freight transport is required to support specific economic activities. Passengers travel to conduct some economic activities. Even tourism can be linked to income level of passengers, which in turn is a result of their economic activities.

Table 4.1.1 shows historic GDP figures and overall transport performance in terms of total ton-km, tons, passenger-km, and passengers. It is evident that GDP and traffic figures are closely related.

In order to determine the relationship among them, regression analyses were performed against the data shown in the Table. Two forms of relationship were tested. One is the linear form and the other power form. Resulting regression equations are shown below with associated coefficients of correlation.

Linear Form

Total ton-km	= 0.0169 x GDP - 0.6508	$R^2 = 0.960$
Total tonnage	= 0.0867 x GDP - 4.114	$R^2 = 0.973$
Total pass.-km	= 0.1471 x GDP - 16.40	$R^2 = 0.983$
Total passengers	= 1.885 x GDP - 152.3	$R^2 = 0.977$

Power Form

Total tonnage = $0.0203 \times GDP^{1.224}$	$R^2 = 0.973$
Total passengers = $0.1212 \times GDP^{1.426}$	$R^2 = 0.978$

where GDP's are in billion Tk., ton-km and pass.-km in billions, and total tonnages and passengers in millions.

High values obtained for the coefficient of correlation do not necessarily mean that the relationship between GDP and transport demand is particularly strong in Bangladesh. They are reflection of assumptions which had to be made during the process of estimating GDP and transport performance and which likely smoothed over the unknown actual fluctuations.

Table 4.1.1 Historic GDP and Total Transport Demand

Year	GDP (billion Tk.)	Ton-km (billion)	Ton (million)	Passenger-km (billion)	Passenger (million)
1975/1976	224.5	-	-	16.7	273.0
1976/1977	228.3	3.11	15.48	17.8	287.5
1977/1978	242.8	3.44	17.16	19.1	302.6
1978/1979	255.3	3.63	17.65	20.3	318.7
1979/1980	258.0	3.82	18.51	21.8	332.7
1980/1981	275.6	3.88	19.12	23.0	348.8
1981/1982	277.9	4.17	20.57	24.9	379.2
1982/1983	287.1	4.30	21.23	26.5	398.9
1983/1984	302.6	4.43	22.11	28.3	419.6
1984/1985	316.2	4.59	23.02	30.1	445.3

Source: GDP figures from BEPP

Transport figures from Appendix Tables 4.1.1 and 4.1.3.

The linear form and the power form both appear to be equally good judging by R square values. However, the adoption of the power form and extending it into the future imply that the elasticity of transport demand with respect to GDP will remain constant at the power values shown in the equations. This in turn implies that no structural change in the economy in terms of transport demand generation would take place. The agriculture sector, which has produced majority of freight transport demand, has been loosing its share in the total GDP and is expected to continue loosing its share in the future, as described in Chapter 2.

Future freight transport demand relative to GDP level, therefore, should be lower. For passengers, the high rate of growth in recent years must be the result of excessively low fares and this situation can not continue in the long run.

On the other hand the adoption of the linear form gives declining GDP elasticity of transport demand as GDP increases. Therefore, it was determined that the linear form be adopted for the GDP-transport demand relationships. Table 4.1.2 shows GDP elasticities of ton-km, tonnage, passenger-km, and passengers calculated for GDP levels in target years. It should be noted that the share of agriculture sector, which was 50% in 1977, is expected to be 30% by 2000. Concomitant reduction in GDP elasticity of transport demand is assumed as shown in Table 4.1.2.

4.1.2 General Transport Demand Growth by District

Nation-wide traffic growth rates were calculated by the elasticities thus developed and GDP growth rates described in Chapter 2 and are shown in Table 4.1.3.

District by district traffic growth rates were also obtained by applying the estimated elasticities to the district GDP growth rates described in Chapter 2. Table 4.1.4 shows freight traffic growth rates by district, and Table 4.1.5 passenger traffic growth rates by district.

4.1.3 Effect of Food Self-Sufficiency

Traffic growth rate described above are applicable insofaras general traffic related to general level of GDP. When some significant structural changes in transport pattern take place such as changes in district food grain import and export following the changes in food surplus-deficit situation of the district, the above growth rates should be modified.

Table 4.1.2 GDP Elasticities of Transport Demand

Year	GDP (billion Tk)	Agriculture Sector Share (%)	Ton-km Elasticity	Ton	Pass.-km Elasticity	Pass.
1976/77	228.3	49.8	1.203	1.262	1.203	1.548
1984/85	316.2	45.1	1.139	1.177	1.545	1.343
1984/90	411.3	41.0	1.103	1.130	1.372	1.244
1994/95	548.1	36.4	1.076	1.095	1.255	1.173
1999/2000	770.9	30.9	1.053	1.066	1.169	1.117

Source: GDP and agriculture sector share from BEPP Elasticities by the Consultants,

Table 4.1.3 Traffic Growth Rate Projections

Period	GDP	Ton-km	Ton	Pass.-km	Pass.
1984/85 - 89/90	5.4	6.1	6.2	7.9	7.0
1989/90 - 94/95	5.9	6.4	6.6	7.7	7.1
1994/95 - 99/2000	7.1	7.6	7.7	8.6	8.1

Source: Table 4.1.2

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Table 4.1.4 District Freight Transport Growth Rates

District	No.	1984/85 - 1989/90	1989/90 - 1994/95	1994/95 - 1999/2000
Chittagong	1	4.4	7.0	8.1
C.H.T.	2	1.7	12.0	12.1
Comilla	3	6.4	5.7	6.8
Noakhali	4	6.4	5.5	6.6
Sylhet	5	4.9	5.3	6.4
Dhaka	6	4.9	8.3	9.3
Faridpur	7	4.5	6.0	7.1
Jamalpur	8	5.9	5.9	7.0
Mymensingh	9	4.9	5.8	7.0
Tangail	10	5.0	5.9	7.1
Barisal	11	6.0	5.1	6.2
Jessore	12	8.2	6.6	7.8
Khulna	13	4.1	6.1	7.2
Kushtia	14	11.3	6.8	7.9
Patuakhali	15	5.0	5.4	6.4
Bogra	16	8.6	7.0	8.1
Dinajpur	17	8.6	7.2	8.3
Pabna	18	9.4	7.0	8.2
Rajshahi	19	8.3	6.5	7.6
Rangpur	20	9.2	6.2	7.3
Bangladesh		6.2	6.6	7.7

Source: Consultants

Table 4.1.5 District Passenger Transport Growth Rates

District	No.	1984/85 - 1989/90	1989/90 - 1994/95	1994/95 - 1999/2000
Chittagong	1	5.0	7.5	8.6
C.H.T.	2	1.9	12.9	12.7
Comilla	3	7.2	6.1	9.2
Noakhali	4	7.3	5.9	6.9
Sylhet	5	5.5	5.7	6.7
Dhaka	6	5.5	8.9	9.8
Faridpur	7	5.1	6.4	7.5
Jamalpur	8	6.7	6.4	7.4
Mymensingh	9	5.5	6.3	7.3
Tangail	10	5.6	6.4	7.4
Barisal	11	6.7	5.5	6.5
Jessore	12	9.3	7.1	8.2
Khulna	13	4.6	6.6	7.6
Kushtia	14	12.8	7.3	8.4
Patuakhali	15	5.6	5.8	6.8
Bogra	16	9.7	7.5	8.5
Dinajpur	17	9.7	7.7	8.7
Pabna	18	10.6	7.5	8.6
Rajshahi	19	9.4	7.0	8.0
Rangpur	20	10.4	6.6	7.7
Bangladesh		7.0	7.1	8.1

Source: Consultants

Under the current program of increasing food grain production, it is expected that the country would become self-sufficient in food grain supply by 1990. District by district food grain surplus-deficit situation would vary considerably as described in Chapter 2. In order to take such changes into account and to modify the general traffic growth rates by district, the following procedures were taken.

First, the total amount of freight tonnage into and out of each district were estimated. For the road mode, the truck origin and destination table developed as a result of the Consultants' O&D survey was used as the basis. Total tonnages for each district were estimated by applying the average load of 4.7 tons to the number of trucks originated and destined to each district. For those districts not well covered by the Consultants' survey, total tonnages were estimated by means of the relationship between the district GDP and the road freight tonnage by district. Figure 4.1.1 shows the plotted points for each district. Tonnages for missing districts were determined by considering district GDP, road network coverage and availability of other modes.

For the IWT mode, a 1982 freight O&D table developed by BIWTA was used after expanding it to match the Consultants' estimate for the total IWT freight tonnage.

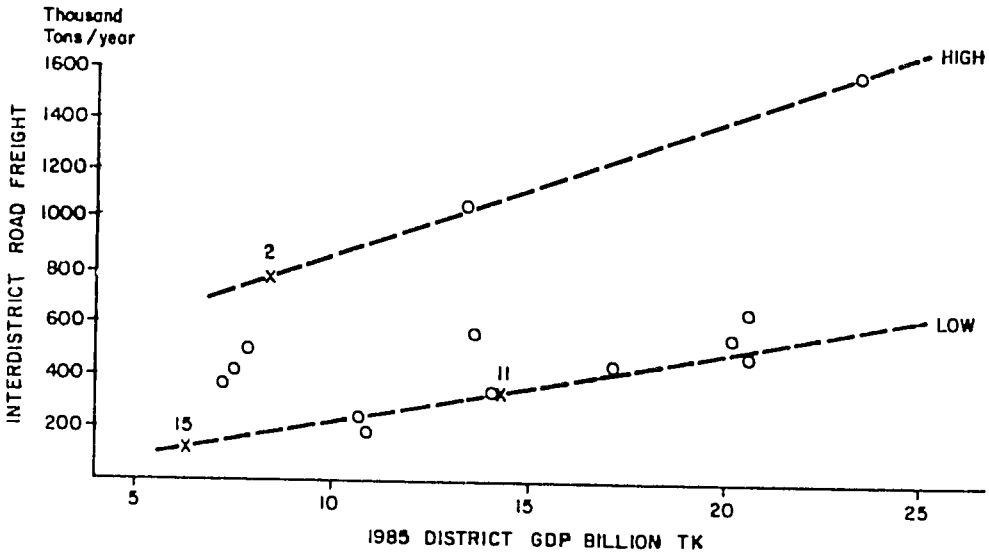
For the rail mode, the total rail freight tonnage shown in Section 3.2 was distributed among districts by means of assumed rail mode share for each mode considering the rail network coverage and the availability of other modes because of the complete lack of origin and destination information on rail traffic. (Because of the same reason of complete absence of O&D data, JICA team has recently attempted to create a freight O&D table by a gravity model based on GDP and interdistrict route distance.)

Freight tonnages into and out of each district by all modes were then obtained by adding the amounts by each mode together.

The foregoing process is summarized in Table 4.1.6.

Secondly, food grain import or export by district, existing and in the future, were expressed in existing annual tonnages and in growth (or decrease) rates based on estimates shown in Table 2.4.11 in Chapter 2. It should be noted that all tonnages described above are the sum of freight into and out of each district. Transport requirements were considered same regardless import to or export from each district.

Thirdly, non-food grain freight was taken as the difference of the total tonnage and the food grain surplus or deficit, and the general freight growth rates were applied to obtain future volumes by district. Combining the future tonnages of food grain surplus or deficit and non-food grain freight, future total freight tonnages, by district and its growth rates were obtained.



NOTE : X INDICATES ASSUMED TRAFFIC LEVELS FOR THE DISTRICTS SHOWN

Fig. 4.1.1 **GDP AND INTERDISTRICT ROAD FREIGHT BY DISTRICT**

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Table 4.1.6 Estimated Interdistrict Freight Traffic by Mode

(in 000 tons)

No.	District	1985 Road Survey Truck Traffic, Into/Out of Dist. No. of Trucks	Annual Tonnage Direct	Annual Tonnage Adjusted	82/83 IWT Inter-Dist. Freight Adjusted to 84/85 All Commodities	84/85 Rail Freight Assumed Rail share (%)	Assumed Tonnage	All Modes
1.	Chittagong	1908	3273	3860 1/	2860 1/	14	1136 1/	7856
	(Port)	-	-	(3653)	(2097)	15	(1015)	(6765) (Food 2107)
2.	Ctg. Hill Tracts	-	750 2/	884	107	0	-	991
3.	Comilla	915	1569	1850	258	11	271	2379
4.	Noakhali	608	1043	1230	8	12	164	1402
5.	Sylhet	282	484	571	292	19	199	1062
6.	Dhaka	2347	4026	4747	2874	19	1739	9360
7.	Faridpur	207	355	418	90	7	41	549
8.	Jamalpur	233	400	472	-	16	88	560
9.	Mymensingh	358	614	724	60	15	135	919
10.	Tangail	289	496	585	-	0	-	585
11.	Barisal	23	350 2/	413	334	0	-	747
12.	Jessore	545	935	1103	3	22	307	1413
13.	Khulna	922	1852	1865	1362	20	812	4039
.	(Chalna Port)							(2500) (Food 700)
14.	Kushtia	230	395	466	4	22	130	600
15.	Patuakhali	-	150 2/	176	92		-	268
16.	Bogra	127	218	257	-	22	71	328
17.	Dinajpur	114	196	231		28	91	322
18.	Pabna	328	563	664	179	18	186	1029
19.	Rajshahi	248	425	502	-	22	140	642
20.	Rangpur	312	535	631		-	250	882
	Total	9530	18359	21647	8526	16	5640	35813
			(Food 28%)					

Note: 1/ Based on actual modal share for June 1984 - January 1985

2/ Estimated in relation to 1985 District GDP and network

Actual calculations were done by using the percentage shares of non-food freight and food grain surplus or deficit in each district in 1985 as the base and applying separate growth rates, calculating growth indices for target years and then adding two together for each target year to obtain combined growth rates.

The above process is summarized in Table 4.1.7 with resulting overall growth rates by district.

For the districts of Chittagong and Khulna where Chittagong and Chalna sea ports are located, effective total freight out of and into the districts including the ports were calculated by means of first treating ports as separate districts and then combining with the actual districts.

Variance in district by district growth rates is large in first period till 1990 due to the changes in food grain transport requirements. Subsequent years show more even patterns.

A considerable amount of uncertainty exists concerning the timing of food self-sufficiency, which is currently envisaged to take place by 1990 as assumed in this study. The likelihood of the timing slipping several years is not small. Should this be the case, traffic into and out of Chittagong and Khulna would be greater than indicated by growth rates shown in Table 4.1.7. Overall pattern, however, would not be much different particularly in later years as the overall share of food grain transport will become smaller.

4.1.4 Freight Transport Demand Projections

Seven major corridors were identified as described in Section 3.4.4. Future freight traffic through these corridors were projected by the following procedures.

Existing (1985) freight origin-destination tables were developed for each of the three modes. For the road mode the results of the Consultants' O&D surveys were taken as the basis. For O&D pairs not well covered by the survey stations estimates were made taking district GDP and road network coverage into account with the total tonnage derived from network-wide traffic counts as the control total. For IWT freight O&D table developed from BIWTA data was expanded to match the total tonnage as developed in Chapter 10 and shown in Section 3.2. For the railways only total tonnages for the east and west zones were available as explained in 4.1.3. These zonal totals were distributed among districts primarily by means of assumed railway shares (established district by assessing networks) against the road and IWT mode for which district totals had been established. Given district totals for the railways, tonnages for each O&D pair were estimated by means of Fratar method with the combined table of road and IWT as the base matrix with adjustments by judgement. This heavily judgemental procedure was considered more suitable than mechanical mehtods such as applying the gravity model since freight

Table 4.1.7 Estimated Interdistrict Freight Traffic, Total & Food Grain, and Growth Rates

District No.	District	1985 Estimated Total Freight Into/Out of District	1985 Annual Cereal Surplus/Deficit Tonnage	Percent to Total Freight	Food Grain Surplus/Deficit Growth Rate - 90	- 95	-2000	General Freight Growth Rate - 90	- 95	- 2000	Cereal Surplus/Deficit Growth Index 1990	1995	2000	General Freight Growth Index 1990	1995	2000	Overall Growth Rate - 90	- 95	- 2000
1.	Chittagong	1091	-216	19.8	8.2	6.3	5.3	4.4	7.0	8.1	29.5	40.0	51.5	99.5	139.5	205.9	5.2	6.8	7.4
	(Chittagong Port)	(6765)	+2107	31.1	-75.0	0	0	6.2	6.6	7.7	0	0	0	93.1	128.1	185.7	-1.4	6.6	7.7
2.	Ctg. Hill Tracts	991	-57	5.8	14.9	11.8	11.0	1.7	12.0	12.1	16.8	29.3	49.3	102.5	180.6	319.7	3.6	12.0	11.9
3.	Comilla	2379	-122	5.1	2.3	5.6	6.4	6.4	5.7	6.8	5.2	6.8	9.3	129.4	170.7	237.2	6.1	5.7	6.8
4.	Noakhali	1402	+ 15	1.1	-2.8	-11.6	-36.4	6.4	5.5	6.6	0.9	0.5	2.4	134.9	176.3	242.5	6.3	5.4	6.7
5.	Sylhet	1062	+209	19.7	-1.5	2.5	4.7	4.9	5.3	6.4	19.2	21.7	27.3	102.0	132.0	180.1	3.9	4.9	6.2
6.	Dhaka	9360	-1047	11.2	5.4	5.8	5.5	4.9	8.3	9.3	13.5	17.9	23.5	112.8	168.0	262.1	4.8	8.0	9.0
7.	Faridpur	549	-329	59.9	-4.7	-9.1	-16.2	4.5	6.0	7.1	43.7	27.1	11.2	48.9	66.9	94.2	-1.3	0.1	2.3
8.	Jamalpur	560	+96	17.1	9.9	7.6	5.3	5.9	5.9	7.0	25.1	36.3	46.9	110.4	147.1	205.3	6.2	6.2	6.7
9.	Mymensingh	919	+394	42.9	3.2	2.6	2.8	4.9	5.8	7.0	45.5	51.9	59.6	72.5	96.1	134.9	3.4	4.6	5.6
10.	Tangail	585	+154	26.3	5.9	4.3	1.6	5.0	5.9	7.1	32.0	39.5	42.8	94.1	125.3	176.5	4.7	5.5	5.9
11.	Barisal	747	-23	3.1	24.9	33.3	16.2	6.0	5.1	6.2	20.4	85.7	181.6	129.7	166.3	224.6	8.5	10.9	10.0
12.	Jessore	1483	-30	2.1	-4.4	24.9	-17.4	8.2	6.6	7.8	1.7	5.3	2.[illegible]	145.2	199.9	290.9	8.0	6.9	7.4
13.	Khulna	1539	-152	9.9	6.9	5.8	4.9	4.1	6.1	7.2	18.0	23.9	30.4	110.1	148.1	209.7	5.1	6.1	6.9
	(Chalna Port)	(2500)	+700	28.0	-75.0	0.	0.	6.2	6.6	7.7	0	0	0	37.3	133.9	194.0	-0.5	6.6	7.7
14.	Kushtia	600	-34	5.7	10.9	9.8	8.8	11.3	6.8	7.9	9.6	15.3	30.4	161.1	223.8	327.3	11.3	7.0	8.4
15.	Patuakhali	268	+70	26.1	12.3	15.1	12.4	5.0	5.4	6.4	46.6	94.1	168.9	94.3	122.7	167.3	7.1	9.0	9.2
16.	Bogra	328	+306	93.3	0.	1.6	-5.2	8.6	7.0	8.1	93.3	101.0	77.3	10.0	14.2	21.0	0.7	2.2	3.1
17.	Dinajpur	322	+265	82.3	1.0	1.8	2.3	8.6	7.2	8.3	93.6	102.2	144.5	26.7	37.9	56.4	3.8	3.1	4.1
18.	Pabna	1029	-12	1.2	46.9	11.6	1.0	9.4	7.0	8.2	8.2	14.2	14.9	54.8	217.2	322.0	10.3	7.3	7.8
19.	Rajshahi	642	+34	5.3	25.5	7.2	8.4	8.3	6.5	7.6	17.1	24.2	36.0	141.1	193.3	278.8	9.6	6.6	7.7
20.	Rangpur	882	+335	38.0	5.3	5.6	6.3	9.2	6.2	7.3	53.4	70.0	95.2	96.3	130.1	185.0	8.4	6.0	7.0
	Bangladesh Total	35813	-144																
1.	Chittagong with Port																-0.4	6.6	7.6
13.	Khulna with Port																1.8	6.4	7.3

Note: Assuming the food grain self-sufficiency by 1990.

movements depend heavily on particularity of origin and destination, not much on distance between them. Resultant 1985 freight O&D tables for each mode are shown in Appendix 4.1.4. The total freight O&D tables covering all modes was then created by combining the three O&D tables.

District by district freight growth rates were obtained as explained by applying the Fratar method with the 1985 total freight O&D table as the base matrix. Resulting 1990, 1995 and 2000 total freight O&D tables are also shown in Appendix 4.1.4.

These present and future total freight O&D tables were then assigned onto a simple network comprising seven major corridors. The results are illustrated in Figures 4.1.2 through 4.1.5 for years 1985, 1990, 1995, and 2000. For the sake of simplicity the direct waterway link connecting Dhaka and Khulna is included in Dhaka-Pabna and Pabna-Khulna corridors.

It is evident that major requirements for transport facilities and services would occur along the southern corridors of Chittagong-Dhaka-Khulna, not in the corridors serving the northern part of the country. Figure 4.1.6 shows growth of freight volume through each of the corridors. Chittagong-Comilla-Dhaka corridor would accommodate the heaviest traffic although the growth upto the year 1990 would be small due to the food self-sufficiency. The east-west link of Dhaka-Pabna corridor would experience the highest growth rate. On the other hand Comilla-Sylhet corridor would not only carry the least amount of traffic but grow at the lowest rate.

The above projections do not take into account the possible shift of cargo from Chittagong Port to Chalna Port due to the capacity constraint of the Chittagong Port. Should this be the case, corridor volumes for corridors No. 5 and No. 7 would be somewhat less and volumes for corridors No. 2 and No. 3 would be somewhat higher, thus achieving balance between the east and the west. Basic picture, however, would not be much different as the southern corridors commanding the dominant position.

4.1.5 Passenger Transport Demand Projections

Due to the complete lack of O&D information for two out of three modes it was not possible to carry out passenger transport demand projections at a comparable level with freight transport demand.

Passenger transport demand would be closely associated with district passenger growth since passenger trips are generally much shorter than freight. Table 4.1.8 shows passenger traffic growth factors for each district. It can be seen that passenger traffic growth would be fairly even throughout the country with a few exceptions.

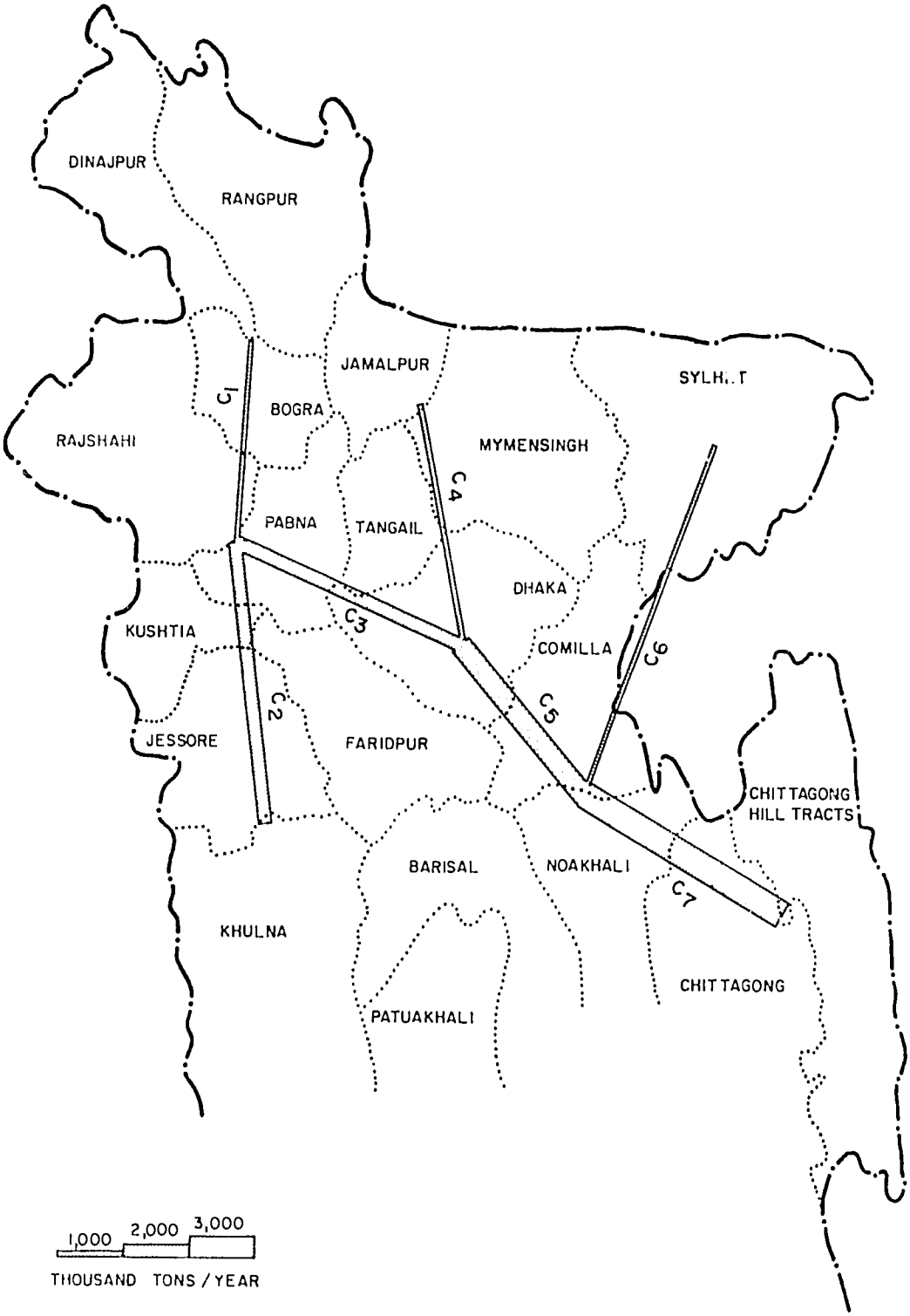

Fig. 4.1.2 1985 FREIGHT TRAFFIC ON MAJOR CORRIDORS

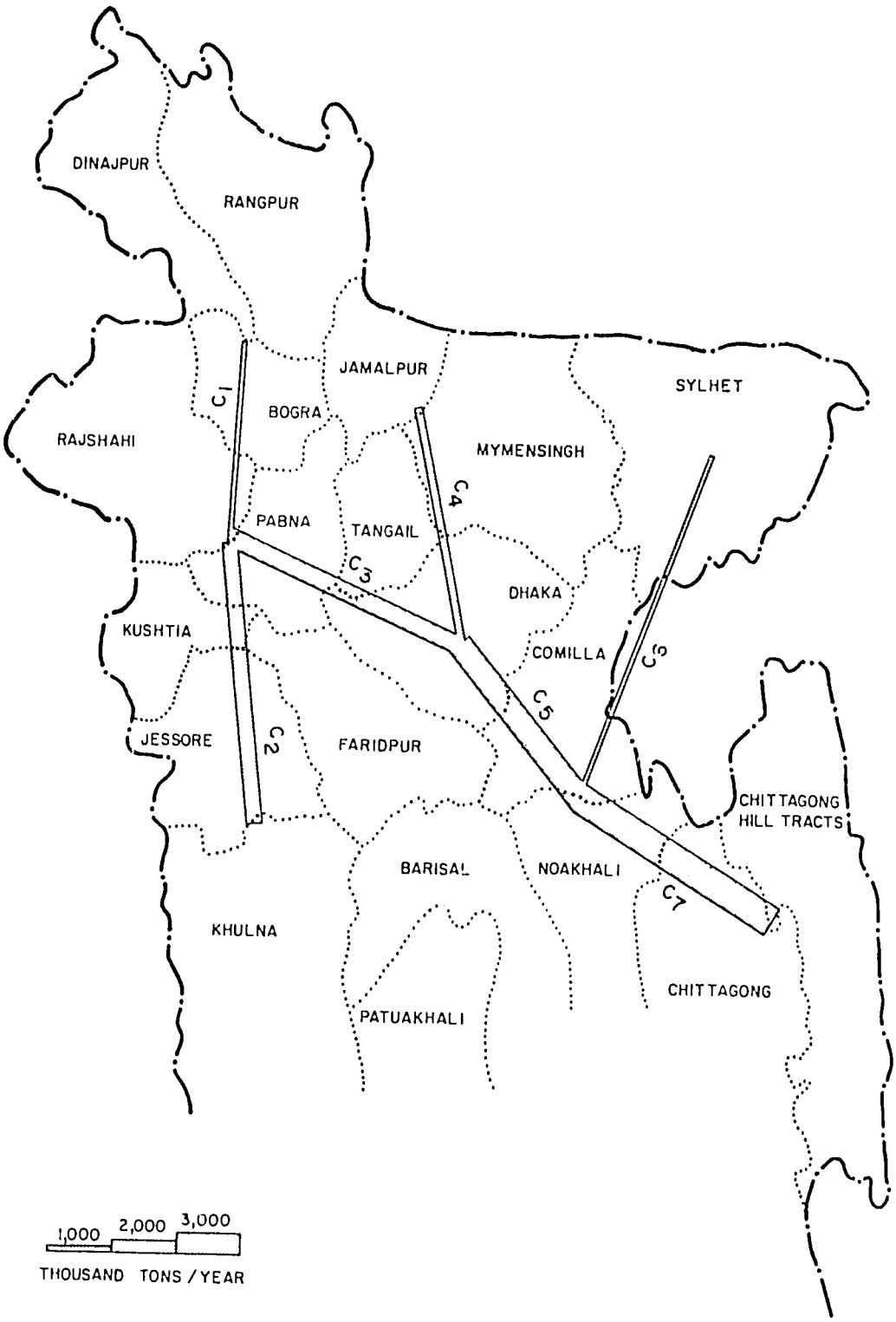

Fig. 4.1.3 1990 FREIGHT TRAFFIC ON MAJOR CORRIDORS

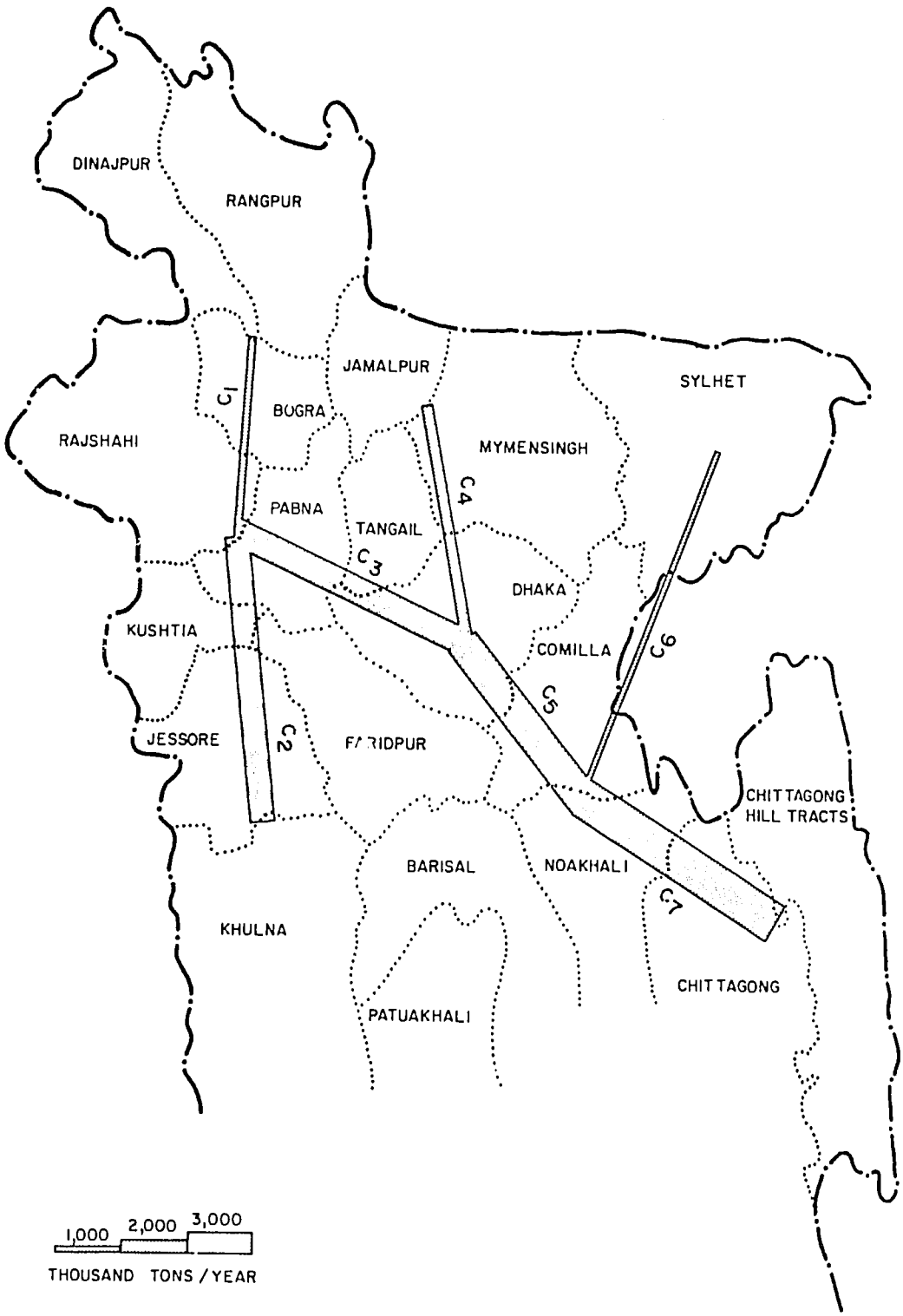

Fig. 4.1.4 1995 FREIGHT TRAFFIC ON MAJOR CORRIDORS

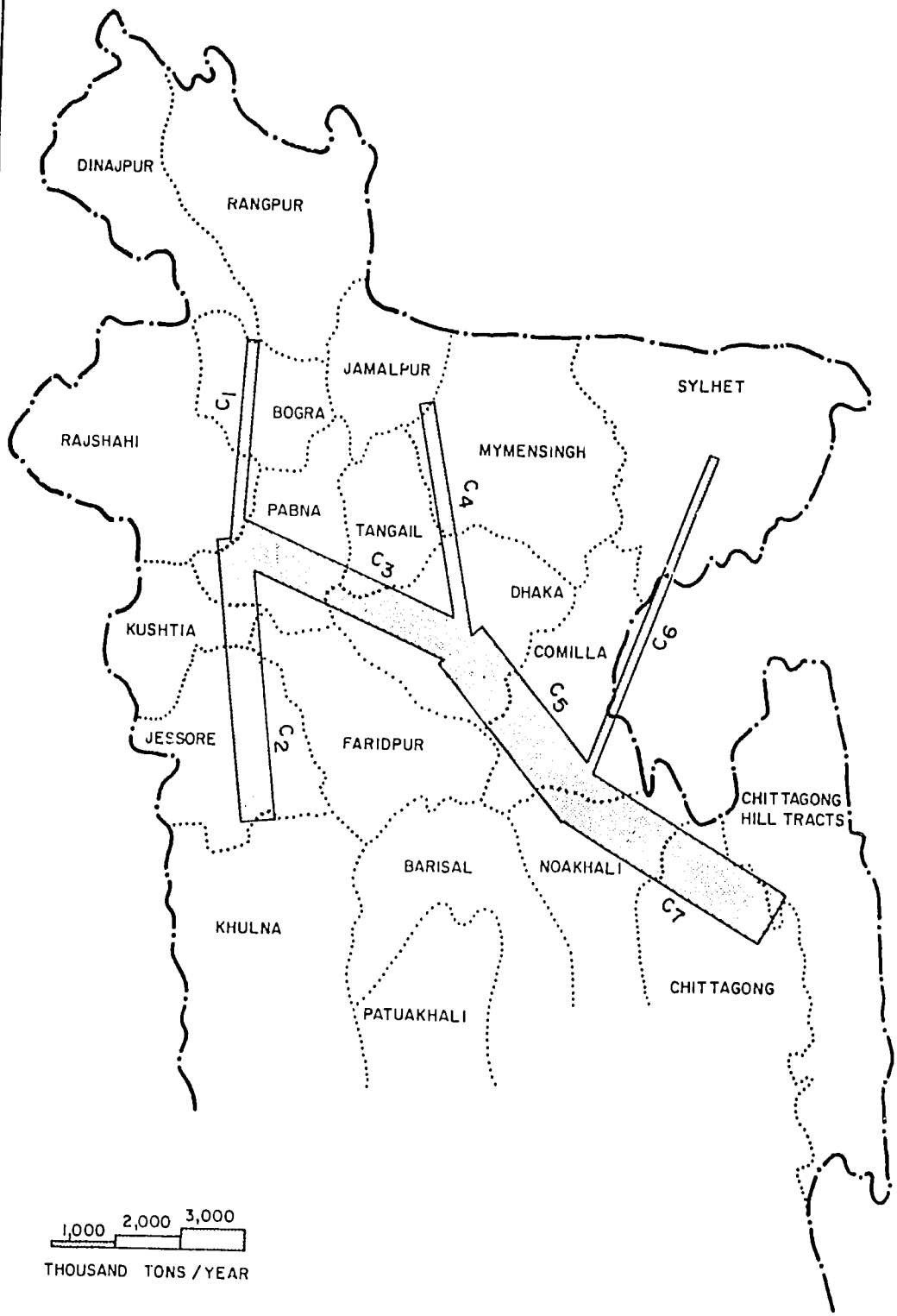

Fig. 4.1.5 2000 FREIGHT TRAFFIC ON MAJOR CORRIDORS

Fig. 4.1.6 Freight Traffic on Major Corridors

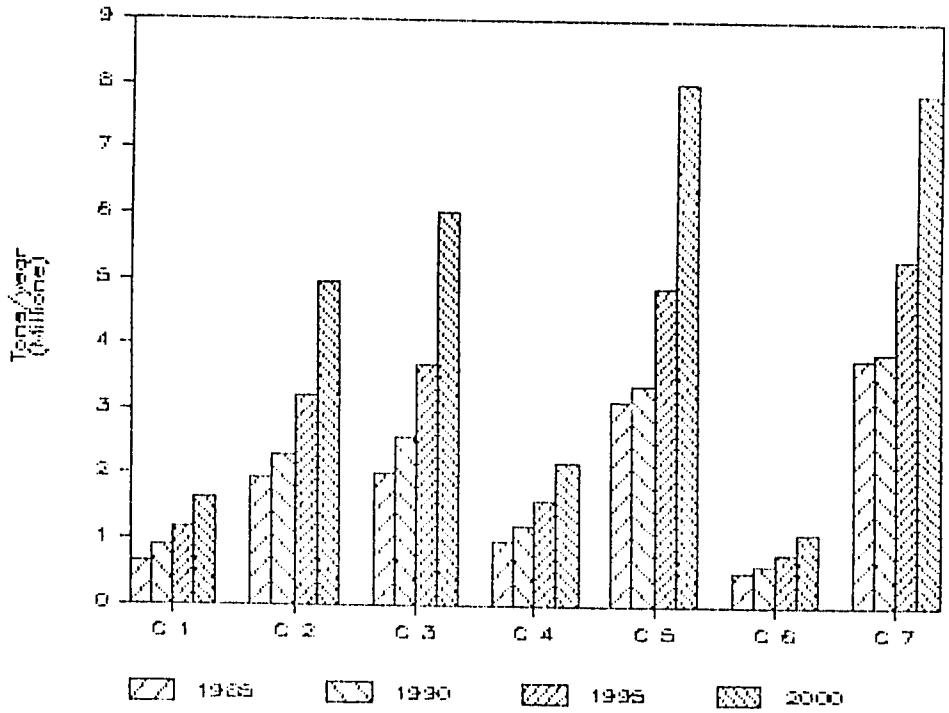

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Table 4.1.8 Passenger Transport Growth Factors by District

(Volume in 1985 = 1.0)

District	No.	1989/90	1994/95	1999/2000
Chittagong	1	1.28	1.83	2.77
C.H.T.	2	1.10	2.02	3.66
Comilla	3	1.42	1.90	2.96
Noakhali	4	1.42	1.89	2.64
Sylhet	5	1.31	1.72	2.38
Dhaka	6	1.31	2.00	3.19
Faridpur	7	1.28	1.75	2.51
Jamalpur	8	1.38	1.89	2.69
Mymensingh	9	1.31	1.77	2.52
Tangail	10	1.31	1.79	2.56
Barisal	11	1.38	1.81	2.48
Jessore	12	1.56	2.20	3.26
Khulna	13	1.25	1.72	2.49
Kushtia	14	1.[illegible]	2.60	3.39
Patuakhali	15	1.31	1.74	2.42
Bogra	16	1.59	2.28	3.43
Dinajpur	17	1.65	2.30	3.49
Pabna	18	1.65	2.38	3.59
Rajshahi	19	1.57	2.20	3.23
Rangpur	20	1.64	2.26	3.27
Bangladesh		1.40	1.98	2.92

4.2 Future Modal Split

4.2.1 Freight

Changes in the modal share of freight transport in the past have been analyzed and the results are presented in Section 3.2. Table 4.2.1 shows trends in the past in terms of growth rates. During the period of 1976-1980, the total freight tonnage grew at an average rate of 5.4% per annum while GDP grew at 4.8% per annum. This growth in the total tonnage was taken up largely by the road mode which grew at 8.7% per annum. IWT grew at a modest rate of 3.6% per annum whereas the rail mode lost its freight at a rate of 1.5% per annum. These trends continued in the next period of 1980-1984 in a somewhat moderate scale as the GDP growth rate decreased to 3.5% per annum. IWT, however, accerelated its performance in the latter period despite the decrease in the overall freight growth rate.

The relationship between the freight tonnage growth rates by each mode and the total freight growth rate have been stable. The growth rate of the road mode has been 50% higher and the rate of the IWT mode 25% lower than the total freight tonnage growth rate. The rail mode showed a negative rate throughout the periods. Exptrapolation of past trends was made by applying the relationships of modal growth rates to the total freight growth in terms tonnage. If the rail mode continue to loose its freight at a rate of 1.4% per annum and the IWT grows at a rate 25% lower than the total freight growth rate, more than three quarters of freight tonnage would be transported by road and the share of the railways would become an insignificant level of 4% by the year 2000.

This pessimistic outlook for railways, however, is unlikely to realize. The ongoing ADB Second Railway Project, which is aimed at arresting this decline, envisage a modest growth of 2.8% per annum from 1987/88 onward. At this growth rate, however, the share of railways would still continue to decline to about 7% by the year 2000 from the current level of 12%.

The rapid growth of the freight transport by road has been achieved despite poor conditions of the road network and the delays caused by the numerous ferry crossings. The replacement of ferries by bridges is likely to increase further the attractiveness of this mode. Under the current framework of encouraging the private sector it is the road mode that can offer the highest responsiveness as it is the easiest market to enter among the three modes with its low capital requirements.

Cost advantage of IWT and, to a lesser degree, of railways in Bangladesh is demonstrated in Chapter 3. There should be a major effort in promoting IWT and railways. Given such effort it is not infeasible to reduce the share of the road mode from the current 63% to 50% in terms of total tonnage or from 54% to 41% in terms of total

Table 4.2.1 Modal Growth Rates, Trend and Projections

Period	Item	GDP	Freight Tons				Passengers			
			Road	Rail	IWT	Total	Road	Rail	IWT	Total
A. Past Trends										
76 - 80	G. Rate	4.8	8.7	-1.5	3.0	5.4	6.8	2.6	5.6	5.0
	Ratio to GDP	-	1.81	-0.31	0.75	1.13	1.42	0.54	1.17	1.04
	Ratio to Total	-	1.61	-0.28	0.67	-	1.36	0.52	1.12	-
80 - 84	G. Rate	3.5	6.5	-1.4	4.0	4.8	7.3	3.3	8.2	6.3
	Ratio to GDP	-	1.86	-0.40	1.14	1.37	2.09	0.94	2.34	1.80
	Ratio to Total	-	1.35	-0.29	0.83	-	1.16	0.52	1.30	-
Average Ratio to Total			1.48	-	0.75	-	1.26	0.52	1.21	
1984/85 Estimates (million)			14.5	2.82	5.73	23.0	171.8	132.5	141.0	445.3
B. Growth by Applying the Ratio										
85 - 90	G. Rate	5.4	(8.0)	-1.4	4.7	6.2	(8.2)	3.6	8.5	7.0
1990 Estimates (million)			(21.3)	2.63	7.21	31.1	(254.5)	158.1	212.0	624.6
90 - 95		5.9	(7.9)	-1.4	5.0	6.6	(7.8)	3.7)	8.6	7.1
1995 Estimates (million)			(31.2)	2.45	9.20	42.8	(370.2)	189.6	320.3	880.1
95 - 20000		7.1	(8.8)	-1.4	5.8	7.7	(8.4)	4.2	9.8	8.1
2000 Estimates (million)			(47.5)	2.28	12.2	67.0	(555.1)	232.9	511.1	1299.1
C. Modal Split, Trend Line (%)										
1985			63.	12	25	100	38	30	32	100
1990			68	9	23	100	41	25	34	100
1995			73	6	21	100	42	22	36	100
2000			76	4	20	100	43	18	39	100
D. Modal Split, Target (%)										
1990			59	13	28	100	41	25	34	100
1995			55	14	31	100	42	22	36	100
2000			50	15	35	100	43	18	39	100
E. Target Amounts (million)										
1990			18.2	4.1	8.7	31.1	41	25	34	100
1995			23.5	6.0	13.3	42.8	42	22	36	100
2000			31.0	9.3	21.7	62.0	43	18	39	100

Note: Figures for road in B. were determined as residual

Source: Consultants.

ton-km by the year 2000, and to increase the shares of IWT and railways from 25% and 12% to 35% and 15% respectively in terms of tonnage.

Figure 4.2.1 shows the projected freight transport tonnages. Trend lines and targets of freight transport up to the year 2000 are illustrated in the Figure.

Table 4.2.2 shows projected freight ton-km by each mode as determined by target modal split percentages. It is hoped that by the year 2000 the rail mode would carry 20% of freight traffic in terms of ton-km and the IWT mode would carry as much as the road mode.

4.2.2 Passengers

The assessment of existing passenger modal split is presented in Section 3.5. The growth rate of railway passengers has been markedly lower than the other two modes although the growth rate in terms of passenger-km has not been so different from the others. The latter point is due to the increasing average lead of railway passengers. Table 4.2.1 shows passenger growth rates of the three modes for the periods of 1976-1980 and 1980-f1984. During the latter period IWT was the fastest growing mode. This latest development should be welcome as IWT is the least cost mode for passengers as well as for freight for most cases.

The complex nature of passenger modal choice is discussed in the preceeding chapter. It is likely that the present trend would continue. Table 4.2.1 shows projected numbers of passengers and consequent modal split percentages for the target years. The road mode and the IWT mode would continue to increase their shares while the rail mode would loose its share from the existing 30% to 18% by the year 2000.

Projected passenger-km by mode are shown in Table 4.2.2 and Figure 4.2.2 illustrates the passenger transport growth trends, past and future.

4.2.3 Road Traffic Projections

Road traffic projections were made in order to identify future investment requirements by the following process.

Derivation of the 1985 road freight O&D table is described in Section 4.1.4. Existing passenger O&D table was derived by means of a similar method. Both tables were then converted in terms of number of vehicles. These 1985 truck and passenger vehicle O&D tables were assigned by computer onto the road network to obtain link by link inter-district traffic volumes. For each link volumes of local traffic were obtained by subtracting inter-district traffic from the total traffic counts. After the determination of future modal split, overall truck traffic growth rates and passenger vehicle traffic growth rates were determined by taking the ton-km growth rates and the

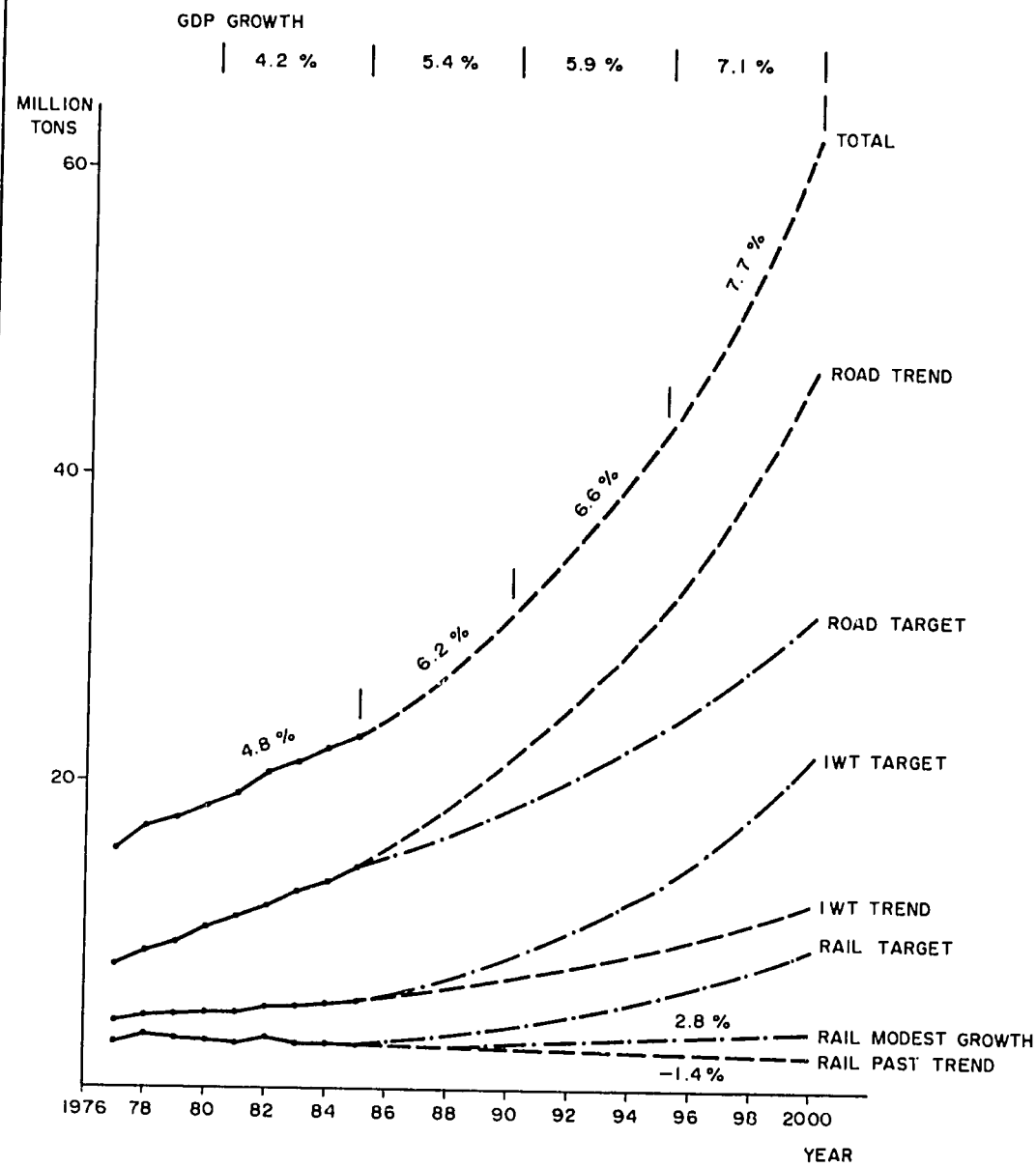

FIGURE 4.2.1 FREIGHT TONNAGE GROWTH

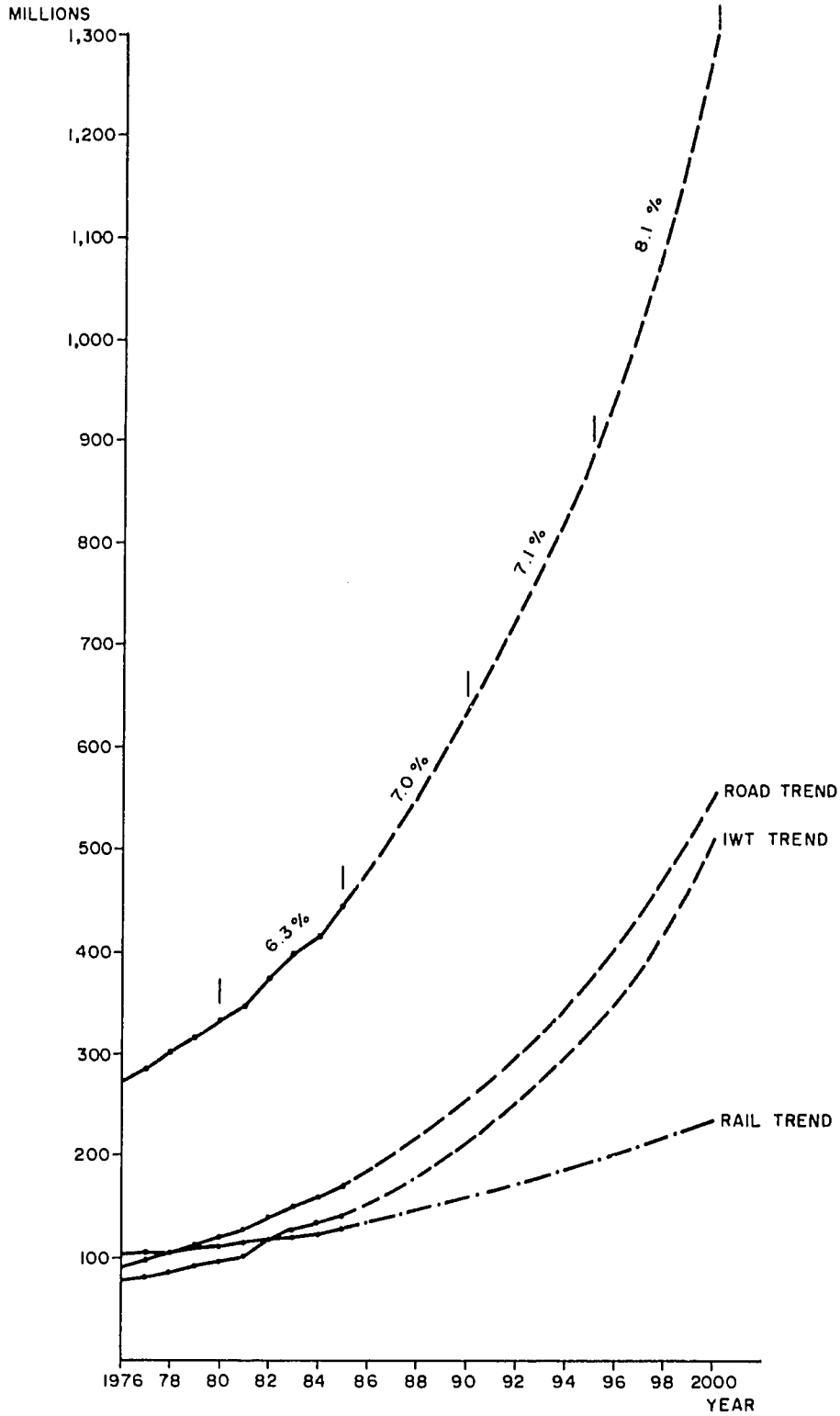

FIGURE 4.2.2 GROWTH OF NO. OF PASSENGERS

Table 4.2.2 Traffic Projetions, Ton-km and Passenger-km

(in millions)

Year	Freight Ton-km				Passenger-km			
	Road	Rail	IWT	Total	Road	Rail	IWT	Total
1985	2460	748	1381	4589	15460	8428	6203	30091
	(54)	(16)	(30)	(100)	(51)	(28)	(21)	(100)
1990	3111	1087	2097	6295	22905	10055	9328	42288
	(50)	(17)	(33)	(100)	(54)	(24)	(22)	(100)
1995	3995	1590	3205	8790	33318	12059	14093	59470
	(45)	(18)	(37)	(100)	(56)	(20)	(24)	(100)
2000	5270	2465	5230	12965	49959	14812	22489	87260
	(41)	(19)	(40)	(100)	(57)	(17)	(26)	(100)

Note: Percentages of intermodal distribution in parentheses

Source: Consultants

Table 4.2.3 Average Increment Per Year

(in millions)

Period	Freight Ton-km				Passenger-km			
	Road	Rail	IWT	Total	Road	Rail	IWT	Total
1980-85	140	-21	36	155	908	375	378	1661
	(90)	(013)	(23)	(100)	(55)	(22)	(23)	(100)
1985-90	130	68	143	341	1489	325	625	2439
	(38)	(20)	(42)	(100)	(61)	(13)	(26)	(100)
1990-95	177	101	222	500	2083	401	953	3437
	(35)	(20)	(45)	(100)	(60)	(12)	(28)	(100)
1995-2000	255	175	405	835	3328	551	1679	5558
	(31)	(21)	(48)	(100)	(60)	(10)	(30)	(100)

Note: Percentages of intermodal distribution in parenthses

Source: Table 4.2.

passenger-km growth rates from Table 4.2.2. District by district growth rates were then determined in proportion to district freight growth rates and district passenger growth rates. The base 1985 tables were expanded to future years by the Fratar method. Expanded inter-district road O&D tables were assigned onto the road network to yield inter-district traffic volumes. Local traffic on each link were expanded to future years by respective district growth rates. Finally inter-district and local traffic were added to obtain the total traffic volumes on each road link.

Figure 4.2.3 and Figure 4.2.4 illustrates projected road traffic for year 1990 and year 2000. If growth of road traffic can be contained within the rates as stipulated in this chapter, the road network in Bangladesh could accommodate road traffic without widening to 4-lane roads except in the immediate surroundings of Dhaka and the section immediately north of Chittagong.

4.2.4 Effects of Jamuna Bridge

Effort for the implementation of a bridge over Jamuna River was officially initiated in the middle of 1985 by the establishment of the Jamuna Bridge Authority.

Ma y alternative will be considered including a multi-purpose one with roadways, railways and a gas pipeline.

If the bridge will be open to all road traffic and no commensurate improvement in service levels of the railways and IWT is implemented, it would severely affect railway and IWT operations by attracting traffic from these modes. An end result could be the heavy reliance on the expensive road transport, an undesirable situation.

It is not possible to even broadly estimate such traffic diversion caused by the construction of Jamuna Bridge due to insufficient available data. The planning of the bridge should proceed with attention sufficiently paid to the effects on other modes.

One option could be to make the bridge only for passenger vehicles. This would significantly lower the construcion cost and at the same time avoiding cargo traffic diversion.

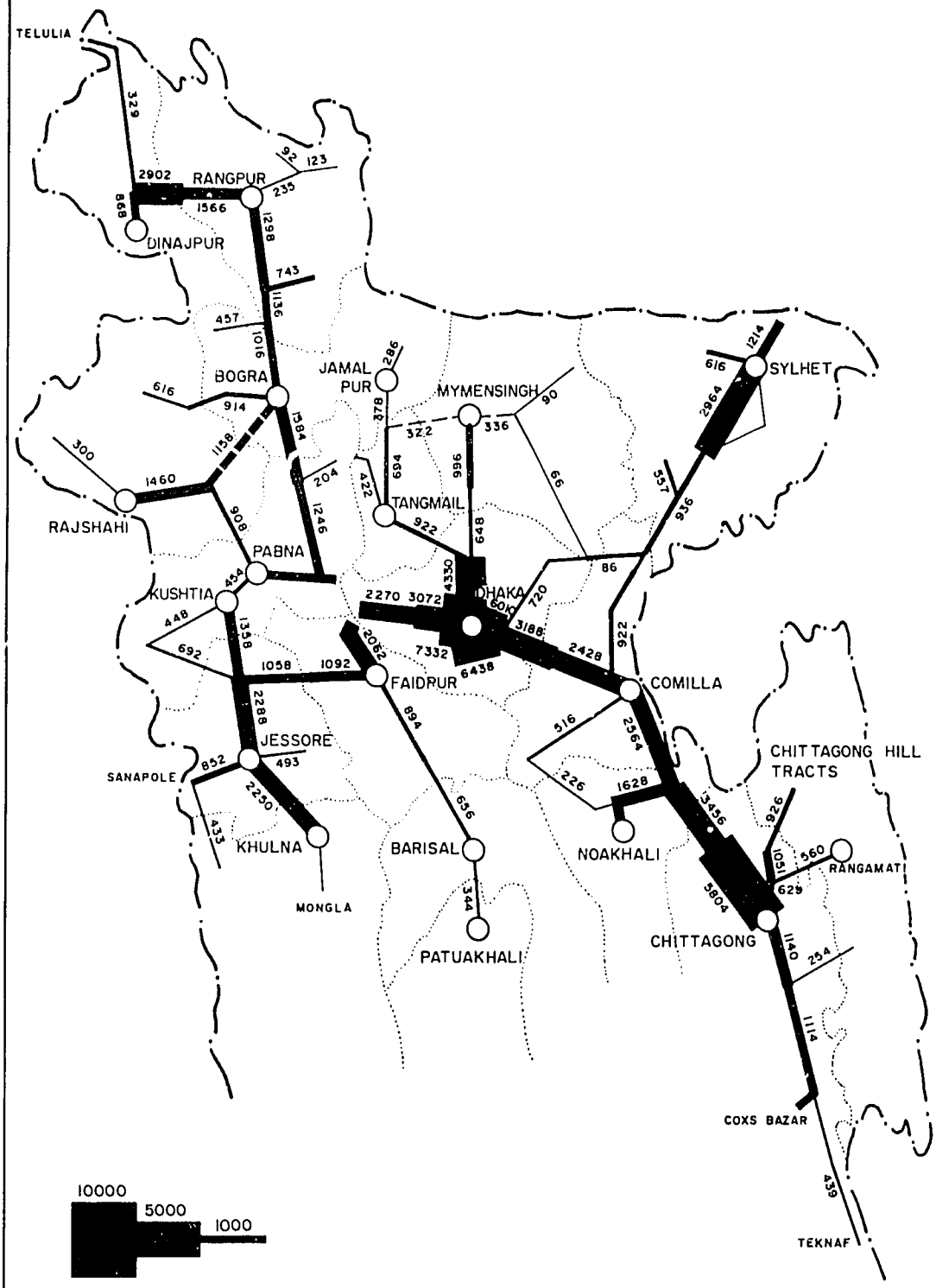

FIGURE 4.2.3 ESTIMATED AADT ON THE EXISTING ARTERIAL ROAD NETWORK, 1990

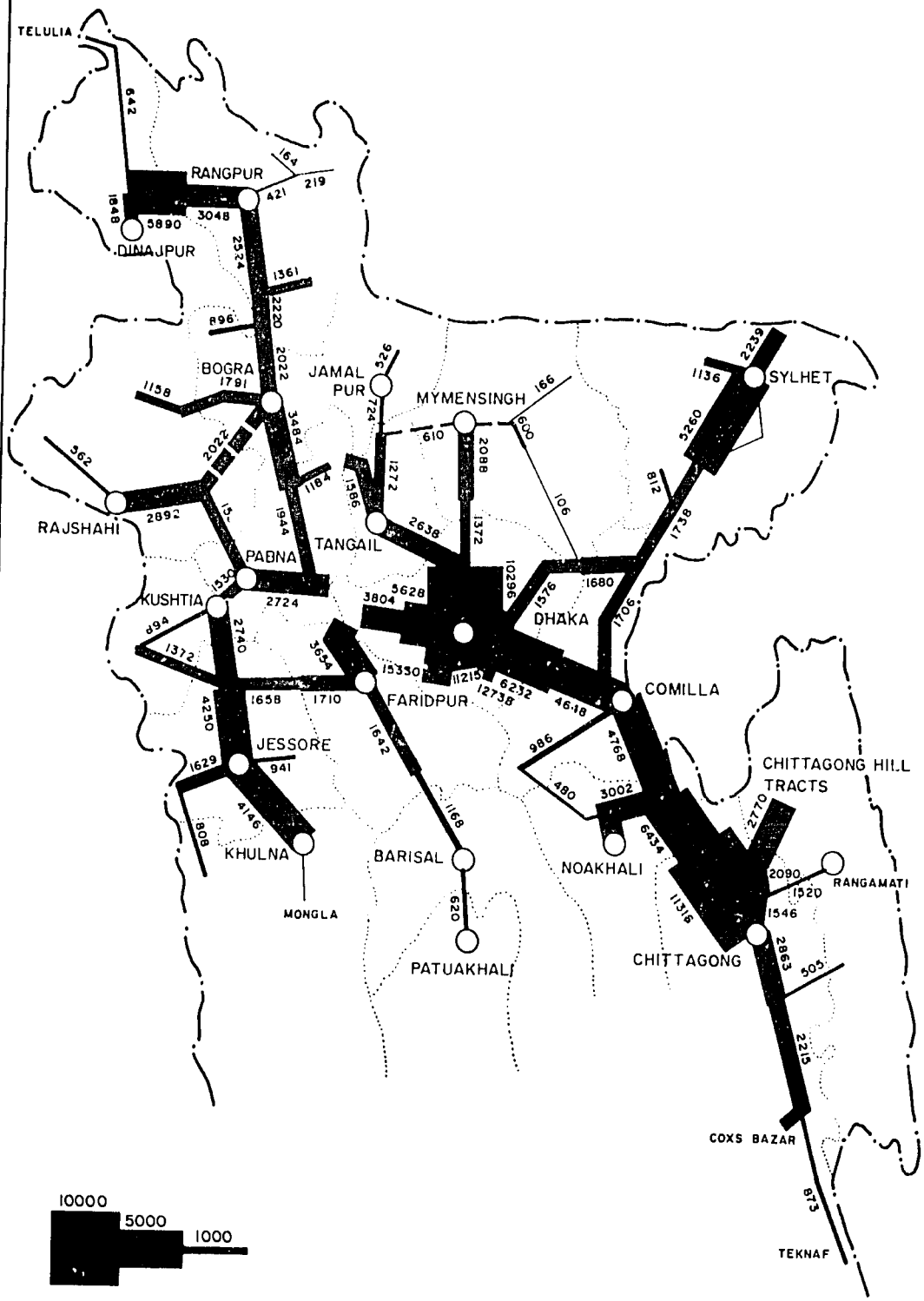

FIGURE 4.2.4 ESTIMATED AADT ON THE EXISTING ARTERIAL ROAD NETWORK, 2000

4.3 Container Traffic Projections

Import and export goods in 1981/82 which may be in the future handled in containers were estimated at 69,000 TEU per year for export and 47.000 TEU for import. Table 4.3.1 shows the breakdown by port and likely amount of empty containers associated with the above loaded containers.

Chalna Port is dominated by jute products export, which is unlikely to increase in the foreseeable future. The current export tonnage of jute products are at the same level as in 1973/74. After reaching the level of 55,000 TEU per year one-way, container flow at Chalna port will stabilize. Any increase in import cargo, either by pur increase or shift from Chittagong will have no effect on the volume of containers. Only a reduction in the number of empty boxes would result.

As for Chittagong Port, the dominant portion is taken by import cargo, particularly general cargo, volume of which has been sensitive to domestic economic conditions. The Chittagong Port Authority is expecting 3% per annum growth in throughput during the TFYP period. Considering the past general cargo import growth and the GDP growth rates of 5.4% for the TFYP period. The number of containers handled in 1989/90 was estimated at 61,000 at the maximum.

Table 4.3.1 Estimated Potential Container Flows 1981/82

(in Thousand TEU)

Port		Loaded	(June)	Empty	Total
Chalna	Import	3		52	55
	Export	50	(50)	5	55
	Total	53		57	110
Chittagong	Import	44		4	48
	Export	19	(15)	29	48
	Total	63		33	96
Bangladesh	Total	116	(65)	90	206

Source: Consultants

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CHAPTER 5

TRANSPORT SECTOR PLAN STRATEGIES

5.1 Introduction

In preceeding chapters national and regional economic prospects are analyzed, characteristics of transport systems and their use are examined in terms of economic optimality and users behavior, and likely future transport demand are determined. In this chapter strategies are presented to develop the transport sector in the most desirable manner under the given conditions in Bangladesh. Analyses of factors contributing to shape the future transport sector in Bangladesh are presented and strategies for developing the sector toward the economically optimum system are proposed. Recommendations concerning the establishment of improved transport sector monitoring systems are also included in this chapter as they are crucial for ensuring that such startegies are properly translated into detailed plans and implemented.

5.2 Overall Framework

The basic tones spelled out in the Thoughts on the Third Five Year Plan 1985-1990, published by the Planning Commission in September 1983, are considered to have set the principal directions of TFYP. The following points are made in the document:

1) The development of Upazilas for which administrative decentralization is being brought about is being emphasized. A move will be made to make available to Upazilas about 20% of development resources by the year 1990.

2) The role of the private sector will be increased. The command role of the Government will be reduced in the same way as local level development will necessitate.

3) However, the increasing role of the private sector will call for a greater emphasis on policy planning to ensure consistency between social goals and private preferences.

4) The ultimate objective of the Plan is to bring about visible and significant improvement in the material and cultural well being of the people.

5) Gainful and productive employment of people will be the corner stone of attaining this goal.

6) To raise labour productivity a conscious choice must be made for a gradual but steady technological transition of the economy from the existing drudgery of physical labour.

7) The opportunity for productive employment should be expanded in the rural areas through organization of local productive forces, local institutions and increasing accessibility to resources.

The above points can be summarized into the following objectives:

Objectives of Third Five Year Plan

1. Economic welfare of people through economic development
2. Enlargement of the private sector
3. Gainful and productive employment of people
4. Productivity improvement through technological transition
5. Expansion of opportunity for productive employment in rural areas through, among others, accessibility increase
6. Administrative decentralization

Development of transport sector can not directly address all of the above TFYP objectives as its subjects are limited. Under the overall TFYP objectives, however, transport sector objectives must be in line with these overall objectives and should be as follows:

Objectives of Transport Sector

11. Provision of adequate and safe transport services so as not to hinder economic development and other objectives of 1 , 5., and 6. above.

12. Reduction in the cost of providing transport services to achieve the objectives 1. and 4. above.

13. Enlargement of the private sector to meet the objective 2. and, indirectly, to contribute towards fulfilling the objectives 1., 3., 4., 5., and 6.

14. Achieving the optimum balance among competing transport modes contributing to the objective 4 and ultimately to the objective 1.

Extensive analyses were made in this study concerning the existing situation of each mode and transport sector as a whole and future prospects as presented in preceeding chapters and Chapter 8 through 11. Based on these analyses and assessment, transport sector strategies for achieving the above objectives were formulated as follows:

Strategies of Transport Sector

101. Rehabilitation and maintenance of existing assets rather than construction or aquisition of new assets to correct existing situation of low utilization of assets.
102. Managerial and operational improvement of transport operators to achieve higher asset utilization and better service quality.

103. Gradual phasing out of public sector operations providing transport services for which the private sector can operate with reasonable return.

104. Rationalization (i.e. selective increase and simplification) of fare, rate and tariff structures to reflect real costs of providing transport services to achieve optimum intersectoral as well as intermodal resource allocation.

105. Establishment of better performance monitoring systems for all modes of transport in order to achieve higher managerial efficiency in operation and planning.

106. Implementation of taxation and credit policies which encourage the better use of existing assets by for example reduced duties on spare parts and the growth of the private sector operators by easier credit.

Relationships among TFYP objectives, transport sector objectives and transport sector strategies are illustrated in Figure 5.1.1.

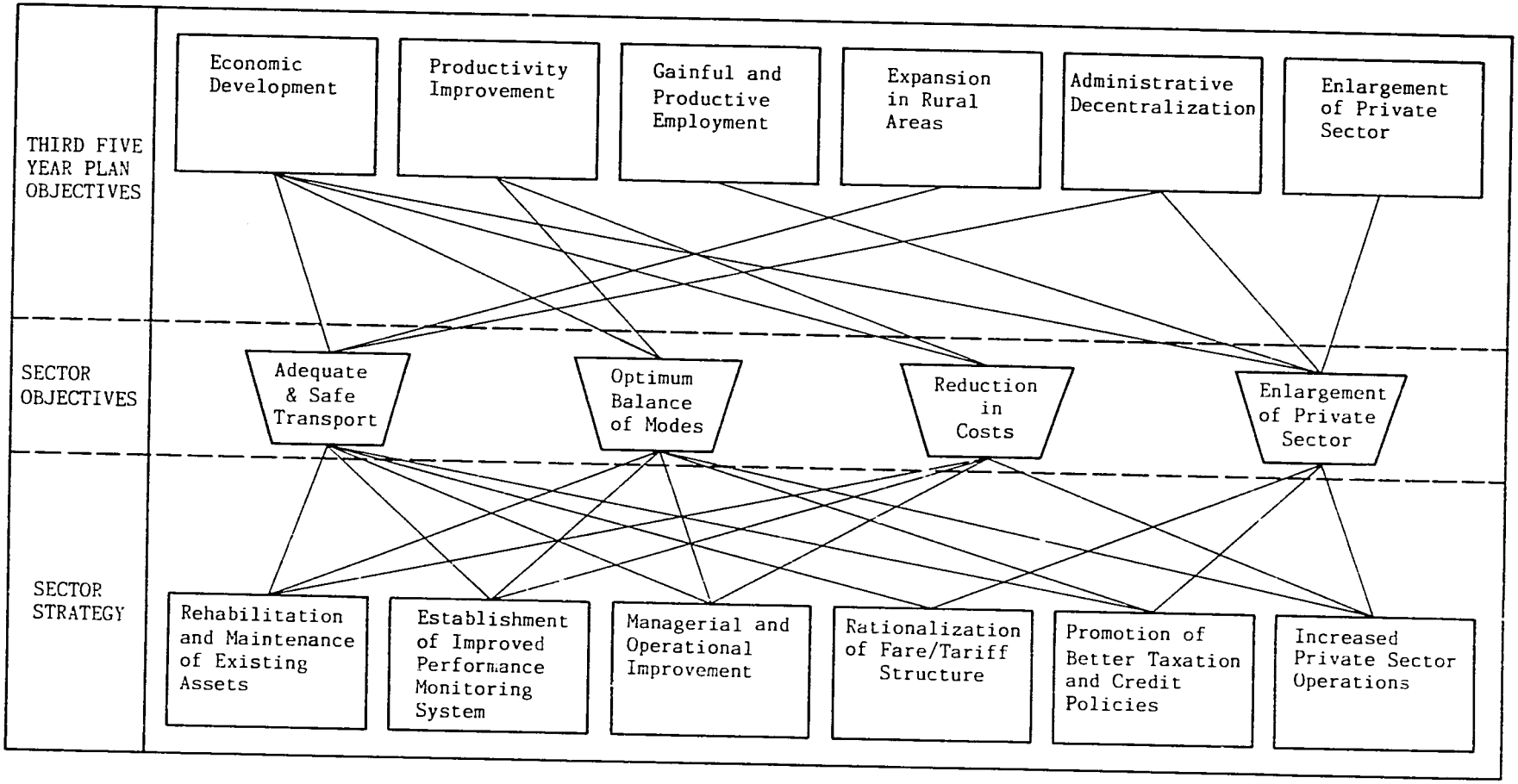

FIGURE 5.1.1 OBJECTIVES AND STRATEGIES OF TRANSPORT SECTOR

5.3 Directions of Institutional Changes

5.3.1 Intermodal Investment Allocation

1) Government Investment

The allocation of budget for development projects is largely done by the determination of the Annual Development Programme (ADP). Some agencies, i.e. Chittagong Port Authority, Bangladesh Shipping Company, and Civil Aviation Department, use their own funds, in addition to provisions by the Government. The determination of sub-sectoral allocations to each different mode of transport, in principle, is done following the guidelines specified in the Five Year Plan. However, in practice actual yearly allocation to each modal agencies may be significantly different from such guidelines.

During the extended Planning Commission meeting presided by the President on 13 June 1985, the ADP for the fiscal year 1985/86 was discussed and approved with some modifications. Table 5.3.1 shows the sub-sectoral allocations since 1978/79 . The 1985/86 allocations are significantly less than the average allocations of SFYP for each transport agency.

Given the limited financial resources there are actually not much choices in the process of determining the allocation. In comparison with the actual allocations for the last two years, for example, the Bangladesh Railways received a large increase this year, and the two inland waterways agencies a sharp decline. The direct reasons for the government to make these changes in modal shares were explained by the Planning Commission. They are: i) five on-going rail projects are to be completed early in the TFYP period, ii) three railway projects have already secured commitments by foreign donors and the government is bound by the commitments, iii) the import of rail carriage has commitment with foreign sources, iv) most schemes by the inland waterway agencies have already been completed, v) for waterway transport agencies no new schemes for this ADP are allowed, and vi) net resource constraints should be distributed among agencies.

When the high priority on-going projects and the projects with commitments by foreign governments are set aside, the amount of remaining available funds is often too little to introduce new projects of significant size.

Table 5.3.2 shows actual allocations to each of the three modes of transport in ADP since 1978/79. Allocations for Upazila road development are excluded from the allocations to the road sector on the grounds that Upazila roads (rural feeder roads) perform the function of initial or final access which is common to all modes.

Table 5.3.1 Annual Development Programme Allocations

(Million Taka)

Year	Rail	Roads		IWT		Ports		Total
	BR	RHD	BRTC	BIWTA	BIWTC	CPA	PCA	
1978/79	458	414	122	98	7	105	265	1469
80	1334	932	142	109	58	168	239	2982
81	1149	814	214	148	198	166	148	2837
82	1188	1004	63	158	190	178	199	2980
83	1865	1724	18	262	118	207	288	4482
84	631	1585	40	231	1	133	258	2879
85	533	1622	62	143	23	455	192	3030
86	1032	1646	29	119	25	308	137	3296
Total of 80/81-84/85	5366	6749	397	942	530	1139	1085	16208
80/81-84/85 (Totals at 84/85 prices)	7449	8450	676	1230	730	1439	1395	21487
% to total	34.7	39.3	3.1	5.7	3.4	6.7	6.5	100.0

Source: Transport Survey Wing, Planning Commission.

Table 5.3.2 Historical ADP Allocations 1978-1986

Year	Rail (million) (Tk)	(%)	Road (million) (Tk)	(%)	IWT (million) (Tk)	(%)	Total (million) (Tk)
78/79	458	46	420	43	106	11	984
80	1334	58	814	35	163	7	2311
81	1149	44	1104	42	346	14	2599
82	1188	46	1067	41	348	13	2603
83	1165	40	1342	47	379	13	2886
84	631	28	1235	55	367	17	2233
85	479	28	1059	63	151	9	1689
86	1032	43	1215	51	144	6	2391
Average 80/81-84/85 in 1984/85 price	1490	43	1557	45	392	12	3439

Note: Figures for road sector exclude allocations for Upazila roads, but include those for BRTC. Figures for IWT include those for BIWTA and BIWTC

Source: Planning Commission

2) Private Sector Investment

While investment in railways is entirely borne by the Government a large part of investment in the road and IWT sub-sectors is made by private sector in the form of acquisition of vehicles and vessels. Accurate data on such investment by the private sector is not available. An attempt was made to estimate the total amount of investment by private sector in vehicle or vessel fleet.

Road Vehicle Fleet Investment

Table 5.3.3 summarizes the base data and subsequent analysis estimating the number of new vehicles added to the road vehicle fleet. Numbers of new vehicles were calculated by adding the annual increment in the number of vehicles on road and the estimated number of vehicles scrapped. It was estimated that on average a total of 7,240 new vehicles were acquired each year during the period 1981-1985, of which 4,400 were cars/jeeps/taxis, 425 buses, 640 minibuses, and 1,790 trucks.

The cost of the above was estimated at Tk. 3,363 million in 1984/85 prices as shown in Table 5.3.4.

IWT Fleet Investment

Breakdown of changes in IWT fleet was made available by BIWTA for the years of 1980/81 and 1981/82. Using estimated average unit prices for various types of vessels, it was determined that the total cost of vessel acquisitions for 488 vessels would be Tk. 1,837 million as shown in Table 5.3.5. During the same time period, the increase in vessel fleet was 415. Therefore, 73 vessels out of the total of 488 should have been for replacement. The average vessel fleet expansion during the period 1981-1985 was estimated at 180 vessels per year as shown in Table 5.3.6. Assuming the same ratio of replacement vessels to the total acquisition as in 1980-1982, the average annual investment in vessel fleet was estimated at Tk. 798 million in 1984/85 prices.

Comparison with Manufacturing and Import Statistics

Published statistics concerning manufacturing and import of transport equipment are shown in Table 5.3.7. In terms of 1984/85 prices the amounts obtained by converting the import amounts by means of retail price/CIF price ratios are smaller than the estimated investement in fleet although they are in the same order of magnitude. It was determined that the amounts derived from additions to fleet should give more reliable estimates.

Private Sector Fleet Investment

Additions to road vehicle and IWT vessel fleet established above include those aquired by BRTC and BIWTC, whose investments are already accounted for the government investments. Private sector investment in fleet was determined by subtracting the average annual allocation to

Table 5.3.3 Annual Increase in Registerred Motor Vehicles and Motor Vehicles on Road

Station Wagons	Motor Cars, Jeeps & Taxis		Buses	Trucks	Total
I. Registerred vehicles					
1977/78 - 78/79	2483		172	1262	3917
1978/79 - 79/80	3469		427	1403	5299
1979/80 - 80/81	3517		812	2297	6626
A. Total	9469		1411	4962	15842
II. Vehicles on Road					
B. Fleet difference 78-81	9176		1410	2625	13211
		Bus	Minibus		
C. Fleet 1981	31939	7183	3549	13496	56167
D. Estimated 85 fleet	89000	89000	6100	17100	81100
E. 1981 - 1985 Increase	17050	1700	2550	3600	24900
III. Req. Veh. Increase 81-85					
F. Difference A-B	293		1	2337	2631
G. Average/year F/3	98		0.3	779	877
H. Ratio to Vehicles on Road G on Road G/C (%)	0.31		0	5.8	1.6
I. Average difference/yr. 81-85 (C+D)/2 * H/100	125		1	887	1013
J. Annual new vehicles E/4 + I	4388	425	638	1787	7238

Table 5.3.4 Investment in New Vehicles

In 1984/85 Prices	Cars, Jeeps Station Wagons	Buses	Mini-Buses	Trucks	Total
Typical Model					
market price 84/85 (000 Taka)	400.0	698.4	399.8	590.5	-
economic cost (")	225.4	630.9	351.2	533.9	-
Annual new vehicle	4388	425	638	1787	7238
Total financial cost (Tk million					
(Tk million)	1756	297	255	1055	3363
less cars/jeeps/wagons	-	-	-	-	1607
Total econ. cost (Tk million)	989	268	224	954	2435
less cars/jeeps/wagons	-	-	-	-	1446
In 1979/80 Prices					
Total financial cost	690	117	100	414	1321
Total economic cost	388	105	88	375	956

Source: Consultants

Table 5.3.5 IWT Fleet Investment Cost

	Average Capacity	Average Unit Cost Tk. million	Addition No. 80/81	Addition No. 81/82	Total Cost Tk. million 80/81	Total Cost Tk. million 81/82
Pass. Vessel	191-350	2.5	12	14	30.0	35.0
Pass. Launch	50-57	0.8	185	29	148.0	23.2
CArgo Vessel	202-319	1.5	80	60	120.0	90.0
Coaster	508-1611	30.0	36	4	1080.0	120.0
Tanker	41-789	18.0	2	1	36.0	18.0
Tow & Tug	-	7.9	8	6	63.2	47.4
Barge (Dry)	360	1.1	27	13	29.7	14.3
Barge (POL)	361	1.1	-	11	-	12.1
			350	138	1506.9	360.0

Note: Capacity in persons for passengers and tons for cargo

Source: BIWTA for number of additional vessels

Table 5.3.6 IWT Fleet Expansion

	79/80	80/81	81/82	82/83	83/84	Average
Cargo fleet	72	85	71	76	93	79
Passenger fleet	52	189	70	93	99	101
Total	124	274	141	169	192	180

Source: BIWTA

Table 5.3.7 Transport Equipment Statistics

(million Tk.)

	80/81	81/82	82/83
Transport equipment manufacturing gross value of production	949.5	732.8	N.A.
Import of motor vehicle for passengers (passenger cars)	248.4 (77.1)	185.1 (74.0)	128.6 (58.5)
Improt of motor vehicles for transport goods	102.2	29.3	34.7
Import of road motor vehicle nec.	115.1	151.4	99.2
Import of trailers and other vehicles	22.8	64.3	43.4
Sub-total	1438.0	1168.9	-
Import of ships, boats and Heating structure	788.4	335.4	878.6
Import of launches	12.7	8.5	28.9

Source: BBS

Note: Retail Price/CIF ratio Car 4.44, Bus 2.69, Mini Bus 2.50, Truck 2.19
Average Bus-Truck 2.33

BRTC and BIWTC in 1984/85 prices from the estimated annual total fleet investment costs. This was done as most of the allocations to BRTC and BIWTC are for the acquisition of new vehicles and vessels. Average annual private sector investment in fleet was estimated at Tk. 3,231 million for the road mode and Tk. 628 million for IWT.

3) Total Public and Private Investment and Comparison with Performance

Combined amounts of public and private investments in the transport sector are shown in Table 5.3.9 in terms of average amount per year. Within the government investment alone, the road mode takes up 45% and the rail mode follows close behind with 43% and IWT with 12%. However, when including private sector investment, the road mode occupies 66% of the total and IWT 14%, and the railways 20%.

Table 5.3.9 compares the performance of each mode with the estimated modal investment. The expensive nature of the road transport is apparent. Sixty-six percent of the total investment in the transport sector was needed to support the road transport a little more than one half of the total in terms, of ton-km or passenger-km. On the other hand only 14% of the total investment was invested in IWT which performed 30% of the total ton-km and 21% of the total passenger-km. The rail mode falls in the middle. When compared with yearly incremental performance, however, the higher investment in the road mode can be explained as it accommodated the majority of additional load. IWT gained high additional ton-km and passenger-km relative to its investment level. Despite its investment level higher than IWT, the rail has lost freight traffic.

If criteria is the return on investment, in this case performance measures, IWT should be given more investment. The desirable direction in modal investment allocations is further discussed taking other factors into consideration in Section 6.2.

Table 5.3.8 Investment by Public Sector and In Fleet

(in 1984/85 prices, Tk. million)

	Rail	Road	IWT	Total
Average Public Sector Investment Per Year 80/81-84/85 1/	1,490	1,557	392	3,439
(%)	(43.3)	(45.3)	(11.4)	(100)
Average Vehicle/Vessel Addition Per Year 80/81-84/85 (No.)	-	7,238	212	-
Average Cost Per Vehicle/Vessel	-	0.465	3.765	-
Average Investmetn in Fleet Per Year	-	3,366	798	-
Less BRTC and BIWTC allocation		135	170	
Private Sector Investmetn in Fleet		3,231	628	3,859
Total Public & Private Investment	1,490	4,788	1,020	7,298
(%)	(20.4)	(65.6)	(14.0)	(100.0)

Note 1/ Excluding Upazila roads

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Table 5.3.9 Comparison of Performance and Investment

		Road	Rail	IWT	Total
1985	Freight ton-km (million)	2460	748	1381	4589
		(54)	(16)	(30)	(100)
1985	Passenger-km (million)	15460	8428	6203	30091
		(51)	(28)	(21)	(100)
1980-85	Average Freight ton-km increment per year (million)	140	-21	36	155
		(90)	(-13)	(23)	(100)
1980-85	Average Passenger-km increment per year (million)	908	375	378	1661
		(55)	(22)	(23)	(100)
1980-85	Average Total Investmet Per Year (million Tk)	4788	1490	1020	7298
		(66)	(20)	(14)	(100)
1980-85	Average Government Investment Per Year (million 76)	1557	1490	392	3439
		(45)	(43)	(12)	(100)

Source: Table 5.3.7

5.3.2 Revision of Fares and Rates

Freight rates and passenger fares should reflect the cost of providing transport services for a two reasons. Firstly, if the operator is a governmental organization, financial loss due to fares and rates lower than the cost would lead to subsidy, which reduce other investment or expenditure opportunities for the government with higher return to the economy. If the operator is a private one, excessively low fares or rates would lead to dangerous over-loading or undermaintenance. Secondly, fare and rate structure affects transport demand through the price mechanism and gives signals to the operator for adjusting and improving its operation so that higher operational efficiency is achieved and proper investments are made.

Aside from rail rates and fares which are entirely under the control of the Government, passenger fares and freight rates of IWT and bus passenger fares are regulated. IWT passenger fares are fixed in terms of per mile basis and IWT freight rates are regulated by means of government determined maximum rates which are differentiated by cargo type. BIWTC, the government IWT operator, maintains own passenger fare schedule, but follows the freight rates common to the private operators. For IWT freight provisions are applied for minimum charge, minimum consignment size, free time for loading/unloading, demurrage, and rebate. Bus fares are regulated by means of maximum chargable rates on per mile basis. Road transport freight rates are unregulated, and truckers charge different rates depending on particular conditions of each route such as road conditions and likelihood of backhaul cargo. BRTC, the government road transport operator, sets its own rate and fare schedules with objectives of being the price setter in the market.

Existing freight rates and passenger fares seem to be low relative to financial costs of operation. Only exception is the IWT passenger services. Figure 5.3.1 shows freight rates and financial costs of each mode, and Figure 5.3.2 shows passenger fare levels and financial costs. Financial costs are those incurred to operators. Infrastructure costs are not added to the financial costs to operators as they should ideally be included in the financial costs through taxation and other user charges. Allocation of infrastructure costs, however, requires a major study and is not explicitly discussed in this study.

Cost levels indicated in the Figures are average costs. For the cases of freight transport by railways and IWT short-run marginal costs would be considerably lower than shown because of the existing excess capacity. In the long run, however, operators would require funds corresponding to the average costs shown in the Figures in order to provide satisfactory services. In the case of railways, including the full capital cost at replacement cost may not be appropriate at least for the short run since a large part of capital investments have been financed by foreign grant. A thorough and realistic study of fund requirements is needed to determine the target level of fares and rates for the railways.

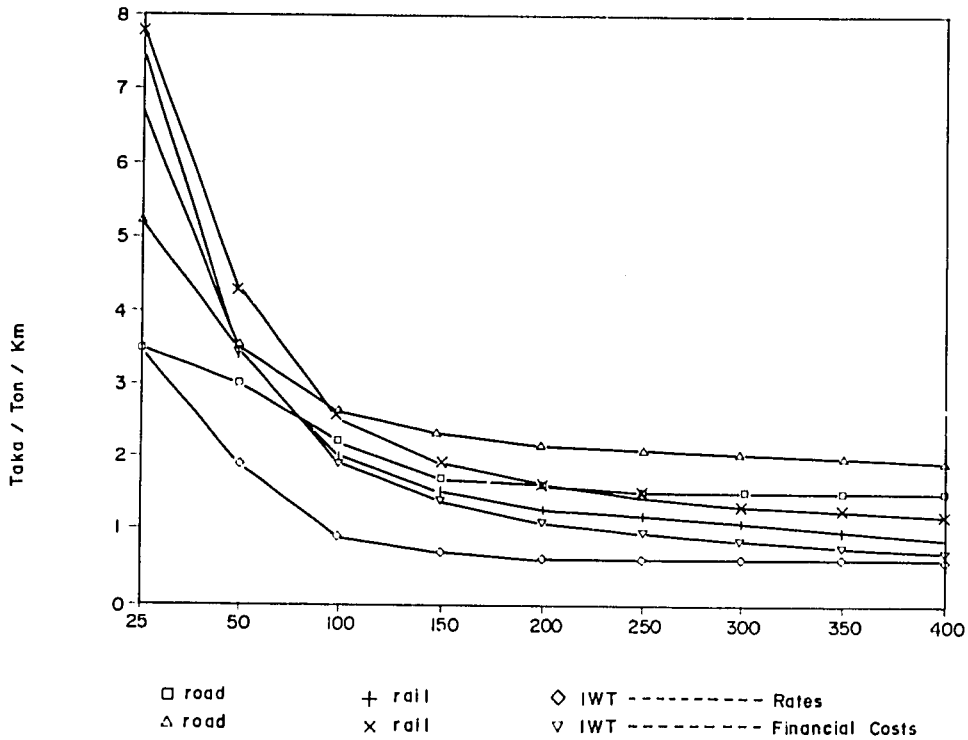


Fig 5.3.1 FREIGHT RATES AND FINANCIAL COSTS

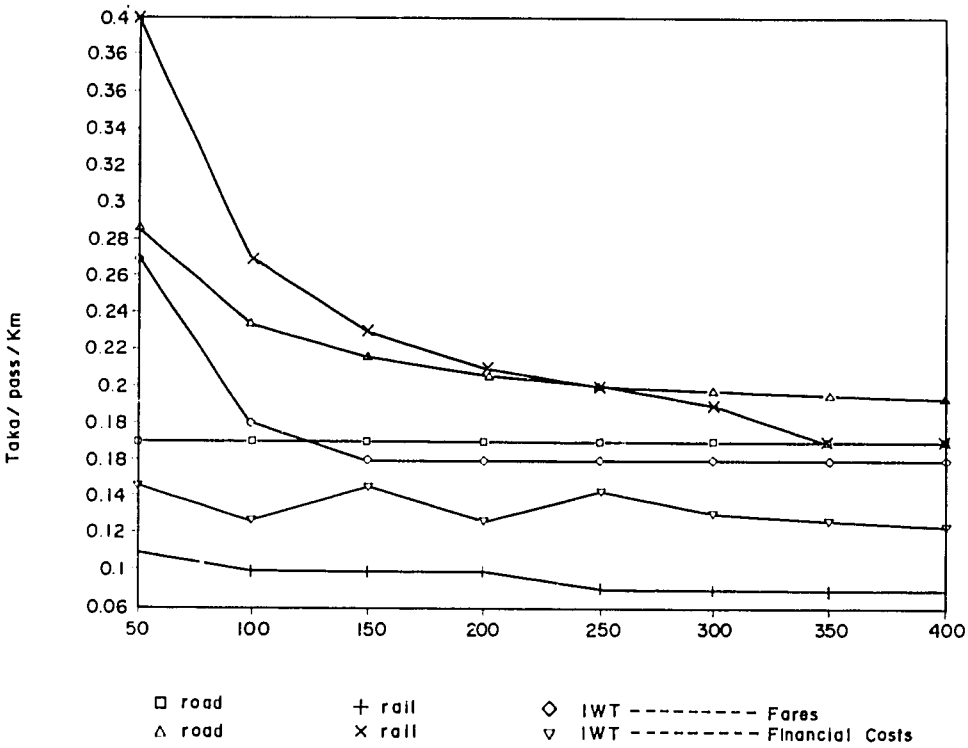


Fig 5.3.2 PASSENGER FARES AND FINANCIAL COSTS

Table 5.3.10 Fare and Rate Increase Needed

Mode	Distance	Passenger			Freight		
		Cost	Fare	Needed Increase	Cost	Rate	Needed Increase
Rail	Average Lead	0.35	0.11	218	1.44	1.2	20
	300 km	0.19	0.09	111	1.34	1.1	22
Road	Average Lead	0.24	0.17	41	2.27	1.6	42
	300 km	0.20	0.17	18	2.03	1.5	35
IWT	Average Lead	0.14	0.30	-	0.98	0.6	63
	300 km	0.13	0.16	-	0.85	0.6	42

Note: Costs and fares for passengers in Taka/pass.-km
Costs and rates for freight in Taka/ton-km
Increase over the present in percent.

Table 5.3.10 shows percentage increases needed to cover the full average financial cost to the operator. These percentage figures indicate order of magnitude of fare and rate revisions.

It may seem strange that costs exceed fares and rates in the road transport and the IWT both of which are largely operated by the private sector. If this is really the case, all private operators should have been bankrupt. These figures were developed under assumptions of proper operations and should be considered as levels desirable for ensuring proper operations.

For freight all modes are in need of upward increase. For road freight rates which is not regulated the Government may encourage operators to charge higher rates through non-regulatory guidance. This will conform with the objective of restraining excessive growth of road freight transport as in the recent past. For the railways and IWT rate increase should be done gradually considering existing excess capacity and consequent low marginal cost. Care must be taken to ensure that undue loss of freight from the railways and IWT does not take place. Experience elsewhere suggests that it is very difficult to recapture freight once it is lost to the road transport.

For passenger transport it is particularly desirable to substantially increase rail fares for short distances. This is needed to discourage short distance travellers from the railways to reduce uneconomical short rail operations. Bus fares require substantial increase as well. The current low level of bus fares and the lengthy process in the government to revise them one hindrance for private capital to flow into the bus passenger service industry. IWT passenger fares do not seem to require any increase.

The above comparision of fares and rates is made with the average costs under existing efficiency. As operational improvment is expected to be implemented, operational efficiency of each mode should be monitored while the revision of fares and rates is done in steps in the future.

5.3.3 Privatization

One of the key issues in the transport sector planning is the privatization. in particular strategies for the Bangladesh Road Transport Corporation (BRTC) and the Bangladesh Inland Water Transport Corporation (BIWTC). Both organizations were established by the government during early 1960's with specific purposes of guiding the sector and checking possible excessive fares and rates charged by private operators. Both organizations also played a role in stimulating better services by setting examples to private operators.

By the time of the Second Five Year Plan, however, the emphasis was shifted to the encouragement of the private sector but the both organizations have remained, incurring large operating losses which have been subsidized by the government. Except for the freight transport of BIWTC, market shares of both organizations are too small to have an impact on the market in general, thus loosing the originally intended roles. Even where their fares and rates do have an impact on the market, it is likely that the result is the artificially low level of fares and rates which leads to economically damaging market distortion, considering the relatively free entry to the transport supplier's market. In the waterway freight transport market the excess capacity and subsequent competition among private operators have made such a price setting role meaningless.

Being a governmental organization, both Corporations have to be operated under considerable disadvantages vis-a-vis private operators. Some of the points made by the officials of the Corporations are:

- Provision of unprofitable services as social service.
- Higher salaries and benefits for employees.
- Beggers, disabled, blind, and destitutes travel free by BRTC buses.
- Armed forces personnel, BDR, Ansar, and students travel at concessional fare.
- Strict observance of government regulations.
- BRTC vehicles are often become the target of vandalism during civil strife and political disturbances with no compensation provided by the Government.

The real question should be worthiness of continuing the operation if it is so difficult.

In the past, curtailment of operations of BRTC and BIWTC has been advocated in many studies by foreign consultants and recommendations by international agencies. Some recommended complete privatization. Although the SFYP mentioned limiting both organizations, little has been done in this direction to date in practice. Considering the employment situation in Bangladesh, this is understandable. Nevertheless, gradual privatization should be done to reduce the drain on the national treasury. To be successful, such a move will probably have to accompany some sort of job guarantee.

The government will have to decide on the functions and the size of BRTC and BIWTC which are to remain in the government hands. For example, the government may wish to keep a minimum fleet for emergency purposes. The relief operations carried out after the last cyclone would have been much more difficult without the presence of the BIWTC fleet.

Unprofitable services provided by BIWTC for off-shore islands are another examples. Certain services of BRTC may be declared social services by the Government and be kept. Such decisions, however, should be made after a careful comparison with alternative methods such as direct subsidy to private operators or users.

BRTC as a first step may start servicing private vehicles by its recently completed modern workshop. The operation should be on commercial basis. Organizational expansion of the workshop, it needed should be done in line with the expansion of the turn over.

Privatization of BRTC and BIWTC will require a considerable preparation period in any case. During the TFYP period allocations to BRTC and BIWTC should be limited to replacement of vehicles and vessels which are to be needed in the Government hands to provide specific social service functions. Expansion of ferry boats will be needed although they may be transfered to the private sector later.

5.3.4 Improvement in Transport Equipment Utilization

There appears to be a serious under-utilization of transport equipment in all public transport corporations including Bangladesh Railways and in mechanized inland water transport of freight as described in Chapters 8 through 10. The TFYP period is an excellent opportunity to arrest this problem because of the apparent excess capacity at present. In the short run, if all investments and efforts are to be placed in improving the utilization by means of better maintenance and repair, handling and storage, and better management in general that may lead to non-expansion of fleet and rolling stock, still no bottleneck would arise even in transitional period. This should be done in TFYP because the need to expand the fleet (and rolling stock) in the TFYP period may well divert the attention from such effort.

5.3.5 Spare Parts Acquisition Procedures

One of the major factors preventing the efficient utilization of transport equipment is the long and cumbersome process required to obtain Government approval for importing spare parts.

In the case of IWT vessels the folloiwng procedures are involved:

(a) Papers must be preapred requesting the needed part for the Ministry of Industry's approval.

(b) They must then be forwarded to the Controller of Import and Export for approval.

(c) The Controller forwards them to BIWTA to verify the need for the parts.

(d) The papers are then returned to the Controller of Import and Export for issuance of import licences.

It is recognized that serious problem may exist in a shortage of foreign exchange, that requires strict control. However, of vessel downtime solely due to processing the required licence is unduly long and very costly. Further it is questionable that BIWTA is in a position to evaluate the private vessel operators needs. It would appear that their role in the process could be eliminated. That Government of Bangladesh should review this process carefully with the aim of speeding the process for obtaining import licences. The implications, not only in cost, but in wasted foreign capital investment in idle ships, should be the overiding consideration.

It is also recommended that the ship repair yards be authorized to acquire and hold spare parts. They should deal directly with the office of Controller of Import and Export and be audited by that office.

Similar problems exist for the railways.

The Government may establish a special section devoted to expediting the spare parts acquisition process for the transport sector.

5.3.6 Number of Projects Undertaken and Implementation Schedule

Table 5.3.11 lists ADP allocations to RHD for year 1985/86, which is the first year of TFYP. A total of 74 projects share the total allocation of Taka 1,186 million. The average allocation for national highways amounts to only Taka 16.1 million per project. With this amount only 4.4 km can be covered at the average per kilometer improvement cost of Taka 3.67 million. What has actually been taking

Table 5.3.11 RHD 1985-86 ADP Allocation as of Mid-June 1985

(In Taka Million)

Project Group	Status	No. of Projects	Total Allocation	Foreign Exchange
National Highways	On-going	21	338.7	159.5
Regional Highways	On-going	17	54.6	-
Sub-regional Highways	On-going	14	134.0	81.0
Feeder Roads	On-going	43	51.4	-
Bridge Construction	On-going	17	169.6	20.0
Reconstruction of Bridges	On-going	2	11.5	-
Infrastructure Scheme	On-going	4	76.3	41.0
New Projects	New	7	9.7	-
Flood Damage	New	1	320.0	270.0
Other		1	20.0	17.0
	Total	74	1185.8	588.5

place is to stretch the kilometrage covered by the small budget available which results in substandard works. Consequently improved sections soon deteriorate, resulting in the waste of money invested.

In addition too small work at too many places would certainly be expensive in a per kilometer cost basis.

Again, this is understandable as the government would try to base its foundation in the nation wide popular support by seemingly treating all areas equally. It should be realized, however, that this is a costly practice. Perhaps some sort of regional rotation method may be introduced in the five year plans, in which each region take turns every year in obtaining funds.

In this study an attempt was made to limit the number of projects undertaken in each year so that each project receives a reasonable sum in any year. For the case of road projects it was not possible to schedule all the selected projects over years taking into account the regional balance or whatever other political considerations, the total required sum over the TFY2 period was distributed among the five years.

Generally speaking, the delay in project completion and subsequent deferring of realization of benefit result in a lower return on investment even when the total cost remains constant. The uneconomic consequence of project completion delay should be emphasized in the process of budget allocation.

5.3.7 Institutional Stengthening of Planning Capability

The simultaneous undertaking of excessively large number of projects is at least partly a result of weakness in the planning process. When the planning process fails to provide project priorities on a firm ground, political or administrative expediency would prevail.

Planning functions in transport agencies in the Government seem to be in need of strengthening. Figures 3.5.3 through 3.5.5 show organization charts of sections responsible for planning in RHD, BR, and BIWTA. Positions shown in the charts are those provided, not necessarily filled. For example, the senior economist in RHD has currently no supporting staff.

Planning of projects can only be done in each modal agency and resulting program plans containing projects are submitted to the Planning Commission, where they are primarily pruned. A central coordinating agency such as the Planning Commission can not generate project plans. Original plans must be formulated in line agencies. Strengthening of line agencies in planning is needed.

The Planning Commission also is in need of strengthening. Transport Survey Wing, for example, is too understaffed to carry out or even supervise any field transport surveys despite its name.

FIGURE 5.3.3 RAILWAY PLANNING ORGANIZATION CHART

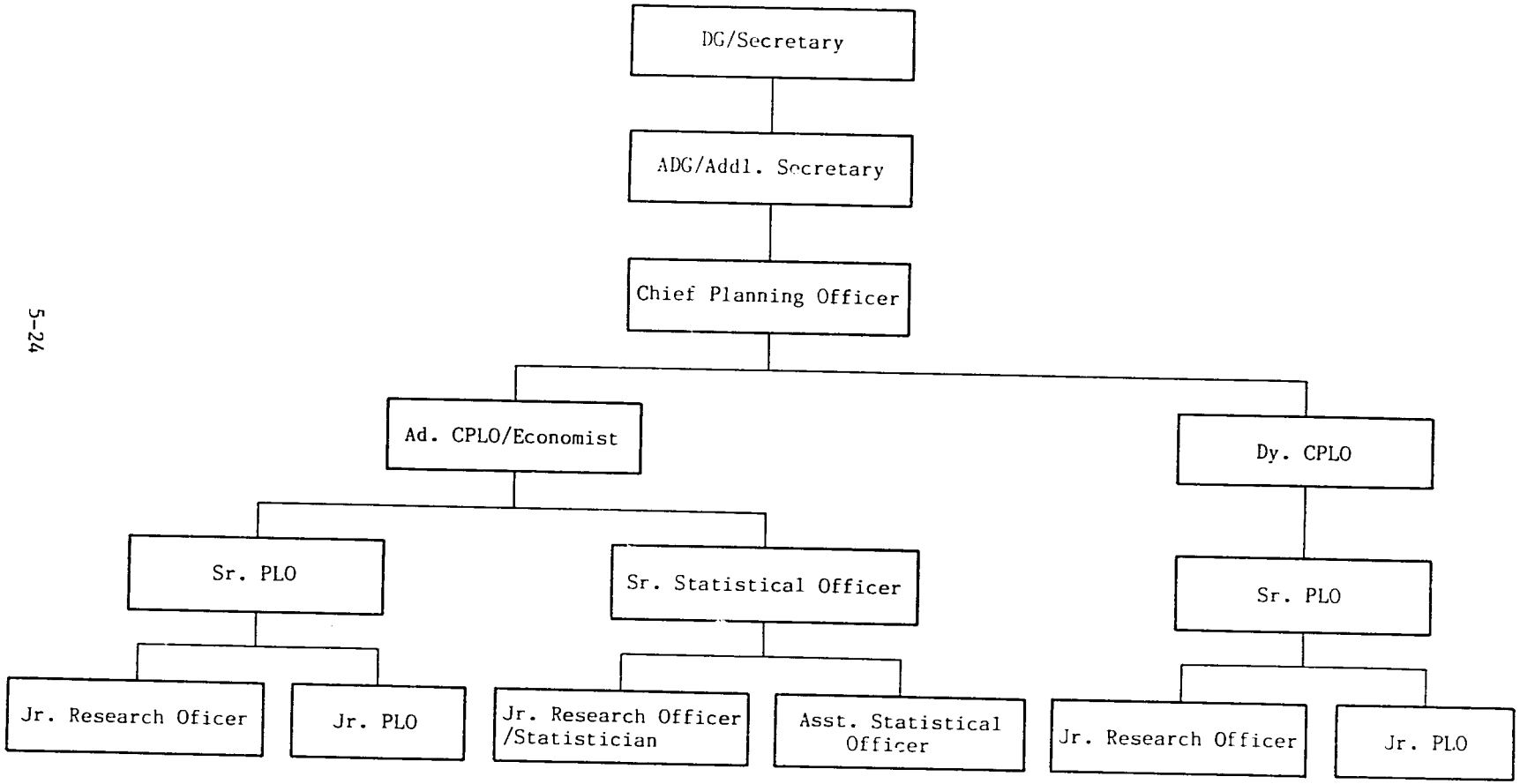
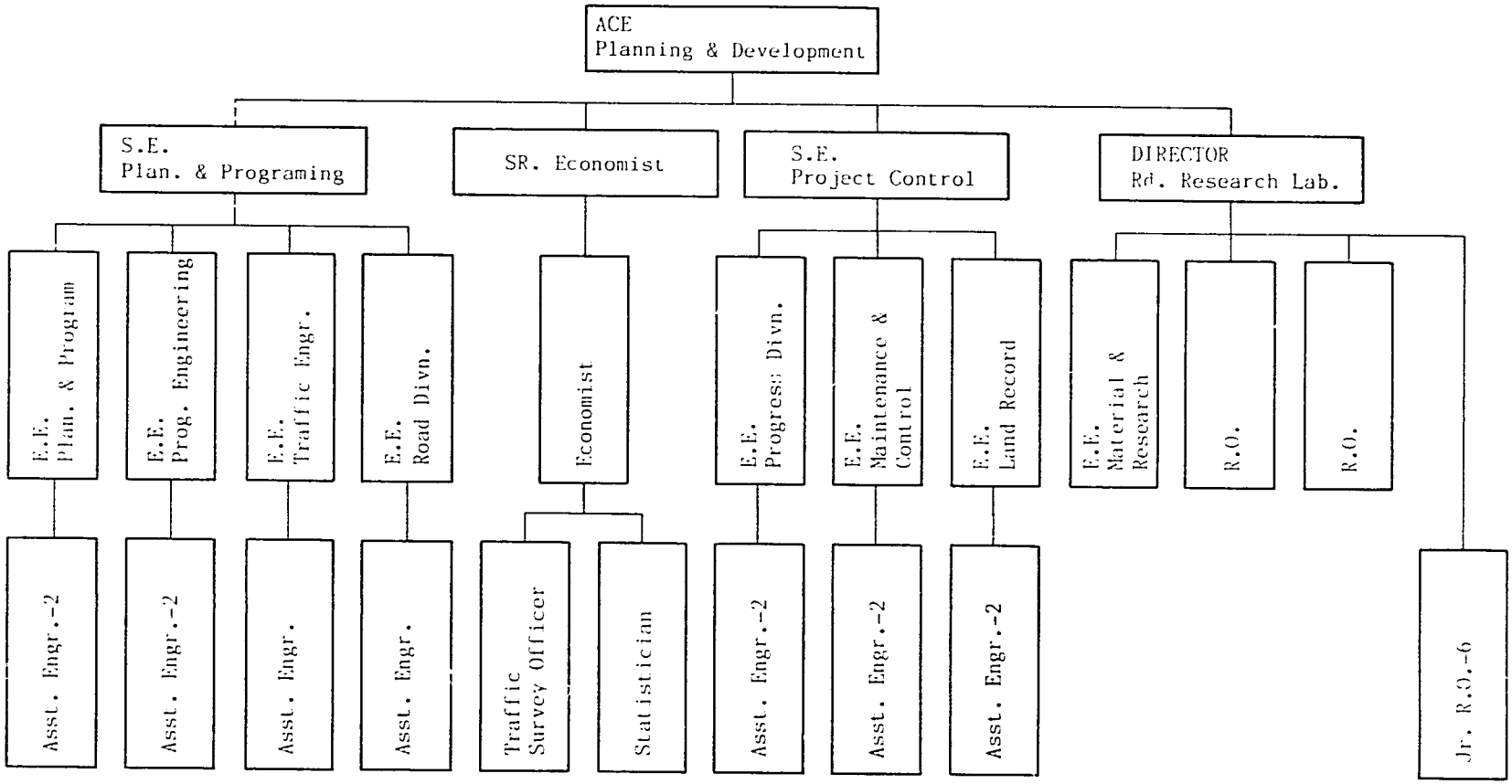


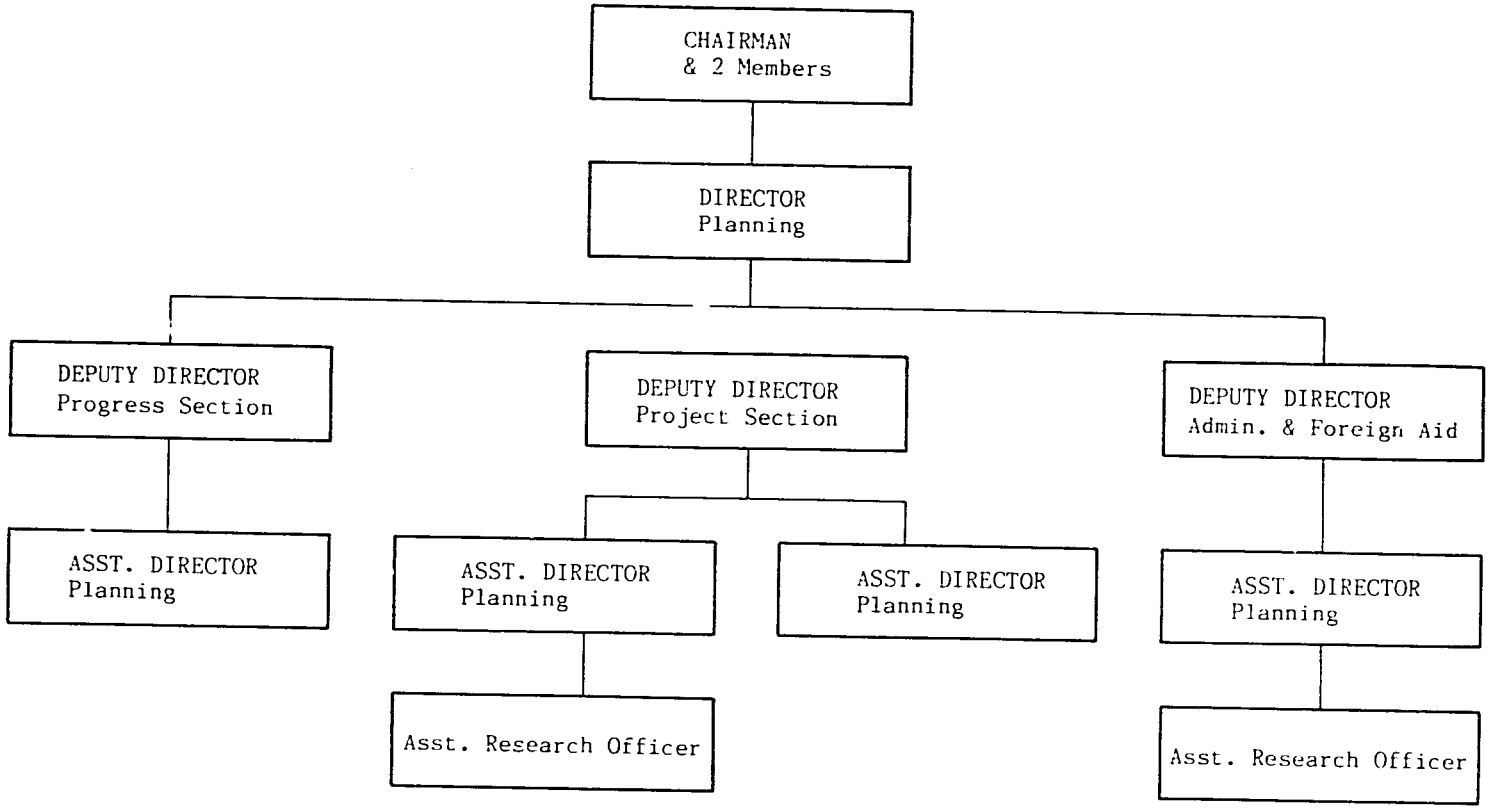
FIGURE 5.3.4 RHD PLANNING ORGANIZATION CHART



Note: Figures indicate number of post.

Reference:
S.E.=Superintending Engineer
E.E.=Executive Engineer
R.O.=Research Officer

FIGURE 5.3.5 BIWTA PLANNING ORGANIZATION CHART



Serious effort should be made in strengthening planning capabilities both in line agencies and in the Planning Commission.

5.3.8 Road Vehicle Limit

Highways in Bangladesh is not only expensive but also difficult to make them structuraly strong because of poor (for highway construction) soil properties and unavailability of suitable materials. The Consultants recommend that the government prohibit the use of three axle trucks. Contrary to often held belief that the greater the number of axles the lighter the axle load, experience in other developing countries shows that actual axle loads and consequent damaging effects by three axle trucks are far larger than two axle trucks. Three axle trucks are built not only for much higher payload but also to endure much higher overloading than two axle trucks. Table 5.3.12 shows average weights and average numbers of standard axles per vehicle in Thailand in Oman. Damaging effect of a three axle truck as expressed in the number of standard axles is two to four times higher than a two axle truck.

Table 5.3.12 Damaging Effect of Two Axle and Three Axle Trucks

	Thailand		Oman	
	2-Axle	3-Axle	2-Axle	3-Axle
Empty Vehicle				
GVW	4.75	8.54	6.7	12.5
% in traffic	62	58	47	50
Average ESA	.022	.042	.118	.270
Loaded Vehicle				
GVW	9.12	18.96	9.9	19.8
Payload	4.37	10.42	3.2	7.3
Average ESA	.960	1.673	1.004	1.947
Overall Average ESA	.378	.727	0.588	1.947

Note: Average ESA depends on the distribution pattern of axle loads and is not proportionate to average GVW.

Source: Y. Motomura, "Techno-economic impact of limit on truck size and weights", ESCAP secretqriate paper, 1983.

5.4 Transport Sector Performance Monitoring System

5.4.1 Introduction

The scarecity of operationally usefull information is a serious problem in Bangladesh and the transport sector is no exception.

Under the existing conditions performance measures of transport modes have to be estimated utilizing assumed values for many unknown factors. A wide margin of error is inevitable. Subsequent planning, therefore, necessarily faces a danger of pursuing wrong or inproper policy directions.

The problem is compounded not only by the lack of proper data collection system but by the prevalent ticketless passengers and under-reporting of freight transported.

It is recommended that effort should be made in implementing a system of measuring the performance of each transport mode.

There should be two types of data collection, one routine and the other periodic. The former should be implemented by each agency to monitor its operation regularly. The latter, however, would best be done on a contract basis by, for example, local consultants under the supervision of the Transport Survey Wing of the Planning Commission.

In the following sections recommendations are made for the performance measurement of each mode. The Transport Survey Wing should be strengthened to coordinate all such data collection and analysis activities in addition to supervising the periodic data collection activities.

5.4.2 Monitoring of Rail Performance

1) Introduction

The railway sector study has recommended a major managerial study of the financial and operating procedures of BR.

Performance indices are an essential part of any review and the Management Consultant would be examining these, and also the collection of data used in obtaining them. Thus the initial monitoring would be performed as part of the study. Then as the recommendations of the study are being prepared and implemented the monitoring system would be developed as part of the financial and operating review.

2) General

The analytical study of expenses incurred through the application of proper statistical methods provides a medium for monitoring performance and the control of expenditures.

A statistical method is a technique used to obtain, analyze and present numerical data, and the elements of statistical technique include the:

1) Collection and assembling of data

2) Classification and coordination of data

3) Presentation of data in:
   a) Textual form, b) Tabular form and c) Graphic form

4) Analysis of data

5) Conclusions derived from the analyses

In administrative and supervisory work the use of these data is a vital tool; however, the interpretation and determination of the significance of this information require much skill. Railroad accounting is a routine of reporting chronologically the expenditures for labor, material, and miscellaneous costs according to the accounting classifications.

On the other hand, if statistical methods are superimposed on accounting results with other data for the purpose of understanding the circumstances of the past and present performance, it is possible to control current expenses and to forecast the work programs and the future money outlays of the various departments.

Figures obtained from special cost studies, and from data available in the official reports and records of the departments provide information on past and present performances, but become of greater value when proper application of them is made. Thus, to know the cost of renewing an asset is to establish a measuring stick for making comparisons of cost of future renewals with incentive to reduce the cost and establish new measuring sticks, and to know the length of life of the asset and the cost lays the foundation for the study of economic asset renewal. In both instances the trend is toward efficiency and economy, the product resulting from a statistical processing of the data developed from special cost studies and from the official reports and records of the various departments.

In the following discussion these subjects are treated under their respective headings, but their close relationship should be kept in mind.

Railroad officers are constantly striving to get the maximum worth from the money spent. They should, therefore, be able to show that their expenditures are efficiently and economically handled as a matter of sound business practice. This requires a knowledge of the unit costs of maintenance, with comparisons of the costs of one period of time with another and of one location with another, and where several methods are in use, one method with another.

3) Data assembly

In preparing, assembling and making use of data for these purposes certain fundamentals must be observed.

The test to be applied before making a statistical investigation and establishing a series of statistical reports is to ascertain whether or not the data will aid in the supervision and control of the department activities so as to bring about more efficient and economical operation. Attempts should be made to avoid the inclusion of unnecessary and inconsequential elements which serve no useful purpose.

The determination of the proper unit of measurement is one of the first essentials. An analysis of the accounting and statistical routine should then be made to know that the basic information required is readily available, and if not, arrangements must be made to obtain the required data.

The field data are the foundation of cost-keeping and must be secured in sufficient detail for the purpose and be accurate. The assembling of the field data and the computation and compiling of costs should be performed in that office best prepared to handle such work. Duplication of work should be avoided and best results will be obtained where it is handled by those most familiar with the character of the work.

Reports and the work connected therewith must be easily understood. Each step in securing and assembling the data must be simple and the transition from one step to the next must be logical and in progressive order, not involved or complicated.

Data must be economically assembled. Where possible, use should be made of information already at hand, and existing facilities should be adapted or expanded for its future accumulation. It should not cost more to get the records than they are worth or the amount that can be effected in savings through their use.

Records must be for a purpose, and the more specific and better defined the purpose, the more valuable will be the result.

Reports and records must be periodic, not only as to the time interval they cover but as to the time they are available. With information readily available, bad practices may be prevented or exposed and promptly corrected, lagging performances checked, and control of expenditures facilitated. The necessities of the case will determine the report frequency.

Information must be comparable. Data should be in sufficient detail to make the differences portrayed by the comparison intelligent, but too much detail is confusing and should be avoided. The number of comparisons which should be made to permit a fair criticism should be sufficient to give a true picture of the situation.

Data should be properly used. If not used, their preparation is a waste of money, and the compilation of such information should be discontinued at once. It should be possible from good records to predict results, to locate trouble definitely, and to point out the possibility of further progress and improvement. In the last analysis, proper use and the savings effected thereby is the proper gage of the value of any statistical record.

Statistics which serve as a guide to the efficiency or inefficiency of work done should be built around the concept of a standard or norm for the work unit. Efficiency is a relative term and cannot be stated except in terms of some yard stick. Only by comparison with a well-established standard can real efficiency or inefficiency be measured. The first object of the establishment of statistical data on operations or work units should, therefore, be to determine such standards for the work units.

When the standards have been established, the relative position of the work unit can be developed and a study made as to the causes of any inefficient work. It should be understood that the standards themselves are not inflexible; in fact, over a period of time the standards themselves should be adjusted in line with progress in efficiency of work. A standard which fits hand work of the pick-and-shovel period will not apply to such work done with the help of modern roadway machines.

In efficiency studies the railway department should be held accountable for changes in the physical quantities of work units to accomplish for changes in the prices which must be paid for labor, material, etc., to do necessary work. Therefore, the statistical data should be set up with full provision for separation between the physical work units (performance) and the money cost which is the product of those physical units and the unit prices in effect at the time. The true effect of the changing performance can thus be analyzed and accorded its proper place in the picture.

1) Operational review

This review is of the most important immediate interest to management as part of the necessary information to ensure a well run railway system.

a) Trains

The standard operating performance indices, the passenger-km, and the ton-km are obvious objectives of monitoring, and must be carried out on a monthly basis from the standard sheets prepared by each station. At busy stations this may have to be brought to even more frequent intervals.

A factor to be brought into the monitoring process are the large fluctuations in traffic caused by external influences; a) Weather, b) Harvesting and c) Religious festivals.

Whilst a) and c) closely affect passenger volumes, with some freight traffic effects, b) affects both strongly. In this context any review must be based on an annual cycle, as any shorter period will present a distorted result.

Raw data, i.e. only partly refined is of great interest to line managers, as it gives an immediate reflection on trends. Trends are the warnings to management of changing situations.

Raw data is required by management for:

Passenger Traffic	Freight Traffic
Passenger-kms	Tonne-kms
Total passengers	Wagons loaded
Carriages in workshops	Wagons in workshops
Av. carriages stopped for repairs	Av. wagons stopped for repairs
Guards journals	Waybills

Locomotives

Locomotives in workshops
Av. locomotives stopped for repairs
Number links worked
Number failures in service

This is required on a monthly basis by the end of the first week of the following month. This means that trends are always on fresh data and no information is older than 5 weeks. The refined data which requires more input will take longer to issue, but should not be more than one month in preparation. The monthly data is then further refined into quarterly and half-yearly issues of statistics, basically similar to the annual report, but with far less detail.

This information must be computerized for the essential speed. However the source data must be reliable, and therefore all statistic reporting and procedures must be systematically reviewed and examined to ensure accuracy in collection and transmission.

b) Depots and workshops

Workshop efficiency is a measure of actual output against possible output.

i) Carriage and wagon shops and depots:
Actual work completed and ready for removal.
- Inspections
- Servicing
- LE
- POH
- Rebuilds
- Construction

ii) Locomotive depots and workshops:
Actual work completed, tested, and ready for removal into service.
- Inspections
- Servicing
- Scheduled maintenance by type
- Renewals of engines and/or generators
- Emergency repairs

iii) Engineering and S&T workshops:
Actual work completed and ready for removal.
- Manufactured switches and crossings
- Repairs to switches and crossings
- Steelwork completed
- Signalling equipment maintained

c) Operational efficiency

Operating efficiency is a measure of how well the railway operating staff can react to day-to-day situations.

i) Timetable strength of coach rake and actual strength of coach rake.

ii) Actual number of 4 sheel equivalent wagons on freight trains, loaded and empty, and estimated tonnage hauled.

iii) Locomotive availability against link by engine number.

5) Financial review

a) General

The review comprises two distinct approaches.

1. Revenue 2. Costs

These are not in anyway related as this is not a commercial review, but a statistical review. For this reason and to avoid conflict in obtaining the statistics, monitoring should be performed by separate teams. The only time that any correlation is required is at Director General level when results are being interpreted for policy action.

The review must be carried out by examination of statistics collected into two groupings:

a) by area b) by line or section of line

The area served by Bangladesh Railway is split geographically into the two zones, and then each zone into two divisions. This satisfies criteria a) and the divisions can be further sub-divided into smaller areas if found necessary.

The second criteria b) is by line or section of line where these are too lengthy.

From this point each source of costs or revenue can be identified two ways - by area or by line.

However of more immediate importance is the financial monitoring of revenue and costs.

b) Revenue

From each station:

i) Number of tickets sold to each destination by number, and revenue collected.

ii) Freight carried by tons or by wagon load, money received by tariff group fully paid, and on account; accounts outstanding, and accounts overdue.

iii) Parcels despatched by destination, and revenue received.

From this data the contribution of each station to the main trunk flows can be determined, and travel patterns established. This is a significant contribution for Marketing Division to reflect changing travel patterns by analyzing the changes and to change services offered to accommodate the change.

c) Costs

Costs fall into three groups.

- Labor
  Man-hours
  Wage rates (or total compensation by work-units and projects)

- Material
  Kind and quantity
  Unit costs (or total costs by kind and quantities for each work unit)

- Miscellaneous charges
  Overhead items (supervision, light, heat, power, rentals, depreciation, interest, etc.)
  Contract or other billed items for work performed by others
  Work train costs

Costs centers are more extensive and more complex than revenue centers. It is necessary to make a broad division between costs which are to revenue account, costs which are associated with capital or "betterment" accounts from railway funds, and those costs which are directly associated with foreign aid projects. The rules formulating these divisions must be clearly drawn.

Each cost center will be reviewed for:

i) Labor

- Wages paid by grade and total sum related to actual staff and manning requirements.

- Overtime paid to each grade and total sum.

- Other expenses and allowances paid by grade and total.

ii) Materials

- Fuel issued to each locomotive and kilometers run during reporting period and actual hours in traffic.

- Value of materials used in maintenance by each item of rolling stock drawn from stores.

- Value of materials used in bridges, track and structure maintenance.

6) Observations

The amount of data obtained is extensive, and initially this will require a large staff to initiate and establish the basis for collection and analysis. However this is not only a "desk job" frequent site surveys must be carried out to verify the data being issued by the reporting centers. When significant patterns have been established the quantity of material will be reduced thus permitting a faster analysis time and reaction time.

Initially the data will be made available to the Management Study Team as a basis for their review and recommendations. The monitoring process must continue to record the effects of the implementation of the study teams recommendations, and as a filter for modifications. The data interpretation will be a useful marketing aid for traffic promotion, and a useful management tool for performance rating.

At this time it is considered that the existing computer system will be re-established and brought under the control of the Director of Planning. Many systems are used purely for accountancy purposes leading to the annual report. This system is primarily a Management Information System with accounting capability. The purpose is to provide timely simple information for early managerial decisions, the accountancy function follows.

5.4.3 Road

In order to make suitable road transport plans, to designs make proper and to control traffic for safety, it is necessary to understand the existing transport situation and its conditions. Therefore the operating regularly and collect pertinent data.

1) Present data collection

Several kinds of surveys regarding the road traffic, inventories and vehicles have been conducted and analyzed by line agencies. However they have been done irregularly. Moreover no central data bank has been established in the RHD headquarters. And also no complete bridge and ferry inventory data on a national basis are available today.

In addition to this, there are many discrepancies among the published figures. For instance, regarding road mileage, the BTS updating report noted that the road mileage figures in all three categories (metalled, un-metalled and under construction) show some discrepancy between the figures given by the RHD Divisional Offices. It was not clear why and how these discrepancies arose. Also, these are many discrepancies between RHD's inventory records and BBS figures. The cause must lie in the present system of data collection. Therefore, establishment of better performance monitoring systems is necessary in order to achieve higher managerial efficiency in operation and planning.

The present organization of the Planning and Development Division in the current RHD organization is shown in Fig. 5.3.4. This Division should have a responsibility to control, analyze and register all data for roads, bridges and culverts, ferries and equipment but it had not been fully managed due to lack of staff and resources constraint.

2) RHD data collection system flow

It is recommended to adopt a new data collection system for RHD and to establish central data bank in RHD, Planning and Development Division, for the operation and planning of national projects.

The recommended RHD data collection flow is shown in Fig. 5.4.1. Planning and Development Division will issue a standard format showing necessary information to be collected to all district offices for analysis or filling. Each district office will collect the format from their road circle and submit to Planning and Development Division. This simple data collecting system flow can easily be maintained, and all data analysis can be standardized.

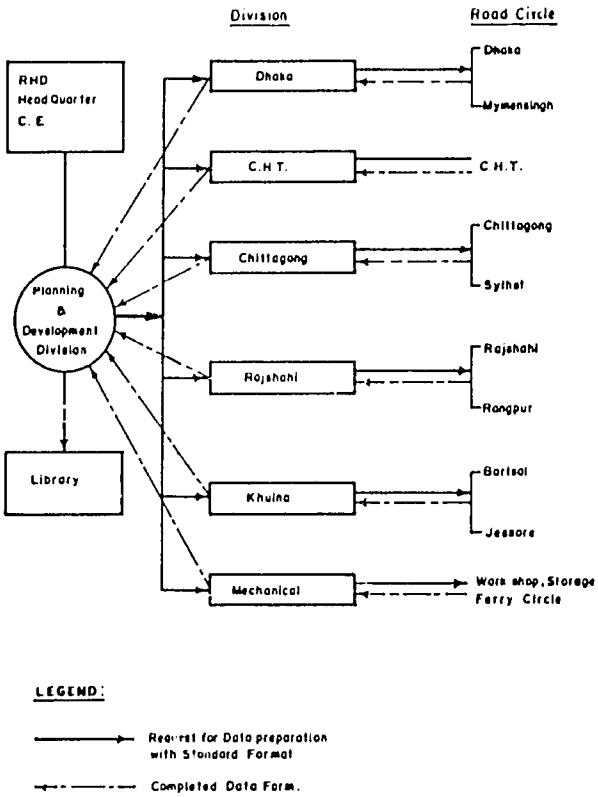


FIG. 5.4.1 RECOMMENDED RHD DATA COLLECTION FLOW

3) Identification of data to be collected

Major items to be controlled by RHD Planning and Development Division are as follows:

i) Infrastructures and ferry inventory
ii) Traffic records
iii) Axle loads
iv) Construction equipment
v) Maintenance records
vi) Vehicle registration
vii) Traffic accidents

Details of data collection methods for the above items is shown in Table 5.4.1.

Table 5.4.1 SUMMARY OF DATA COLLECTION METHODS, ROAD SECTOR

No.	Classification	Major Purpose	Survey	Frequency	Major Items to be Analyzed	Section in Charge
i)	Infrastructure and Ferry Inventory	Preparation of inspection/maintenance construction schedule	Road inventory Bridge/culvert inventory Ferry inventory	Once a year - do - - do -	. Category-wise road length/width/pavement condition . Location/size/length/type . Location/number/type/capacity of boats	Economic Section Plan & Programming
ii)	Traffic Analysis	Traffic map preparation/road network planning/passenger and freight movement analysis	Traffic counts Vehicle-OD (include truck-OD) Passenger-OD	National Hwy (AADT 1000) - Every 3 months - National Hwy (AADT 1000) - Every 6 months - Regional Hwy - Once a year Every 5 years (National base) Every 5 years (National base)	. AADT estimation . Traffic map preparation . Traffic composition . Annual growth . Vehicle-OD matrix . Freight movement/commodity analysis . Passenger-OD matrix . Road transport performance	Economist Section Plan & Programming Transport Survey Wing, Planning Commission (Supervision)
iii)	Axle Loads	Pavement design/commodity movement analysis	Axle load survey (key stations on the National Hwy)	Once a year	. Axle load distribution . Standard axle load	Road Research Laboratory
iv)	Construction Equipment	Maximum utilization of equipment/spare parts control	Inventory and stock control	Once a year	. Operation efficiency . Stock control/adjustment	Mechanical Division
v)	Maintenance	Programming of maintenance schedule	Bridge/pavement/traffice safety divices inspection	Once a year	. Classification of present conditions . Preparation of maintenance program procedure	Project Control Section
vi)	Vehicle Registration	Traffice forecast/planning	*	Once a year	. Number of vehicles on road	Plan & Programming
vii)	Traffic Accidents	Road design and traffic safety	*	Once a year	. Analysis of traffic accidents related to road infrastructure	Road Research Laboratory

* Remarks: No. (6) & (7) are not controlled by RHD, should co-ordinate with responsible authority.

5.4.4 IWT and Ports

Performance Monitoring for IWT

The Second Inland Water Transport Study Volume 2, prepared by Louis Berger International and Rahman & Associate, dated November 30, 1980, recommended the establishment of Management Information System (MIS) and IWT sector data bank within BIWTA. This recommendation is now formally submitted as a Technical Assistance Project Proposal, under the Third Five Year Plan.

This project should go forward if the following three conditions are met:

First, discussions on the use of computer based Information System with many management officers of BIWTA and BIWTC indicated a lack of understanding as to what information was needed or how such information would or could be applied to their planning and managerial operations. This lack of understanding on computer applications was further confirmed by the visit to 3 computer centers where the usage of present equipment is estimated at approximately 30% of capacity.

The establishment of a MIS should be adopted provided that an administrative system to ensure the motivation for its use be first established for top and middle management.

Second, a study of input data, how they are collected, verified and derived, their accuracy and form of delivery must be determined and a data base collection program implemented.

Due to consistent lack of realistic, timely, accurate or sufficient statistical data, economic, planning, scheduling, and other analyses have often been based on given estimates. Under these circumstances present data for economic analysis, operational planning inventory control and vessel scheduling are inaccurate or unavailable.

This problem is caused by the lack of continued inputs of basic data into the Inland Water Transport Sector's data base. Present planning data therefore is often based on straight percentage increases built on the results of the Bangladesh Transport Survey of November, 1974. This data base has been widely used as a basis in the subsequent studies including the Second Inland Water Transport Study (1980) as regretably necessitated and noted by the Consultants. This latter study's data have since 1980 been the base data upon which most statistics are based.

Before a Management Information System can be implemented it will be necessary to establish a new realistic data base and the methodology for maintaining this data on a continuing and current basis. This absolute requirement must be incorporated into the Proforma Proposal for a MIS.

In order to achieve this objective a total restructuring of the present statistical reporting system may be necessary. In this regard a statistical data reporting system should be enforced on the private sector.

Third, implementation and direct supervision of program planning and applications must be under a computer expert for programming until the system is fully understood and operational. This period is expected to take 1 1/2 years.

Inspection of BIWTA records shows that information required for computer programs are available. The question is their reliability. The last annual Ports and Traffic Report was published in 1978/79. This is an excellent report but its use is questionable for planning purposes in 1985/86.

The present computer used by BIWTA for hydrographic survey data collection purposes could be utilized as the starting point for training and programs for the MIS program.

A basic plan for implementation of a MIS was developed in cooperation with the Dhaka office of IBM and is available.

Both the BWDB and BIWTA are using separate computer data banks for the correlation of data. The two separate systems are in the early stages of development. This represents another duplication of equipment, trained personnel and expense. The BIWTA computer is to also function, in the future, as a base training unit for their planned Management Information System (MIS). Under a merged system of survey and data collection the present under-utilized BWDB computer could handle all survey and data bank requirements. The BIWTA small computer would then be used to implement the basic training of personnel and the beginning of programs for the MIS requirements.

Data items recommended to be collected are summarized in Table 5.4.2.

Port Performance Monitoring

Port statistics are collected and kept at a fair level. It is recommended that statistics on port productivity on a ship-by-ship basis be collected and summarized.

Table 5.4.2 SUMMARY OF DATA COLLECTION METHODS, IWT SECTOR

No.	Classification	Major Purpose	Survey	Frequency	Major Items to be Analyzed	Section in Charge
i)	Infr structure	Preparation of inspection/maintenance construction schedule	Waterway inventory Navigational Aid inventory Port inventory	Once a year - do - - do -	. Category-wise waterway length/depth conditions . Location/type . Size/type/capacity facilities	BIWTA Planning Division
ii)	Traffic Analysis	Traffic map preparation/waterway network planning/passenger and freight movement analysis	Traffic counts Passenger-OD Freight-OD	Major ports - daily Minor ports - twice monthly Rural landing - three times a year Every 5 years (National base) Every 5 years (National base)	. Monthly traffic estimation . Traffic map preparation . Annual growth . Vessel-OD matrix . Freight movement/commodity analysis . Passenger-OD matrix	Economist Section Plan & Programming Transport Survey Wing, Planning Commission (Supervision)
iii)	Port Productivity	Port productivity analysis	Cargo handling survey	Once a year	. Cargo handling rate . Vessel waiting time	Planning Division
iv)	Vessel Productivity	Maximum utilization of equipment	Inventory and stock control	Once a year	. Operation efficiency . Stock control/adjustment	Planning Division
v)	Maintenance/ Construction Equipment	Programming of construction maintenance schedule	Inventory utilization	Once a year	. Preparation of maintenance program procedure	Planning Division
vi)	Vessel Registration	Traffice forecast/planning		Once a year	. Number of vessels in use	Planning Division
vii)	Traffic Accidents	Traffic safety		Once a year	. Analysis of traffic accidents related	Planning Division

CHAPTER 6

TRANSPORT SECTOR PLAN 1986-1990

6.1 Gross Investment Targets

The Second Five Year Plan (SFYP) allocated 13% of the total to the Transport Sector. The total amount allocated to the subsectors subject to this study, i.e. roads, railways, inland waterways, and ports, was Taka 21,700 million at 1979/80 prices. The original allocations set forth in SFYP are shown in Table 6.1.1. The above amount is equivalent to Taka 41,200 million at 1984/85 prices.

Actual allocations to the subsectors in the Annual Development Programmes (ADP) in the subsequent years, however, fell far short of the original plan in real terms. Thus the final version of the SFYP publiched in May 1983 presented a realistic plan with all figures revised downward. Revised figures are also shown in Table 6.1.1.

Table 5.3.1 in Chapter 5 shows actual allocations in ADP in recent years and the totals for the SFYP period by subsector. The actual combined total is a little more than 50% of the original plan in real terms but roughly as planned in the final version. Many projects initiated by SFYP have not been completed during the plan period and are being ca ied over to TFYP.

Investment in the tranpsort sector has been fairly stable at around 13% of the total of the public sector investments. Considering the fact that the basic transport network is in place and other sector's needs are as pressing as of the transport sector, if not more, it is unlikely that the share of the transport sector in the public investment would be allowed to increase in the foreseeable future. Thus, the Bangladesh Energy Planning Project postualated the share of investment in the transport and communications sector at a constant 15% of the gross investment up to the year 2000. Transport investments inevitably involve high foreign currency contents and require funding sources overseas. Limitations in this aspect would also prevent a quantum increase in the transport sector investments as a whole.

In fact the total public sector investment as well as the investment in the transport sector have been declining in recent years. The average of public sector investment in transport excluding ocean shipping and aviation during the SFYP period was about Taka 4.3 billion per year in 1984/85 prices. However, the annual figures foi the last two years are well below the average and the total figure for the year 1985/86 is expected to be about 25% less than the above average.

Table 6.1.1 Second Five Year Plan Transport Sector Allocations

Subsector	Original Plan		Revised Plan (1983 Version)	
	Tk, million	%	Tk, million	%
Rail	8,000	36.8	4,139	39.2
Road	9,000	41.5	3,800	36.0
BRTC	800	3.7	278	2.6
BIWTA	1,020	4.7	649	6.1
BIWTC	700	3.2	518	4.9
Chittagong Port	1,400	6.5	636	6.0
Chalna Port	780	3.5	545	5.2
	21,700	100.0	10,565	100.0
Transport Sector	26,350		12,870	

Source: SFYP Draft and Final Versions.

By September 1985, the Planning Commission has determined the financial allocation for the transport sector of TFYP as shown in Table 6.1.2. The total allocations to subsectors subject to this study amounts to Tk. 21,070 million, roughly the same level as the actual total during SFYP.

According to the middle, reference scenario stipulated by BEPP, achieving the GDP growth of average 5.8% per annum would require 7% per annum increase in real terms in investment over the performance of SFYP for TFYP, 10% per annum increase for Fourth Five Year Plan period, and 9% per annum increase for Fifth Year Plan. The growth rate of transport sector investment was assumed the same as for gross investment.

Although the planned TFYP Transport sector investment is short of what was assumed in BEPP, the above investment growth rates for fourth and fifth five year plans are adopted in this study, giving totals of Tk. 33,930 million for the fourth and Tk. 52,210 million for the fifth plan.

Table 6.1.2 Draft TFYP Transport Sector Allocation

(Tk. million)

Sub-sector	Allocation Total	Allocation Percent
1. Railways	7810.0	26.82
2. (a) Roads and Highways (RHD)	7000.0	24.04
(b) Chittagong Hill Tracts	1040.0	3.57
(c) Upazila roads	4460.0	15.32
3. Jamuna Multi-purpose Bridge Authority	750.0	2.58
4. Bangladesh Road Transport Corporation (BRTC)	250.0	0.86
Sub-total	21310.0	73.19
5. Chittagong Port	3010.0	10.34
6. Chalna Port	740.0	2.54
7. Bangladesh Inalnd Water Transport Authoirty (BIWTA)	880.0	3.02
8. Bangladesh Inalnd Water Transport Corporation (BIWTC)	340.0	1.17
9. Bangladesh Shipping Corporation (BSC)	510.0	1.75
10. Marine Academy	210.0	0.68
11. Departemnt of Shipping	28.3	0.10
12. Mercantile Marine Department	1.7	-
Sub-total	5710.0	19.60
13. Civil Aviation	700.0	2.40
14. Bangladesh Biman	1400.0	4.81
Sub-total	2100.0	7.21
Total	29120.0	100.00

6.2 Intermodal Priorities and Budget Allocation

6.2.1 Intermodal Priorities

The transport sector should be considered as a whole system, not only because different modes complement each other as in the case of delivery service function by the road mode to other modes but also different modes often compete each other. In this sense it can be misleading to put priorities to projects of different modes by means of a measure designed to evaluate individual projects such as EIRR.

Suppose a highway and a railway or a waterway are competing in a corridor and both require major rehabilitation. Because of the operating cost of the road transport is significantly higher than the other, the reduction in operating cost due to rehabilitation is also high, resulting in a high EIRR. On the other hand the other mode has a low level of operating cost with smaller amount of possible cost reduction, resulting in a low EIRR. The highway rehabilitation project may be selected if based on EIRR alone. This would guarantee a high return to the economy in the short run. In the long run, however, traffic would shift to the rehabilitated highway due to deteriorating service by the other mode. The net result could well be the higher total cost to the economy because of increased traffic for the highway at cost higher than the other mode and because of the higher unit operating cost due to inadequate traffic volume.

If evaluation of each project takes into account effects on the other mode, the above scenario can be avoided. Such broader approach, however, is rarely taken in actual practice partly because of difficulty in assessihng long term effects and partly because of sectionalism.

Intermodal priorities can be determined only when potentiality of each mode based on its inherent characteristics and long term effects are adequately taken into consideration.

The cost advantage of IWT for interdistrict freight transport has been demonstrated in Chapter 3. This mode also possess the largest potential for cost reduction. In terms of tonnage most of increase in the future is expected to take place in the southern corridors of Chittagong-Dhaka-Khulna, which IWT can serve well without heavy capital investment such as capital dredging or cannalization. Even to the northern districts where IWT can reach it maintains the cost advantage over others. This mode should be developed and its use encouraged as much as possible. Due to the past neglect its infrastructure is poor. Particularly poor cargo handling, facilities and arrangements, is a serious problem. Effort should be taken to improve cargo handling of IWT so that it can attract sufficient number of shippers to realize its potential.

IWT, however, can not be expected to capture all freight traffic with its limited coverage, slow speed, and extra cargo handling and feeder requirements.

In sharing the remainder of freight traffic an optimum modal split could exist between the road and the railway modes as explained in Chapter 3. For low traffic corridors the road mode should be given priority. For high volume corridors, however, the railways shoud be given priority.

For passenger transport IWT mode should be given as much encouragement as possible in order to minimize the total cost to the economy. Passengers preference, however, can not easily be controled as demonstrated by the dominance of the road mode in long distance passenger trip market despite higher fare. Every effort should be made to restrain the growth of road passenger traffic to avoid the costly construction of 4 lane highways in the future. The best restraint could well be the improvment in service quality of other modes, which should be given high priority.

6.2.2 Intermodal Budget Allocation

A major re-orientation of development budget allocation in the transport sector is necessary in order to achieve the desirable developent as described in Chapter 4.

Table 6.2.1 shows the ratios of performance measures and government investment amounts for each mode. For example, the road mode achieved 1.58 ton-km in 1985 for every Taka of average annual governemnt investment in this mode, and an average of 0.090 ton-km increase per year during the SFYP period for every Taka of average annual government investment. Similar measures were calculated for passenger-km for each mode and shown in the Table.

Assuming these ratios remain constant, future government investment requirements corresponding to projected ton-km and passenger-km for each mode can be calculated. Investment requirements were calculated from the total ton-km or passenger-km projections and from the average annual increase in ton-km or passenger-km, and percentage shares were calculated separately for both cases. Table 6.2.2 shows percentage shares of government investment amount thus calculated. Simple averages were then taken to indicate overall averages. The resulting figures are 45% for the road mode throughout the three periods, starting from 36% in TFYP period and declining to 31% in the Fifth FYP period for the railways, and starting from 19% and increased to 24% for the IWT mode.

Several factors must be considered.

IWT require investments higher than the level comparable to the past in order to attract traffic growing faster than other modes.

The railways are over-capitalized at present and does not require investment at the level relative to performance as determined by the past performance/investment ratio. However, more investements will be needed later to accommodate the desired growth.

Table 6.2.1 Performance Per Government Investment

	Road	Rail	IWT
1985 total ton-km/Tk	1.58	0.502	3.52
1985 total pass.-km/Tk	9.93	5.66	15.82
SFYP annual increment ton-km/Tk	0.090	-0.014	0.092
SFYP annual increment pass.-km/Tk	0.583	0.252	0.964

Source: Table 5.3.9

Table 6.2.2 Government Investment Allocation Derived From Traffic Projections

			Road	Rail	IWT
Allocation Derived from total					
	Freight	1990	42	46	12
		1995	38	48	14
		2000	34	51	15
	Passenger	1990	49	38	13
		1995	53	33	14
		2000	55	29	16
Allocation Derived from increment					
	Freight	1990	34	30	36
		1995	33	27	40
		2000	30	23	47
	Passenger	1990	57	29	14
		1995	58	26	16
		2000	59	23	18
Overall Average					
		1990	45	36	19
		1995	45	34	21
		2000	45	31	24

Source: Tables 4.2.2 and 4.2.3

The road mode at present is in need of large scale rehabilitation and improvement in order to protect past investments. However, in later stage investment in the road sector should be restrained in order to avoid undesirable road traffic growth which necessitates costly construction of 4-lane highways.

Therefore, modal shares of government investment were determined as shown in Table 6.2.3.

Table 6.2.3. Modal Shares of Government Budget

(in percent)

	Road	Rail	IWT	Total
Third Five Year Plan	47	32	21	100
Fourth Five Year Plan	43	33	24	100
Fifth Five Year Plan	40	35	25	100

Source: Consultants

Including the port sub-sector, allocations within the transport sector for the coming three plans were determined as shown in Table 6.2.4.

Table 6.2.4 Transport Sector Investment Allocations

Mode	Road	Rail	IWT	Port	Total
Agencies	RHD BRTC	BR	BIWTA BIWTC	PCA CPA	
Allocations (Tk. million)					
Thrid Five Year Plan	8,800	6,000	3,930	2,340	21,070
Fourth Five Year Plan	12,970	9,950	7,240	3,770	33,930
Fifth Five Year Plan	18,570	16,240	11,600	5,800	52,210

Source: Consultants

6.3 Recommended Modal Actions

6.3.1 Introduction

Objectives and strategies for the development of the transport sector are described in Chapter 5. Sectoral objectives and strategies must then be translated into objectives for each mode. Considering the conditions and prospects of each mode as analyzed in Chapters 2 through 4 and in Chapters 8 through 11, actions to achieve the stated objectives for each mode were identified. Following sections lists these objectives of development of each mode and recommended actions to be taken. Modal objectives are related to sector objectives, and modal actions are related to sector strategies. Figure 6.3.1 illustrates how modal actions are tied to transport sector strategies to show that modal actions as a whole would work in concert with the sector strategies and toward the attainment of transport sector objectives.

6.3.2 Rail

Objectives of Railway Sub-Sector

21. Improvement in productivity to attain at least the pre-war level.
22. Provision of railway transport services to those segments of transport demand market to which the sub-sector has the best overall economic advantage at least in the long run.
23. Improvement in financial position toward financial self-sufficiency.

Actions for Railway Sub-Sector

201. Improvement in rolling stock utilization by means of better operation and better maintenance.
202. Rehabilitation of existing infrastructure to restore the capacitiy.
203. Restructuring of management and operational practices toward market-oreinted and market-responsive ones so that potentials of the railway sub-sector can be realized vis-a-vis other competing modes. This would require organizational restructuring at all levels of management with re-defined responsibilities and overhauling of types and levels of services.
204. Implementation of a firm program to eradicate fraud such as ticket-less travel, waste and abuse of railway property.
205. Upward revision of passenger fares and freight rates to reduce government subsidy and subsequent distortion in transport demand market. Passenger fares have to be increased by 100%-200% and freight rates by 20% to become financially self-sufficient under the current conditions. Actual increase should be done in steps while considering the improvement in performance.

TRANSPORT SECTOR STRATEGY	Rehabilitation and Mainteannce of Existing Assets	Establishment of Improved Performance Monitoring System	Managerial and Operational Improvement	Rationalization of Fare/Tariff Structure	Promotion of Better Taxation and Credit Policies	Increased Private Sector Operations
RAILWAY						
Objectives	22. Provision of Services		21. Productivity Improvement	23. Improved Financial Position		
Actions	201, 202	208	201, 203, 204, 206	205		207
ROAD						
Objectives	31. Provision of Access		32. Cost Reduction	33. Growth of Private Sector		
Actions	301, 302, 304	306	307	305		303
WATERWAY						
Objectives	41. Productivity Improvement		42. Modal Expansion	43. Safety	44. Privatigation	
Actions	401, 402, 403, 404	410	401, 402, 409, 404, 405	406	408	407

FIGURE 6.3.1 TRANSPORT SECTOR STRATEGIES AND MODAL ACTIONS

206. Improvement in railway operation functions which have direct effects on productivity, such as signalling, communication, and track safety.
207. Involvement of private sector in selected railway manufacturing operations.
208. Upgrading of management information system.

6.3.3 Road

Objectives of Road and Road Transport Sub-Sector

31. Provision of adequate road access to all major centers of the country to ensure national integrity and the role of each center acting as a hub for the development of surrounding rural areas.
32. Reduction in the road transport cost where transport demand is substantial and operating conditions are poor.
33. Healthy growth of private sector operations.

Actions for Road and Road Transport Sub-Sector

301. Rehabilitation and upgrading of arterial national highways which carry substantial long-distance through-traffic. This indicates that highway sections forming a part of the national "H" shaped trunk road network should be given priority.
302. Reconstruction of war-damaged bridges and narrow bridges located within the above trunk road network should be given priority.
303. Gradual and selective phasing out or privatigation of the operations of the Bangladesh Road Transport Corporation.
304. Improvement of major ferry servcices particularly those forming parts of the trunk road network.
305. Increase (20%-40%) in bus fares to ensure that operators' revenue is sufficient for improving roadworthiness and safety of the bus fleet. Major increase (35%-45%) in freight rates through administrative guidance so that truckers can avoid economically damaging overloading.
306. Establishment of systematic data collection and evaluation systems for infrastructure, vehicle fleet, and traffic.
307. Allocation of development fund to a fewer number of projects to improve the efficiency of implementation.

6.3.4 IWT and Ports

Objectives of Ports and Waterway Transport Sub-Sector

41. Improvement in productivity of fixed assets, vessels, and operating organizations.
42. Securing this mode on selected routes by means of Provision of infrastructure and other action.
43. Safety of human life and property in the inland and territorial water of Bangladesh.

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44. Privatization of operations in the sub-sector to the extent possible.

Actions for Ports and Waterway Transport Sub-Sector

401. Increased share of the IWT sub-sector in the total budget allocation to the transport sector so that the return on the total investment in the transport sector can be increased.
402. Improvement in cargo handling and in vessel repair facilities to increase vessel productivity.
403. Implementation of systematic dredging and river training programs to secure economically viable waterways.
404. Provision of navigational aids and better training of pilots to ensure safety and shorter vessel turn round.
405. Provision of berthing and landing facilities at selected locations to ensure better service, shorter vessel turn round, and higher productivity. Planning and implementation of items 404, 405, and 406 should take into account the changing demand pattern and the expanded role of this sub-sector.
406. Periodic review of fares and freight rates to ensure the healthy growth of the waterway transport industry.
407. Gradual phasing out of BIWTC operations except for the maintenance of a minimum fleet and selected unprofitable routes which are considered of national interest.
408. Provision of incentives to private operators to modernize and to raise the efficiency of their operation.
409. Thorough review of the functions of the Chalna Port to determine its future considering the possible shift of cargo from Chittagong.
410. Establishment of reliable data collection system to ensure proper planning.

6.4 Criteria for Project Selection

6.4.1 Introduction

Criteria for evaluating projects in the national planning context should necessarily be different from those for evaluating an individual project or a group of similar projects. In the latter, the emphasis is on finding out whether the subject project would produce a sufficient level of return on capital or not. The estimation of future return would be done in detail to ensure that the minimum return would at least be secured. If a project is ensured of a sufficient return in one aspect, it may be enough to make a decision to implement although the project may bring in returns in other aspects as well. In the national planning context, however, the problem is not in deciding the implementation of an individual project but in selecting projects among a large number of projects.

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More importantly, in the context of national planning the choice can never be made on a single criterion alone, such as economic return. Considerations other than purely economic often play a large role in evaluating projects. Many aspects of project consequences are hard to quantify. Nevertheless, they may be equally important as the economic returns, depending on the particular objectives of the plan. In practice choices are often made on ad hoc basis.

Specific development objectives of each mode have been established as decribed in Chapter 5. They have been derived from transport sector objectives, which in turn have been derived from TFYP objectives. Because of the nature of the transport sector, the modal objectives can not directly address some of the TFYP objectives which are more of social nature. Thus, if project selection criteria are based solely on modal objectives, it is possible that some of the selected projects may be undesirable from the view point of a certain TFYP objective. For example, when a project is slightly less valuable than the other project to achieve the modal objectives but has a higher potential for generating rural employment, from the view point of overall TFYP objectives the former should be chosen instead of the latter.

Therefore, some of the TFYP objectives which can not be adequately addressed by modal objectives were added to modal objectives to form a set of project selection criteria.

It is not essential to have absolute values of expected returns of each project for the purpose of selecting some out of many. Ranking of projects in terms of their desirability is sufficient for the purpose. A system of determining the ranking of projects, therefore, was established for the purpose of selecting projects in formulating the transport sector plans.

The evaluation index of project i, Ei, can be expressed as follows:

$$Ei = \sum_{j} w_j . f(Yij)$$

Where Yij is the value or index of project i concerning criterion j, f(y,j) is the normalized index of project i with regard to criterion j, and w_j is the weight of criterion j.

It is necessary to take into account not only the beneficial effects but also cost effectiveness of project. Wherever economic benefits are quantifiable, index y as expressed in EIRR or FYRR are themselves a measure of cost effectiveness and no further normalization is needed. For each of the other criteria a 5-point system with the maximum 5 point for the maximum positive effect and 1 point for the minimum or maximum negative effect were assigned. It was determined that when an evaluator assigns an evaluation point to a project he or she could only do so relative to the size of project. The cost effectiveness element should be implicitly included in the point itself. It was decided therefore the 5-point system of evaluation without explicitly including the cost element was to be adopted.

For evaluating transport projects in Bangladesh, however, it appears that the existing data base is not firm enough to make a comparison across different modes using a single set of generalized criteria. Even where economic benefits are quantifiable, resulting values cannot be compared across different modes with a reasonable level of confidence as uncertainties concerning the level of accuracy in absolute terms are considerable. It was decided therefore that the ranking of projects be made only within each mode using mode-specific criteria and associated weights.

For each mode a set of criteria and two sets of associated weights were established. This was done to accommodate two distinctive cases, one for which a quantitative measure of economic evaluation can readily be estimated, and the other for which such quantitative measures are hard to come by. When a quantitative measure can be estimated, such a measure can naturally be given a large weight relative to other criteria. If such a measure cannot be obtained, a different set of weights for each criteria has to be applied to compensate for the lack of such quantitative measure of economic evaluation such as Economic Internal Rate of Return and First Year Rate of Return.

In the following sections some selected methods for estimating economic evaluation measures are described as well as subjects and associated point system for other criteria. The methods to estimate economic evaluation measures presented here are intended to be applied in the context of broadly ranking projects and not to evaluate project feasibility. They should, however, be regarded as a convenient tool for ranking projects within each mode.

These weights and indices shown in the following sections were determined after discussions with responsible government officials concerning the relative importance of modal as well as overall TFYP objectives. When deemed necessary, revisions can be made by altering the indices and weights as appropriate and re-calculate the overall indices by using the same system of evaluation.

6.4.2 Criteria for Railway Sub-Sector Projects

Because the railway operation is largely indivisible, it is extremely difficult to estimate economic benefits attributable to any individual project. An attempt was made in the evaluation of the ADB Second Railway Project in Bangladesh in 1984. The project consists of various components including rehabilitation of track, improvement of rolling stock repair facilities, installation of telecommunication network, and consultancy services. It was assumed that traffic would shift back from other modes and the overall unit transport cost would decrease when the project was completed. Economic benefits were calculated on the basis of these assumed improvements on an overall basis. It is difficult to relate specific investment to specific changes in performance or output except for special cases such as replacing certain workers by machines.

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No attempt was made in this study to estimate in economic terms the benefits of railway projects in a quantitative manner since the primary objective is to rank various individual projects.

To assist in arriving at a ranking system a subjective method has been used which grades the benefits to be obtained, and awards points based on the grading which are then weighted in accordance to the influence of the criteria.

The grading for each criteria with the assigned points and weighting are given in Table 6.4.1.

The following table gives the parameters considered against each of the six criteria for the discipline of the project. Thus in considering a track project the parameter considered for productivity improvement is train speed, but for a building project it must be increased productivity arising from the use of the building. Similarly a Mechanical Engineering Project cannot be considered under the same parameters as a Civil Engineering Project.

These tables are used in project evaluation considered in Section 6.5.2 Railways.

Table 6.4.1 Criteria for Railway Sub-Sector Project Selection

Criteria	Scoring Points 5	4	3	2	1	Weight
Sub-Sector Criteria						
1. Productivity Improvement	High Gain	Medium Gain	Low Gain	None	Adverse Effect	0.40
2. Service Necessity	High	Medium	Low	None	Adverse Effect to Operation	0.20
3. Financial Improvement	Large Gain	Medium Gain	Small Gain	None	Adverse Effect	0.15
					Sub-total	0.75
Overall TFYP Objective Criteria						
4. Rural Employment	Large Increase	Medium Increase	Small Increase	No Effect	Adverse Effect	0.07
5. Administrative Decentralization	Large Effect	Medium Effect	Low Effect	No Effect	Adverse Effect	0.08
6. Private Sector Encouragement	Highly Positive	Medium Positive	Slightly Positive	No Effect	Adverse Effect	0.10
					Sub-total	0.25
					Total	1.00

Evaluation of Criteria by Discipline

Civil Engineering Projects

1. Increase in train speed, rise in output
2. Safety of trains, operational necessity
3. Reduction in costs, increase in revenue
4. Recruitment of temporary labor, increased labor requirements
5. Movement away from Dhaka and Chittagong
6. Investment by private industry, construction contracts required

Mechanical Engineering Projects

1. Increased output, rise in train speed
2. Reduction in theft, improved service quality
3. Reduced maintenance costs, new traffic sources
4. Increase in local labor requirements
5. Movement away from Dhaka and Chittagong
6. Investment by private industry, local purchase increase

Signal Engineering Projects

1. Increase in train speed, increased output
2. Improved train safety, class of line served
3. Reduced costs, reduced maintenance
4. Increase in local labor requirements
5. Movement away from Dhaka and Chittagong
6. Investment by private industry, local purchase increase

Electrical Engineering Projects

1. Rise in output
2. Increase in safety
3. Reduction in costs
4. Recruitment of labor
5. Movement away from Dhaka and Chittagong
6. Procurement contracts awarded

Multi-Purpose Schemes and Studies

These are based on potential long term effects.

1. Increased output/cost, traffic increase
2. Increased safety and service quality
3. Reduction in costs, gain in revenue
4. Increase in local labor, recruitment of temporary labor
5. Movement away from Dhaka and Chittagong
6. Investment by private industry, contracts awarded to private sector

6.4.3 Criteria for Road Sub-Sector Projects

Table 6.4.2 lists criteria and associated weights for the road sub-sector. For highway improvement projects and bridge projects, EIRR should be used in lieu of criteria 1 and 2 with the combined weight of 0.60. EIRR of a highway improvement project can be obtained by means of Figure 6.4.1 for a given set of ADT data and construction cost. EIRR of a standard bridge construction project replacing ferry service can be obtained by reading from Figure 6.4.2 for a given set of data of crossing length, ADT and average time loss. These charts are not intended to be used in evaluating feasibility of individual projects. They are, however, sufficient for the purpose of ranking projects. Methods of deriving these charts are described in Appendix 6.4.2A and Appendix 6.4.2B.

In evaluating each project against the criteria shown in Table 6.4.2 following points are taken into consideration.

Encouragement of Private Sector

Highway construction or improvement projects in general bring about favourable effects on local contractors by directly creating work. It is also contended that the improvement of highway network has a wider impact on local communities in exposing themselves to the outside world than other modes resulting in more stimulus to local entrepreneurs.

Expansion of the Government run BRTC fleet and operation is a negative action against the agove stated objective. Conversely, reduction in the fleet size or operation is a positive action.

Employment

In road construction/improvement projects employment opportunities are generated often to a substantial degree to the local community. But the effect is short-lasting. Although the effect is showt-lasting, it should be taken into account.

The expansion of road transport operations by the Government sector enterprise can be equally substituted by the expansion of private sector operations and net effects would be nil. However, establishment of public functions such as training center or central workshop can be considered net employment generating projects.

6.4.4 Criteria for Water Transport Sub-Sector Projects

Table 6.4.3 lists criteria and associated weights for the waterway transport sub-sector. As in the case of highway improvement projects, EIRR should be used instead of criteria 1 and 2 for projects intended to shorten vessel turn round time. A method to obtain order-of-magnitude EIRR for such projects is presented in Appendix 6.4.4.

Following points were taken into consideration during the evaluation process:

Table 6.4.2 Criteria for Road Sub-Sector Project Selection

Criteria	Scoring Points 5	4	3	2	1	Weight
Sub-Sector Criteria						
1. Adequate Road Transport	Very High Demand	High Market Demand	Medium Demand	Low Market Demand	No Market Demand	0.35
2. Transport Cost Reduction	Large Reduction	Medium Reduction	Small Reduction	None	Increase	0.25
(1 + 2) EIRR	>25%	20 - 25%	15 - 20%	10 - 15%	<10%	(0.60)
3. Private Sector Encouragement	Highly Positive	Medium Positive	Slightly Positive	No Effect	Negative	0.15
					Sub-total	0.75
Overall TFYP Objective Criteria						
4. Gainfull Employment	High Positive Effect	Medium Effect	Low Positive Effect	No Effect	Adverse Effect	0.10
5. Rural Employment	Large Increase	Medium Increase	Small Increase	No Effect	Adverse Effect	0.10
6. Administrative Decentralization	High Effect	Medium Effect	Low Effect	No Effect	Adverse Effect	0.05
					Sub-total	0.25
					Total	1.00

Note: When EIRR is available, it should be used in lieu of criteria 1 and 2 with the combined weight of 0.60

Table 6.4.3 Criteria for IWT Sub-Sector Project Selection

Criteria	Scoring Points 5	4	3	2	1	Weight
Sub-Sector Criteria						
1. Productivity Improvement	High Gain	Medium Gain	Low Gain	None	Averse Effect	0.40
2. Provision of Adequate Intrastructure	Very High Demand	High Market Demand	Medium Demand	Low Market Demand	No Market Demand	0.15
(1 + 2) EIRR	>25%	20 - 25%	15 - 20%	10 - 15%	<10%	(0.55)
3. Safety	High Improvement	Medium Improvemnet	Low Improvement	No Improvement	Adverse Effect	0.10
4. Private Sector Encouragement	Highly Positive	Medium Positive	Slightly Positive	No Effect	Negative	0.10
					Sub-total	0.75
Overall TFYP Objective Criteria						
5. Gainful Employment	High Positive Effect	Medium Effect	Low Positive Effect	No Effect	Adverse Effect	0.10
6. Rural Employment	Large Increase	Medium Increase	Small Increase	No Effect	Adverse Effect	0.10
7. Administrative Decentralization	High Effect	Medium Effect	Low Effect	No Effect	Adverse Effect	0.05
					Sub-Total	0.25
					Total	1.00

Note: When EIRR is available, it should be used in lieu of criteria 1 and 2 with the combined weight of 0.55

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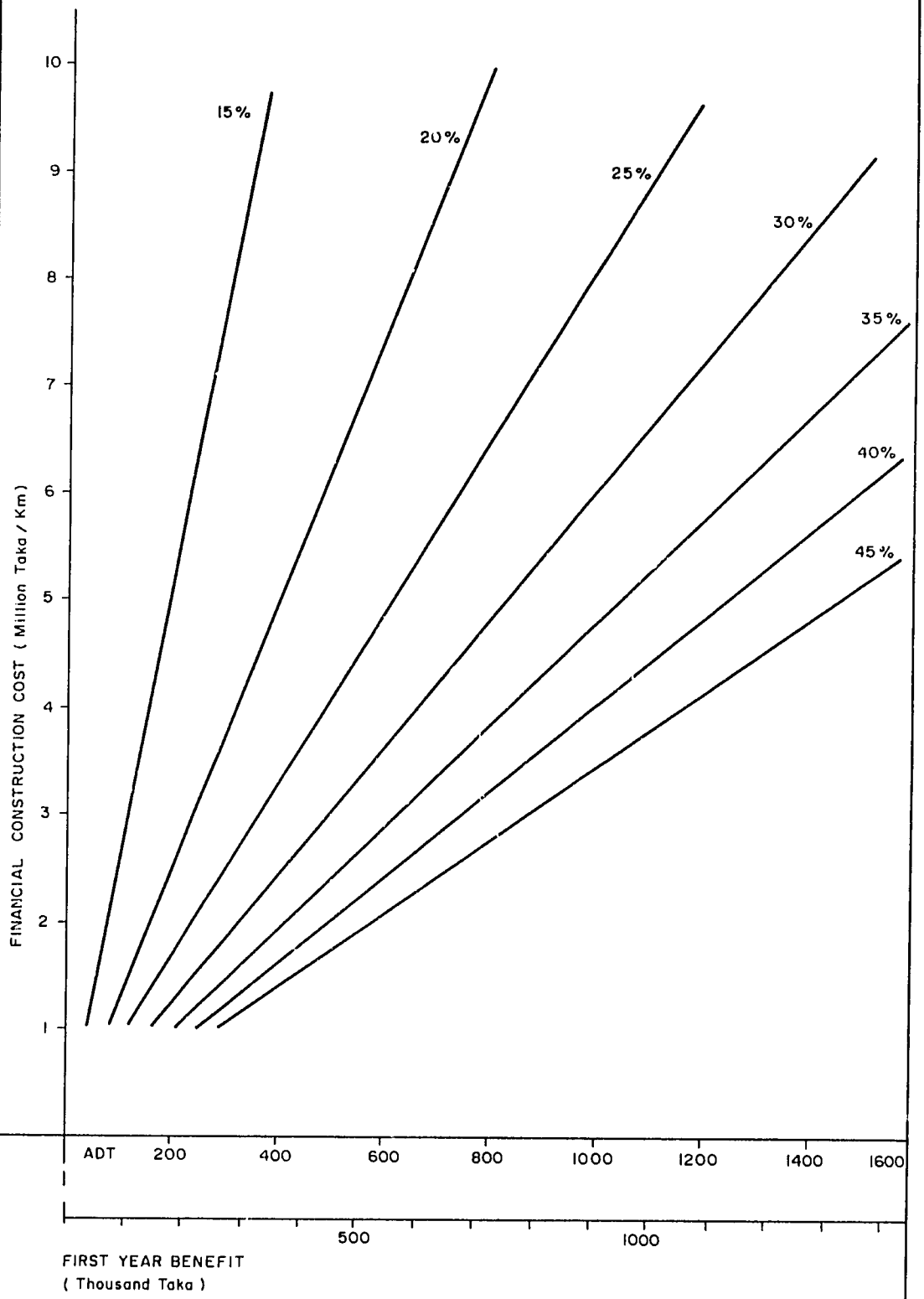

FIGURE 6.4.1 EIRR OF HIGHWAY IMPROVEMENT

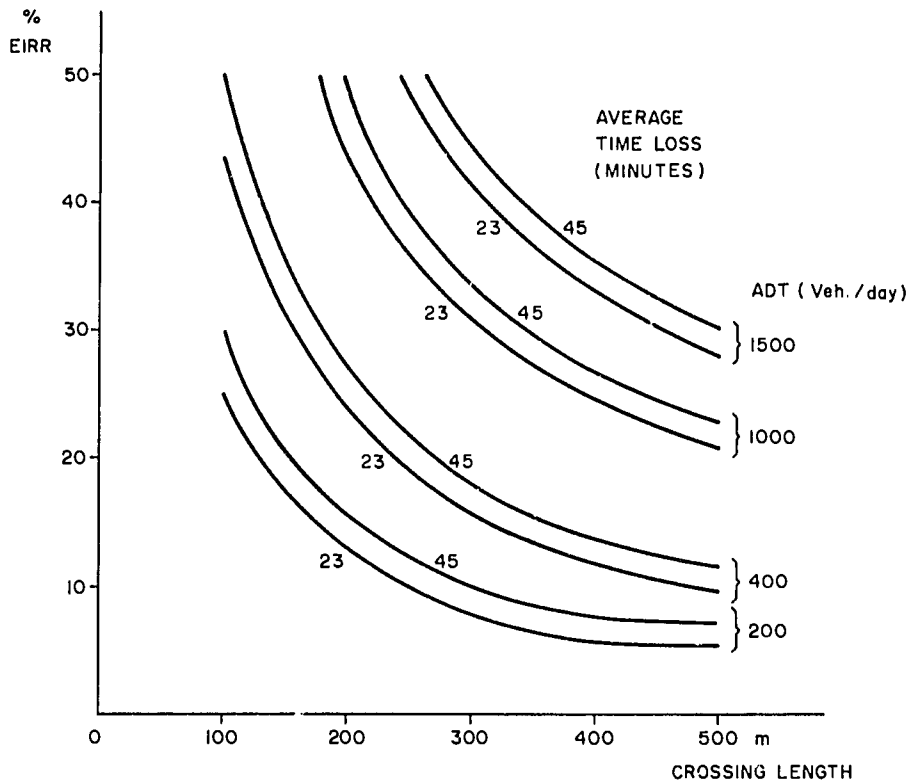

FIGURE 6.4.2 EIRR OF STANDARD BRIDGE CONSTRUCTION

Private Sector Encouragement

Many opportunities exist to strengthen the private sector in this mode of transportation. BIWTC's programme should be reviewed and evaluated from this point of view.

Employment

As explained in Chapter 10 and Chapter 11, improvement in cargo handling is needed to improve the productivity of vessels. This would inevitablly bring conflict with stevedores in ports, both sea and inland. A worker may be kept on welfare grounds as long as he does not impede the whole operation and thus lowering the productivity. If keeping the position is incompatible to the productivity improvement, welfare aspect of the job should better be performed elsewhere. If no alternative job can be found, social cost of unemployment should be assessed against the gain in productivity.

Rural Accessibility

If BIWTC's certain opeations are designed specifically to satisfy this objective, then it should be explicitly stated so and treated as such.

6.5 List of Projects and Evaluation

6.5.1 Introduction

All projects proposed by transport agencies were evaluated by means of the system of project selection criteria described in the preceeding section. In the following sections lists of projects are shown for each agency. Evaluation scores assigned against each criteria are shown for each project. Assigned score/weighted value of the score are shown under each criteria and the total of weighted scores is shown.

For example, the project at the top of the list in Table 6.5.1, track renewal, was given a full score of 5 points for the criterion No. 1, "increase in train speed, rise in output". The score was then multiplied by the weight of criteria No. 1 to yield a weighted score, i.e. 5 x 0.40 = 2.0. In Table 6.5.1 this process is explained as 5/2.0 under the criteria weighting 1. For criteria 2 through 6 scores and weighted scores are similarly shown where the number left of the slash indicates the score given to the project for the subject criterion and the number right of the slash indicates the weight given to the subject criterion. Total weight as shown at the second right most column is the sum of weighted scores, e.g. for the "track renewal" project, 2.0 + 1.0 + 0.6 + 0.21 + 0.16 + 0.2 = 4.17. All projects were ranked in the order of the total weighted score. Ranking of each project is shown in the right most column.

6.5.2 Railways

The projects evaluated were obtained from the "Tentative List of Projects Proposed for Inclusion in the Third Five Year Plan". The project cost is in Millions of Taka.

Railway Sub-Sector

Table 6.5.1 Evaluation of Civil Engineering Projects

Sl. No.	Name of Project	Est. Cost		Criteria Weighting						Total Weight	Rank
		Total	F.E.	1	2	3	4	5	6		
1.	Track Renewal	180.94	38.0	5/2.0	5/1.0	4/0.6	3/0.21	2/0.16	2/0.2	4.17	3
2.	Rehabilitation of Metre Gauge Section	1726.5	1031.68	5/2.0	5/1.0	4/0.6	3/0.21	2/0.16	2/0.2	4.17	3
3.	Rehabilitation of Bridges in Khulna Parbatipur Section Broad Gauge	222.02	97.85	3/1.2	5/1.0	2/0.3	2/0.14	2/0.16	3/0.3	3.50	15
4.	Recoupment of Ballast and Ballasting of Non-ballasted Sections	294.0	2.78	5/2.0	5/1.0	3/0.45	3/0.21	2/0.16	3/0.3	4.12	6
5.	Improvement of Operational Facilities on the Section Kulaura-Sylhet	9.29	-	5/2.0	5/1.0	3/0.45	3/0.21	2/0.16	3/0.3	4.12	6
6.	Setting-up of a Plant for Manufacturing MG and BG Pre-stressed Concrete Sleepers	159.09	90.60	4/1.6	3/0.60	3.0.45	3/0.21	2/0.16	3/0.3	3.32	18
7.	Setting-up of a Training Academy for Officers and Staff Phase-I	72.07	0.70	5/2.0	4/0.8	3/0.45	2/0.14	3/0.24	2/0.2	3.83	11
8.	Passenger Amenities Phase-II	56.36	-	3/1.2	4/0.8	3/0.45	2/0.14	3/0.24	2/0.2	3.03	23
9.	Construction of a 50-bed Railway Hospital at Dhaka	71.58	12.09	3/1.2	4/0.8	2/0.3	2/0.14	3/0.24	2/0.2	2.88	25
10.	Track Renewal, Phase-II	1693.32	334.5	5/2.0	5/1.0	4/0.6	3/0.21	2/0.16	2/0.2	4.17	3
11.	Setting-up of a Training Academy for Officers and Staff Phase-II (Equipment for Demonstration and Model Room etc.)	120.0	55.0	5/2.0	4/0.8	3/0.45	2/0.[illegible]	3/0.24	2/0.2	3.83	11

Table 6.5.1 Evaluation of Civil Engineering Projects (Continued)

Sl. No.	Name of Projects	Est. Cost		Criteria Weighting						Total Weight	Rank
		Total	F.E.	1	2	3	4	5	6		
12.	Replacement of Sleeper Treatment Plan at Kanchannagar	60.0	42.50	4/1.6	3/0.6	4/0.6	4/0.28	2/0.16	4/0.4	3.64	14
13.	Re-conditioning of 507100 Nos. of BG x MG Steel Sleeper	336.9	195.4	5/2.0	5/1.0	5/0.75	2/0.14	2/0.16	4/0.4	4.45	1
14.	Replacement of Kushiara Bridge	30.0	20.0	3/1.2	5/1.0	3/0.45	2/0.14	2/0.16	3/0.3	3.25	19
15.	Shifting of Kholahati Depot and Construction of a Depot at Parbatipur	37.6	-	4/1.6	4/0.8	4/0.60	4/0.28	2/0.16	3/0.3	3.74	13
16.	Recoupment of Ballast and Ballasting of Non-ballasted Section-Phase-II	62.20	26.0	5/2.0	5/1.0	3/0.45	3/0.21	2/0.16	3/0.3	4.12	6
17.	Plant and Machinery for Track Workshop at Chittagong and Bridge Workshop at Saidpur	65.0	55.0	5/2.0	3/0.60	4/0.6	2/0.14	2/0.16	4/0.40	3.90	9
18.	Construction of Office and Residential Accommodation for Officers and Staff GM/West Rajshahi including Hospital	250.0	3.0	5/2.0	4/0.8	4/0.6	4/0.28	5/0.40	3/0.30	4.38	2
19.	Construction of Office and Residential Accommodation and Auxiliary Facilities for Officers and Staff under Director Gen. Rly.	100.0	-	4/1.6	3/0.60	3/0.45	2/0.14	2/0.16	2/0.20	3.15	21
20.	Remodelling of Chittagong Yard and Construction of a New Station Building	50.0	-	4/1.6	3/0.60	4/0.6	2/0.14	2/0.16	3/0.30	3.40	16
21.	Remodelling of Tejgaon Station and Construction of New Station Building	30.0	-	3/1.2	3/0.6	3/0.45	2/0.14	2/0.16	3/0.30	2.85	26
22.	Provision of Office Accommodation of GRP and RNB including Female "Hazat"	35.0	-	3/1.2	4/0.8	3/0.45	2/0.16	2/0.16	3/0.30	3.07	22

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Table 6.5.1 Evaluation of Civil Engineering Projects (Continued)

Sl. No.	Name of Project	Est. Cost		Criteria Weighting						Total Weight	Rank
		Total	F.E.	1	2	3	4	5	6		
23.	Expansion and Construction of Stores Depots at Phartali, Saidpur, Parbatipur and Construction Divisional Depots at Dhaka and Paksey	65.0	-	4/1.60	4/0.80	5/0.75	3/0.21	4/0.32	2/0.20	3.88	10
24.	Rehabilitation of Existing Bridges and Construction of Additional Bridges on Flood affected Areas to provide Additional Waterways	300.0	120.0	3/1.20	5/1.0	3/0.45	4/0.28	2/0.16	3/0.30	3.39	17
25.	Doubling of Track between Aliswar-Haksani Naoti including Modification of Signalling	100.0	40.0	4/1.60	3/0.6	3/0.45	3/0.21	2/0.16	2/0.20	3.22	
26.	Shifting of Marine Headquarters to Dewanganj Bazar	14.20	1.50	3/1.20	3/0.6	2/0.30	2/0.14	2/0.16	2/0.20	2.60	28
27.	Provision of Residential Accommodation	100.0	-	3/1.20	3/0.6	3/0.45	3/0.21	2/0.16	3/0.30	2.92	24
28.	Construction of Boundary Wall-Phase-II	15.0	-			Unable to evaluate					
29.	Improvement of Water Supply at various places	30.0	-			Unable to evaluate					
30.	Line Capacity Works	30.0	-			Unable to evaluate					
31.	Construction of D Class Stations	10.0	-	2/0.80	3/0.60	4/0.60	4/0.28	2/0.16	3/0.3	2.74	27
32.	Passenger Amenities Phase III	100.0	-			Unable to evaluate					
33.	Rehabilitation of Jessore-Benapole Line	31.7	0.20			Unable to evaluate					
34.	Engineering and Other Structural Works	150.0	-			Unable to evaluate					

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Table 6.5.2 Evaluation of Mechanical Engineering Projects

Sl. No.	Name of Project	Est. Cost		Criteria Weighting						Total Weight	Rank
		Total	F.E.	1	2	3	4	5	6		
1.	Purchase 97 BG and 195 MG Coaches	1132.29	781.74	5/2.00	5/1.00	4/0.60	2/0.14	2/0.16	2/0.20	4.10	8
2.	Purchase 37 Main Line Locomotives	1489.23	1093.98	5/2.00	5/1.00	4/0.60	3/0.21	2/0.16	2/0.20	4.17	5
3.	Replacement 5650 Bearings with Roller Bearings	251.5	165.32	5/2.00	5/1.00	4/0.60	3/0.21	2/0.16	2/0.20	4.17	5
4.	Procurement of Plant and Machinery	73.26	43.92	5/2.00	3/0.60	4/0.60	2/0.14	2/0.16	2/0.20	3.70	11
5.	Establishment of Modern Workshop (Backshop)	1330.91	732.69	5/2.00	5/1.00	4/0.60	4/0.28	2/0.16	4/0.40	4.44	2
6.	Introduction of Container Service including Study	300.0	240.0	5/2.00	5/1.00	5/0.75	2/0.14	2/0.16	5/0.50	4.55	1
7.	Construction of 120 MG Coaches	387.0	154.8	4/1.60	5/1.00	4/0.60	4/0.28	2/0.16	4/0.40	4.04	9
8.	Purchase of 69 MG 137 BG Coaches	1150.0	792.5	4/1.60	5/1.00	4/0.60	2/0.14	2/0.16	2/0.20	3.70	11
8A	Repairs to Rolling Stock	57.0	-	3/1.20	5/1.00	3/0.45	3/0.21	2/0.16	4/0.40	3.42	13
9.	Rehabilitation of 100 MG and 50 BG Coaches	320.0	190.0	3/1.20	5/1.00	3/0.45	3/0.21	2/0.16	4/0.40	3.42	13
10.	Replacement 5000 Bearings	37.5	19.0	5/2.00	5/1.00	4/0.60	3/0.21	2/0.16	2/0.20	4.17	5
11.	Modernization & Expansion of Workshops	97.5	48.0	5/2.00	5/1.00	4/0.60	4/0.28	2/0.16	4/0.40	4.44	2
12.	Replacement of 5 MG Cranes	100.0	60.0	3/1.20	3/0.60	2/0.30	2/0.14	2/0.16	2/0.20	2.60	16
13.	Conversion to Air Brake	50.0	20.0	5/2.00	5/1.00	5/0.75	3/0.21	2/0.16	2/0.20	4.32	4
14.	Modification to Turbochargers	85.0	60.0	3/1.20	4/0.80	3/0.60	2/0.14	2/0.16	2/0.20	3.10	15
15.	Creation Local Manufacturing Plant	39.9	26.3	4/1.60	4/0.80	3/0.60	4/0.28	2/0.16	5/0.50	3.94	10

Table 6.5.3 Evaluation of Signal Engineering Project

Sl. No.	Name of Project	Est. Cost		Criteria Weighting						Total Weight	Rank
		Total	F.E.	1	2	3	4	5	6		
1.	Relay Interlocking and Improved Railway Signalling	241.55	118.73	5/2.0	5/1.0	4/0.60	2/0.14	2/0.16	2/0.20	4.10	2
2.	Provision of Relay Interlocking at 10 Stations	680.0	272.0	5/2.0	4/0.8	4/0.60	3/0.21	2/0.16	2/0.20	3.97	3
3.	Replacement of Signalling Equipment 13 Stations	195.0	78.0	5/2.0	4/0.8	4/0.60	3/0.21	2/0.16	2/0.20	3.97	3
4.	Mechanical Interlocking (Abdulpur - Amnura)	120.0	48.0	4/1.6	4/0.80	3/0.45	3/0.21	2/0.16	3/0.30	3.52	7
5.	Mechanical Interlocking at 4 Stations	45.0	18.0	4/1.6	4/0.80	3/0.45	3/0.21	2/0.16	3/0.30	3.52	7
6.	Setting-up Workshop in West Zone	40.0	15.0	5/2.0	5/1.0	5/0.75	2/0.14	4/0.32	3/0.30	4.51	1
7.	Block Instruments in lieu of Train Wire	10.0	1.40	3/1.2	3/0.60	3/0.45	2/0.14	2/0.16	2/0.20	2.75	9
8.	Double Wire Interlocking 9 Stations (Kaunia - Bonapara)	100.0	70.0	4/1.6	4/0.80	4/0.60	3/0.21	2/0.16	3/0.30	3.67	5
9.	Double Wire Interlocking at 8 Stations (Jagati - Belgachi)	95.0	60.0	4/1.6	4/0.80	4/0.60	3/0.21	2/0.16	3/0.30	3.67	5

Table 6.5.4 Evaluation of Electrical Engineering Projects

Sl. No.	Name of Projects	Est. Cost		Criteria Weighting						Total Weight	Rank
		Total	F.E.	1	2	3	4	5	6		
1.	Rehabilitation of Saidpur Power House	40.0	15.0	4/1.6	5/1.0	4/0.60	2/0.14	2/0.16	4/0.40	3.90	3
2.	Electrification of Staff Quarters Phase-II	27.0	-	3/1.2	3/0.6	3/0.45	3/0.21	2/0.16	4/0.40	3.02	4
3.	New Sub-station	7.0	2.0	4/1.6	5/1.0	4/0.60	3/0.21	2/0.16	4/0.40	3.97	2
4.	Plant and Machinery	27.65	8.66	5/2.0	5/1.0	5/0.75	4/0.28	2/0.16	4/0.40	4.59	1

Table 6.5.5 Evaluation of Multi-purpose Schemes

Sl. No.	Name of Project	Est. Cost		Criteria Weighting						Total Weight	Rank
		Total	F.E.	1	2	3	4	5	6		
1.	Fertilizer Transport Project	170.03	77.61	5/2.00	4/0.80	5/0.75	3/0.21	2/0.16	4/0.40	4.32	1
2.	System Improvement & Rehabilitation (ADB)	1864.80	973.32	5/2.00	4/0.80	5/0.75	3/0.21	2/0.16	4/0.40	4.32	1
3.	Rehabilitation of Bangladesh Railways (CIDA)	4475	2600	5/2.00	4/0.80	5/0.75	3/0.21	2/0.16	4/0.40	4.32	1
4.	Modernization of Ticket Printing Press	15	8								
5.	Establishment of Ticket Printing Press	25	10	4/1.6	4/0.80	5/0.75	2/0.14	2/0.16	2/0.20	3.65	4
6.	Modernization of Printing Press	62.5	35								

Table 6.5.6 Evaluation of Feasibility Studies

Sl. No.	Name of Project	Est. Cost		Criteria Weighting						Total Weight	Rank
		Total	F.E.	1	2	3	4	5	6		
1.	Road-kail Bridge over Rupsa	5.81	4.86	5/2.0	5/1.0	4/0.60	4/0.28	2/0.16	4/0.40	4.44	1
2.	Productivity Study C & W Shops	2.15	1.80	5/2.0	5/1.0	5/0.75	2/0.14	2/0.16	2/0.20	4.25	2
3.	Study 3 Road-Rail Bridges	6.0	4.0	4/1.6	5/1.0	3/0.45	2/0.14	2/0.16	2/0.20	3.55	5
4.	Study of Waterways & Bridge Substructures	3.0	0.5	3/1.2	5/1.0	3/0.45	3/0.21	2/0.16	4/0.40	3.42	6
5.	Computerisation of Railways	10.0	5.0	5/2.0	5/1.0	5/0.75	2/0.14	2/0.16	2/0.20	4.25	2
6.	Introduction of Electric Traction	12.5	9.0	Unable to evaluate							
7.	Setting-up of C & W Manufacturing Plant	2.15	1.6	4/1.6	5/1.0	4/0.60	3/0.21	2/0.16	4/0.40	3.97	4

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Table 6.6.2 Third Five Year Plan for Bangladesh Railways

	Project	85/86		86/87		87/88		88/89		89/90		TFYP Total		Ranking
		Total	F.E.	Total	F.E.	Total	F.E.	Total	F.E.	Total	F.E.	Total	F.E.	
1.	System Improvement (ADB)	174	111	362	194	543	290	543	290	181	83	1803	968	1/6
2.	Fertilizer Transport (IDA)	61	43	36	8	29	7	-	-	-	-	126	59	1/6
3.	Modern Workshop (SFD)	175	83	276	149	276	149	276	149	276	149	279	679	1/15
4.	Relay Interlock & Signal(Swe.FRG)	15	-	-	-	-	-	-	-	-	-	15	-	2/9
5.	Recoupment of Ballast	8	-	9	-	9	-	9	-	8	-	43	-	6/27
6.	Rehabilitation of MJ(Can. SFD)	223	152	120	82	120	82	120	82	210	143	793	541	3/27
7.	Carriages by own workshop	20	-	-	-	-	-	-	-	-	-	20		9/16
8.	Repairs to Rolling Stock	9	-	12	-	12	-	12	-	12	-	57	-	13/16
9.	Replacement bearings (UK)	6	4	10	6	12	8	12	8	-	-	40	26	5/16
10.	Training Academy phase-I	20	-	10	1	-	-	-	-	-	-	30	1	11/27
11.	Training Academy Phase-II	-	-	60	30	60	25	-	-	-	-	120	55	11/27
12.	Plant and Machinary (Bul.Swe.)	26	15	12	10	-	-	-	-	-	-	38	25	11/16
13.	Locomotive purchase (30)(Can)	185	137	185	137	185	137	185	137	186	139	926	687	5/16
14.	Pass. Carriage purchase(Japn.Korea etc.)	227	158	-	-	-	-	-	-	200	139	427	297	8/16
15.	Track Renewal	3	-	-	-	-	-	15	8	-	-	18	8	3/27
16.	Carriage Purchase (Romania)	9	-	-	-	-	-	-	-	29	20	38	20	11/16
17.	Railway Hospital (FRG)	37	-	9	-	-	-	-	-	-	-	46	-	25/27
18.	Concrete sleeper plant (FRG.Ind)	30	30	-	-	-	-	-	-	-	-	30	30	16/27
19.	Passenger Amenities Phase-II	1	-	-	-	-	-	-	-	-	-	1	-	23/27
20.	Relay Interlock & Signal(FRG.Swe.Uk)	-	-	-	-	-	-	-	-	50	20	50	20	2/9
21.	Reconditon of sleepers(Uk)	-	-	-	-	-	-	50	29	50	29	100	58	1/27
	Total	1229	733	1101	617	1246	698	1222	713	1202	712	6000	3473	

Note: 1. Studies are not included in the above.

a. Container study
b. Rail-cum-Road Bridge over River Rupsa
c. Productivity study Pahartali C&W Shops

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6.5.3 Road and Road Transport

- Road and Highways Department
- Bangladesh Road Transport Corporation

Remarks for the Table of Project Evaluation (Road Sector)

1. Locations of the RHD's Projects are shown in the project list by the following sings.

   A : National Highway between Aricha and Dhaka

   C : National Highway between Chittagong and Dhaka

   D : National Highway between Dinajpur and Dhaka

   J : National Highway between Jamalpur and Dhaka

   K : National Highway between Khulna and Rhaka

   M : National Highway between Mymensingh and Dhaka

   R : National Highway between Rajshahi and Nagarbari

   S : National Highway between Sylhet and Dhaka

   E : Other Highways.

2. Figures in evaluation column show scoring points/weighted points based on the criteria shown in Table 6.4.2

A. ON GOING

FOREIGN AID SCHEMES

Table 6.5.7 LIST OF PROJECTS AND EVALUATION
-ROAD SECTOR-

NO	NAME OF SCHEME	SUMMARY OF SCHEME			ESTIMATED COST	FINANCIAL PROGRESS	REQUIREMENT FUND FOR COMPLETION	** EVALUATION						
		LENGTH (KM)	Source of Aid	AADT 1985	(84/85 PRICE)	(%)	(84/85 PRICE)	(1),(2)	(3)	(4)	(5)	(6)	WEIGHT	RANKING
1.*	FENI BYPASS (Upgrading National Highway)	29	IDA	2520	213.1	52	102.6	5/3.0	3/0.45	3/0.3	3/0.3	3/0.15	4.2	2
2.*	COMILLA & CHANDINA BY PASS (New Construction, National Highway)	24	IDA	1390	457.7	52	218.2	3/1.8	3/0.45	4/0.4	3/0.3	3/0.15	3.1	5
3.*	KHULNA-MONGLA ROAD (New Construction, National Highway)	36	ADB	1600	620.0	98	12.0	4/2.4	3/0.45	3/0.3	5/0.5	5/0.25	3.9	3
4.*	Construction of 4 RADIAL ROAD in CHT (New Construction, District Roads)	68	-	2000	388.1	28	280.7	5/3.0	3/0.45	4/0.4	5/0.5	5/0.25	4.6	1
5.*	POSTOGOLA BRIDGE	2340 rft	Chinese AID	(600)	500.0	4	478.1	2/1.2	4/0.6	5/0.5	3/0.3	3/0.15	2.75	7
6.*	BANGLADESH ROAD RESEARCH LABORATORY	-	IDA	-	315.8	20	251.8	*** (1) 3/1.05 (2) 4/1.00	2/0.3	3/0.3	2/0.2	2/0.1	2.95	6
7.*	Improvement and modernisation of FERRY & FERRY GHAT & introduction of new FERRIES.	-	Dutch & U.K.	-	677.6	43	385.4	*** (1) 3/1.05 (2) 4/1.00	2/0.3	3/0.3	4/0.4	4/0.2	3.25	4

* Selected Investment Project for TFYP

** EVALUATION ITEMS: (1),(2) EIRR (3) Private Sector Encouragement (4) Gainful Employment (5) Rural Employment (6) Administrative Decentralization

***(1) Adequate Road Transport ***(2) Transport Cost Reduction

B. ON GOING SCHEMES

Table 6.5.8

(1) ROAD SCHEMES (1/5) UPGRADING PROGRAMME NATIONAL HIGHWAY-1

NO	NAME OF SCHEME	SUMMARY OF SCHEME			ESTIMATED COST	FINANCIAL PROGRESS	REQUIREMENT FUND FOR COMPLETION	** EVALUATION						
		LENGTH (KM)	LOCATION	AADT 1985	(84/85 PRICE)	(%)	(84/85 PRICE)	(1),(2)	(3)	(4)	(5)	(6)	WEIGHT	RANKING
8 *	Boudkandi-Chittagong	216	C	2,600	845.3	22	654.5	5/3.0	4/0.60	5/0.5	3/0.3	3/0.15	4.55	1
9 *	Chittagong-Cox-bazar	151	E	1,000	786.7	19	634.5	5/3.0	4/0.60	5/0.5	3/0.3	3/0.15	4.55	1
10	Cox-bazar-Teknaf	80	E	380	43.7	05	41.4	5/3.0	3/0.45	3/0.3	3/0.3	3/0.15	4.20	5
11	Mainamati-Companiganj-Sarail	80	E	600	141.5	28	101.2	5/3.0	3/0.45	2/0.3	3/0.3	3/0.15	4.20	5
12	Feni-Mairjdicourt	45	E	1,130	112.0	0	112.0	5/3.0	3/0.45	3/0.3	3/0.3	3/0.15	4.20	5
13	Chittagong-Rangamati	74	E	480	253.1	18	207.2	5/3.0	3/0.45	4/0.4	3/0.3	3/0.15	4.30	4
14*	Demra-Narshindi	39	S	1,080	123.3	39	74.0	5/3.0	3/0.45	3/0.3	3/0.3	3/0.15	4.20	5
15*	Sarail-Madhabpur-Moulvi Bazar-Sylhet Tamabil	216	S	1,200	410.5	25	305.4	5/3.0	4/0.60	4/0.4	3/0.3	3/0.15	4.45	2
16	Mymensingh-Trishal	21	M	780	106.6	14	90.8	5/3.0	3/0.45	3/0.3	3/0.3	3/0.15	4.20	5
17	Banani Railway Crossing-Tongi	13	M	3,360	58.3	32	39.4	5/3.0	3/0.45	3/0.3	3/0.3	3/0.15	4.20	5
18	Tong-Joydebpur	13	M	3,360	50.0	-	50.0	5/3.0	3/0.45	3/0.3	3/0.3	3/0.15	4.20	5
19.	Modhupur-Jamalpur	42	J	230	114.7	8	104.7	4/2.4	3/0.45	3/0.3	3/0.3	3/0.15	3.60	8
20*	Joydebpur-Tangail-Modhupur	113	J	610	280.0	-	280.0	5/3.0	3/0.45	4/0.4	3/0.3	3/0.15	4.30	4
21*	Dhaka-Aricha (Dhaka-Nayarhat portion)	26	A	1,850	201.4	21	158.9	5/3.0	3/0.45	4/0.4	3/0.3	3/0.15	4.30	4
22*	Dhaka-Aricha (Nayarhat-Aricha portion)	50	A	1,230	121.2	88	13.8	5/3.0	3/0.45	3/0.3	3/0.3	3/0.15	4.20	5
23*	Nagarbari-Sherpur-Gobinganj	148	D	800	474.3	28	337.7	5/3.0	4/0.60	4/0.4	3/0.3	3/0.15	4.45	2
24*	Gobinganj-Rangpur-Syedpur-Beladanga	138	D	940	448.8	27	323.2	5/3.0	4/0.60	4/0.4	3/0.3	3/0.15	4.45	2

* Selected Investment Project for TFYP

** EVALUATION ITEMS: (1),(2) EIRR (3) Private Sector Encouragement (4) Gainful Employment (5) Rural Employment (6) Administrative Decentralization

Table 6.5.8 (Continued)

(1) ROAD SCHEMES (2/5) UPGRADING PROGRAMME NATIONAL HIGHWAY-2

NO	NAME OF SCHEME	SUMMARY OF SCHEME			ESTIMATED COST	FINANCIAL PROGRESS	REQUIREMENT FUND FOR COMPLETION	** EVALUATION						
		LENGTH (KM)	LOCATION	AADT 1985	(84/85 PRICE)	(%)	(84/85 PRICE)	(1),(2)	(3)	(4)	(5)	(6)	WEIGHT	RANKING
25	Beladanga-Panchgarh	77	E	220	192.0	0	192.0	4/2.4	3/0.45	3/0.3	3/0.3	3/0.15	3.6	8
26	Panchgarh-Tetulia	41	E	220	120.4	05	113.3	3/1.8	3/0.45	3/0.3	3/0.3	3/0.15	3.0	11
27	Nagarbari (Kashinathpur) -Pabna	45	R	560	210.7	24	158.4	4/2.4	3/0.45	3/0.3	3/0.3	3/0.15	3.6	8
28	Pabna-Ishwardi	29	R	500	78.2	20	62.3	5/3.0	3/0.45	3/0.3	3/0.3	3/0.15	4.2	5
29*	Rajshahi-Nator	90	R	920	385.9	25	288.5	5/3.0	3/0.45	4/0.4	3/0.3	3/0.15	4.3	4
30*	Goalanda-Faridpur-Jhenaidah	105	K	800	367.6	20	291.4	5/3.0	3/0.45	4/0.4	3/0.3	3/0.15	4.3	4
31*	Jhenaidah-Jessore	45	K	1,300	150.1	36	95.1	5/3.0	3/0.45	3/0.3	3/0.3	3/0.15	4.2	5
32	Jessore-Benapole	39	E	570	96.0	0	96.0	5/3.0	3/0.45	3/0.3	3/0.3	3/0.15	4.2	5
33*	Jessore-Khulna	61	K	1,600	202.9	23	154.7	5/3.0	3/0.45	3/0.3	3/0.3	3/0.15	4.2	5
34*	Jenaidah-Kushtia-Bheramaraghat	72	K	710	383.0	0	383.0	5/3.0	4/0.60	4/0.4	3/0.3	3/0.15	4.45	2
35	Faridpur-Bhanga-Madaripur	55	E	550	192.5	08	176.1	5/3.0	3/0.45	3/0.3	3/0.3	3/0.15	4.2	5
36	Madaripur-Barisal	68	E	430	219.6	04	208.9	5/3.0	3/0.45	4/0.4	3/0.3	3/0.15	4.3	4

* Selected Investment Project for TFYP

** EVALUATION ITEMS: (1),(2) EIRR (3) Private Sector Encouragement (4) Gainful Employment (5) Rural Employment (6) Administrative Decentralization

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Table 6.5.8 (Continued)

(1) ROAD SCHEMES (3/5) UPGRADING PROGRAMME REGIONAL HIGHWAY

NO	NAME OF SCHEME	SUMMARY OF SCHEME			ESTIMATED COST	FINANCIAL PROGRESS	REQUIREMENT FUND FOR COMPLETION	** EVALUATION						
		LENGTH (KM)	LOCATION	AADT 1985	(84/85 PRICE)	(%)	(84/85 PRICE)	(1),(2)	(3)	(4)	(5)	(6)	WEIGHT	RANKING
37.	Comilla-Chandpur	69	E	370	216.0	10	193.3	4/2.4	3/0.45	3/0.3	4/0.4	4/0.2	3.75	6
38.	Hymensingh-Netrokona	32	E	70	79.6	17	65.8	2/1.2	3/0.45	3/0.3	4/0.4	4/0.2	2.55	12

** EVALUATION ITEMS: (1),(2) EIRR (3) Private Sector Encouragement (4) Gainful Employment (5) Rural Employment (6) Administrative Decentralization

Table 6.5.8 (Continued)

(1) ROAD SCHEMES (4/5) NEW CONSTRUCTION PROGRAMME NATIONAL HIGHWAY

NO	NAME OF SCHEME	SUMMARY OF SCHEME			ESTIMATED COST	FINANCIAL PROGRESS	REQUIREMENT FUND FOR COMPLETION	** EVALUATION						
		LENGTH (KM)	LOCATION	AADT 1985	(84/85 PRICE)	%	(84/85 PRICE)	(1),(2)	(3)	(4)	(5)	(6)	WEIGHT	RANKING
39.	Narsindi-Ashuganj-Sarail-Moulvi Bazar-Fenchuganj-Sylhet Road	127	S	700	800.2	33	533.8	4/2.4	4/0.60	5/0.5	4/0.4	4/0.2	4.10	6
40.*	Joydebpur-Bhuluka-Trishal	72	M	600	251.7	68	79.1	5/3.0	3/0.45	3/0.3	4/0.4	4/0.2	4.35	3
41.	Tetulia-Bangla-banth	18	E	200	65.3	3	62.8	3/1.8	3/0.45	3/0.3	4/0.4	4/0.2	3.15	10
42.*	Dauladia-Goalanda	6	E	1350	32.7	97	0.9	5/3.0	3/0.45	3/0.3	4/0.4	4/0.2	4.35	3
43.	Jessore-Magura	45	E	500	184.9	21	145.2	4/2.4	3/0.45	3/0.3	4/0.4	4/0.2	3.75	6
44.	Dhaka-Khulna -Alternate Road													
	a) Dhaka-Mawa	35	E	600	548.6	41	321.8	3/1.8	4/0.60	4/0.4	4/0.4	4/0.2	3.4	9
	b) Mawa-Bhanga	29												
45.	Barishal-Patuakhali	39	E	260	206.8	49	104.5	3/1.8	3/0.45	3/0.3	4/0.4	4/0.2	3.15	10
46.	Polder Road	8	E	2000	149.8	24	112.6	4/2.4	3/0.45	3/0.3	4/0.4	4/0.2	3.75	6

* Selected Investment Project for TFYP

** EVALUATION ITEMS: (1),(2) EIRR (3) Private Sector Encouragement (4) Gainful Employment (5) Rural Employment (6) Administrative Decentralization

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Table 6.5.8 (Continued)

(1) ROAD SCHEMES (5/5) NEW CONST. PROGRAMME REGIONAL HIGHWAY

NO	NAME OF SCHEME	SUMMARY OF SCHEME			ESTIMATED COST	FINANCIAL PROGRESS	REQUIREMENT FUND FOR COMPLETION	** EVALUATION						
		LENGTH (KM)	LOCATION	AADT 1985	(84/85 PRICE)	(%)	(84/85 PRICE)	(1),(2)	(3)	(4)	(5)	(6)	WEIGHT	RANKING
47.	Chandpur-Raipur	29	E	190	147.2	12	129.1	3/1.8	3/0.45	3/0.3	4/0.4	4/0.2	3.15	10
48.	Sylhet-Sunamganj	68	E	460	212.8	26	156.6	5/3.0	3/0.45	3/0.3	4/0.4	4/0.2	4.35	3
49.	Kishoregonj-Katiadi-Bhairab Bazar(with link to Bazitpur and Kuliarchar Upazila)	56	E	300	169.4	20	134.2	4/2.4	3/0.45	3/0.3	4/0.4	4/0.2	3.75	6
50.	Tekerhat-Gopalgonj	35	E	200	134.1	17	111.2	3/1.8	3/0.45	3/0.3	4/0.4	4/0.2	3.15	10
51.	Tangail-Alenga-Bhuapur-Chargabchhara	24	E	260	67.3	50	33.4	4/2.4	3/0.45	3/0.3	4/0.4	4/0.2	3.75	6
52.	Sirajganj-Hatikamrul	19	E	300	84.0	37	52.8	3/1.8	3/0.45	3/0.3	4/0.4	4/0.2	3.15	10
53.	Bogra-Nator	72	E	650	194.0	57	82.6	5/3.0	3/0.45	3/0.3	4/0.4	4/0.2	4.35	3
54.	Bogra-Shantahar	43	E	600	117.6	59	47.3	5/3.0	3/0.45	3/0.3	4/0.4	4/0.2	4.35	3
55.	Rangpur-Kurigram	58	E	150	149.9	44	83.2	3/1.8	3/0.45	3/0.3	4/0.4	4/0.2	3.15	10
56.	Road from Rangpur-Kurigram Road to Lalmonirhat	13	E	60	25.9	19	21.0	2/1.2	3/0.45	3/0.3	4/0.4	4/0.2	2.55	12
57.	Madaripur-Vedergonj	26	E	150	151.0	8	137.9	2/1.2	3/0.45	3/0.3	4/0.4	4/0.2	2.55	12
58.	Khulna-Shatkhira	31	E	150	121.2	36	77.0	3/1.8	3/0.45	3/0.3	4/0.4	4/0.2	3.15	10
59.	Khulna-Bagerhat	21	E	150	104.8	27	76.2	2/1.2	3/0.45	3/0.3	4/0.4	4/0.2	2.55	12
60.	Barishal-Jhalkathi	18	E	150	104.8	31	72.0	2/1.2	3/0.45	3/0.3	4/0.4	4/0.2	2.55	12
61.	Pirojpur-Bagerhat	21	E	150	62.9	10	56.6	3/1.8	3/0.45	3/0.3	4/0.4	4/0.2	3.15	10

** EVALUATION ITEMS: (1),(2) EIRR (3) Private Sector Encouragement (4) Gainful Employment (5) Rural Employment (6) Administrative Decentralization

Table 6.5.9

(2) BRIDGE SCHEMES (1/2) NEW CONSTRUCTION PROGRAMME

NO	NAME OF SCHEME	SUMMARY OF SCHEME			ESTIMATED COST	FINANCIAL PROGRESS	REQUIREMENT FUND FOR COMPLETION	** EVALUATION						
		LENGTH (Rft)	LOCATION	AADT 1985	(84/85 PRICE)	(%)	(84/85 PRICE)	(1),(2)	(3)	(4)	(5)	(6)	WEIGHT	RANK-ING
62	Construction of Panchagar bridge on Dinajpur-Tetulia Rd.	840 Rft	E	(220)	36.5	75	8.9	2/1.2	3/0.45	3/0.3	4/0.4	4/0.2	2.55	5
63	Construction of Shahjalal Bridge on Sylhet surma River	1040	S	(400)	117.9	71	34.1	3/1.8	3/0.45	3/0.3	4/0.4	4/0.2	3.15	4
64	Reconstruction of Liton and Tulashigonga Bridges on Naogaon-Shantahar Road	400	E	(410)	21.8	72	6.1	5/3.0	3/0.45	3/0.3	4/0.4	4/0.2	4.35	2
65	Construction of Thakurgaon station road Bridge	510	E	(220)	26.6	36	17.0	3/1.8	3/0.45	3/0.3	4/0.4	4/0.2	3.15	4
66	Construction of Nalka Bridge on Shirajganj-Hatikamrul Road	752	E	(300)	34.6	67	11.4	3/1.8	3/0.45	3/0.3	4/0.4	4/0.2	3.15	4
67	Construction of Shangu Bridge	551	E	(480)	43.0	10	36.5	5/3.0	3/0.45	3/0.3	4/0.4	4/0.2	4.35	2
68	Construction of Bridge at 50 mile of Mymensigh-Tangail Road	150	J	(500)	7.6	09	6.9	5/3.0	3/0.45	3/0.3	4/0.4	4/0.2	4.35	2
69	Trimohoni Bridge	546	E	(180)	40.9	10	36.4	2/1.2	3/0.45	3/0.3	4/0.4	4/0.2	2.55	5
70	Sherpur Bridge	857	E	(270)	80.1	13	69.6	2/1.2	3/0.45	3/0.3	4/0.4	4/0.2	2.55	5
	RECONSTRUCTION SCHEME													
71*	Reconstruction war-damaged Bridges	1116	Na	(850)	726.7	55	321.0	5/3.0	4/0.60	4/0.4	4/0.4	4/0.2	4.6	1
72*	Reconstruction of narrow Bridges on Dhaka-Chittagong Highway	3785	C	(2600)	100.6	38	61.7	5/3.0	3/0.45	3/0.3	4/0.4	4/0.2	4.35	2

* Selected Investment Project for TFYP

** EVALUATION ITEMS: (1),(2) EIRR (3) Private Sector Encouragement (4) Gainful Employment (5) Rural Employment (6) Administrative Decentralization

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Table 6.5.9 (Continued)

(2) BRIDGE SCHEMES (2/2) NEW CONSTRUCTION PROGRAMME BRIDGE (2/2)

NO	NAME OF SCHEME	SUMMARY OF SCHEME			ESTIMATED COST	FINANCIAL PROGRESS	REQUIREMENT FUND FOR COMPLETION	** EVALUATION						
		LENGTH (Km)	LOCATION	AADT 1985	(84/85 PRICE)	(%)	(84/85 PRICE)	(1),(2)	(3)	(4)	(5)	(6)	WEIGHT	RANKING
	FEASIBILITY STUDY/ CONSTRUCTION													
73	Mohsin Bridge	895		(460)	55.0	5	52.5	4/2.4	3/0.45	3/0.3	4/0.4	4/0.2	3.75	3
74	Baily Bridge on Brahmanbaria by-pass	100		(350)	2.8	91	0.3	5/3.0	3/0.45	3/0.3	4/0.4	4/0.2	4.35	2
75	Bridge over Bhogai River	240		(780)	11.0	9	10.0	5/3.0	3/0.45	3/0.3	4/0.4	4/0.2	4.35	2

** EVALUATION ITEMS: (1),(2) EIRR (3) Private Sector Encouragement (4) Gainful Employment (5) Rural Employment (6) Administrative Decentralization

Table 6.5.10 (Continued)

(3) INFRASTRUCTURE SCHEMES

NO.	NAME OF SCHEME	SUMMARY OF SCHEME			ESTIMATED COST	FINANCIAL PROGRESS	REQUIREMENT FUND FOR COMPLETION	** EVALUATION							
		LENGTH (KM)	LOCATION	AADT 1985	(84/85 PRICE)	(%)	(84/85 PRICE)	(1)	(2)	(3)	(4)	(5)	(6)	WEIGHT	RANKING
76*	Investigation, Surveying, Planning and Design of Roads & bridges	-	-	-	284.1	11	252.3	4/1.4	3/0.75	3/0.45	4/0.4	3/0.3	3/0.15	3.45	2
77*	Procurement of transport equipment, machineries, and spare parts and baily bridges	-	-	-	1485.1	29	1041.6	5/1.75	3/0.75	5/0.75	5/0.5	3/0.3	3/0.15	4.20	1

* Selected Investment Project for TFYP

** EVALUATION ITEMS: (1) Adequate Road Transport (2) Transport Cost Reduction (3) Private Sector Encouragement (4) Gainful Employment (5) Rural Employment (6) Administrative Decentralization

Table 6.5.11 (Continued)

C. NEW SCHEMES

BRIDGE SCHEMES

NO	NAME OF SCHEME	SUMMARY OF SCHEME			ESTIMATED COST	FINANCIAL PROGRESS	REQUIREMENT FUND FOR COMPLETION	** EVALUATION						
		LENGTH (Rft)	LOCATION	AADT 1985	(84/85 PRICE)	(%)	(84/85 PRICE)	(1),(2)	(3)	(4)	(5)	(6)	WEIGHT	RANKING
78*	Meghna Bridge	2900	C	(1400)	1,100.0	0	1,100.0	3/1.8	4/0.60	5/0.5	4/0.4	4/0.2	3.5	1
79	Goral Bridge at Fakirkhali	1740	K	(450)	234.9	0	234.9	2/1.2	3/0.45	4/0.4	4/0.4	4/0.2	2.65	3
80	Second Buriganga Bridge at babubazar in Dhaka City	2300	E	(3000)	4500	0	450.0	3/1.8	4/0.60	5/0.5	4/0.4	4/0.2	3.5	1
81	Kushiara Bridge at Fenchuganj on Dhaka Sylhet Road	1000	S	(270)	100.0	0	100.0	2/1.2	3/0.45	3/0.3	4/0.4	4/0.2	2.55	4
82	Shikarpur Bridge on Faridpur-Barisal Road	1250	E	(430)	134.4	0	134.4	2/1.2	3/0.45	3/0.3	4/0.4	4/0.2	2.55	4
83	Dwarika Bridge on Faridpur-Barisal Road	1200	E	(430)	129.0	0	129.0	2/1.2	3/0.45	3/0.3	4/0.4	4/0.2	2.55	4
84	Dhaleswari Bridge I on Dhaka-Mawa Road	1250	K	(600)	134.4	0	134.4	3/1.8	3/0.45	4/0.4	4/0.4	4/0.2	3.25	2
85	Dhaleswari Bridge II on Dhaka Mawa Road	1450	K	(600)	179.4	0	179.4	3/1.8	3/0.45	4/0.4	4/0.4	4/0.2	3.25	2

* Selected Investment Project for TFYP

** EVALUATION ITEMS: (1),(2) EIRR (3) Private Sector Encouragement (4) Gainful Employment (5) Rural Employment (6) Administrative Decentralization

Table 6.5.12

(2) FEASIBILITY STUDY SCHEMES

NO	NAME OF SCHEME	SUMMARY OF SCHEME			ESTIMATED COST (84/85 PRICE)	FINANCIAL PROGRESS (%)	REQUIREMENT FUND FOR COMPLETION (84/85 PRICE)	** EVALUATION							
		LENGTH ( )	LOCATION	AADT 1985				(1)	(2)	(3)	(4)	(5)	(6)	WEIGHT	RANKING
86.*	F/S, construction of the road Section from Bhanga to Khulna/Mongla.	-	-	-	100.00	0	100.00	5/1.75	5/1.25	3/0.45	3/0.3	4/0.4	4/0.2	4.35	1
87.	F/S, construction of Arial Khan Bridge Dhaka-Khulna Road	-	-	-	50.0	0	50.0	5/1.75	3/0.75	3/0.45	3/0.3	4/0.4	4/0.2	3.85	3
88.	F/S, construction of Rupsa Bridge on Khulna-Mongla Road	-	-	-	50.00	0	50.0	5/1.75	3/0.75	3/0.45	3/0.3	4/0.4	4/0.2	3.85	3
89.	F/S, construction Karnafully Bridge on Chittagong-Cox's Bazar Road	-	-	-	500.0	0	500.0	5/1.75	3/0.75	4/0.6	5/0.5	4/0.4	4/0.2	4.20	2

* Selected Investment Project for TFYP

** EVALUATION ITEMS: (1) Adequate Road Transport (2) Transport Cost Reduction (3) Private Sector Encouragement (4) Gainful Employment (5) Rural Employment (6) Administrative Decentralization

Table 6.5.13

BRTC SCHEMES

NO	NAME OF SCHEME	SUMMARY OF SCHEME			ESTIMATED COST		REQUIREMENT FUND FOR COMPLETION		** EVALUATION							
		LENGTH (KM)	LOCATION	AADT 1985	(84/85 PRICE)	(F.A.)	(84/85 PRICE)	(F.A.)	(1)	(2)	(3)	(4)	(5)	(6)	WEIGHT	RANKING
1	Acquisition of 400 buses are replacement (Incl. double)	-	-	-	650.0	(F.A) (273.0)	650.0	(F.A.) (273.0)	2/0.7	4/1.0	2/0.3	2/0.2	2/0.2	2/0.1	2.5	2
2	Acquisition of 500 buses for expansion of BRTC services	-	-	-	450.0	(190.0)	450.0	(190.0)	3/1.05	2/0.5	1/0.15	3/0.3	2/0.2	2/0.1	2.3	4
3	Scheme for replacement of 173 Trucks	-	-	-	122.0	(54.5)	122.0	(54.5)	2/0.7	4/1.0	2/0.3	2/0.2	2/0.2	2/0.1	2.5	2
4	Acquisition of 250 Trucks for expansion of Trucks services	-	-	-	175.0	(78.7)	175.0	(78.7)	3/1.05	2/0.5	1/0.15	3/0.3	2/0.2	2/0.1	2.3	4
5	Acquisition of 100 Mini-buses for replacement and expansion	-	-	-	50.0	-	50.0	-	2/0.7	3/0.75	2/0.3	3/0.3	2/0.2	2/0.1	2.35	3
6	Improvement of existing Depots/Sub-Depots/Workshop	-	-	-	25.0	-	25.0	-	3/1.05	4/1.0	1/0.15	5/0.5	2/0.2	2/0.1	3.0	1
7	Establishment of Regional Training Institute	-	-	-	20.0	(10.0)	20.0	(10.0)	2/0.7	2/0.5	2/0.3	4/0.4	2/0.2	2/0.1	2.2	5
8	Establishment of 25 Bed Hospital	-	-	-	1.0	-	1.0	-	1/0.35	2/0.5	2/0.3	3/0.3	2/0.2	2/0.1	1.75	6
9	Acquisition of 4 inspection and 4 Recovery Veh.	-	-	-	5.0	(2.0)	5.0	(2.0)	2/0.7	3/0.75	2/0.3	3/0.3	2/0.2	2/0.1	2.35	3
10	Technical Assistance in the form of expatriate services.	-	-	-	12.0	(12.0)	12.0	(12.0)	2/0.7	3/0.75	2/0.3	3/0.3	2/0.2	2/0.1	2.35	3
11	Introduction of Electric Trolly bus services in Dhaka/Chittagong	-	-	-	10.0	(6.0)	10.0	(6.0)	1/0.35	2/0.5	1/0.15	3/0.3	3/0.3	3/0.15	1.75	7
12.	Acquisition of Two Automatic Vehicle washing Plant by BRTC	-	-	-	2.5	(1.5)	2.5	(1.5)	1/0.35	2/0.5	1/0.15	3/0.3	2/0.2	2/0.1	1.60	8

** EVALUATION ITEMS: (1) Adequate Road Transport (2) Transport Cost Reduction (3) Private Sector Encouragement (4) Gainful Employment (5) Rural Employment (6) Administrative Decentralization

6.5.4 Inland Waterway Transport and Ports

- Bangladesh Inland Waterway Transport Authority
- Bangladesh Inland Waterway Transport Corporation
- Chittagong Port Authority
- Port of Chalna Authority

Table 6.5.14 BIWTA Proposed Projects for TFYP

On-going Projects

(Taka in lacs)

Sl. No.	Name of the Projects	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
1.	Resuscitation of 6 nos. dead and dying waterways of Bangladesh.	4200.00	-	5/2.00	3/0.45	3/0.30	2/0.20	3/0.3	3/0.3	2/0.10	3.65
2.	Development of Inland river ports at Bhairab Bazar, Narshingdi and Azmiriganj.	249.00	-	4/1.60	3/0.45	3/0.30	3/0.30	4/0.4	2/0.2	3/0.15	3.40
3.	Major overhauling of IWT vessels.	600.00	100.00	3/1.20	2/0.30	4/0.40	3/0.30	2/0.20	2/0.20	2/0.10	2.70
4.	Procurement of 4 nos. hydrographic survey vessels.	805.00	640.00	2/0.80	2/0.30	3/0.30	2/0.20	2/0.20	2/0.20	2/0.10	2.10
5.	Conversion of wooden jetty into RCC jetty as at CSD ghat, Barisal.	198.00	30.00	4/1.60	4/0.60	4/0.40	3/0.30	3/0.3	2/0.20	2/0.10	3.50
6.	Technical, Economic and hydrological studies for preparation of master plan for development of waterways in Bangladesh.	176.00	111.00	Unable to evaluate							
7.	Development of ferry terminal facilities at Mawa and Kewrakardi on the Padma river.	246.00	-	4/1.60	4/0.60	4/0.40	3/0.30	3/0.30	3/0.30	2/0.10	3.60

Table 6.5.14 BIWTA Proposed Projects for TFYP On-going Project (Continued)

(Taka in lacs)

Sl. No.	Name of the Projects	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
8.	Development of 50 nos. launch landing station in rural areas of Bangladesh.	903.00	-	4/1.60	3/0.45	3/0.30	3/0.30	3/0.30	4/0.40	2/0.10	3.45
9.	Construction of passenger shed, truck/car parks, water supply, electrifications access road etc. at Bhuapur Balashi and Chilmari ferry ghats.	62.00	-	4/1.6	5/0.75	3/0.30	4/0.40	3/0.30	3/0.30	2/0.10	3.65
10.	Construction of 5 nos. wooden jetties to meet the emergency need of traffic at Roosevelt jetty.	57.00	-	5/2.0	3/0.45	2/0.20	3/0.30	3/0.30	2/0.20	2/0.10	3.55
11.	Technical and economic study for handling containers at inland river ports.	100.00	100.00	5/2.0	5/0.75	4/0.40	5/0.50	4/0.40	2/0.20	2/0.10	4.35
12.	Procurement of 4 nos. launches from Crash Programme.	68.00	-	4/1.60	3/0.45	3/0.30	2/0.20	3/0.30	3/0.30	2/0.10	3.25
	Sub-Total:	7664.00	981.00								
	Expected expenditure upto June'85	4057.00	128.00								
	Requirement during TFYP:	3607.00	853.00								

Table 6.5.15 BIWTA Proposed Projects for TFYP New Projects

Sl. No.	Name of the Project	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
	NEW PROJECTS										
	A. IMPROVEMENT/RE-EXCAVATION OF INLAND WATERWAYS										
1.	Resuscitation of 10 nos. waterways of Bangladesh.	7800.00	-	5/2.00	4/0.60	4/0.40	2/0.20	3/0.30	3/0.30	2/0.10	3.90
2.	Re-excavation/improvement of existing feeder waterways connecting the Upazilla head quarters and growth centres.	4100.00	-	5/2.00	5/0.75	3/0.30	4/0.40	3/0.30	4/0.40	2/0.10	4.25
3.	Improvement of 25 nos. navigable river routes.	2500.00	-	4/1.60	3/0.45	3/0.30	3/0.30	3/0.30	3/0.30	2/0.10	3.35
4.	Construction of 5 nos. groins-in Kirton Khola to prevent erosion in the Barisal Port area.	1050.00	-	3/1.20	5/0.75	5/0.50	4/0.40	3/0.30	3/0.30	2/0.10	3.55
5.	Re-excavation/improvement of Lakhya River from Katchpur upto Polash.	400.00	-	4/1.60	4/0.60	3/0.30	3/0.30	3/0.30	3/0.30	2/0.10	3.50
6.	Construction of Groins at Gopechar in the Lakhya river.	1400.00	-	3/1.20	5/0.75	5/0.50	4/0.40	3/0.30	3/0.30	2/0.10	3.55
	Total:	17250.00									

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Table 6.5.15 BIWTA Proposed Projects for TFYP (Continued)

(Taka in lacs)

Sl. No.	Name of the Project	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
	B. DEVELOPMENT OF INLAND RIVER PORTS AND LAUNCH LANDING STATIONS										
1.	Development of Khulna Port (Phase - II)	1500.00	1000.00	4/1.60	4/0.60	4/0.40	4/0.40	4/0.40	3/0.30	2/0.10	3.80
2.	Development of 150 nos. launch landing stations in the rural areas including Upa-zila headquarters.	2883.00	200.00	4/1.60	5/0.75	3/0.30	3/0.30	3/0.30	4/0.40	5/0.25	3.90
3.	Improvement of existing ferry terminal facilities at Aricha Nagarbari, Kazirhat Sirajgonj, etc.	300.00	-	5/2.00	5/0.75	5/0.50	5/0.50	4/0.40	4/0.40	2/0.10	4.65
4.	Construction of passenger terminal and development of landing facilities at Firingi Bazar ghat, Chittagong.	250.00	-	4/1.60	4/0.60	4/0.40	3/0.30	4/0.40	3/0.30	2/0.10	3.70
5.	Provision of facilities for handling of containerized traffic at inland river ports.	30000.00	20000.00	5/2.0	3/0.45	4/0.40	5/0.50	5/0.50	3/0.30	2/0.10	4.25
6.	Development of 10 nos. Class-II Ports at different places of Bangladesh.	468.00	-	4/1.60	4/0.60	4/0.40	3/0.30	3/0.30	4/0.40	2/0.10	3.70
7.	Provision of landing facilities at Hatiya and sandwip.	122.00	78.00	5/2.00	4/0.60	5/0.50	4/0.40	3/0.30	4/0.40	2/0.10	4.30
	Sub-Total:	35523.00	21278.00								

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Table 6.5.15 BIWTA Proposed Projects for TFYP (Continued)

(Taka in lacs)

Sl. No.	Name of the Project	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
	C. PROCUREMENT OF VESSELS AND DREDGERS										
1.	Procurement of operational and survey vessels for BIWTA.	5475.00	3975.00	3/1.20	3/0.45	2/0.20	4/0.40	2/0.20	2/0.20	2/0.10	2.75
2.	Replacement of 3 nos. existing cutter suction dredgers along with ancillary craft and pipe lines.	3500.00	3000.00	4/1.60	2/0.30	2/0.20	2/0.20	2/0.20	2/0.20	2/0.10	2.80
3.	Improvement in sails and oars system and boat design for increasing operational efficiency of existing boats.	100.00	100.00	4/1.60	3/0.45	2/0.20	4/0.40	2/0.20	2/0.20	2/0.10	3.15
4.	Pilot project for construction of 3 nos. ferrocement pontoons.	60.00	20.00	3/1.20	3/0.45	4/0.40	4/0.40	2/0.20	2/0.20	2/0.10	2.95
5.	Procurement of pre-fabricated materials for providing emergency landing facilities.	200.00	150.00	4/1.60	3/0.45	4/0.40	3/0.40	2/0.20	2/0.20	2/0.10	3.35
	Sub-Total:	9335.00	7245.00								

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Table 6.5.15 BIWTA Proposed Projects for TFYP (Continued)

(Taka in lacs)

Sl. No.	Name of the Project	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
	D. REPAIR AND REPLACEMENT OF VESSELS PONTOONS, GANGWAYS ETC.										
1.	Modernization and expansion of Barisal Workshops.	1000.00	800.00	5/2.00	5/0.75	5/0.50	2/0.20	4/0.40	3/3.30	2/0.10	
2.	Repair and replacement of old pontoons of BIWTA.	600.00	-	3/1.20	4/0.60	5/0.50	2/0.20	3/0.30	2/0.20	2/0.10	
3.	Modernization of existing Decoa Chain system of BIWTA.	200.00	100.00	4/1.60	5/0.75	5/0.50	2/0.20	2/0.20	2/0.20	2/0.10	
	Sub-Total:	1800.00	900.00								
	E. HYDROGRAPHIC SURVEY AND FEASIBILITY STUDIES										
1.	Hydrographic survey and data collection work for inland and coastal waterways of Bangladesh (1985-90).	2634.00	532.00	5/2.00	3/0.45	5/0.50	3/0.30	4/0.40	3/0.30	2/0.10	
2.	Feasibility study for the preparation of master plan for Dhaka Port.	140.00	93.00	4/1.60	4/0.60	3/0.30	3/0.30	4/0.40	2/0.20	2/0.10	

Table 6.5.15 BIWTA Proposed Projects for TFYP (Continued)

(Taka in lacs)

Sl. No.	Name of the Projects	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
3.	Training of personnel responsible for development and planning in IWT Sector.	134.00	134.00	5/2.00	5/0.75	5/0.50	2/0.20	5/0.50	3/0.30	2/0.10	
4.	Establishment of MIS & Data Bank.	119.00	78.00	5/2.00	5/0.75	2/0.20	2/0.20	4/0.40	3/0.30	2/0.10	
5.	Establishment of a regional centre for development of appropriate technology for inland water transport in Bangladesh.	1234.00	1100.00	4/1.60	5/0.75	3/0.3	4/0.40	3/0.30	3/0.30	3/0.15	3.80
6.	Study for re-establishment of SLW and SHW levels.	70.00	50.00	4/1.60	3/0.60	3/0.3	2/0.20	2/0.20	2/0.20	2/0.10	3.20
7.	Feasibility study for canalization of the Atrai-Jamuna and the Korotoya rivers in the district of Rajshahi, Bogra, Rangpur, Dinajpur & Pabna upto Baghari port.	300.00	250.00	5/2.0	5/0.75	4/0.4	4/0.4	2/0.20	4/0.40	2/0.10	4.25
8.	Short feasibility studies by local consultant for the schemes - (I) establishment of 150 nos. launch landing stations and (II) Development of 10 nos. Class-II port.	19.00	-	5/2.00	4/0.60	3/0.30	3/0.30	3/0.30	3/0.30	2/0.10	3.90
	Sub-Total:	4659.00	2237.00								

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Table 6.5.15 BIWTA Proposed Projects for TFYP (Continued)

(Taka in lacs)

Sl. No.	Name of the Project	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
	F. SCHEME FOR PROVIDING AIDS TO NAVIGATIONAL FACILITIES:										
1.	Provision of aids to navigation in the inland waterways in Bangladesh.	500.00	400.00	5/2.0	5/0.75	5/0.50	4/0.40	3/0.30	3/0.30	2/0.10	4.35
2.	Construction of 3 nos. sub-section offices at Bhairab Bazar, Chilmari and Santirhat.	50.00	-	5/2.0	3/0.45	3/0.30	2/0.20	4/0.40	4/0.40	4/0.20	3.95
	Sub-Total:	550.00	400.00								
	Requirement for new project during TFYP	69108.00	32060.00								
	Total requirement during TFYP	72715.00	32913.00								

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Table 6.5.16 BIWTC Proposed Projects for TFYP On-going Projects

(Taka in lacs)

Sl. No.	Name of the Project	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
	On-going project										
1.	Dieselization and renovation of 3 passenger vessels.	1138.00	404.00	4/1.6	3/0.45	3/0.30	2/0.20	2/0.20	2/0.20	2/0.10	3.05
2.	Acquisition of vessels for carriage of fertilizer.	516.00	-	4/1.6	3/0.45	2/0.20	2/0.20	3/0.30	3/0.30	2/0.10	3.15
3.	Modernization of repair yards	1000.00	800.00	5/2.0	5/0.75	3/0.30	5/0.50	3/0.30	2/0.20	2/0.10	4.15
4.	Acquisition of 2 Ro.Ro. ferries with 3 pontoons.	1417.00	1200.00	4/1.6	3/0.45	4/0.40	2/0.20	3/0.30	3/0.30	2/0.10	3.35
	Sub-Total:	4071.00	2404.00								
	Expected expenditure upto June '85	1625.40	628.40								
	Allocation required in the TFYP	2445.60	1775.60								

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Table 6.5.17 BIWTC Proposed Projects for TFYP New Projects

(Taka in lacs)

Sl. No.	Name of the Project	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
1.	Replacement of 4 nos. 1600 DWT Coasters	2400.00	2000.00	3/1.2	3/0.45	3/0.30	2/0.20	2/0.20	2/0.20	2/0.10	2.65
2.	Replacement of 3 nos. 1600 DWT Oil Tankers.	1800.00	1500.00	3/1.2	2/0.30	3/0.30	2/0.20	2/0.20	2/0.20	2/0.10	2.50
3.	Acquisition of 14 Nos. Roll-on-Roll-Off ferreis.	7200.00	6000.00	4/1.6	4/0.60	4/0.40	4/0.40	3/0.30	3/0.30	2/0.10	3.70
4.	Conversion of 22 Dumb barges into self-propelled barges.	1430.00	715.00	3/1.2	3/0.45	2/0.20	2/0.20	3/0.30	3/0.30	2/0.10	2.75
5.	Acquisition of 6 nos. tugs.	300.00	180.00	4/1.6	2/0.30	4/0.40	2/0.20	3/0.30	3/0.30	2/0.10	3.20
6.	Acquisition of a floating dock	500.00	400.00	4/1.6	3/0.45	2/0.20	2/0.20	2/0.20	2/0.20	2/0.10	2.95
7.	Re-engining and modification of 16 nos. existing BIWTC vessles	1482.00	920.00	4/1.6	3/0.45	3/0.30	3/0.30	2/0.20	2/0.20	2/0.10	3.15
8.	Acquisition of 5 nos. coastal passenger vessels	1250.00	-	4/1.6	4/0.60	3/0.30	2/0.20	3/0.30	2/0.20	2/0.10	3.30
9.	Acquisition of 6 nos. container ships.	3000.00	1500.00	5/2.0	2/0.30	4/0.40	4/0.40	3/0.30	2/0.20	2/0.10	3.70
	Sub-Total:	19362.00	13215.00								
	Total requirement in the TFYP	21807.60	14990.60								

Table 6.5.18 Chittagong Port Authority Proposed Projects for TFYP

(Taka in lacs)

Sl. No.	Name of Projects	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
	A. ON-GOING PROJECTS										
1.	Construction of 2 nos. Multi-purpose Berths with back-up Facilities and Procurement of Cargo Handling Equipment	34983.05	21273.34	4/1.60	5/0.75	3/0.30	3/0.30	3/0.30	2/0.20	2/0.10	3.55
2.	Expert Service for Accounting, Finance & Tariff Study	64.07	15.93	Unable to evaluate							
	Sub-Total:	35047.12	21289.27								
	Expected expenditure upto June, 1985	5479.42	2312.82								
	Allocation required in TFYP	29567.70	18976.45								
	B. NEW PRODUCTS										
1.	Procurement of one Trailing Suction Hopper Dredger	4823.80	3882.80	4/1.60	5/0.75	4/0.40	2/0.20	3/0.30	2/0.20	2/0.10	3.55
2.	Dredging in the Navigation Channel of the River Karnafuli.	930.85	755.34	5/2.0	5/0.75	5/0.50	2/0.20	3/0.30	2/0.20	2/0.10	4.05
3.	Procurement of Vessels & Craft	2200.00	1600.00	3/1.20	4/0.60	4/0.40	3/0.30	3/0.30	2/0.20	2/0.10	3.10
4.	Construction of Hazardous Godown	500.00	-	3/1.20	3/0.45	4/0.40	3/0.30	2/0.20	2/0.20	2/0.10	2.85
5.	Construction of Housing Complex for Employees	1000.00	-	3/1.20	3/0.45	2/0.20	3/0.30	3/0.30	2/0.20	2/0.10	2.75

Table 6.5.18 Chittagong Port Authority Proposed Projects for TFYP (Continued)

Sl. No.	Name of Projects	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
6.	(a) Feasibility Study for Reconstruction of Jetties 14-17 (b) Reconstruction of Jetties 14-17	10000.00	6000.00	4/1.60	3/0.45	3/0.30	3/0.30	3/0.30	2/0.20	2/0.10	3.25
7.	Construction of 2 nos. Storage Sheds behind Jetties 4,5 and 6.	500.00	-	3/1.20	3/0.45	3/0.30	3/0.30	3/0.30	2/0.20	2/0.10	2.85
8.	Construction of 2 nos. Dolphin Jetties at RM-6 and RM-7	900.00	90.00	3/1.20	3/0.45	4/0.40	3/0.30	3/0.30	2/0.20	2/0.10	2.95
9.	Feasibility Study & Construction of Embayment upstream of Jetty No.1 to Sadarghat	5527.00	1046.00	3/1.2	3/0.45	4/0.40	3/0.3	3/0.3	2/0.20	2/0.10	2.95
10.	Improvement of Water Supply System in the Port	100.00	-	3/1.2	5/0.75	4/0.40	3/0.30	3/0.30	2/0.20	2/0.10	3.25
11.	Construction and Equipping 33kV Sub-station and Renovation of Existing 11kV Sub-station	300.00	100.00	4/1.6	5/0.75	4/0.40	3/0.30	3/0.30	2/0.20	2/0.10	3.65
12.	Detailed Technical & Economic Feasibility Study for Construction of Deep Draft Port	400.00	300.00	Unable to evaluate							
13.	Improvement of Open Area for Storage of Cargo	500.00	-	5/2.0	4/0.60	3/0.30	3/0.30	3/0.30	2/0.20	2/0.10	3.80
14.	Modernisation of Training Institute	200.00	-	3/1.2	4/0.60	3/0.30	4/0.40	5/0.50	3/0.30	2/0.10	3.40
	Sub-Total:	27881.65	13174.14								
	Total requirement during TFYP:	57449.35	32150.59								

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Table 6.5.19 Port of Chalna Authority Proposed Projects for TFYP

(Taka in lacs)

Sl. No.	Name of Projects	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
	A. ON-GOING PROJECT										
1.	Permanent Port on Pussur River	26462.64	5669.55	5/2.0	4/0.60	5/0.5	4/0.40	5/0.50	3/0.30	5/0.25	4.55
	Expected expenditure upto June, 1985	17088.11	3941.07								
	Allocation required in the TFYP	9374.53	1728.28								
	B. NEW PROJECTS										
1.	Development of Fresh Water Sources at Mongla and Construction of Water Treatment and Distribution Plant	1498.00	448.40	3/1.2	4/0.60	3/0.30	3/0.30	3/0.30	2/0.20	2/0.10	3.00
2.	Reconstruction of Roosevelt Jetty	2500.00	1000.00	4/1.6	5/0.75	3/0.30	5/0.50	4/0.40	3/0.30	2/0.10	3.95
3.	River Training Works	2000.00	300.00	2/0.80	3/0.45	5/0.50	5/0.50	3/0.30	3/0.30	2/0.10	2.95
4.	Establishment of Geodetic Control Point and Transferring of Datum along the Pussur River from Mongla to Hiron Point	120.00	-			Unable to evaluate					
5.	Procurement of a Training Suction Hopper Dredger	4000.00	3800.00	4/1.60	5/0.75	4/0.40	2/0.20	3/0.30	2/0.20	2/0.10	3.55
6.	Feasibility Study for Construction of two Multipurpose Berths at Mongla	200.00	150.00			Unable to evaluate					

Table 6.5.19 Port of Chalna Authority Proposed Projects for TFYP (Continued)

(Taka in lacs)

Sl. No.	Name of Projects	Estimated Cost		Criteria							Total Weight
		Total	F.E.	1	2	3	4	5	6	7	
7.	Procurement of Cargo Handling Equipment	1500.00	800.00	5/2.0	5/0.75	5/0.50	3/0.30	3/0.30	2/0.20	2/0.10	4.15
8.	Procurement of Electronic Survey Equipment and Navigational Aids	1200.00	950.00	3/1.2	5/0.75	5/0.50	3/0.30	3/0.30	2/0.20	2/0.10	3.35
9.	Development of Container Marshalling Yard at Mongla	1000.00	200.00	5/2.0	5/0.75	3/0.30	4/0.40	4/0.40	2/0.20	2/0.10	4.15
10.	Construction of Berths for IWT Vessels	1000.00	-	5/2.0	5/0.75	3/0.30	3/0.30	3/0.30	3/0.30	2/0.10	4.05
11.	Feasibility Study for a Deep Draft Anchorage in the Pussur River	150.00	150.00	Unable to evaluate							
12.	Construction of Residential and Office Accommodation at Mongla	1000.00	-	3/1.20	4/0.60	2/0.20	3/0.30	3/0.30	2/0.20	2/0.10	2.90
	Sub-Total:	16168.00	7798.40								
	Total requirement in the TFYP:	25542.53	9526.68								

6.6 Transport Sector Plan 1986-1990

6.6.1 Introduction

Lists of proposed projects for each sub-sector are presented in the preceeding section. On-going projects are included in the lists.

As stated earlier a large number of on-going projects initiated in the SFYP or even earlier could not be completed by the end of the SFYP period and spilled over into TFYP. Table 6.6.1 summarizes the spill over of on-going projects and compares them with the proposed TFYP subsectoral allocations. It is clear that if all on-going projects are allowed to complete on-going projects alone will require not only all of the TFYP allocations but more funds well into the Fourth Five Year Plan for the rail and road subsectors. If on-going projects are given priority, few new projects are possible in TFYP.

It was decided therefore, in response to the Planning Commission's request, that all projects, on-going or new, were to be evaluated on an equal basis. The evaluation methodology is presented in Section 6.4 and the resulting scores and ranking of each project on the basis of the overall score are shown in the project lists presented in Section 6.5.

Table 6.6.1 SFYP On-going Projects Remaining Portions

(million taka)

	Rail	Road	IWT	PCA
A. Spill over beyond 84/85	6594	12336	605	937
B. Proposed TFYP Allocation	6000	8800	3900	1080
C. A/B	1.10	1.40	0.16	0.87

Source: Planning Commission and the Consultants.

Projects for TFYP presented in the following sub-sections were selected primarily based on the ranking of each project. Annual outlays were determined for years 1985/86 - 1989/90. On-going projects not included in the proposed plan are recommended to be discontinued.

6.6.2 Railways

The feature of the railway budget is the size of the budget items for the major schemes. The ADB system improvement and the SFD financed workshop scheme take over 51% of the budget.

When the rehabilitation of the meter gauge and the completion of the SFYP coach purchase accounts for an additional 20%, the remaining balance has to be spread widely.

Replacement locomotives are necessary and 30 are required. This reduction from 37 is made pro-rata, but still accounts for 15.5% of the balance. Evaluation of rolling stock requirements is shown in Volume II, Section 8.6.

The remaining 13% has been put into completing projects - hospital, training academy, plant and machinery, signalling and fertilizer projects.

The heavy on-going projects have taken up most of the funding leaving priority projects to start at the end of the plan to carry over into the Fourth Year Plan.

The budget breakdown is:

Civil Engineering:	1,181 million Taka	19.7%
Mechanical Engineering:	2,825 million Taka	47.1%
Signal & Communications:	65 million Taka	1.1%
Multipurpose Schemes:	1,929 million Taka	32.1%
TOTAL	6,000 million Taka	100.0%

Table 6.6.2 Third Five Year Plan for Bangladesh Railways

	Project	85/86		86/87		87/88		88/89		89/90		TFYP Total		Remarks
		Total	F.E.	Total	F.E.	Total	F.E.	Total	F.E.	Total	F.E.	Total	F.E.	
1.	System Improvement (ADB)	174	111	362	194	543	290	543	290	181	83	1803	968	1/6
2.	Fertilizer Transport (IDA)	61	43	36	8	29	7	-	-	-	-	126	59	4/4
3.	Modern Workshop (SFD)	175	83	276	149	276	149	276	149	276	149	1279	679	1/16
4.	Relay Interlock & Signal(Swe.FRG)	15	-	-	-	-	-	-	-	-	-	15	-	2/9
5.	Recoupment of Ballast	8	-	9	-	9	-	9	-	8	-	43	-	7/27
6.	Rehabilitation of MG(Can. SFD)	223	152	120	82	120	82	120	82	210	143	793	541	4/27
7.	Carriages by own workshop	20	-	-	-	-	-	-	-	-	-	20	-	5/16
8.	Repairs to Rolling Stock	9	-	12	-	12	-	12	-	12	-	57	-	13/16
9.	Replacement bearings (UK)	6	4	10	6	12	8	12	8	-	-	40	26	4/16
10.	Training Academy phase-I	20	-	10	1	-	-	-	-	-	-	30	1	13/27
11.	Training Academy Phase-II	-	-	60	30	60	25	-	-	-	-	120	55	13/27
12.	Plant and Machinary (Bul.Swe.)	26	15	12	10	-	-	-	-	-	-	38	25	9/16
13.	Locomotive purchase (30)(Can)	185	137	185	137	185	137	185	137	186	139	926	687	6/16
14.	Pass. Carriage purchase(Japn.Korea etc.)	227	158	-	-	-	-	-	-	200	139	427	297	9/16
15.	Track Renewal	3	-	-	-	-	-	15	8	-	-	18	8	4/27
16.	Carriage Purchase (Romania)	9	-	-	-	-	-	-	-	29	20	38	20	9/16
17.	Railway Hospital (FRG)	37	-	9	-	-	-	-	-	-	-	46	-	25/27
18.	Concrete sleeper plant (FRG.Ind)	30	30	-	-	-	-	-	-	-	-	30	30	10/27
19.	Passenger Amenities Phase-II	1	-	-	-	-	-	-	-	-	-	1	-	23/27
20.	Relay Interlock & Signal(FRG.Swe.Uk)	-	-	-	-	-	-	-	-	50	20	50	20	3/9
21.	Recondition of sleepers(UK)	-	-	-	-	-	-	-	-	100	58	100	58	1/27
	Total	1229	733	1101	617	1246	698	1172	674	1252	741	6000	3473	

Note: 1. Studies are not included in the above.

a. Container study
b. Rail-cum-Road Bridge over River Rupsa
c. Productivity study Pahartali C&W Shops

6.6.3 Road

1) Project identification and selection

a) RHD schemes

A list of RHD's proposed schemes with their required funds for TFYP has been worked out by the working group for road and road transport sub-sector on road development under RHD. It is mentioned in the report that the working group selected the schemes listed in Table 6.6.4 for their incorporation in the TFYP based on the following priorities.

i) National and regional road's schemes in current ADP

ii) Some priority sections of national and regional roads but are not included in the current ADP

iii) Bridge schemes of important river gaps on the road system

iv) All foreign-aided schemes in the ADP

v) On-going bridge schemes

vi) Remaining schemes on reconstruction of war-damaged bridges

vii) Reconstruction of narrow bridges of Dhaka-Chittagong route

viii) Other RHD schemes in the ADP

ix) Some important roads and bridge schemes beyond the ADP

In the RHD's schemes, on-going projects constitute 83.7% of the total requirement fund for completion of schemes, while on-going foreign aided schemes constitute 8.9% of the total.

The RHD's priorities above are reasonable. However, the number of project is quite large and far exceeds the resource constraint of TFYP. Therefore, selection was made carefully based primarily on the evaluation method described in 6.4.3. In addition the following criteria were also taken into consideration for the selection of top priority project.

Item		Top Priority Project
Road Classification	;	National Highway Schemes within "H" shape trunk road network (Ref. Volume II, Fig. 9.6.2)
Project Status	;	On-going Project
Construction Program	;	Road Improvement Project
Bridge Construction	;	Reconstruction of war damaged and narrow bridges

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b) BRTC schemes (buses, trucks and workshops)

BRTC selected total of 12 schemes listed in Table 6.5.13 for the TFYP based on the following investment policies;

(a) To optimize the use of existing facilities.

(b) To meet the increased demand of passenger traffic in the cities of Dhaka and Chittagong where private sector is quite reluctant to operate their bus service.

(c) Expansion of bus and truck services is needed to subsidize the loss of city service and bus services.

(d) To provide bus and truck in the rural areas connecting newly created Upazila.

(e) To supplement the private services and to provide dependable services during hartal strikes and emergency.

(f) To provide minibus services in terrace and the area where large bus service is not possible to operate.

(g) To reduce the dependence on Rickshaw services.

2) Investment project description

An evaluation has been carried out for the projects and resulting scores and ranking orders are also shown in Tables 6.5.7 through 6.5.12.

The investment projects for the TFYP of RHD's and BRTC's schemes are summarized in Tables 6.6.3 and 6.6.5.

(1) Foreign aided schemes

All of the seven foreign aided on-going projects which include 4 road construction schemes, 1 bridge construction and 2 infrastructure schemes were selected as important projects to be completed in TFYP. The road construction schemes such as Feni bypass, Comilla-Chandina bypass and Khulna-Mongla road make a contribution in guiding the upgrading of national highways in Bangladesh by their minimum standards.

(2) National road schemes

The arterial road network has been developed in the shape of alphabet capital "H" following the North-South traffic connecting from Chittagong to Sylhet or Mymensingh through Dhaka in East Bangladesh and from Khulna to Rangpur in West Bangladesh. This "H" shape route is the major frame of road transport network in Bangladesh.

However, it is observed that more than half of the national roads have not enough carriageway width for two road even in the "H" shape route.

Upgrading of national highway sections constituting the part of the trunk "H" with high EIRR should be completed in TFYP as top priority. Sections included in this proposed plan are shown in Fig. 6.6.1.

(3) Bridge schemes

Rehabilitation and restoration work for the war damaged bridges have been continuing since the war but not yet completed. War damaged bridges and narrow bridges in the Dhaka-Chittagong route are recommended to be completed within the TFYP. The construction of the Meghna bridge will be likely to start with a foreign assistance.

(4) East-west traffic study

As a result of OD surveys in this study, it was found that the east-west traffic by road occupying about 10% of total passengers and goods movement carried by trucks as described in Sections 9.2.2 and 9.2.3, Volume II.

At present, there are two places where road traffic can cross the Jamuna river from East to West Bangladesh. One is Aricha as a main point and the other one is Dualatdia, north of Aricha. BRTC have a plan to strengthen terminal facilities and ferry fleet of the both terminals to mitigate the existing traffic congestion at Aricha and meet future traffic increase.

In addition BRTC intends to operate a ferry services at Mawa, south of Aricha, left bank of Padma river which are related to the Dhaka-Khulna road construction scheme. On the other hand, Jamuna bridge scheme is now being planned simultaneously by the Government of Bangladesh.

In order to clarify a future traffic flow and strike a good balance among these Jamuna crossing schemes, it is recommended that a further east-west traffic study be carried out based on detailed traffic surveys covering the whole country. These schemes should include a feasibility study of the construction of the road section from Bhanga to Khulna/Mongla.

(5) BRTC schemes

For healthy growth of private sector operations, no expansion of the fleet strength of the BRTC is recommend during TFYP. The condemned buses, trucks and minibuses are suggested to be replaced during TFYP. The depots and workshops are also suggested to be improved for the traffic safety.

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A plan total of Taka 250 million is limited to be allocated for the purposes above.

During the TFYP period the roles of BRTC in the subsequent plan period should be determined in detail and preparations should start for privatization of most of its operations.

Table 6.6.3 Summary of Selected RHD Investment Projects

(Unit: Million Taka)

Category of Schemes	Nos. of Schemes	Required Fund for Completion of Schemes	(%)	Budget for TFYP	(%)	Nos. of Schemes Accommodated	Amount Spilled over beyond TFYP
A. Foreign Aided Schemes	7	1,728.8	(8.9)	1,728.8	(20.2)	7	-
B. On-going Schemes							
(1) Roads (National & Regional H'way)	54	8,639.3	(44.6)	4,074.7	(47.7)	16	4,564.6
(2) Bridges	14	674.4	(3.5)	382.7	(4.5)	2	291.7
(3) Infrastructures	2	1,293.9	(6.7)	300.0	(3.5)	2	993.9
C. New Schemes							
(1) Bridge Construction	8	2,462.1	(12.7)	800.0	(9.3)	1	1,662.1
(2) Feasibility Study	4	700.0	(3.6)	150.0	(1.8)	2	550.0
D. Others (Feeder Road Schemes and Road Schemes in CHT)	L.S.	3,861.6	(20.0)	1,113.8	(13.0)	-	2,747.8
Total		19,360.1	(100.0)	8,550.0	(100.0)		10,810.1

Table 6.6.4 List of Selected Investment Projects for TFYP (RHD)

(Amount in Million Taka)

Ref. No.	Name of Schemes (Nos. of Schemes)	Length (km)	Category of Schemes	Estimated Cost at 84/85 Price	Financial Progress upto June 85 (%)	Required Fund for TFYP at 84/85 Price	Amount Spilled over Beyond TFYP
(A)	Foreign Aided Schemes (7)						
1	Feni bypass	29.0	Upgrading	213.1	(52)	102.6	-
2	Comilla-Chandina bypass	24	New Road	457.7	(52)	218.2	-
3	Khulna-Mongla Road	36	New Road	620.0	(98)	12.0	-
4	4 Radial Road in CHT	68	New Road	388.1	(28)	280.7	-
5	Postogola Bridge	2340 Rft	New Bridge	500.0	(4)	478.1	-
6	B. Road Research Laboratory		Infra.	315.8	(20)	251.8	-
7	Improvement and Modernization of Ferry		Infra.	677.6	(43)	385.4	-
	Sub-Total					1,728.8	-
(B)	On-going Schemes (20)						
8	Daudkandi-Chittagong	216	Upgrading	845.3	(22)	654.5	-
9	Chittagong-Cox's Bazar	151	Upgrading	786.7	(19)	634.5	-
14	Demra-Narshindi	39	Upgrading	123.3	(39)	74.0	-
15	Sarail-Madhabpur-Moulvibazar Sylhet-Tamabil	216	Upgrading	410.5	(25)	305.4	-
20	Joydebpur-Tangail-Modhupur	113	Upgrading	280.0	(0)	280.0	-
21	Dhaka-Aricha (Dhaka-Nayarhat Portion)	26	Upgrading	201.4	(21)	158.9	-
22	Dhaka-Aricha (Nayarhat-Aricha Portion)	50	Upgrading	121.2	(88)	13.8	-
23	Nagarbari-Sherpur-Gobinganj	148	Upgrading	474.3	(28)	337.7	-
24	Gobinganj-Rangpur-Syedpur-Beladanga	138	Upgrading	448.8	(27)	323.2	-
29	Rajshahi-Nator	90	Upgrading	385.9	(25)	288.5	-
30	Goalanda-Faridpur-Jhenaidah	105	Upgrading	376.6	(20)	291.4	-
31	Jhenaidah-Jessore	45	Upgrading	150.1	(36)	95.1	-
33	Jessore-Khulna	61	Upgrading	202.9	(23)	154.7	-
34	Jhenaidah-Kushtia-Bheramaraghat	72	Upgrading	383.0	(0)	383.0	-
40	Joydebpur-Bhaluka-Irishal	72	New Road	251.7	(68)	79.1	-
42	Dauladia-Goalanda	6	New Road	32.7	(97)	0.9	-
71	War damaged Bridges	1116 Rft	Reconstruction	726.7	(55)	321.0	-
72	Narrow Bridges	3785 Rft	Reconstruction	100.6	(38)	61.7	-
76	Investigation, Surveying Planning and Design of R/B		Infra.	284.1	(11)	50.0	202.3
77	Procurement of Equipment		Infra.	1,485.1	(29)	250.0	791.6
	Sub-Total					4,757.4	
(C)	New Schemes (4)						
73	Meghna Bridge	2900 Rft	New Bridge	1,100.0	(-)	800.0	300.0
86	Bhanga-Khulna/Mongla		Feasibility Study	100.0	(-)	100.0	-
*	East-West Traffic Study		Feasibility Study	50.0	(-)	50.0	-
	Sub-Total					950.0	
(D)	Others (Feeder Road Schemes and Road Schemes in CHT)			4,950.0	(22)	1,113.6	2,747.2
	Total					8,550.0	

* Consultant's Recommendation

Note: Ref. No. correspond to those in Table

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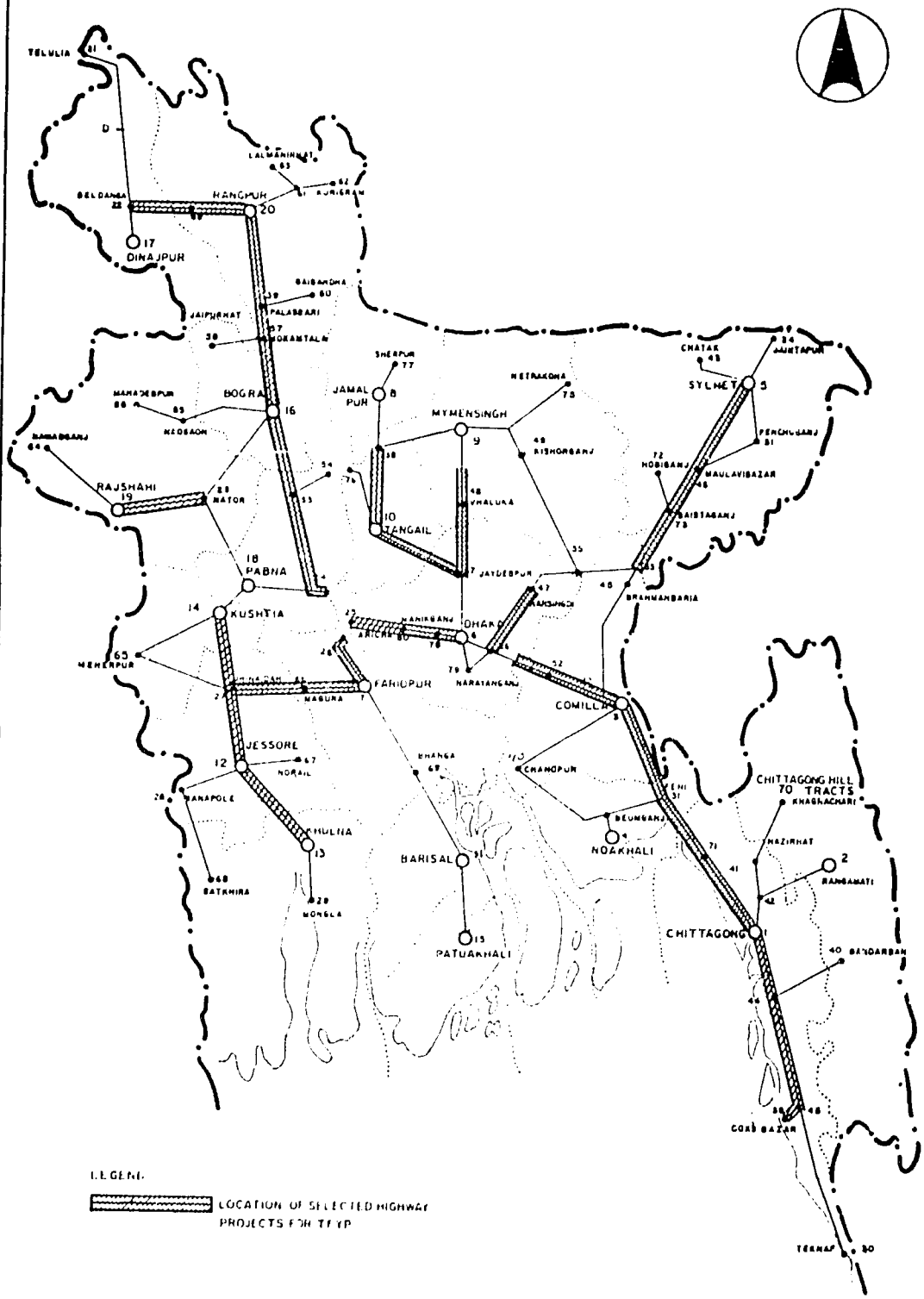

FIG. 6.6.1 LOCATION OF SELECTED HIGHWAY PROJECTS FOR TFYP

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Table 6.6.5 LIST OF SELECTED INVESTMENT PROJECT FOR TFYP (BRTC)

Ref. No.	Project	Estimated Cost at 84/85 Price	Required Fund for TFYP at 84/85 Price	Amount Spilled over beyond TFYP
1	Replacement bus acquisition	650.0	163.0	487.0
3	Replacement truck acquisition	122.0	35.0	87.0
5	Replacement minibus acquisition	50.0	10.0	40.0
6	Improvement of depot, workshop	25.0	25.0	-
9	Acquisition of inspection vehicles	5.0	5.0	-
10	Technical assistance	12.0	12.0	-
	Total	864.0	250.0	614.0

Ref. No. correspond to those in Table

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Assessment of the Recommended Projects and Draft TFYP

(1) Highway Projects

The major highway projects included in draft TFYP can be summarized as follows:

i) National Highway - Upgrading Widening Project (1,931 km)

Nagarbari	- Dinajpur highway	(212 km)
Nagarbari	- Rajshahi highway	(154 km)
Dhaka	- Chittagong highway	(102 km)
Tangai	- Mymensigh highway	(45 km)
Chittagong	- Cox's Bazar	(114 km)

ii) Regional Highway - Construction/Improvement (322 km)

Missing links of regional network in the southern and central region.

Consultants selected total of 16 National Highway - upgrading schemes (1,548 km) for TFYP.

The specified 5 projects (627 km) in draft TFYP are included in the Consultants selection as high ranking projects which EIRP is more than 25%.

In addition to these 5 projects, Consultants propose 11 schemes located within the "H" shaped trunk road network as shown in Chapter 9.5.1 to be upgraded immediately.

The investment program for Five Year Plan should be prepared more realistically than before. Judging from the past records of road investment plans, on-going schemes covered almost all of the existing road network. These schemes were not completed within five years. There are many projects which have been continuing more than 10 years. Fig. 6.6.2 shows the financial progress of the RHD's on-going road schemes as of June 30, 1985.

Road investment should not be allocated to too many projects in the road network with small amount of money. Allocations should be to top priority projects so that the expected benefits can be obtained.

(2) Bridge Projects

The draft TFYP includes 6,098 meters of major bridges on the arterial road system including Meghna bridge, Buriganga bridge, Gorai bridge, bridges on Faridpur-Barisal, Dhaka-Sylhet and Dhaka-Mymensingh highways. Consultants recommend reconstruction schemes of war damaged bridges and narrow bridges on Dhaka-Chittagong highway as top priority projects.

RHD spent on average 100 million Taka per year for bridge and culverts schemes during SFYP which occupied about 7% of the total expenditure of RHD.

The RHD proposed that the total amount of 2,462.1 million Taka is required for completion of bridge schemes for TFYP which is about 12.7% of total required fund.

Consultants recommend allocate a total amount of 1,660 million Taka for the bridge schemes to be invested which include Meghna and Postgola bridge construction projects.

(3) Infrastructure

The following schemes are included in draft TFYP.

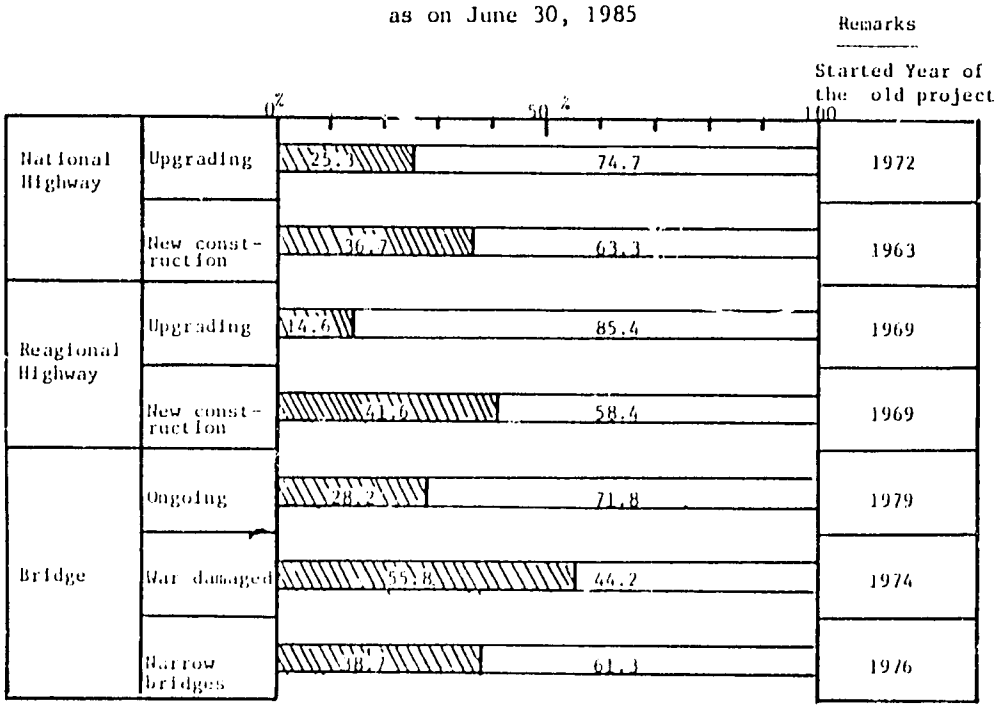
1) Improvement and modernization of existing ferries and ferry terminals

2) Procurement of equipment/machinery which are basic for standard road construction as per the specifications

3) Strengthening of Central Road Research Laboratory

The schemes above are fully acceptable, and Consultants also recommend to allocate the fund for TFYP total amount of 887.2 million Taka.

Fig. 6.6.2 Financial Progress of On-Going Project as on June 30, 1985



6.6.4 IWT and Ports

1) IWT

This budget has a major increase over the original proposal and in complete contrast to the other sub-sectors.

This has meant that the original proposals have been totally absorbed and other outstanding on-going projects included.

This still left a considerable portion for new projects where emphasis could be made on maintenance and improving and opening up new facilities in rural areas. Water crafts are also included.

Where project selection is necessary this has been determined by the evaluation ranking.

2) Ports

Better utilization of existing assets is emphasized in the proposed budget. Dredging of channels are given priority. On-going port expansion projects are to be continued. Feasibility studies should be carried out for future major improvement plans.

Table 6.6.6 TFYP for BIWTA (Inland Water Transport Authority)

(in Taka million)

Ref. No.	Project	Total	F.E.	Total	F.E.	Total	F.E.	Total	F.E.	Total	F.E.	Total	F.E.
B3	Improvement of ferry terminals	8	-	22	-	-	-	-	-	-	-	30	-
O1	Resuscitation of waters	30	-	100	-	100	-	100	-	90	-	420	-
O2	Inland river ports	4	-	6	-	5	-	5	-	5	-	25	-
O7	Ferry terminal on Padma	2	-	23	-	-	-	-	-	-	-	25	-
O8	Rural launch landing	10	-	40	-	40	-	-	-	-	-	90	-
O3	Overhauling of vessels	5	-	55	10	-	-	-	-	-	-	60	10
O4	4-survey vessels	16	5	-	-	21	20	21	20	22	19	80	64
	Flood Rehabilitation	25	-	-	-	17	-	-	-	-	-	42	-
O6&11	Flood Studies	20	10	58	31	57	31	58	31	57	31	250	3
D1	Barisal workshop	-	-	50	40	50	40	-	-	-	-	100	80
F1	Navigational aid	-	-	50	40	-	-	-	-	-	-	50	40
A1	Resuscitation of 10 waterwats	-	-	68	-	180	-	258	-	282	-	780	-
A3	Improve 25 river routes	-	-	-	-	85	-	50	-	80	-	215	-
A5	Re-excavate Lakhya river	-	-	-	-	-	-	40	-	-	-	40	-
D1	Modernize Decca System	-	-	20	10	-	-	-	-	-	-	20	10
A2	Re-excavate feeder waterways	-	-	-	-	136	-	137	-	137	-	410	-
A4	Constract 5 groins in Barisal	-	-	-	-	46	-	59	-	-	-	105	-
B4	Construct pass. terminal Chittagong	-	-	25	-	-	-	-	-	-	-	25	-
B2	Rural landings	-	-	-	-	50	10	119	10	119	-	288	20
C1	Operation & Survey vessels	-	-	-	-	-	-	46	34	-	-	46	34
B1	Khulna Port(Phase-II)	-	-	-	-	-	-	75	50	75	50	150	100
C3	Sails and cars for country boat	-	-	-	-	-	-	-	-	10	10	10	10
B6	10 Class II Ports	-	-	-	-	-	-	-	-	47	-	47	-
A9	Ferry Ghat impr. Bhuapur & Chilmari	-	-	-	-	-	-	6	-	-	-	6	-
A6	Groins in Lakhya river	-	-	-	-	-	-	-	-	70	-	70	-
B7	Provision of Landings at Hatiya and Sandwip	-	-	-	-	12	8	-	-	-	-	12	8
C2	Replacement of existing dredgers and others	-	-	-	-	-	-	-	-	50	40	50	40
	Total:	120	15	517	131	799	109	966	145	1046	150	3448	550

Note : 1. Reference numbers correspond to those in Table 6.5.14 and Table 6.5.15

2. 85/86 allocations are actual.

Table 6.6.7 Tentative TFYP for BIWTC (Inland Water Transport Corporation)

(Taka million)

Ref. No.	Project	85/86 Total	85/86 F.E.	86/87 Total	86/87 F.E.	87/88 Total	87/88 F.E.	88/89 Total	88/89 F.E.	89/90 Total	89/90 F.E.	Total TFYP Total	Total TFYP F.E.
04	2 Ro-Ro ferries & 3 pontoons	25	25	59	48	58	47	-	-	-	-	142	120
01	Dieselization project balance	-	-	20	-	-	-	-	-	-	-	20	-
02	Fertilizer project balance	-	-	10	-	-	-	-	-	-	-	10	-
N3	5 Ro-Ro ferries & parts	-	-	-	-	-	-	40	35	50	40	90	75
N6	Equipment for dock yard	-	-	-	-	-	-	50	40	-	-	50	40
	New item -social function	-	-	-	-	50	40	-	-	-	-	50	40
	New item-implementation	-	-	-	-	-	-	40	35	80	70	120	105
	Total:	25	25	89	48	108	87	130	110	130	110	482	380

Note: 1. Ref. No. correspond with those in Tables 6.5.16 and 6.5.17.

2. 85/86 allocations are actual.

Table 6.6.8 TFYP for C.P.A. (Chittagong Port)

Ref. No.		85/86 Total	85/86 F.E.	86/87 Total	86/87 F.E.	87/88 Total	87/88 F.E.
A 1	Two multi-purpose berths	854	506	854	585	854	585
A 2	Expert service for accounting and others	3	1	-	-	-	-
B 2	Dredging of navigation channel	-	-	50	41	43	35
B 1	Procurement of dredger	90	74	95	78	95	78
B 13	Improvement of open area	50	-	-	-	-	-
B 4	Hazardous godown	-	-	-	-	-	-
B 11	Electrical supply	-	-	-	-	-	-
B 3	Procurement of vessels	-	-	-	-	40	20
B 10	Improvemnet of water supply	10	-	-	-	-	-
B 5	Housing for employees	-	-	23	-	47	-
B 9	F/S of embayment	-	-	-	-	-	-
B 14	Modernization of training inst.	20	-	-	-	-	-
B 12	F/S of deep draft port	-	-	14	10	26	20
New Item - Implementation B9 or B12		-	-	-	-	-	-
	Total excluding multipurpose berths:	153	75	202	119	251	153

Ref. No.	88/89 Total	88/89 F.E.	89/90 Total	89/90 F.E.	Total FYYP Total	Total FYYP F.E.
A 1	-	-	-	-	2562	1516
A 2	-	-	-	-	3	1
B 2	-	-	-	-	93	76
B 1	100	82	102	76	482	388
B 13	-	-	-	-	50	-
B 4	50	-	-	-	50	-
B 11	30	10	-	-	30	10
B 3	70	30	110	50	220	100
B 10	-	-	-	-	10	-
B 5	24	-	6	-	100	-
B 9	25	15	-	-	25	15
B 14	-	-	-	-	40	30
New Item	-	-	142	89	142	89
Total exclusing multipurpose berths.	299	137	360	215	1265	709

Note: 1. Ref. No. corresponds with those in Table 6.5.18
2. 85/86 allocations are actual.

Table 6.6.9 TFYP for PCA (Port of Chalna)

(Taka million)

Ref. No.	Project	85/86		86/87		87/88	
		Total	F.E.	Total	F.E.	Total	F.E.
A 1	Permanent port on Pussur River	138	12	100	18	100	18
B 7	Cargo handling equipment	-	-	-	-	36	19
B 5	Procurement of trailing suction dredger	-	-	-	-	-	-
B 8	Survey equipment & nav. aids	-	-	-	-	-	-
B 9	Container Yard at Mongla	-	-	-	-	-	-
B 1	Fresh water sources and system	-	-	50	15	50	15
B 12	Construction of office & residential in Mongla	-	-	25	-	25	-
B 3	River training works	-	-	-	-	-	-
B 6	F/S of floating terminal	-	-	-	-	10	8
B 4	Establishment of control point	-	-	-	-	-	-
New Item - dredging		-	-	-	-	-	-
		138	12	175	33	186	52

Ref. No.	88/89		89/90		Total TFYP	
	Total	F.E.	Total	F.E.	Total	F.E.
A 1	100	18	100	18	538	84
B 7	30	18	34	16	100	53
B 5	-	-	-	-	-	-
B 8	-	-	30	24	30	24
B 9	50	10	50	10	100	20
B 1	-	-	-	-	100	30
B 12	25	-	25	-	100	-
B 3	5	-	30	30	35	30
B 6	10	7	-	-	20	15
B 4	-	-	12	-	12	-
New Item	50	45	-	-	50	45
	270	98	281	98	1075	322

Note: 1. Ref. No. correspond with those in Table 6.5.19
2. 85/86 allocations are actual.

6.7 Recommended Studies

During the course of the Study several subjects were identified as important but left largely unexamined due to their being out of the scope of the Study. Consultants, however, recommend that the following subjects be studied in detail in the TFYP period. Locations of the subject are shown in Figure 6.7.1.

1) Container Transport System by Railways

A feasibility study of container transport by rail should be carried out. Existing highways between Chittagong and Dhaka are unsuited for regular transport of containers. An ESCAP study carried out in 1983 concluded container transport by IWT infeasible due to high infrastructure costs. Land access problem to Narayanganj would necessitate the destuffing to be carried out in Narayanganj, which would also diminish the value of the IWT container transport option. On the other hand the rail option seems promising as sufficient yard area is available in Dhaka. Customs procedures should be examined to design the best system. The possibility of the entire system or a part of it being operated by a private firm should be explored.

2) Northwest Region Integrated Transport System

A considerable number of industrial and mining projects are being planned to be located in the Northwest region as shown in Figure 2.4.2. They include cement factories, fertilizer plants, a coal mine, and stone querries, all of which are large bulk generating sources. Because of the uncertainty concerning timing and output scale of these projects, the ONPP project did not take their transport requirements into account and, consequently, nor in this Study. Their effects on transport requirements, however, could be enormous. In addition this region is expected to become a major food grain exporting region.

At present Baghabari is the only inland port of significance to serve this region. It is, however, located at the southern end of he region. Considering the IWT's clear cost advantage, an inland prt near these industrial and mining projects may prove to be a project yielding a high return. Currently the depth of Jamuna upstream of Baghabari is maintained at a minimum of 6 feet. Shallow draft pusher barge system, for example, may be considered. The upstream port will require access road and probably access rail link. As improvement of Dhaka port is being planned, the entire system of an inland port, access road and rail links, transport vessels, and ports in the other end should be considered as an integrated system.

3) East-West Traffic Study

Traffic crossing Jamuna is expected to grow faster than others as described in Chapter 4. Shifting of traffic from Chittagong to Chalna may become necessity because of capatity constraint of Chittagong port. Now that the preparation for the Jamuna Bridge is underway with the establishment of the Jamuna Bridge Authority, a major study of east-west traffic is needed.

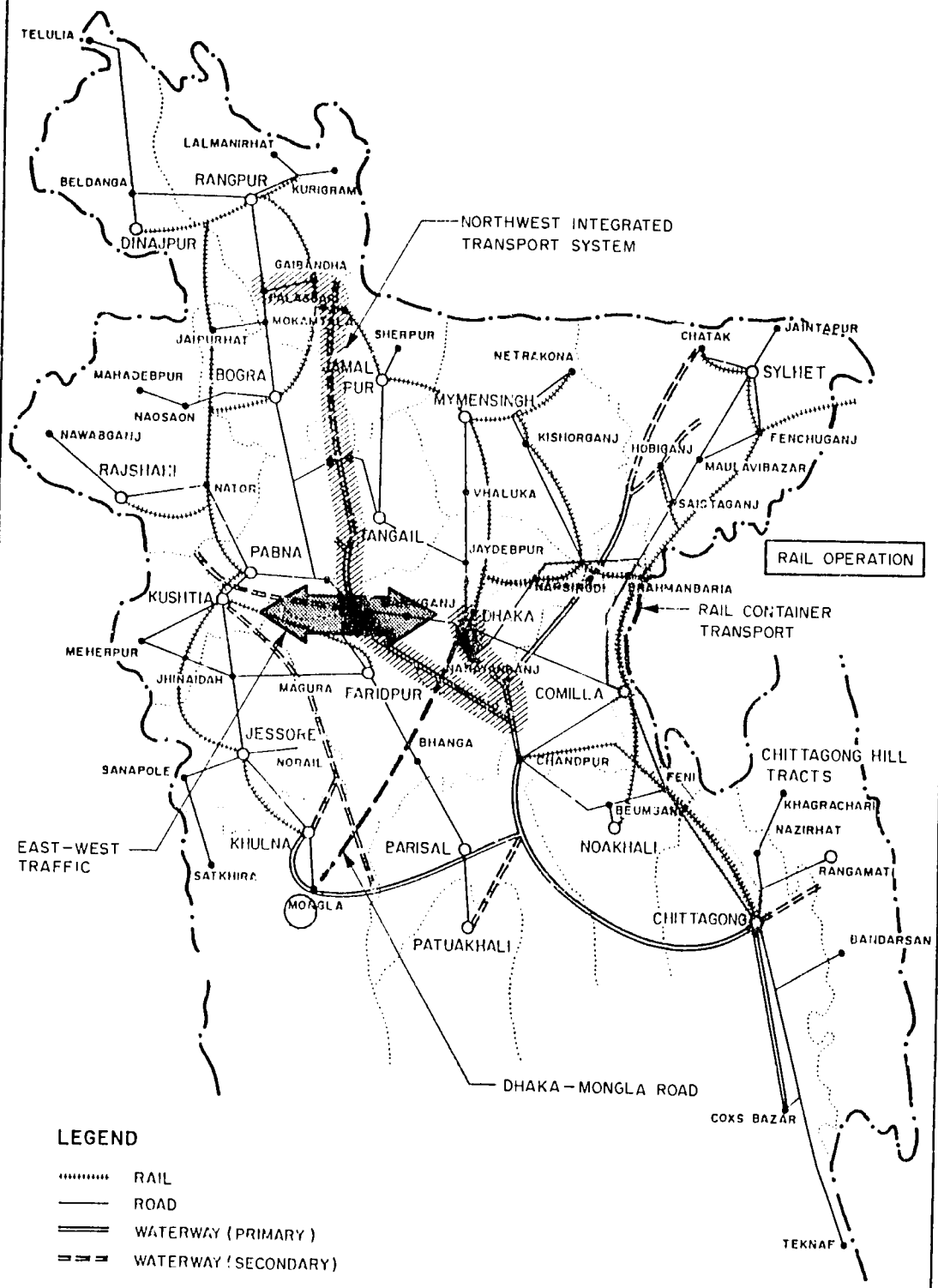


FIGURE 6.7.1 RECOMMENDED STUDIES

4) Dhaka-Mongla Road

Related to the above is the study of Dhaka-Mongla Road. RHD has started the construction of a portion of the road. Its construction cost, if it is implemented for its full length, would be high due to numerous river crossings, but its benefits would also be high. Its effect on IWT, however, would be significant. The road should be carefully assessed.

5) Railway Operation Study

Strengthening of railways should be one of the long term goals as explained in preceeding sections. The most important problem facing the Bangladesh Railways is managerial, as demonstrated in Chapter 8. A major study should be undertaken with a specific objective of finding and implementing concrete and workable operational procedures to substantially improve railway operational efficiency, not only to the railway organization itself but also to the eyes of railway customers, existing and potential. Marketing methods and procedures would be one of the prominent components of the study along with train operation improvements.

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CHAPTER 7

TRANSPORT SECTOR PLANS, 1991-1995, 1996-2000

7.1 Planning Framework for the Period 1991-1995

7.1.1 Transport Demand

Increase in traffic demand over the current level during the Fourth Year Plan period of 1991-1995 are shown in Table 7.1.1. By the end of the FFYP period transport systems in Bangladesh would be carrying 92% more freight traffic and 98% more passenger traffic than the level in 1984/85 assuming that GDP would grow at a rate of 5.4% during the TFYP period and at 5.9% during the FFYP period.

These projections are directly linked with assumed GDP growth rates rather than the extrapolation of trends of the recent past. A simple extrapolation of recent trends would give much lower future traffic levels except for the passenger traffic of IWT. If the above stated target GDP growth rates are to be achieved, a logical consequence is that traffic would grow at a higher rate than the GDP growth rate such as shown in Table 7.1.1 changes in modal split would be brought about primarily by operational improvements in the rail mode and in the IWT mode.

7.1.2 Policy Framework

Provision of infrastructure and operational improvements of IWT initiated in TFYP should continue in Fourth Five Year Plan. Improvements in railway operations should also be given priority. No widening of highways to 4 lanes or double tracking of railway sections will be necessary during FFYP.

Privatization of BRTC and BIWTC would be confirmed by the end of TFYP so that FFYP would include detailed plans of the scaled down organizations with their functions clearly defined.

Laws and regulations concerning spare parts acquisition would be streamlined with the possible establishment of a coordinating agency.

Planning capabilities of line agencies would be strengthened and regular transport performance monitoring systems would be instituted and Transport Division of Planning Commission would start periodic traffic surveys by contracting local consultants.

Three axle trucks would officially be banned by FFYP.

Fares and rates should continue to be reviewed and revised to ensure desirable transport sector development.

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Table 7.1.1 Demand Growth Factors

Year	GDP	Rail		Road		IWT		Total	
		Freight	Pass.	Freight	Pass.	Freight	Pass.	Freight	Pass.
1984/85	100	100	100	100	100	100	100	100	100
1989/90	130	145	119	126	148	152	150	137	140
1994/95	173	213	143	162	216	232	227	192	198

Note: Figures are growth indices of total ton-km and passenger-km with 1984/85 levels as 100.

Source: Table 4.2.2

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7.2 Potential Projects and Their Ranking

Chapter 6 demonstrates that the total amount requested by each agency for the projects proposed for TFYP far exceeds the likely amount of resources for each agency. Table 7.2.1 reiterates the point for each agency. A large portion of proposed projects cannot be completed or even undertaken during the TFYP period and will spill over into FFYP. Thus many projects not included in the Sector Plan presented in Section 6.6 will have to be reconsidered for FFYP. Names of these projects are listed in the project lists shown in Section 6.5 as well as their ranking.

Table 7.2.1 Spill Over From TFYP to FFYP

(million Tk.)

Mode	Road	Rail	IWT	Port	Total
Agencies	RHD BRTC	BR	BIWTA BIWTC	PCA CPA	
Requested for TFYP	20,224	7,961	9,453	5,342	42,980
Proposed TFYP Allocation	8,800	6,000	3,930	2,340	21,070
Spill Over to FFYP	11,424	1,961	5,523	3,002	21,910

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7.3 Transport Sector Plan 1990/91-1994/95

7.3.1 Railways Sub-Sector

It is important to continue improving the service level of railway operations so that the railways can adequately compete with the road transport on the improved highway network. The value of improved rolling stock utilization is clearly demonstrated in Volume II, Chapter 8. To this end the same theme as in the Third Five Year Plan is continued. Major emphasis still being rehabilitation and improvement in asset utilization. The major significant development must be the carriage and wagon plant. It will make a significant impact on overcrowding when it comes on stream. Therefore funds must be provide for construction of the plant, and for the manufacture of rolling stock. This plant is a candidate for private sector involvement, which will releave the railway of foreign fund requirements.

To cope with the increase in traffic track rehabilitation and signalling improvements are to continue. This will prevent any need to double track sections as train speed and reliability improve.

The sleeper rehabilitation program will finish, and a change over to production as a private venture enterprise should be encouraged. An annual requirement of about 2,300 tons is required for a sleeper renewal program.

Budget Summary:

General Carry-over	600 million Taka	6.0%
Civil Engineering	1,437 million Taka	14.5%
Mechanical Engineering	5,665 million Taka	56.9%
Signalling and Telecoms	805 million Taka	8.1%
Sundry Schemes	1,443 million Taka	14.5%
GRAND TOTAL	9,950 million Taka	100.0%

The projected railway budget is Tk. 9,950 million.

This budget must focus on the completion of on-going projects and the start of the expansion program.

			Million Taka
General	1.	Completion of projects nor finished in TFYP (10%)	600
Civil Engineering	1.	Reconditioning Sleepers	237
	2.	Offices GM West	250
	3.	Ballasting	75
	4.	Track Renewals Phase II	500
	5.	Engineering Workshops	65
	6.	Bridges	220
	7.	Engineering Works	90
		Total:	1,437
Mechanical Engineering	1.	30 locomotives	950
	2.	225 Coaches	1,544
	3.	Carriage & Wagon Plant	3,171
		Total:	5,665
Signals & Telecoms	1.	Mechanical Interlock	120
	2.	West Zone Workshop	40
	3.	Double Wire Interlock	195
	4.	Radio Tokens	150
	5.	Tokenless Block	200
		Total:	805
Sundry	1.	Multi-purpose Schemes (Incl. container transport system)	1,443

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7.3.2 Road and Road Trnsport Sub-Sector

The projected road budget is Tk. 12,970 million. This should be allocated primarily to the completion of on-going Projects.

		million Tk.
A.	On-going Schemes	
1)	Highways	
	Upgrading national hwy	1,753.7
	Upgrading regional hwy	259.1
	New construction of national hwy	1,280.7
	New construction of regional hwy	1,271.1
2)	Bridges	
	New construction program	291.7
3)	Infrastructure	
	Investigation/survey/planning and design of roads and bridges	202.3
	Procurement of Transport equipment, machineries and spare parts	791.6
B.	New Schemes	
1)	Bridges	3,505.9
	Including Meghna-Gumuti bridge, (1,500.0) and Meghna Spill Over (300.0)	
2)	Feasibility Studies	550.0
C.	Feeder Road Schemes	3,063.9
	Total	12,970.0

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7.3.3 IWT and Ports Sub-Sector

IWT

The projected budget for the IWT sub-sector for the Fourth Five Year Plan is TK. 7,240 million.

By the end of TFYP details of privatization procedures for BIWTC should have been worked out. However, BIWTC would be allocated a substantial sum of budget for its remaining operations, which should be primarily social services.

Investments should be made in improving cargo handling productivity. This would involve not only purchase and maintenance of equipment but also development of a system as a whole such as yard space and access roads and rail sidings.

Vessel fleet should be gradually renewed with modern efficient vessels and infrastructure should be modified to take the maximum advantage of new vessels.

Capital dredging will probably be necessary in certain waterways. River training works will require substantial amounts. Many more cargo jetties and passenger landing stations will be required to accommodate greatly increased demand.

Management information system for IWT sub-sector would be implemented.

Ports Sub-Sector

The projected budget is Tk. 3,770 million for FFYP. Dredging will be required to accommodate increasingly large vessels and for expanded jetties.

More cargo handling equipment will be required and associated on-shore facilities will be constructed.

By the time the proposed container transport system by rail is in place, associated investments in the Chittagong Port must be in place.

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7.4 A Perspective for Transport Sector Development 1995-2000

7.4.1 Demand Level

If the assumed GDP growth of 6.1% per annum on average between 1985 and 2000 is achieved, transport systems in Bangladesh in the year 2000 will be carrying 2.82 times of freight traffic and 2.90 times of passenger traffic than the present level.

Given the proper modal split as stipulated in this Study, the existing linehaul transport facilities such as highways, rail tracks, and waterways will be able to accommodate the markedly increased traffic as shown above.

7.4.2 Problems and Desirable Solutions

However, if the present trend of rapid growth of the road transport in the expense of other modes is left unabated, the consequence by the year 2000 would be a costly and wasteful transport system of extensive 4-lane highways and underutilized railways and waterways.

Road transport is particularly expensive when traffic volume is high. Highway construction in Bangladesh are expensive to construct and to maintain. Their weak pavement is prone to deterioration, further pushing up vehicle operating costs at high traffic volumes. Large trucks with low unit transport cost can not be introduced because of weak pavement leaving the unit cost high. Conditions in Bangladesh do not favor road transport. Serious efforts should be made to promote firstly IWT and secondly the railways.

IWT, however, may face a problem by the year 2000.

The siltation of rivers would be such that the network of navigable waterways may have to be significantly altered. Apparently deterioration of the river system through massive siltation is taking place. The main causes of this phenomenon are:

a) The increase in the volume of sediment carried by the river system due to the increased erosion in the headwaters outside of Bangladesh, which in turn is likely to be a result of over-cultivation in the headwater area.

b) The reduction in river flows through the withdrawal of water mainly for irrigation in India and Bangladesh. Recent construction of numerous barrages by India just outside of the border may have contributed to this.

c) The construction of dikes and embankment in the coastal region.

Table 7.4.1 Reduction in Navigable Waterways

Year	Source	Total Length of Inland Waterway, with more than 6 ft. draft (km)
1973	BTS (1975)	3640
1979	Review of BTS (1980)	1340
1984	BIWTA (1985)	2853

Source: Consultants

Although the severity of the problem does not seem to be as serious as previously thought, the total length of the main network of inland waterways with more than 6 ft draft would decrease by 30% at the current rate by the year 2000.

By then, a clear functional classification of waterways and division of market between country boats and motorized vessels should be determined.

The above constraints, however, may be a blessing in disguise. If all three modes are properly functioning after the two successive five year plans with emphasis on the operational improvement rather than system expansion, the above constraints may help each mode to concentrate on areas where they have a competitive advantage. That is, for the freight transport, short distance but wide coverage service for the road mode, long distance service for the rail mode and long specialized service for the waterway mode. The above constraints may accentuate the inherent advantages of each mode.

A concerted effort will be needed to realize the economically desirable modal split. Diversion can take place only when the alternative mode provides a better service, not only in the out-of-pocket cost but in the overall level of service including non-monetary factors described in Chapter 3.

Operational improvements should continue to be given a high priority. Improvement in terminal facilities for cargo handling as well as delivery/pickup services should be emphasized. Above all it would be vital for the successful development of the railways and IWT to encourage and to allow the management quickly responding the market requirements.

7.4.3 Possible Major Changes

The trunk network of transport facilities in the year 2000 will be basically the same as in the year 1985. Several additions to physical infrastructure, however, are conceivable.

1) Jamuna Bridge

This may be a road cum rail bridge with a gas pipeline likely near Aricha. The bridge may be restricted to passenger vehicles only.

2) Rail Container Transport System

The system may be operated by the private sector between Chittagong and Dhaka with customs inspection performed in a container yard in Dhaka.

3) Northwest Integrated Transport System

The system primarily connects mines, plants and factories in the Northwest with Dhaka by mainly waterways but access links and specialized cargo handling facilities are included.

4) Dhaka-Mongla Road

The road would help to give Chalna Port a larger role.

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Appendix 3.1

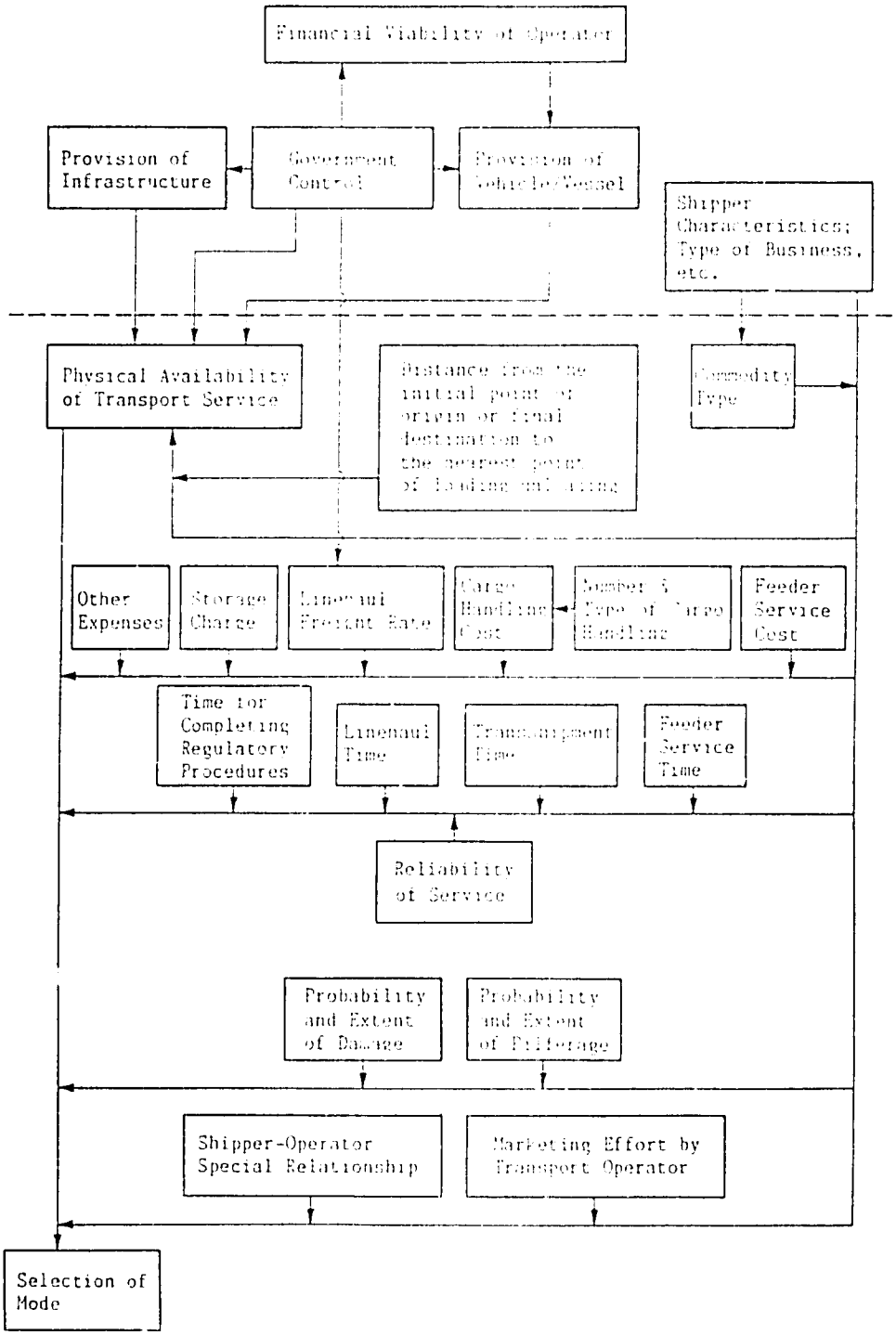
Table 3.1.1 FACTORS AFFECTING ECONOMIC OPTIMUM MODAL SPLIT

Item	Mode: Rail	Road	Waterway
o Traffic			
• Traffic Type	commodity type, passenger type		
* Modal Split	distribution of traffic among modes		
- Modal traffic volume	←	←	←
- Modal traffic growth	←	←	←
o Cost of Transport Supply			
• Vehicle/vessel	locomotive wagon, coach	truck, trailer bus, minibus car/jeep, rickshaw	coaster, barge launch, steamer
* Capital cost			
- Replacement value	←	←	←
- Interest rate	←	←	←
- Utilization	turn round down time	annual kilometer down time	turn round down time
* Operating cost			
- Capacity	tons/train pass./train	tons/truck pass. occupancy	tons/vessel pass./vessel
- Load factor	←	←	←
- Facility condition	track	pavement	waterway
- Vehicle/vessel characteristics	train speed fuel & lub. costs	vehicle speed feul & lub. costs	vessel speed fuel & lub. costs
- Crew cost	economic wage & other pay	economic wage & other pay	economic wage & other pay
- Maintenance cost	←	←	←
- Management cost	←	←	←
- Operational practice	←	←	←

Table 3.1.1 FACTORS AFFECTING ECONOMIC OPTIMUM MODAL SPLIT (Continued)

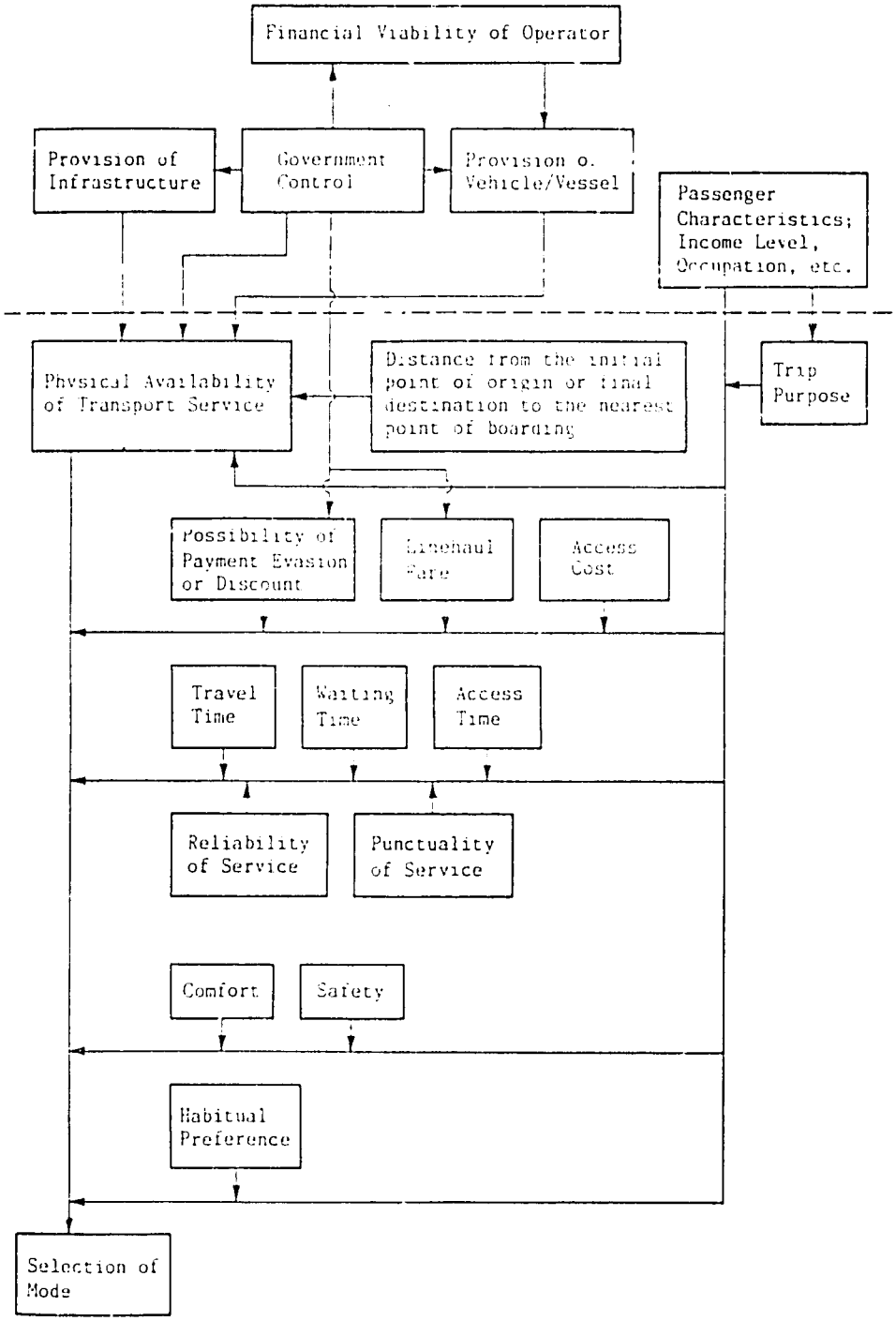
Item	Mode: Rail	Road	Waterway
• Infrastructure			
* Link capital cost			
- New construction	new link double tracking	new link, additional carriageway, ferry	new waterway
- Improvement	Rehabilitation, Signalling	Rehabilitation, Widening, Re-surfacing	Rehabilitation, River training, Capital dredging
- Interest rate	←	←	←
- Design life	←	←	←
* Link maintenance cost	track, bridge other	pavement, bridge, other	maintenance dredging
* Ancillary facility cost			
- Facility construction	yard, station, communication	ferry terminal	jetty, landing station, nevigation aid
- Facility maintenance	←	←	←
• Cargo handling			
* Feeder operation			
- Feeder requirement	←	←	←
- Feeder service cost	←	←	←
* Handling			
- Handling cost	←	←	←
o Cost of Passengers or Goods in transit			
- Opportunity cost	value of time of goods and passenger	value of time of goods and passenger	value of time of goods and passenger

Fig. 3.1.2 FACTORS AFFECTING MODAL CHOICE OF FREIGHT SHIPPER



Note: All the above factors are evaluated by shipper relative to other modes.

Fig. 3.1.3 FACTORS AFFECTING MODAL CHOICE OF PASSENGER



Note: All the above factors are evaluated by passenger relative to other modes.

Appendix 3.2

Table 3.2.1 Growth of Ton-Kilometres by Mode 1976/77 to 1984/85

Year	Ton-kilometres (million)				Modal Percentage			
	Road	Rail	IWT	Total	Road	Rail	IWT	Total
1976/77	1370[C]	712[D]	1026[C]	3108	44	23	33	100
1977/78	1489[C]	786[D]	1163[C]	3438	43	23	34	100
1978/79	1618[C]	838[D]	1178[C]	3634	45	23	32	100
1979/80	1759[C]	855[D]	1201[C]	3815	46	22	31	100
1980/81	1912[C]	787[D]	1180[C]	3879	49	20	31	100
1981/82	2037[C]	845[D]	1291[C]	4173	49	20	31	100
1982/83	2169[C]	814[D]	1319[C]	4302	50	19	31	100
1983/84	2310[C]	779[D]	1345[C]	4434	52	18	30	100
1984/85	2460[T]	748[E]	1381[C]	4589	54	16	30	100
G.R. 1976 to 1980	8.7	2.5	3.6	5.7% p.a.				
G.R. 1980 to 1984	6.5	-1.3	0	4.3% p.a.				

Notes:
C = Calculated
D = Published data
E = Extrapolated
T = Traffic counts

Source: Consultants calculations

Appendix 3.2

Table 3.2.2 Growth of Passenger-Kilometres by Mode 1975/76 to 1984/85

Year	Pass-kilometres (million)				Modal Percentage			
	Road	Rail	IWT	Total	Road	Rail	IWT	Total
1975/76	8380 C	4874	3412 C	16666	50	30	20	100
1976/77	8953 C	5160	3646 C	17759	50	29	21	100
1977/78	9566 C	5606	3896 C	19068	50	29	21	100
1978/79	10220 C	5956	4164 C	20340	50	29	21	100
1979/80	10918 C	6555	4314 C	21787	50	30	20	100
1980/81	11665 C	6780	4530 C	22975	51	29	20	100
1981/82	12516 C	7086	5314 C	24916	50	29	21	100
1982/83	13429 C	7436	5605 C	26470	51	28	21	100
1983/84	14409 C	7982	5896 I	28287	51	28	21	100
1984/85	15460 T	8428 E	6203 C	30091	51	28	21	100

G.R. 1975 to 1980	6.8	6.8	5.8	6.6	% p.a.
G.R. 1980 to 1984	7.3	5.5	8.2	7.0	% p.a.

Notes:
- I = Interpolated
- T = Estimated from traffic volumes
- E = Extrapolated from estimated data series (see 3.3.2)
- C = Calculated (see 5.6 and 7.1.2.)

Source: Consultants calculations

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Fig. 3.4.3 Total Cost of Freight Transport/km

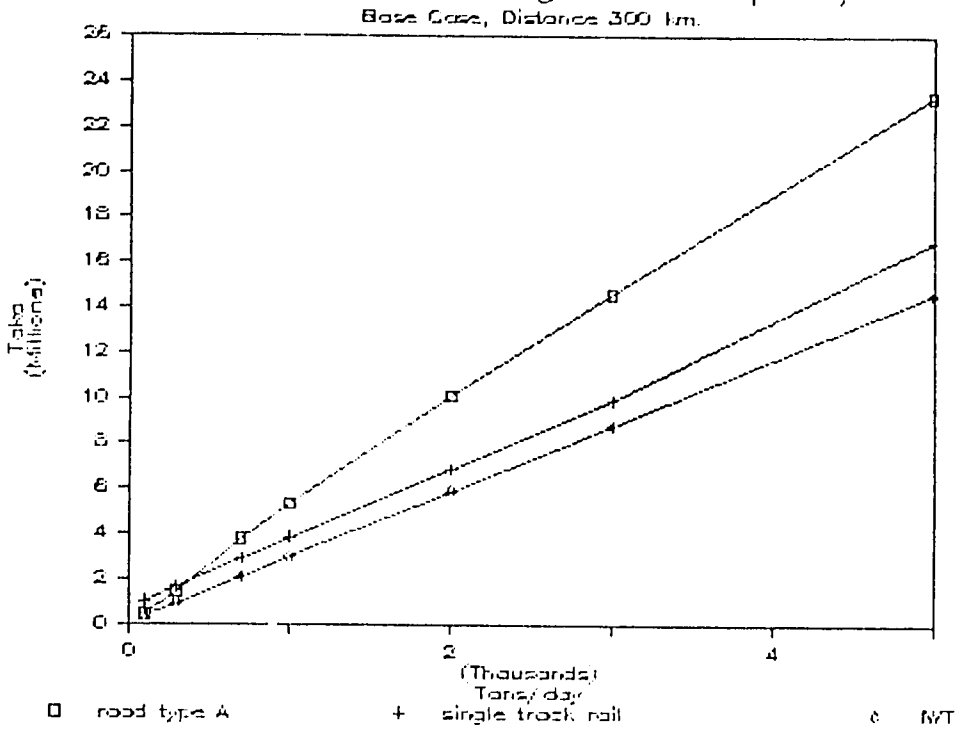
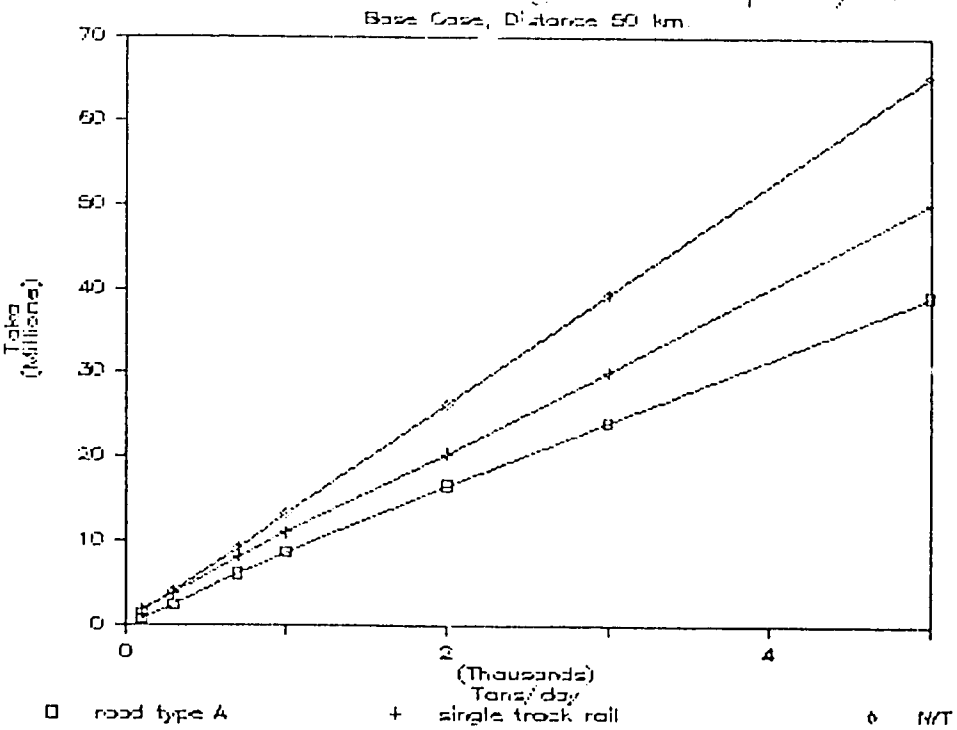


Fig. 3.4.4 Total Cost of Freight Transport/km



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Appendix 3.4.1 Modal Cost Model Structures and Input Values

1. Rail Mode Cost Model and Input Values

Freight:

Conversion of Freight Demand

To : Freight tonnage per day (initial)
Ti : Freight tonnage per day in year i

$$Ti = To(1+Rgt)^{(i-1)}$$

Rgt : Freight demand annual growth rate; 0.06

TPW : Average load per wagon (ton/car); 10.12
NWT : Number of wagons per train

NWT = T/TPW (Minimum=10) ;T≤427
= 42.2 ;T>427

FNTD : Number of freight trains per day

FNTD = 1 ;T≤427
= INTEGER(T/NWT/TPW)+1 ;T>427

TNTD : Total number of trains per day

TNTD = FNTD x 4 ;FNTD<5
= FNTD + 15 ;FNTD≥5

Operating Cost

FE : Financial-economic conversion factor; 0.857
LHD : Line haul distance (km)
FOPC : Freight operating cost (million TK/km)

$$FOPC = 0.0077 \times (10653/LHD + 67.7) \times Ti \times FE \times 365 \times 10^{-6}$$

Rolling Stock Capital Cost

WHCC : Wagon hourly capital cost (TK); 13.2
FTTL : Average freight train trip length (km); 47.3
FSPD : Average freight train speed (km/hr); 9.93,
(for improved case 11.7)
LFTR : Average locomotive turn round (days); 0.293,
(for improved case 0.249)
WFTR : Average wagon turn round (days); 17.6,
(for improved case 8.8)
LRHT : Locomotive running hours/trip (hours)

LRHT = FTTL/FSPD

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LFTH : Locomotive terminal hours/trip (hours)

$$LFTH = (24 \times LFTR) - LRHT$$

LFCC : Annualized locomotive capital cost/km (million TK)

$$LFCC = FNTD \times LHCC/LHD \times (LHD/FSPD + LFTH) \times FE \times 365 \times 10^{-6}$$

WATL : Average wagon trip length (km); 265

WARH : Average wagon running hours (hours)

$$WARH = WATL/FSPD$$

WATH : Average wagon terminal hours/trip

$$WATH = (WATR \times 24) - WARH$$

RHAO : Ratio of wagon hours attributable to average train operation

$$RHAO = LRHT/WARH$$

WTHO : Wagon terminal hours attributable to train operation

$$WTHO = WATH \times RHAO$$

WFCC : Annualized wagon capital cost per km

$$WFCC = FNTD \times WHCC/LHD \times (LHD/FSPD + WTHO) \times NWT \times FE \times 365 \times 10^{-6}$$

Track Capacity

TCAP : Track capacity (number of trains per day);
- 35 for single track rail
- 70 for double track rail

Capital Cost of Signalling Improvements

ACSI : Capital cost of signalling improvement per km

CRFF : Capital recovery factor for 15 year at 15%; 0.17102

TCSI : Total capital cost of signalling improvement per km (million TK); 1.54

- single track rail

$$ACSI = 0 \quad ; TNTD < (0.8 \times TCAP)$$
$$= TCSI \times CRFF \times FE \times 10 \quad ; 70 \leq TNTD \geq (0.8 \times TCAP)$$
$$= TCSI \times CRFF \times FE \times 2.5 \times 10 \quad ; TNTD > 70$$

- double track rail

$$ACSI = 0 \quad ; TNTD \leq TCAP$$
$$= TCSI \times CRFF \times FE \times 1.5 \times 10 \quad ; TNTD > TCAP$$

Capital Cost of Rehabilitation

RIVL : Rehabilitation interval (year)

$$RIVL = (-40/TCAP \times TNTD) + 50 \quad \text{(Minimum 10)}$$

TCRH : Rehabilitation cost total (million TK/km); 0.88

CRFV : Capital recovery factor at 15%

$$CRFV = 0.15 \times (1.15)^{RIVL} / (1.15)^{RIVL} - 1$$

RHCC : Rehabilitation capital cost annual (million TK/km/yr)

- single track rail

$$RHCC = TCRH \times CRFV$$

- double track rail

$$RHCC = TCRH \times CRFV \times 1.3$$

Double Tracking

DTCC : Double tracking cost total per km (million TK); 5.0

ADTC : Annualized double tracking cost (million TK)

- single track rail

$$ADTC = 0 \quad ; TNTD < (1.10 \times TCAP)$$
$$= DTCC \times CRFF \times FE \quad ; TNTD \geq (1.10 \times TCAP)$$

- double track rail

$$ADTC = 0$$

Planning Horizon

Nx : Limit year; 10

Total Cost

ATCF : Annual total cost (million TK)

$$ATCF = FOPCi + LFCCi + WFCCi + ACSII + RHCCi + ADTCi$$

PVTF : Present value of total cost

Rd : Discount rate; 0.15

$$PVTF = \sum_{i=1}^{Nx} \frac{ATCFi}{(1+Rd)}$$

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Passenger:

Conversion of Passenger Demand

Po : Number of passengers per day (initial)
Pi : Number of passengers per day in year i

$$Pi = Po \times (1+Rgp)^{(i-1)}$$

Rgp : Annual growth rate of passenger; 0.06

PPC : Passenger coach capacity per coach, 88
LDF : Load factor; 1.55
NCT : Number of coaches per train

$$NCT = P/PPC \times LDF \quad (\text{Minimum } 3) \quad ; P \leq 1296$$
$$= 9.5 \quad ; P > 1296$$

PNTD : Number of passenger trains per day

$$PNTD = 1 \quad ; P \leq 1296$$
$$= INTEGER(P/PPC \times LDF \times NCT) + 1 \quad ; P > 1296$$

TNTD : Total number of trains per day

$$TNTD = INTEGER(PNTD \times 1.33) + 1 \quad ; PNTD < 15$$
$$= PNTD + 5 \quad ; PNTD \geq 15$$

Operating Cost

POPC : Passenger service operating cost (million TK/km)

$$POPC = 0.0253 \times (86.5/LHD + 4.26) \times Pi \times FE \times 365 \times 10^{-6}$$

Rolling Stock Capital Cost

LHCC : Locomotive hourly capital cost (TK); 440
CHCC : Carriage hourly capital cost (TK); 93.3
PTTL : Average passenger train trip length (km); 94.5
PSPD : Average passenger train speed (km/hr); 30,
(for improved case 35)
LPTR : Average locomotive turn round (days); 0.587,
(for improved case 0.499)
CPTR : Average carriage turn round (days); 0.556,
(for improved case 0.439)
RHPT : Average running hours per trip (hours)

$$RHPT = PTTL/PSPD$$

LTHT : Average locomotive terminal hours per trip (hours)

$$LTHT = (24 \times LPTR) - RHPT$$

CTHT : Average carriage terminal hours per trip (hours)

$$CTHT = (24 \times CPTR) - RHPT$$

LACC : Annualized locomotive capital cost per km (million TK)

$$LACC = PNTD \times LHCC/LHD \times (LHD/PSPD + LTHT) \times FE \times 365 \times 10^{-6}$$

CACC : Annualized carriage capital cost per km (million TK)

$$CACC = PNTD \times NCT \times \frac{CHCC}{LHD} \times \left(\frac{LHD}{PSPD} + CTHT\right) \times FE \times 365 \times 10^{-6}$$

TACC : Total annualized rolling stock capital cost per km (million TK)

$$TACC = LACC + CACC$$

Capital Cost of Signalling Improvements

Same as freight service

Capital Cost of Rehabilitation

Same as freight service

Double Tracking

Same as freight service

Total Cost

ATCP : Annual total cost (million TK)

$$ATCPi = POPCi + LACCi + CACCi + ACSIi + RHCCi + ADTCi$$

PVTP : Present value of total cost

$$PVTP = \sum_{i=1}^{Nx} \frac{ATCPi}{(1+Rd)}$$

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2. Road Mode Cost Model and Input Values

Conversion of Freight Tonnage

T	: Freight tonnage per day	
Wg	: Average gross weight per truck (tons);	11.7
We	: Average empty weight (tons);	5.0
f	: Average load factor;	0.7
l	: Average load (tons)	

$$l = (Wg - We) \times f$$

Vt : Number of trucks per day

$$Vt = T/l$$

tl	: Average standard axles per loaded truck;	1.32
te	: Average standard axles per empty truck;	0.022
to	: Overall Average standard axles per truck	

$$to = f \times tl + (1-f) \times te$$

St : Number of standard axles per year (trucks)

$$St = Vt \times to \times 365$$

Conversion of Number of Passengers

P	: Number of passengers per day	
O1	: Average occupancy of buses;	53
O2	: Average occupancy of mini-buses;	26
O3	: Average occupancy of car-taxi-jeep;	3.6
O4	: Average occupancy of rickshaw;	1.5
C1	: Composition in percent of buses;	40.8
C2	: Composition in percent of mini-buses;	18.7
C3	: Composition in percent of car-taxi-jeep;	22.8
C4	: Composition in percent of rickshaw;	17.8

Vp : Number of passenger vehicles per day

$$Vp = \frac{P}{1/100 \sum_{j=1}^{4} CiCi} = P/27.6$$

Vj : Number of passenger vehicles of type j

$$Vj = Vp \times Cj$$

S1	: Number of standard axles/vehicle of bus;	0.40
S2	: Number of standard axles/vehicle of mini-bus;	0.10
S3	: Number of standard axles/vehicle of car-taxi-jeep;	0.0
S4	: Number of standard axles/vehicle of rickshaw;	0.0

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Sp : Number of standard axles per year (passenger vehicles)

$$Sp = \sum_{j=1}^{4} VjSj \times 365$$

Estimation of Pavement Life

d : Pavement deflection at 4100 kg (mm); 1.0,
(for improved case 0.8)

CALu: Maximum cumulative axle load (million ESA)

$$\log CALu = -4.975\ (0.1 + \log d)$$

Rg : Traffic annual growth rate
(different rates; truck or passenger); 0.06

CALo: Existing cumulative axle load; 0

Np : Number of years

if $\sum_{i=0}^{Np} St(1+Rgt) \geq CALu-CALo$

or $\sum_{i=0}^{Np} Sp(1+Rgp) \geq CALu-CALo$

then pavement life = Np

Np2 : 2nd surfacing timing

$$Np2 = Np + 10$$

Widening Timing

Ct : Truck traffic percentage (%); 44

V : Total traffic volume per day

$$V = Vt/Ct \times 100$$

or $V = Vp/(1-Ct) \times 100$

C1 : Capacity of type A road (vpd); 8600

C2 : Capacity of type B road (vpd); 4800

C3 : Capacity of type C road (vpd); 990

k : Type of road (A or B or C); 1,2,3

Nw : Number of years

if $V(1+Rg)^{Nw} > Ck$

then widening timing is in year Nw

Nw2 : 2nd improvement

$$Nw2 = Nw + 10$$

Switch

if $Nw \leq Np$; Widening only

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Planning Horizon

Nx : Limit year; 10

Rehabilitation /Improvement Cost (Economic)

R1 : R/I cost per km of type A road (million TK); 1.84
R2 : R/I cost per km of type B road (million TK); 2.05
R3 : R/I cost per km of type C road (million TK); 2.62

Rd : Discount rate; 0.15

PRC : Present value of rehabilitation

if Np=Nx; PRC = 0

else $PRC = Rk/(1+Rd)^{(Np-1)} \times (10-Np)/10$

Widening Cost

W1 : Widening cost per km of type A road (million TK); 11.0
W2 : Widening cost per km of type B road (million TK); 2.05
W3 : Widening cost per km of type C road (million TK); 2.62

PWC : Present value of widening

if Nw=Nx; PWC = 0

else $PWC = Wk/(1+Rd)^{(Nw-1)} \times (10-Nw)/10$

- for road type B and C

if $V \times (1+r)^{Nw'} > C1$ (capacity of type A) and Nw'<Nx
then in year "Nw'" have to make four-lanes road

and $PWC = Wk/(1+r)^{(Nw-1)} \times (10-Nw)/10 + W1/(1+r)^{(Nw'-1)} \times (10-Nw')/10$

Road Surface deterioration

RNe : Existing surface roughness (mm/km); 4750
RNm : Maximum surface roughness (mm/km); 8000
RNo : Initial surface roughness (mm/km); 2000
y : Years from the present year

RN(y):Roughness in year y

-for Np<Nw

for y=Np RN(y) = RNm
y=Np2 RN(y) = RNm

for years 1 to Np-1

$$RN(y) = RNe + (RNm-RNe / CALu-CALo) \times \left(\sum_{i=0}^{y} St(1+Rgt)^{i} \right)$$

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for y=Np+1 RN(y) = RNo

for years Np+1 to Np2-1

RN(y) = RNo + RNm-RNo/10 x [y/(y-Np)]

-for Nw<Nx

Same as the above except changing the subscript p to w

if Nw'≤Nx (for road type B and C only)

for y=Nw' RN(y) = RNm

for years Nw'+1 to Nw'+10

RN(y) = RNo + RNm-RNo/10 x [y/(y-Nw')]

Calculate RN(y) values for y = 1 to Nx

<u>VOC (Vehicle Operating Cost)</u>

DIST: Distance (km)

OC1 : VOC per bus in good condition (TK/km)

OC1 = (6.25 + (DIST/23.5 + 8.51)x23/DIST) x 0.925

OC2 : VOC per mini-bus in good condition (TK/km)

OC2 = (3.77 + (DIST/23.5 + 8.51)x17.4/DIST) x 0.925

OC3 : VOC per car-taxi-jeep in good condition (TK/km)

OC3 = (3.17 + 6.53) x 0.925

OC4 : VOC per rickshaw in good condition (TK/km)

OC4 = 0

OCt : VOC per truck in good condition (TK/km)

OCt = (4.31 + (DIST/28 +7.6)x38.6/DIST) x 0.893

Xy : Dummy, one thousand of RN

Xy = RN(y)/1000

FVpy: VOC multiplier for passenger vehicle for year y

$FVpy = 0.0230 \times Xy^2 - 0.0979 \times Xy + 1.1039$

FVty: VOC multiplier for truck for year y

$FVty = 0.0126 \times Xy^2 - 0.00415 \times Xy + 0.9546$

Vty : Number of trucks per day in year y

$$Vty = Vt \times (1+Rgt)^{(y-1)}$$

VOCty: Annual truck VOC in year y (million TK)

$$VOCty = 365 \times Vty \times OCt \times FVty \times 10^{-6}$$

PVOCt: Present value of truck VOC

$$PVOCt = \sum_{i=1}^{Nx} VOCty \times 1/(1+Rgt)^{(i-1)}$$

Vjy : Number of type j passenger vehicles in year y

$$Vjy = Vj \times (1+Rgp)^{(y-1)}$$

VOCpy: Annual passenger vehicle VOC in year y (million TK)

$$VOCpy = \sum_{j=1}^{4} Vjy \times 365 \times OCj \times FVpy \times 10^{-6}$$

PVOCp: Present value of passenger VOC

$$PVOCp = \sum_{i=1}^{Nx} VOCpy /(1+Rgp)^{(i-1)}$$

<u>Total Cost (Present Value)</u>

TCt : Total present value of truck transport cost

TCt = (PRC or PWC) + PVOCt

TCp : Total present value of passenger transport cost

TCp = (PRC or PWC) + PVOCp

3. Water Mode Cost Model and Input Values

Freight:

To : Freight tonnage per day (initial)
Ti : Freight tonnage in year i

$$Ti = To \times (1+Rgt)^{(i-1)}$$

Rgt . Freight demad annual growth rate; 0.06

Wo : Average payload per vessel (tons); 818
N : Number of vessels per day

$$N = Ti/Wo$$

W : Average load = Wo

Vessel Cost

DIST : Distance (km)
VA : Average speed (km/hr); 10.4
NSD : Non-steaming days per round trip; 10.3,
(for improved case 4.3)
FCD : Fixed cost per day per vessel (Taka); 14800
FTVC : Total vessel fixed cost per km per day

$$FTVC = (2 \times DIST/VA/24 + NSD) \times FCD/DIST \times N$$

AFTVC : Annual fixed cost per km (million TK)

$$AFTVC = FTVC \times 365 \times 10^{-6}$$

LDC : Payload dependent variable cost fraction; 0.30
VCV : Variable cost per km per vessel (Taka); 91.6
VTVC : Total vessel variable cost per km

$$VTVC = N \times VCV \times (2 - LDC)$$

AVTVC : Annual variable cost (million TK)

$$AVTVC = VTVC \times 365 \times 10^{-6}$$

TVC : Total vessel cost per day per km

$$TVC = FTVC + VTVC$$

ATVC : Annual total vessel cost per km (million TK)

$$ATVC = TVC \times 365 \times 10^{-6}$$

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Handling Cost

LUC : Loading /unloading cost per ton (TaKa); 9.4
THC : Total handling cost per day per km

THC = Ti x LUC/300

ATHC : Annual handling cost

$$ATHC = THC \times 365 \times 10^{-6}$$

Dredging

DRG : Dredging cost per year per km (Taka); 7945

Berthing Facility Construction

HRH : Handling rate per vessel (tons/hr); 17.4
HRD : Handling rate per vessel per day (tons/day)

HRD = HRH x 8

BDR : Required berthing per vessel days

BRD = [INTEGER(Wo/HRD)+1] x 2

NVPY : Number of berthing vessels per year

NVPY = INTEGER(365/BRD)

CAPB : Annual capacity per berth

CAPB = NVPY x Wo

NBR : Number of berths required

NBR = INTEGER(365 x T/CAPB) + 1

CCB : Capital cost of a berth (Taka); 6190000
CRF : Capital recovery factor at 15% for 25 years; 0.1545
ACB : Annualized capital cost berths

$$ACB = CCB \times CRF \times NBR \times 10^{-6} / DIST$$

Annual Total Cost

ATCi : Annual total cost in year i

ATCi = AFTVC + AVTVC + THC + DRG + ACB

Planning Horizon

Nx : Limit year; 10

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Present Value of Total Cost

PVTC = Present value of total cost (milion TK)

$$PVTC = \sum_{i=1}^{Nx} ATCi \times 1/(1+Rd)^{(i-1)}$$

Rd : Discount rate; 0.15

Passenger:

Conversion of Number of Passengers

Po : Initial year passengers

Pi : Number of passengers per day in year i

$$Pi = Po \times (1+Rgp)^{(i-1)}$$

Rgp : Passenger annual growth rate; 0.06

LCAP : Average capacity per vessel; 180

LF : Load factor; 1.90

NVD : Number of vessel departures per day

NVD = INTEGER(Pi/LCAP x LF) + 1

Vessel Operating Cost

VAS : Average speed (km/hr); 11.4

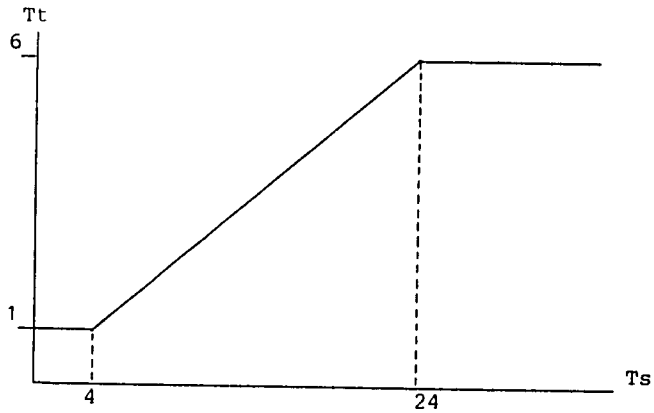
NHSH : Non-steaming hours/steaming hours; 0.217, (for improved case 0.10)

FCPV : Total fixed cost per vessel per year (Taka); 619300

Ts : Sailing time (hours)

Ts = DIST/VAS

Tt : Terminal time per trip (hours)



322

Nd : Number of departures per day

Nd-1 = INTEGER(12/ Ts+Tt) (Minimum Nd=1)

Ti : Idling hours per day

Ti = [24 - (Ts + Tt)] x Nd ;(Ts + Tt)≤24
= [48 - (Ts + Tt)] x Nd /2 ;24<(Ts + Tt)≤48

Tj : Idling hours per trip

Tj = Ti/Nd

Ta : Total hours per trip

Ta = Ts + Tt + Tj

FCSK : Fixed cost per vessel per km (Taka)

FCSK = Ta x (1+NHSH) x FCPV /365/24/DIST

AFC : Annual fixed cost per km (million TK)

AFC = FCSK x NVD x 365 x 10^{-6}

VCPC : Variable cost per km (Taka); 14.75
VTPC : Total vessel variable cost per km per day

VTPC = NVD x VCPC

AVC : Annual variable cost per km (million TK)

AVC = VTPC x 365 x 10^{-6}

TAVC : Total annual vessel cost per km (million TK)

TAVC = AFC + AVC

Dredging

DRG : Dredging cost per year per km (Taka); 7945

Passenger Terminal

LSCC : Landing station capital cost (Taka); 1820000
LSCA : Landind station unit capacity; 9216
CRF : Capital recovery factor at 15% for 25 years; 0.1545
NLS : Number of land facility units

NLS = INTEGER(P/LSCA) + 1

ACCL : Annualized capital cost of landing facilities

ACCL = LSCC x CRF x NLS X 10^{-6} /DIST

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Present Value of Total Cost

PVCPV : Present value of total cost

$$PVCPV = \sum_{i=1}^{Nx} (AFCi + AVCi + DRG + ACCLi)$$

Appendix 3.4.2 Structure of Dynamic Programming Model

Cost Functions

Xk : Traffic level (passengers or tons per day) of mode k

Zk(Xk): Cost function of mode k

$$Zk(Xk) = \frac{Ce+1 - Ce}{Te+1 - Te} \times (Xk - Te) + Ce$$

(Te , Ce): Given points of cost function;

Te : Traffic level
Ce : Cost

Traffic Level

W : Total traffic

Increment

Δ : Increment; 0.025

Initial

F1(0) = Z1(0)

F2(0) = Z2(0)

F3(0) = Z3(0)

Iteration

i = 1 to 40

F1(i) = Z1(i Δ W)

F2(i) = Min[Z2(j2 Δ W) + F1(i-j2)]; j2=0,i

F3(i) = Min[Z3(j3 Δ W) + F2(i-j3)]; j3=0,i

H1(i) = i

H2(i) = j2 (giving minimum F2)

H3(i) = j3 (giving minimum F3)

Optimum Combination

j3' = H3(40)

i2' = 40 - j3'

j2' = H2(i2')

i1' = i2' - j2'

Optimum combination (traffic) in fraction

i1'.Δ for mode 1

j2'.Δ for mode 2

j3'.Δ for mode 3

MV : Minimum total combination cost

MV = F3(40)

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Fig. 3.4.17 Total Cost of Freight by Rail/km

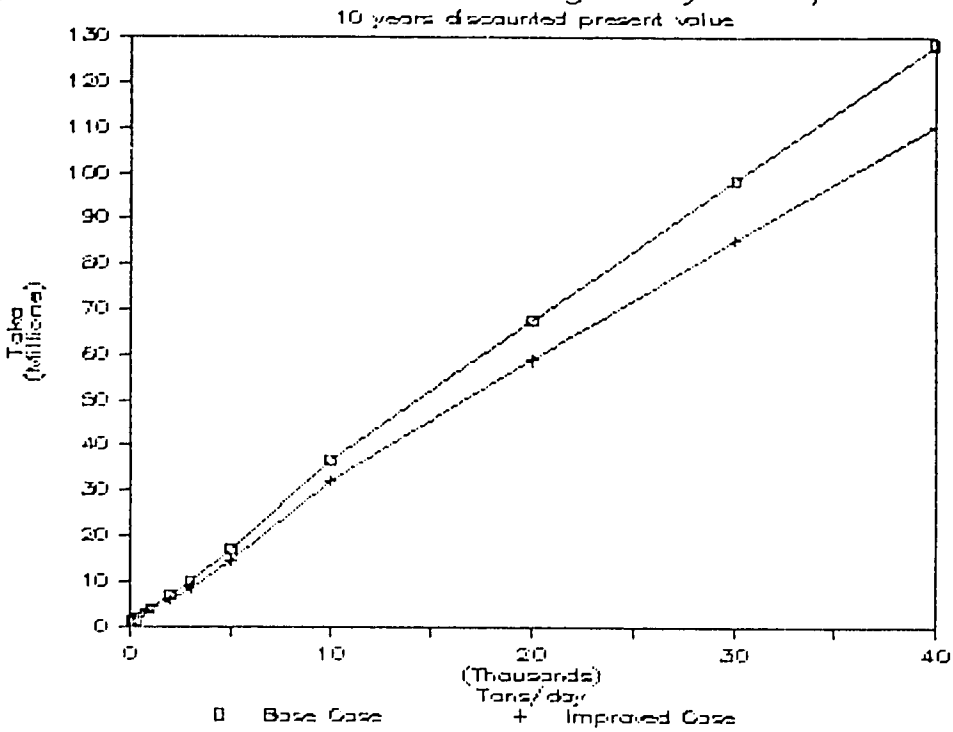

Fig. 3.4.18 Total Cost of Passenger by Rail/km

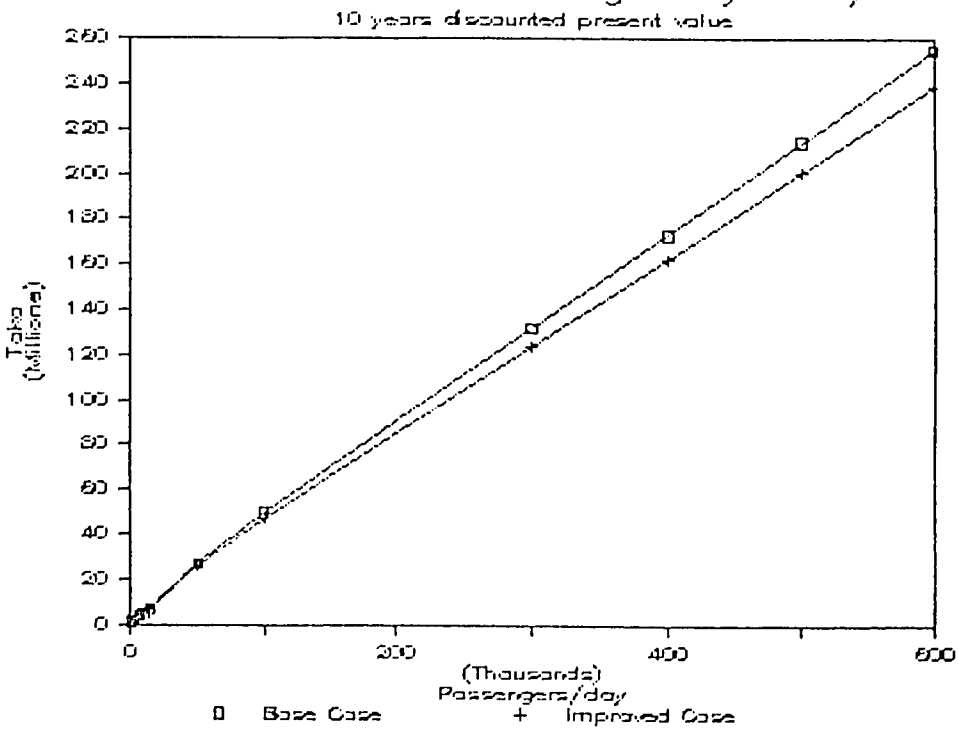

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Fig. 3.4.19 Total Cost of Freight by Road/km

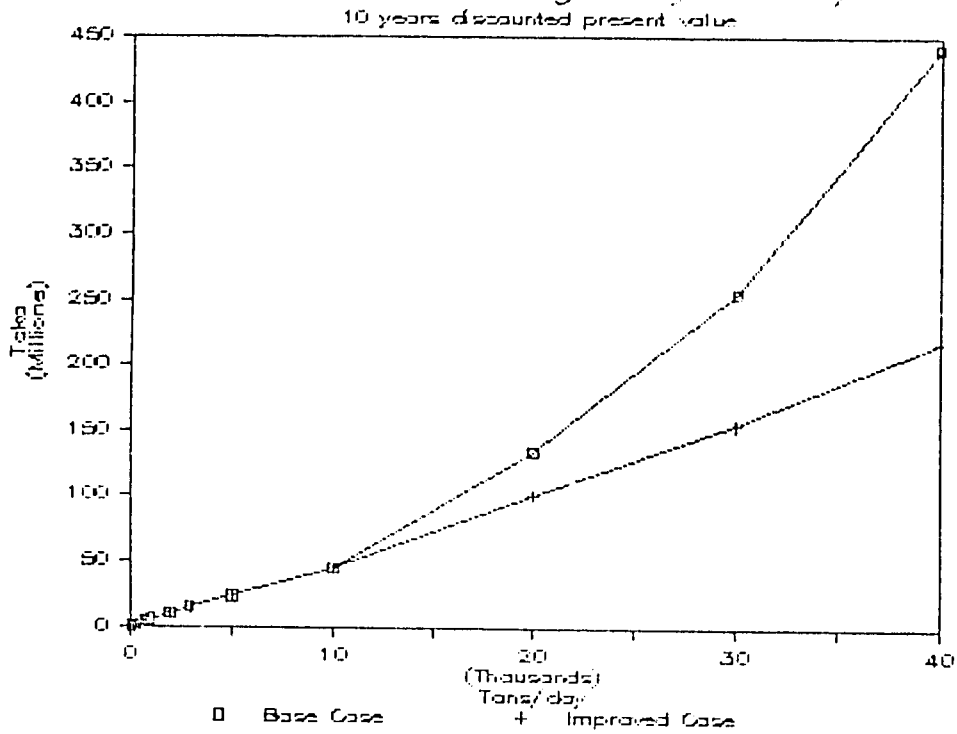

Fig. 3.4.20 Total Cost of Passenger by Road/km

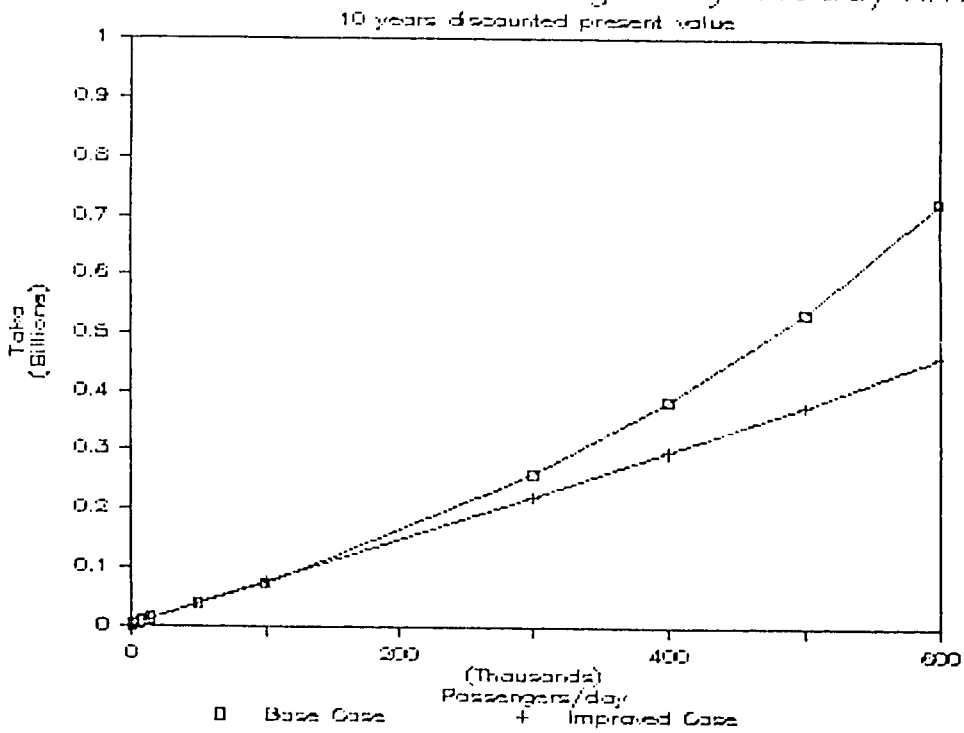

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Fig. 3.4.22 Total Cost of Freight by IWT/km

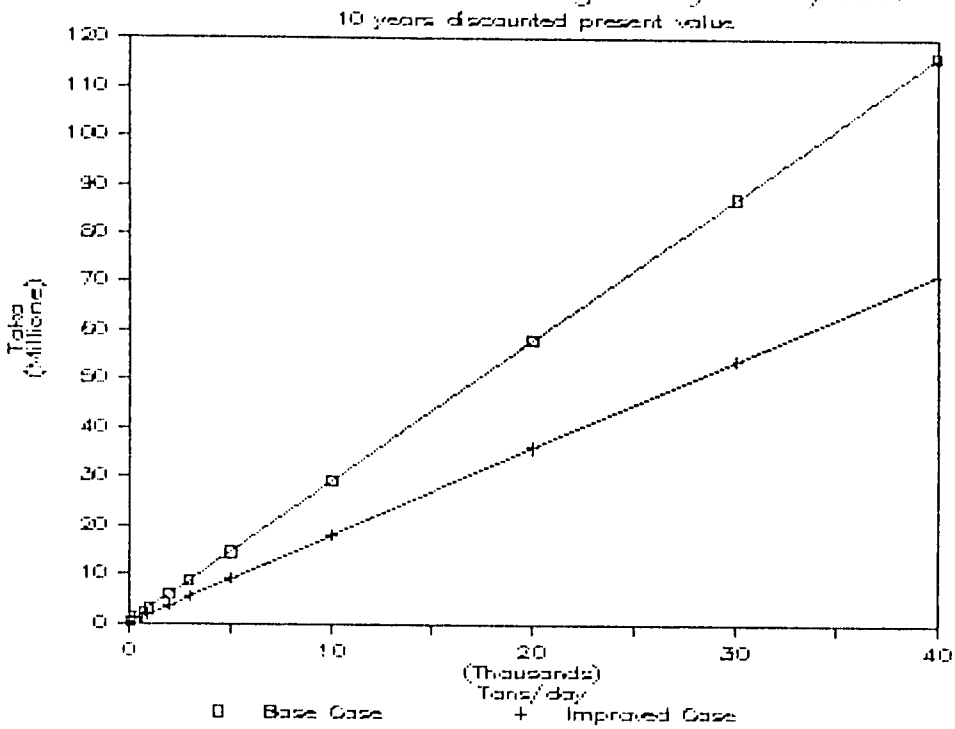
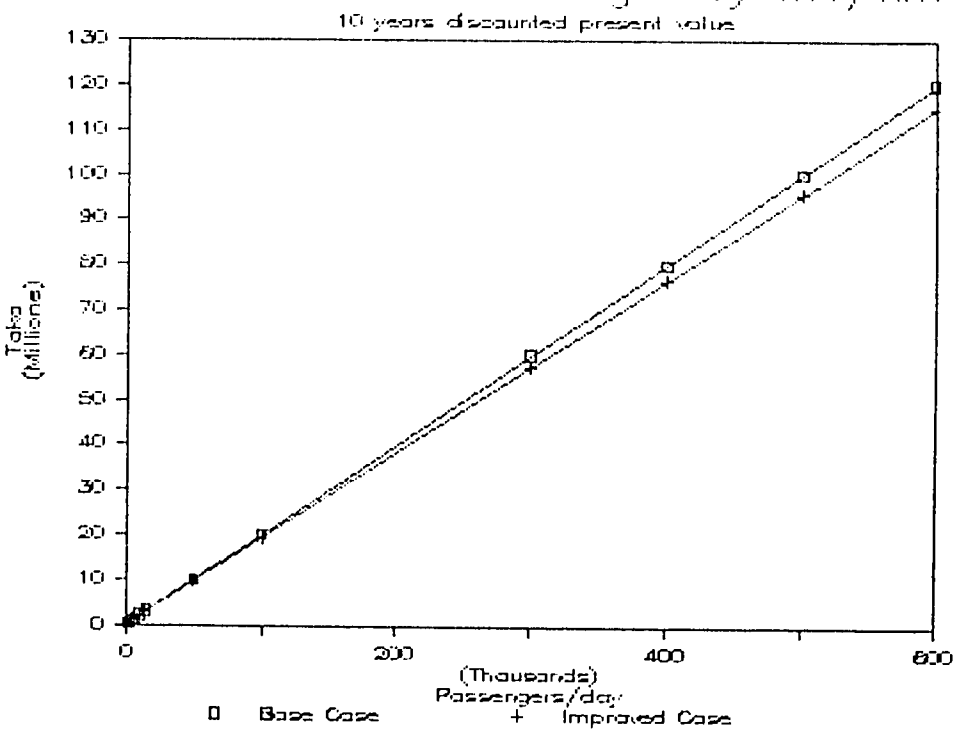


Fig. 3.4.23 Total Cost of Passenger by IWT/km



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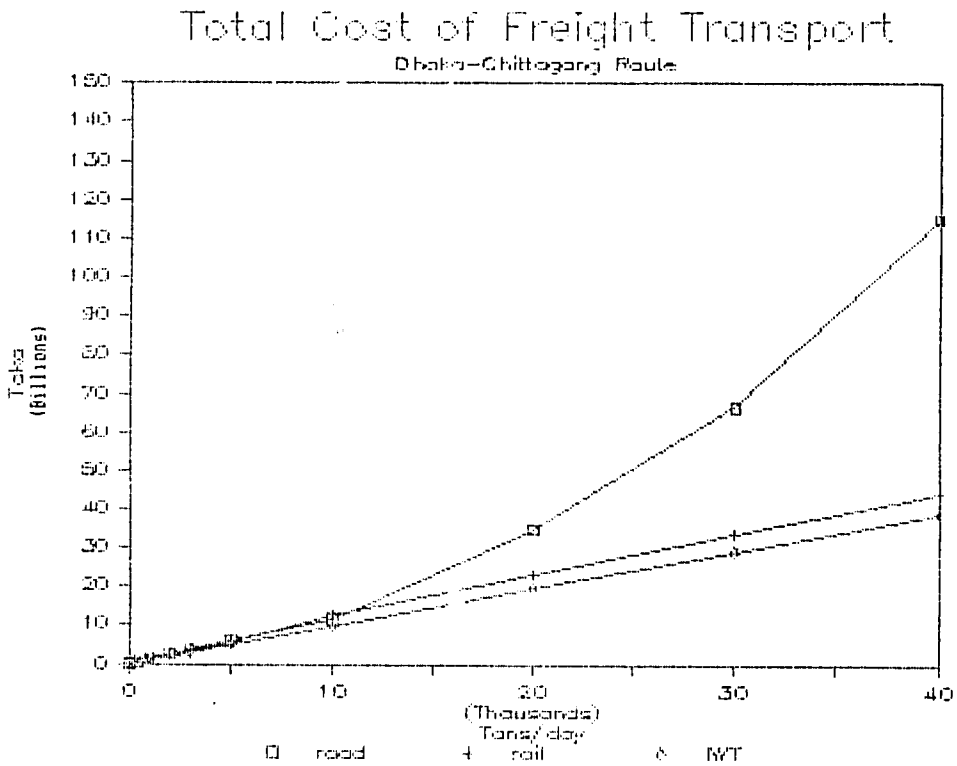
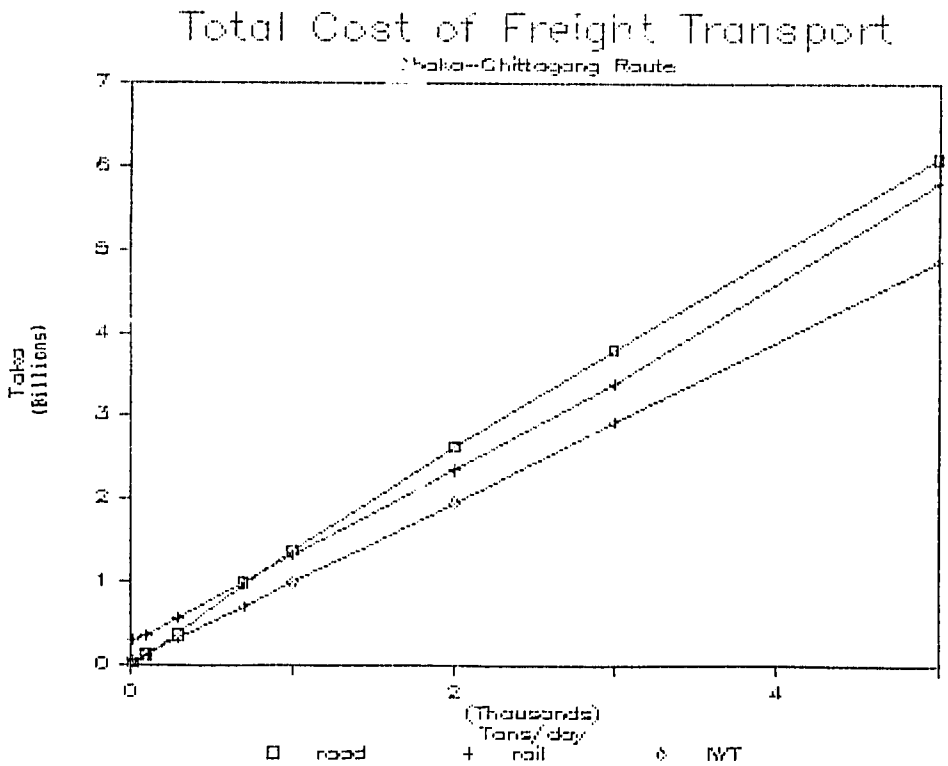
Appendix 3.5 Cooridors Traffic Costs





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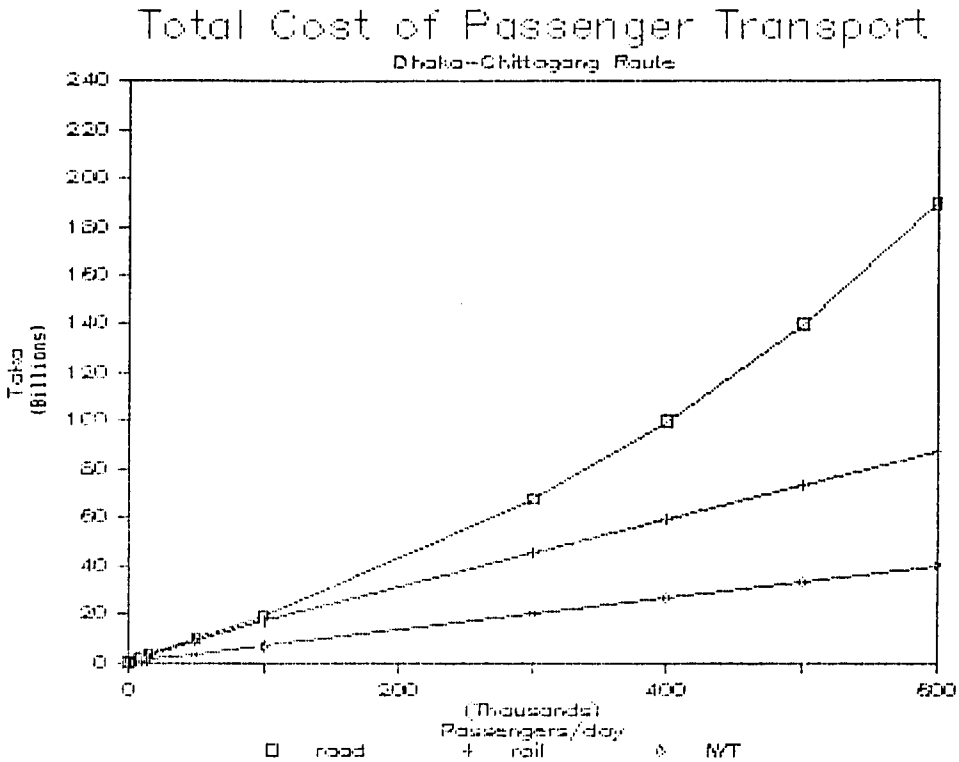
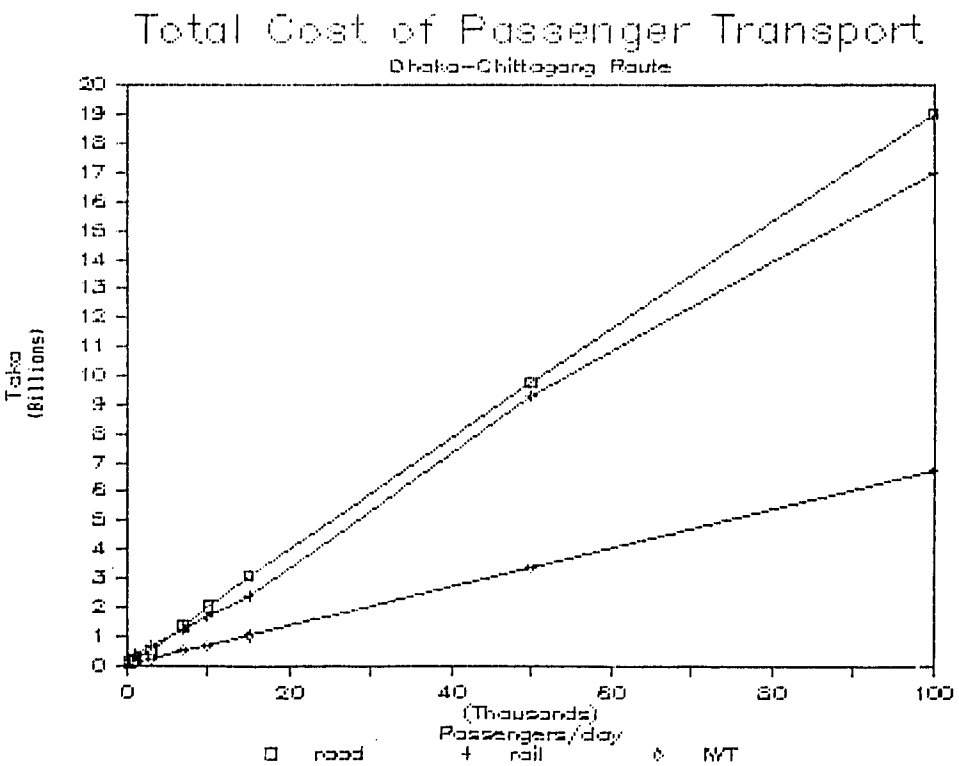
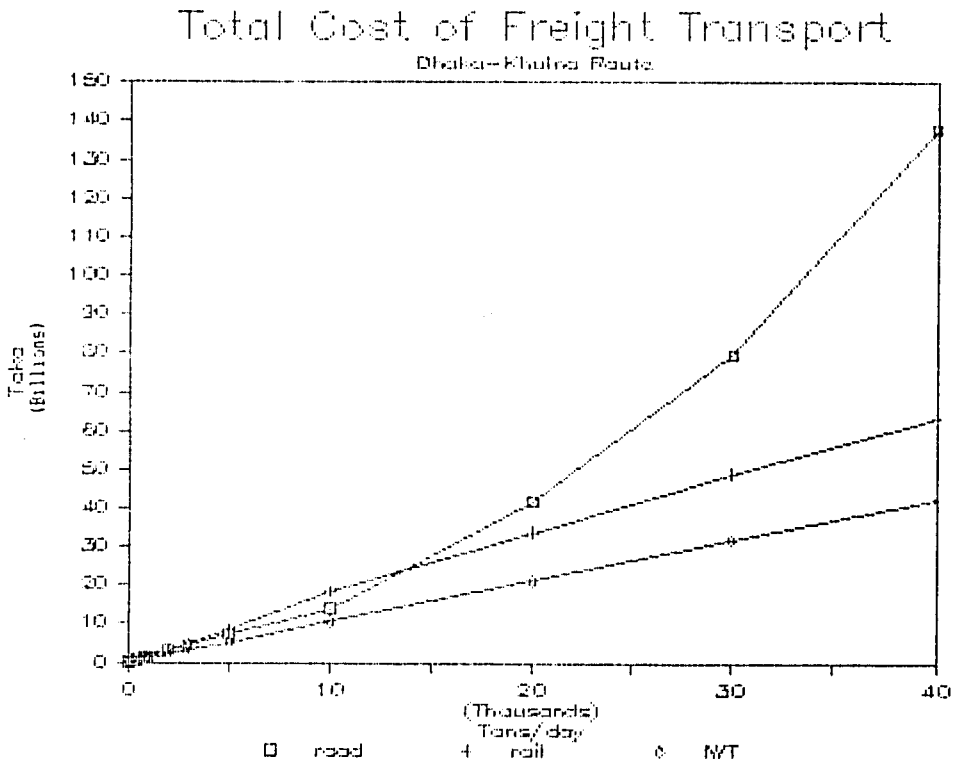
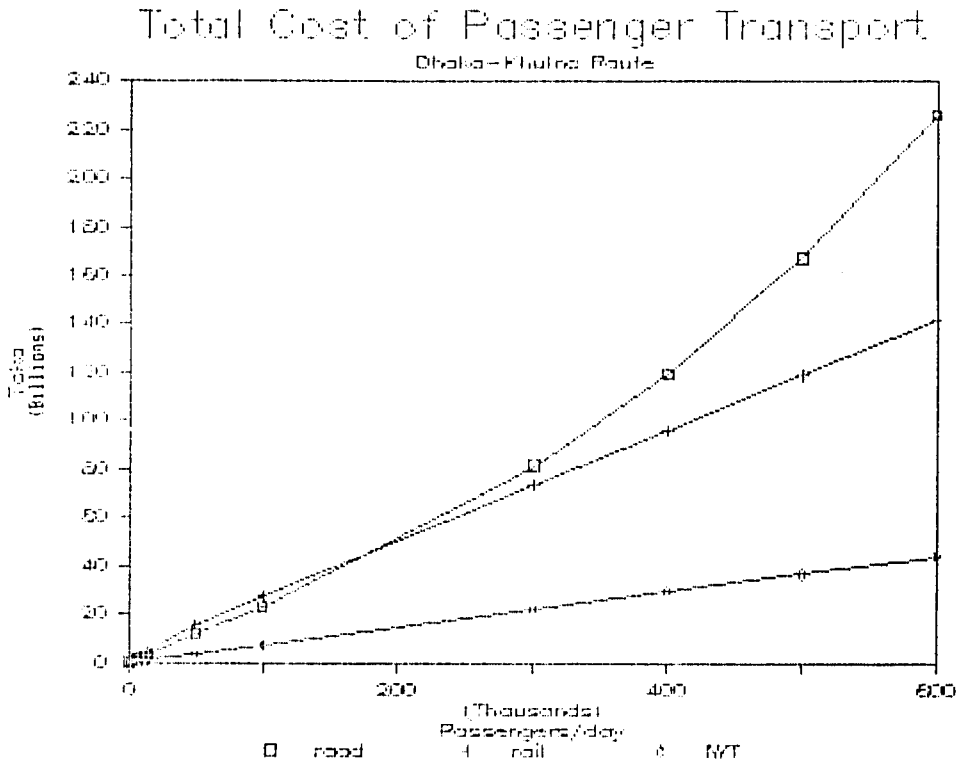

Total Cost of Passenger Transport
Dhaka-Chittagong Route
Taka (Billions)
240
220
200
180
160
140
120
100
80
60
40
20
0
0
200
400
600
(Thousands) Passengers/day
road
rail
NVT

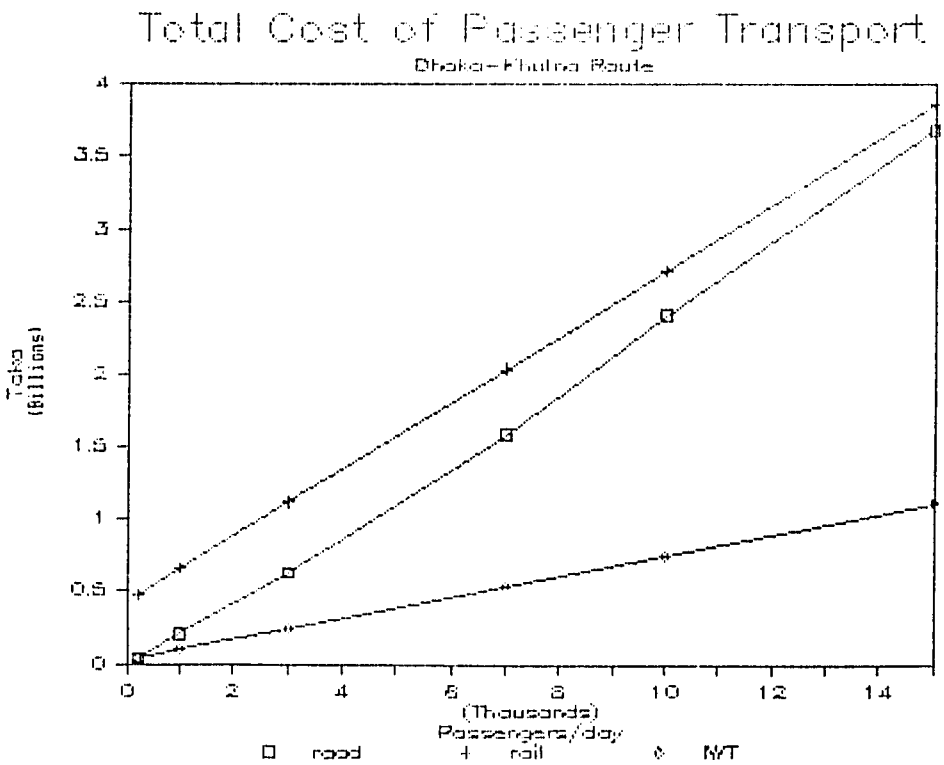

Total Cost of Passenger Transport
Dhaka-Chittagong Route
Taka (Billions)
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
0
20
40
60
80
100
(Thousands) Passengers/day
road
rail
NVT

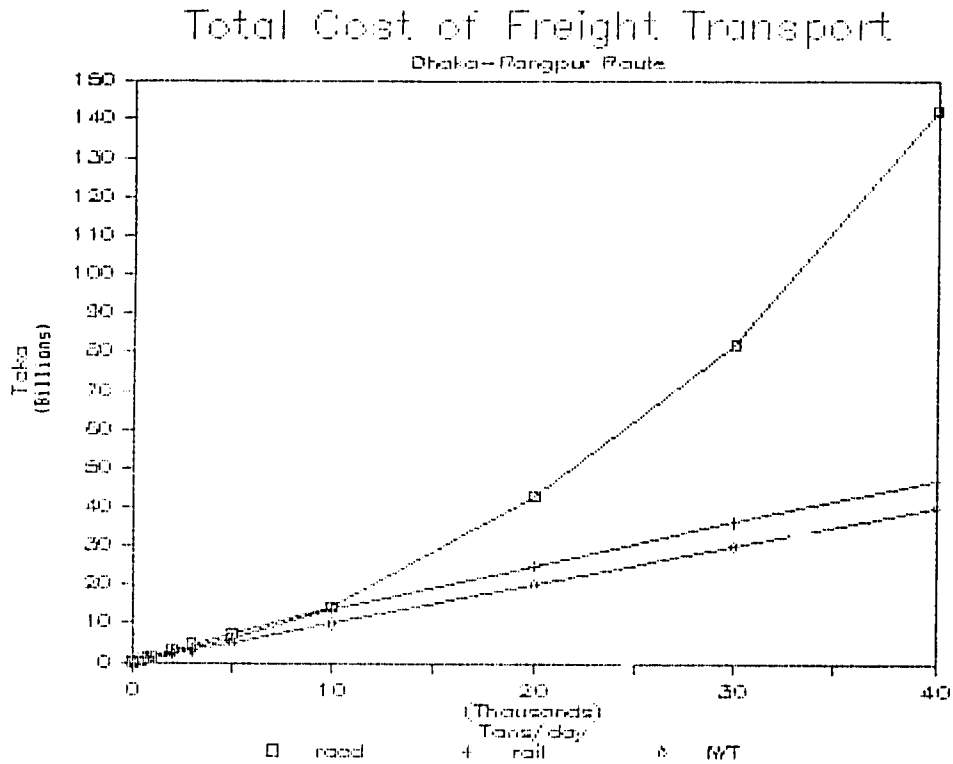
331

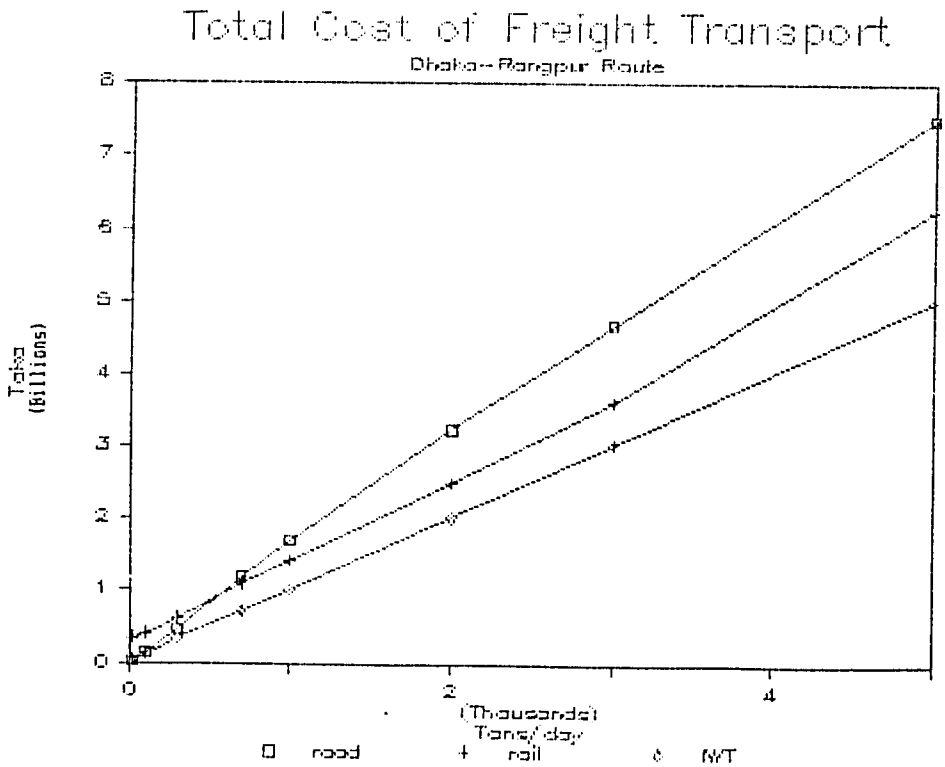

Total Cost of Freight Transport
Dhaka-Khulna Route
Taka
(Billions)
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
(Thousands)
Tons/day
□ road
+ rail
◇ N/T

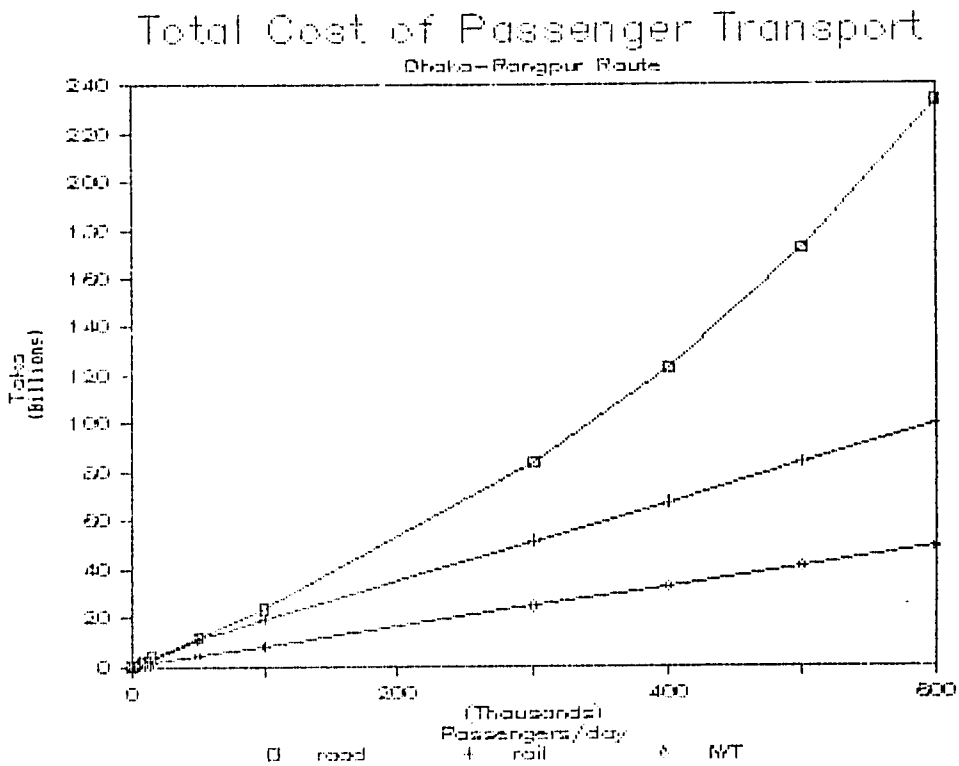
372

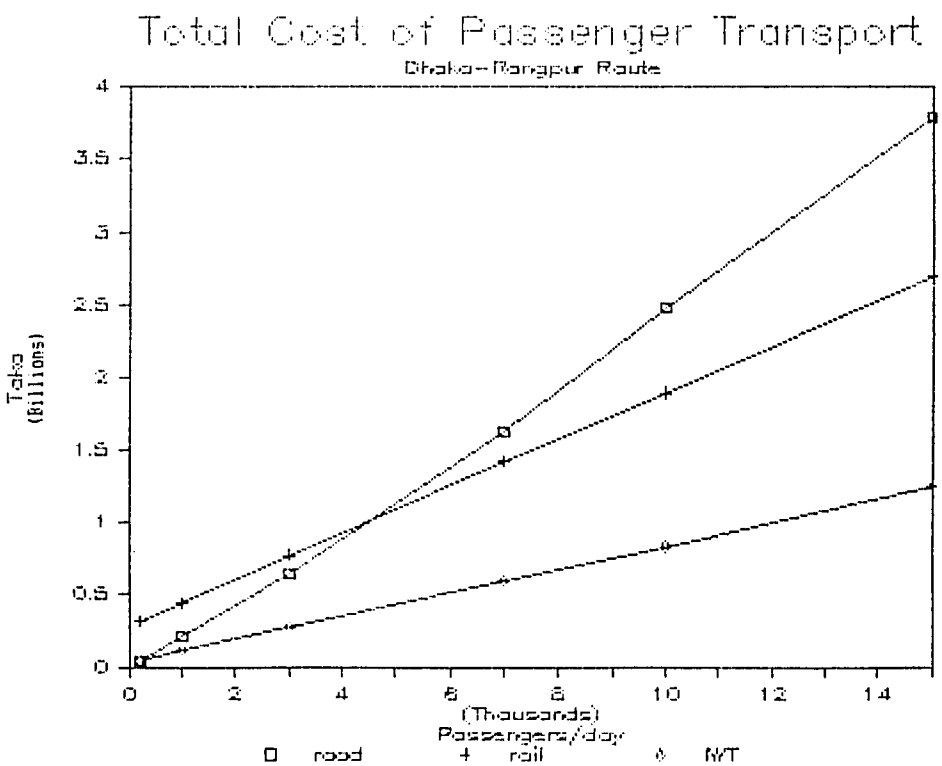

Total Cost of Passenger Transport
Dhaka-Khulna Route
Taka (Billions)
0
20
40
60
80
100
120
140
160
180
200
220
240
0
200
400
600
(Thousands) Passengers/day
road
rail
N/T

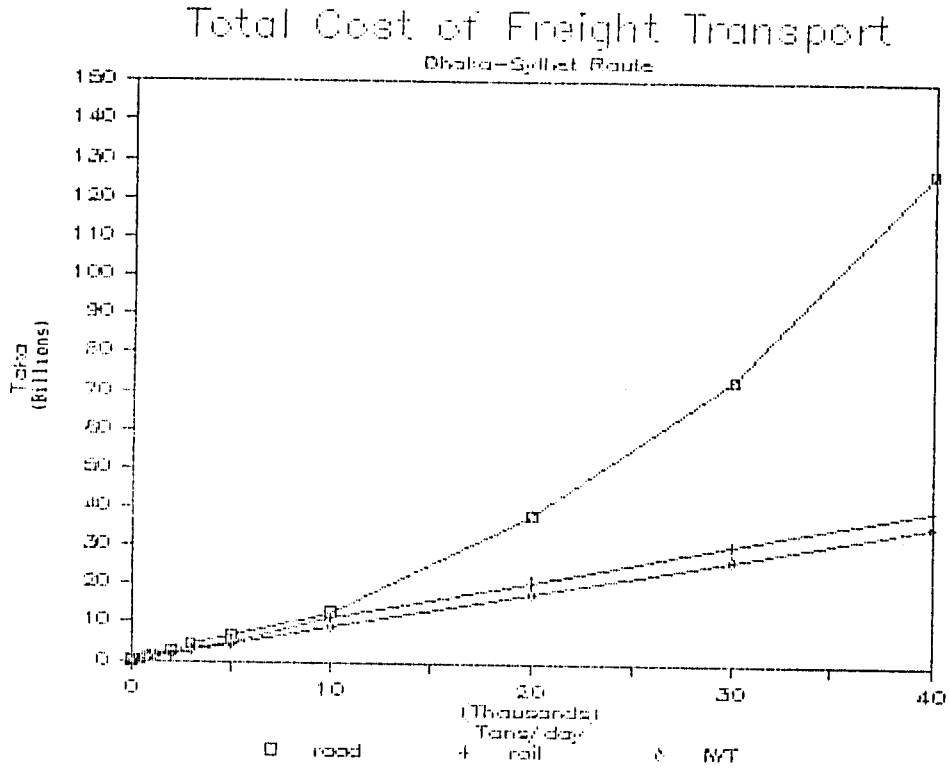

Total Cost of Passenger Transport
Dhaka-Khulna Route
Taka (Billions)
0
0.5
1
1.5
2
2.5
3
3.5
4
0
2
4
6
8
10
12
14
(Thousands) Passengers/day
road
rail
N/T

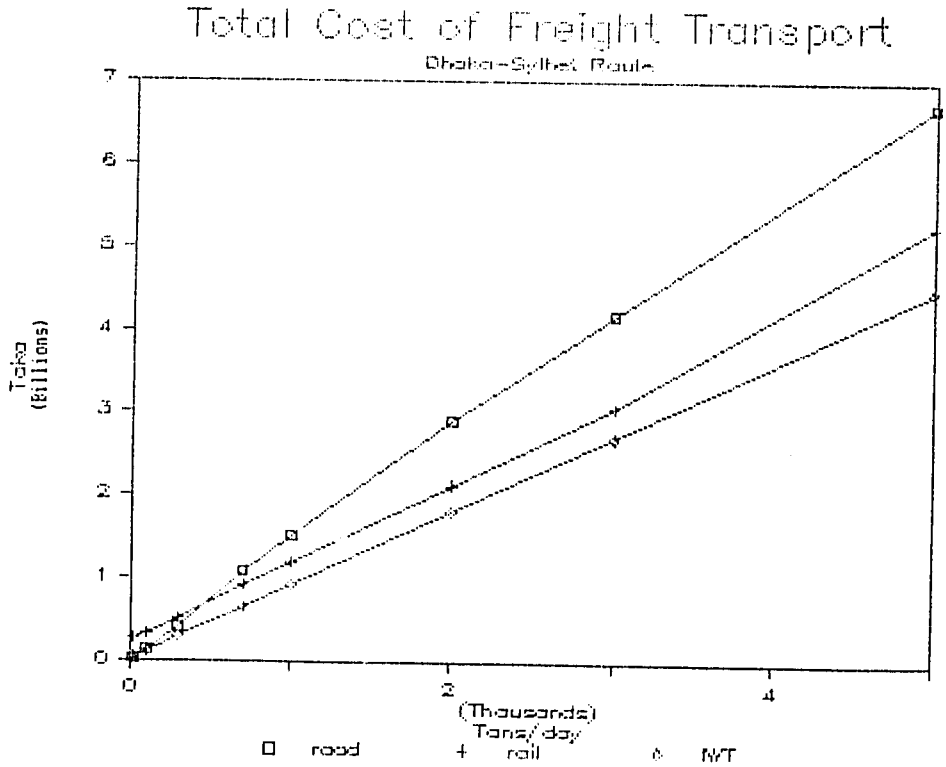

Total Cost of Freight Transport
Dhaka-Rangpur Route
Taka (Billions)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
0
10
20
30
40
(Thousands) Tons/day
road
rail
W/T


Total Cost of Freight Transport
Dhaka-Rangpur Route
Taka (Billions)
0
1
2
3
4
5
6
7
8
0
2
4
(Thousands) Tons/day
road
rail
W/T

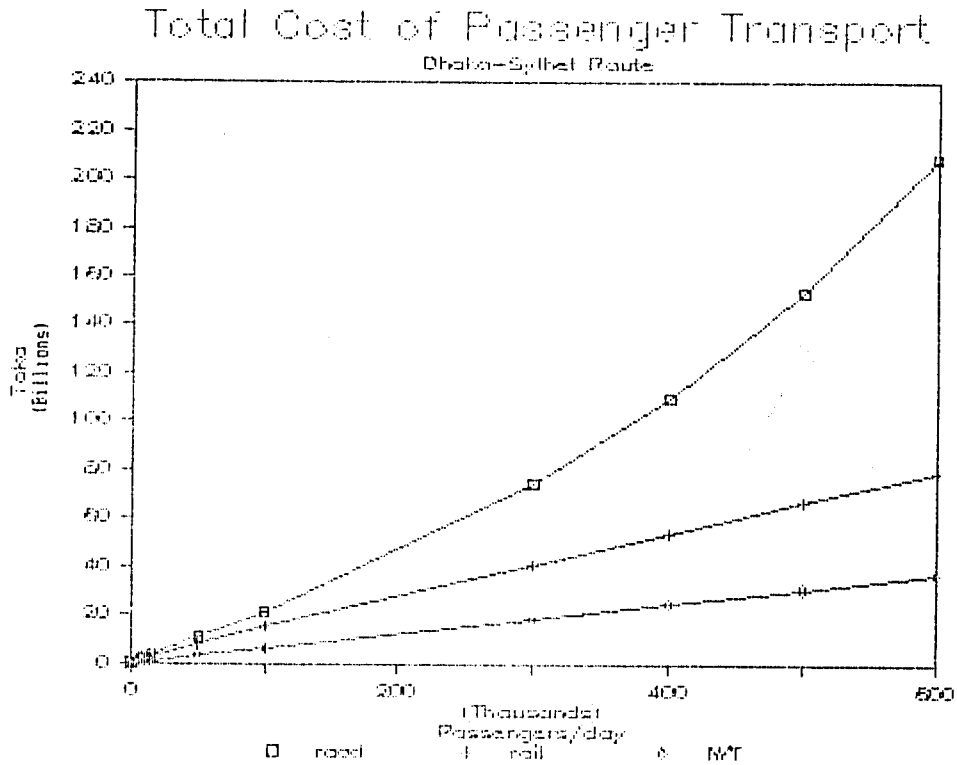

Total Cost of Passenger Transport
Dhaka-Rangpur Route
Taka (Billions)
240
220
200
180
160
140
120
100
80
60
40
20
0
0
200
400
600
(Thousands) Passengers/day
road
rail
N/T

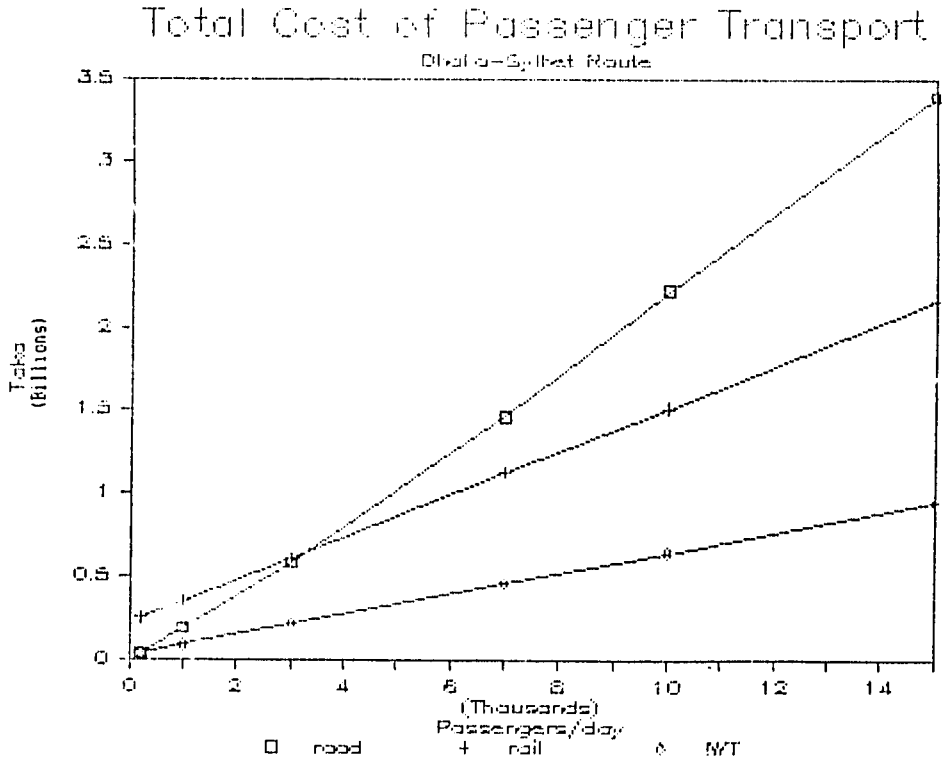

Total Cost of Passenger Transport
Dhaka-Rangpur Route
Taka (Billions)
4
3.5
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
10
12
14
(Thousands) Passengers/day
road
rail
N/T

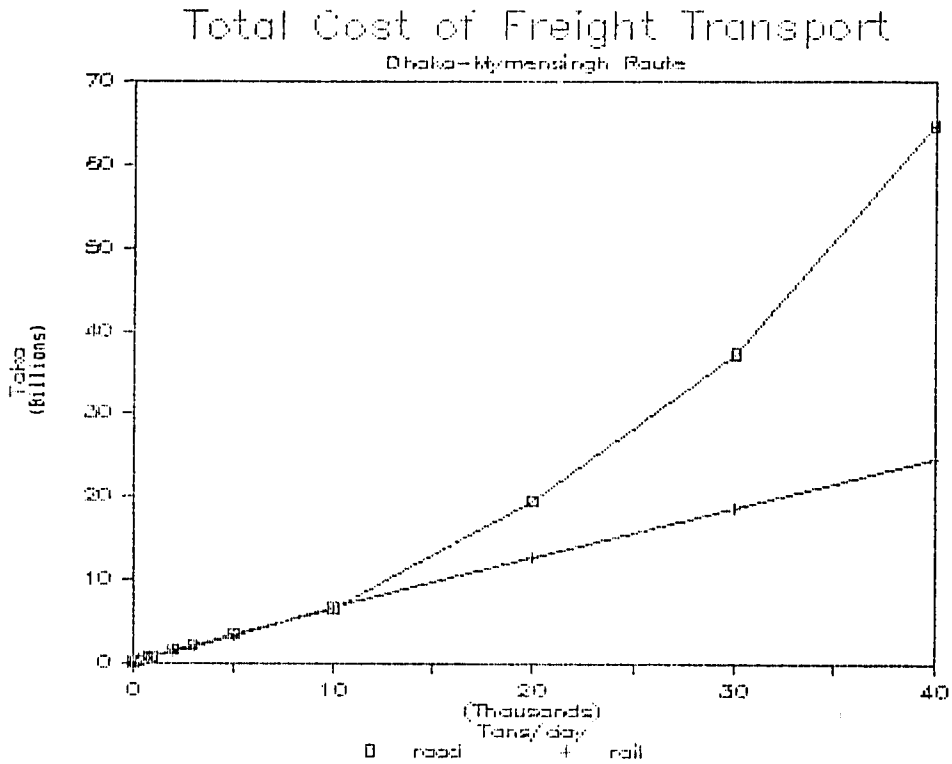

Total Cost of Freight Transport
Dhaka-Sylhet Route
Taka (Billions)
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
(Thousands) Tons/day
road
rail
NVT

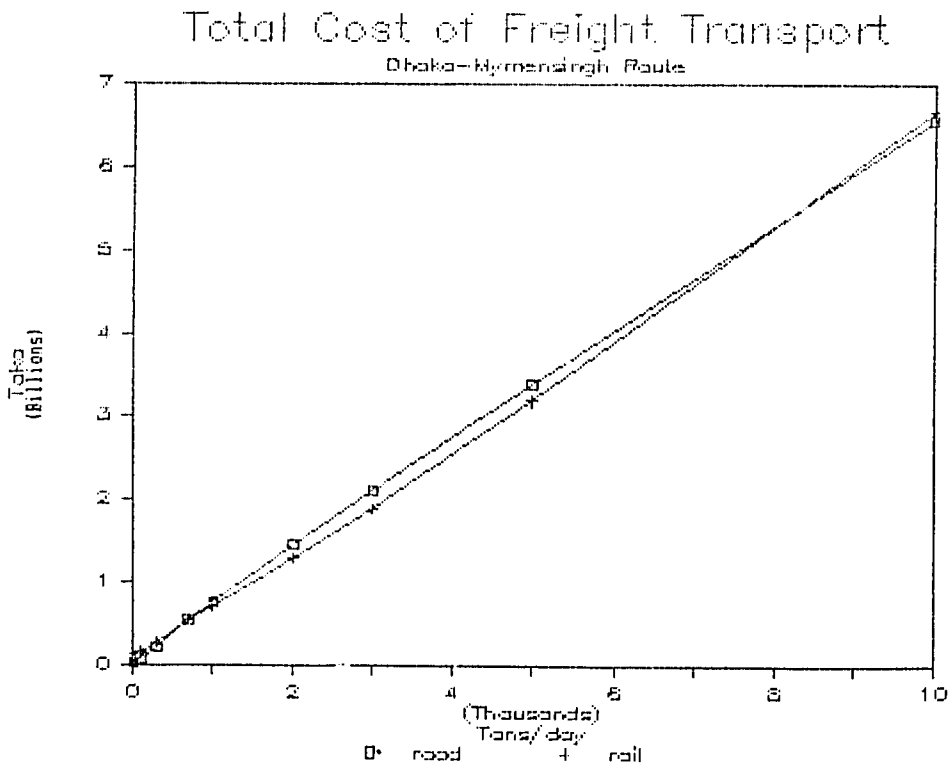

Total Cost of Freight Transport
Dhaka-Sylhet Route
Taka (Billions)
7
6
5
4
3
2
1
0
0
2
4
(Thousands) Tons/day
road
rail
NVT

336

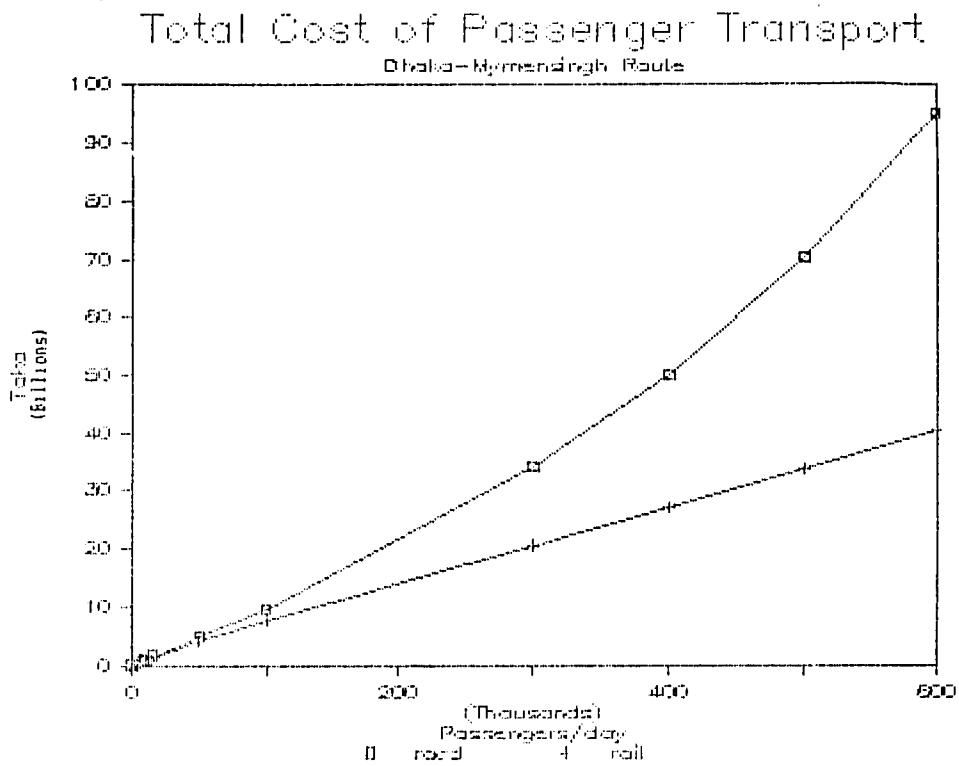

Total Cost of Passenger Transport
Dhaka-Sylhet Route
Taka (Billions)
240
220
200
180
160
140
120
100
80
60
40
20
0
0
200
400
600
(Thousands) Passengers/day
road
rail
N/T

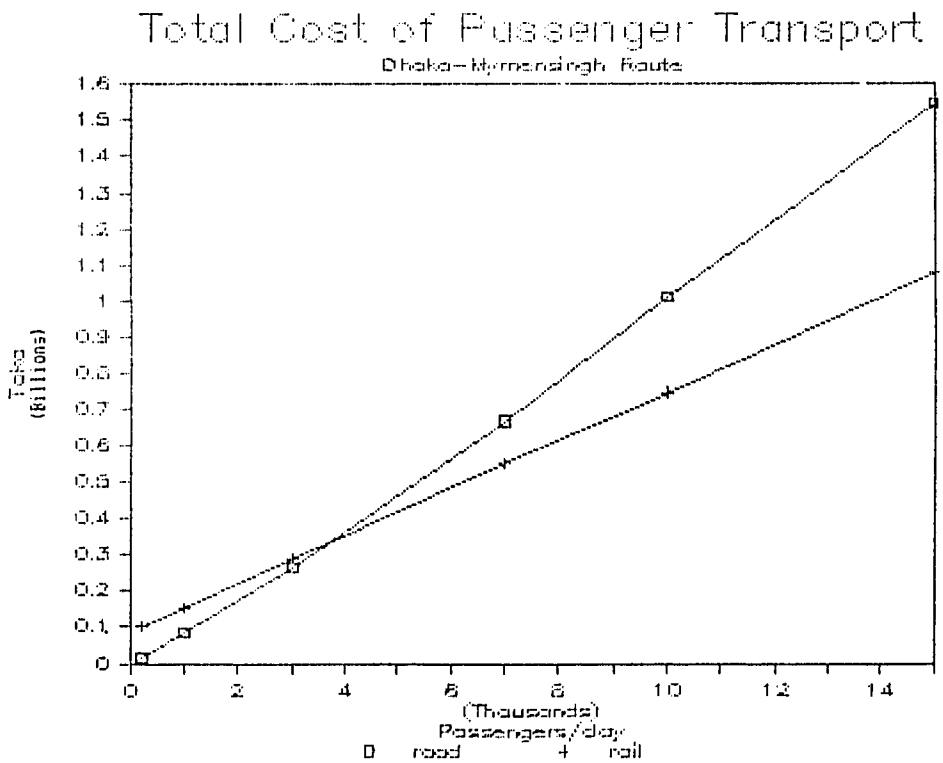

Total Cost of Passenger Transport
Dhaka-Sylhet Route
Taka (Billions)
3.5
3
2.5
2
1.5
1
0.5
0
0
2
4
6
8
10
12
14
(Thousands) Passengers/day
road
rail
N/T


Total Cost of Freight Transport
Dhaka-Mymensingh Route
Taka (Billions)
70
60
50
40
30
20
10
0
0
10
20
30
40
(Thousands) Tons/day
□ road
+ rail


Total Cost of Freight Transport
Dhaka-Mymensingh Route
Taka (Billions)
7
6
5
4
3
2
1
0
0
2
4
6
8
10
(Thousands) Tons/day
□ road
+ rail

7/8


Total Cost of Passenger Transport
Dhaka-Mymensingh Route
Taka (Billions)
100
90
80
70
60
50
40
30
20
10
0
0
200
400
600
(Thousands)
Passengers/day
□ road
+ rail


Total Cost of Passenger Transport
Dhaka-Mymensingh Route
Taka (Billions)
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
14
(Thousands)
Passengers/day
□ road
+ rail

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Appendix 4.1.4 O-D Tables of Freight Transport

1985 O-D MATRIX OF TOTAL FREIGHT TRANSPORT

(THOUSAND TONS/YEAR)

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	:TOTAL
1 :	0	164	374	229	38	870	11	20	14	2	16	6	202	7	2	6	5	6	10	10	1992
2 :	164	0	27	27	0	13	0	0	0	0	0	0	1	0	0	0	0	0	0	0	232
3 :	374	27	0	0	99	116	0	4	3	0	3	0	13	0	0	0	0	4	3	0	646
4 :	229	27	0	0	4	63	2	0	0	0	0	0	0	0	0	0	0	0	3	4	352
5 :	38	0	99	4	0	84	2	0	6	0	3	0	9	0	1	0	0	6	0	0	252
6 :	870	13	116	83	84	0	27	104	185	133	31	63	217	65	3	45	30	55	27	63	2234
7 :	11	0	0	2	2	27	0	0	0	0	27	18	57	1	10	0	1	3	0	6	165
8 :	20	0	4	0	0	104	0	0	0	0	0	0	0	0	0	0	0	2	0	0	130
9 :	14	0	3	0	6	185	0	0	0	0	0	3	0	0	0	0	0	2	0	2	215
10 :	2	0	0	0	0	133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135
11 :	16	0	3	0	3	31	27	0	0	0	0	14	34	13	30	1	0	0	0	0	172
12 :	6	0	0	0	0	63	18	0	3	0	14	0	191	26	0	6	0	8	0	0	335
13 :	202	1	13	0	9	217	57	0	0	0	34	191	0	95	15	11	4	47	37	18	951
14 :	7	0	0	0	0	65	1	0	0	0	13	26	95	0	0	0	0	3	0	9	219
15 :	2	0	0	0	1	3	10	0	0	0	30	0	15	0	0	0	0	0	0	0	61
16 :	6	0	0	0	0	45	0	0	0	0	1	6	11	0	0	0	2	10	0	15	96
17 :	5	0	0	0	0	30	1	0	0	0	0	0	4	0	0	2	0	10	2	17	71
18 :	6	0	4	0	6	55	3	2	2	0	0	8	47	3	0	10	10	0	49	35	240
19 :	10	0	3	3	0	27	0	0	0	0	0	0	37	0	0	0	2	49	0	14	145
20 :	10	0	0	4	0	83	6	0	2	0	0	0	18	9	0	15	17	35	14	0	213
TOTAL:	1992	232	646	352	252	2234	165	130	215	135	172	335	951	219	61	96	71	240	145	213	17712

340

1985 O-D MATRIX OF FREIGHT TRANSPORT BY RAIL (THOUSAND TONS/YEAR)

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	:TOTAL
1 :	0	0	72	21	16	48	1	4	2	0	0	5	47	5	0	3	3	2	4	4	236
2 :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3 :	72	0	0	0	13	27	0	2	2	0	0	0	3	0	0	0	0	2	2	0	123
4 :	21	0	0	0	3	5	1	0	0	0	0	0	0	0	0	0	0	0	2	2	34
5 :	16	0	13	3	0	7	1	0	2	0	0	0	3	0	0	0	0	2	0	0	47
6 :	48	0	27	5	7	0	2	12	18	0	0	35	82	27	0	28	9	10	9	39	358
7 :	1	0	0	1	1	2	0	0	0	0	0	1	1	1	0	0	0	0	0	0	8
8 :	4	0	2	0	0	12	0	0	0	0	0	0	0	0	0	0	0	1	0	0	19
9 :	2	0	2	0	2	18	0	0	0	0	0	2	0	0	0	0	0	1	0	2	29
10 :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11 :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 :	5	0	0	0	0	35	1	0	2	0	0	0	7	12	0	0	0	4	0	0	66
13 :	47	0	3	0	3	82	1	0	0	0	0	7	0	12	0	2	2	7	3	6	175
14 :	5	0	0	0	0	27	1	0	0	0	0	12	12	0	0	0	0	2	0	3	62
15 :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 :	3	0	0	0	0	28	0	0	0	0	0	0	2	0	0	0	1	2	0	2	38
17 :	2	0	0	0	0	9	0	0	0	0	0	0	2	0	0	1	0	1	1	2	18
18 :	2	0	2	0	2	10	0	1	1	0	0	4	7	2	0	2	1	0	2	2	38
19 :	4	0	2	2	0	9	0	0	0	0	0	0	3	0	0	0	1	2	0	6	29
20 :	4	0	0	2	0	39	0	0	2	0	0	0	6	3	0	2	2	2	6	0	68
TOTAL:	236	0	123	34	47	358	8	19	29	0	0	66	175	62	0	38	18	38	29	68	2696

1985 O-D MATRIX OF FREIGHT TRANSPORT BY ROAD (THOUSAND TONS/YEAR)

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	:TOTAL
1 :	0	138	275	205	20	346	6	16	7	2	1	1	1	0	0	2	2	1	6	6	1035
2 :	138	0	27	27	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	205
3 :	275	27	0	0	71	81	0	2	1	0	0	0	0	0	0	0	0	0	0	0	457
4 :	205	27	0	0	0	77	0	0	0	0	0	0	0	0	0	0	0	0	0	1	310
5 :	20	0	71	0	0	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	130
6 :	346	13	81	77	39	0	13	91	158	133	2	27	2[illegible]	37	0	17	20	12	18	44	1150
7 :	6	0	0	0	0	13	0	0	0	0	27	17	49	0	10	0	1	3	0	6	132
8 :	16	0	2	0	0	91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	109
9 :	7	0	1	0	0	158	0	0	0	0	0	0	0	0	0	0	0	0	0	0	166
10 :	2	0	0	0	0	133	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135
11 :	1	0	0	0	0	2	27	0	0	0	0	13	3	13	30	1	0	0	0	0	90
12 :	1	0	0	0	0	27	17	0	0	0	13	0	184	14	0	6	0	3	0	0	265
13 :	1	0	0	0	0	22	49	0	0	0	3	184	[illegible]	83	0	6	1	35	33	11	430
14 :	0	0	0	0	0	37	0	0	0	0	13	14	83	0	0	0	0	0	0	6	153
15 :	0	0	0	0	0	0	10	0	0	0	30	0	0	0	0	0	0	0	0	0	40
16 :	2	0	0	0	0	17	0	0	0	0	1	6	8	0	0	0	0	8	0	12	54
17 :	2	0	0	0	0	20	1	0	0	0	0	0	1	0	0	0	0	8	0	15	47
18 :	1	0	0	0	0	12	3	0	0	0	0	3	35	0	0	8	8	0	47	33	150
19 :	6	0	0	0	0	18	0	0	0	0	0	0	33	0	0	0	0	47	0	8	112
20 :	6	0	0	1	0	44	6	0	0	0	0	0	11	6	0	12	15	33	8	0	142
TOTAL:	1035	205	457	310	130	1150	132	109	166	135	90	265	430	153	40	54	47	150	112	142	10624

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1985 O-D MATRIX OF FREIGHT TRANSPORT BY WATER (THOUSAND TONS/YEAR)

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	:TOTAL
1 :	0	25	26	1	1	476	3	0	4	0	15	0	153	1	2	0	0	2	0	0	709
2 :	25	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	26
3 :	26	0	0	0	15	7	0	0	0	0	3	0	10	0	0	0	0	1	0	0	62
4 :	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
5 :	1	0	15	0	0	37	0	0	3	0	3	0	5	0	1	0	0	3	0	0	68
6 :	476	0	7	0	37	0	12	0	7	0	28	0	112	0	3	0	0	31	0	0	713
7 :	3	0	0	0	0	12	0	0	0	0	0	0	6	0	0	0	0	0	0	0	21
8 :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9 :	4	0	0	0	3	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
10 :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11 :	15	0	3	0	3	28	0	0	0	0	0	0	31	0	0	0	0	0	0	0	80
12 :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 :	153	1	10	0	5	112	6	0	0	0	31	0	0	0	15	0	0	4	0	0	337
14 :	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
15 :	2	0	0	0	1	3	0	0	0	0	0	0	15	0	0	0	0	0	0	0	21
16 :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18 :	2	0	1	0	3	31	0	0	0	0	0	0	4	0	0	0	0	0	0	0	41
19 :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL:	709	26	62	1	68	713	21	0	14	0	80	0	337	1	21	0	0	41	0	0	4188

1990 O-D MATRIX OF TOTAL FREIGHT TRANSPORT (THOUSAND TONS/YEAR)

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	:TOTAL
1 :	0	155	419	256	29	858	6	18	10	2	15	7	145	9	2	4	4	6	11	10	1966
2 :	155	0	50	50	0	20	0	0	0	0	0	0	1	0	0	0	0	0	0	0	276
3 :	419	50	0	0	142	203	0	8	5	0	7	0	18	0	0	0	0	8	6	0	866
4 :	256	50	0	0	6	146	2	0	0	0	0	0	0	0	0	0	0	0	7	9	476
5 :	29	0	142	6	0	103	1	0	6	0	4	0	9	0	2	0	0	3	0	0	310
6 :	858	20	203	146	103	0	29	146	223	170	61	103	282	123	7	46	35	96	43	125	2819
7 :	6	0	0	2	1	29	0	0	0	0	30	25	37	1	11	0	1	3	0	6	152
8 :	18	0	8	0	0	146	0	0	0	0	0	0	0	0	0	0	0	4	0	0	176
9 :	10	0	5	0	6	223	0	0	0	0	0	4	0	0	0	0	0	3	0	3	254
10 :	2	0	0	0	0	170	0	0	0	0	0	0	0	0	0	0	0	0	0	0	172
11 :	15	0	7	0	4	61	30	0	0	0	0	29	44	28	46	2	0	0	1	1	268
12 :	7	0	0	0	0	103	25	0	4	0	29	0	236	61	0	9	0	16	1	1	492
13 :	145	1	18	0	9	282	37	0	0	0	44	236	0	127	20	8	3	54	39	20	1043
14 :	9	0	0	0	0	123	1	0	0	0	28	61	127	0	0	0	0	7	0	19	375
15 :	2	0	0	0	2	7	11	0	0	0	46	0	20	0	0	0	0	0	0	0	88
16 :	4	0	0	0	0	46	0	0	0	0	2	9	8	0	0	0	2	13	0	17	101
17 :	4	0	0	0	0	35	1	0	0	0	0	0	3	0	0	2	0	15	3	23	86
18 :	6	0	8	0	8	96	3	4	3	0	0	16	54	7	0	13	15	0	95	64	392
19 :	11	0	6	7	0	43	0	0	0	0	1	1	39	0	0	0	3	95	0	25	231
20 :	10	0	0	9	0	125	6	0	3	0	1	1	20	19	0	17	23	64	25	0	323
TOTAL:	1966	276	866	476	310	2819	152	176	254	172	268	492	1043	375	88	101	86	392	231	323	21732

2000 O-D MATRIX OF TOTAL FREIGHT TRANSPORT (THOUSAND TONS/YEAR)

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	:TOTAL
1 :	0	458	613	335	56	2004	17	33	27	9	45	26	208	33	10	12	13	32	29	29	3989
2 :	458	0	148	132	0	106	0	0	0	0	0	0	14	0	0	0	0	0	0	0	858
3 :	613	148	0	0	175	508	0	21	17	0	20	0	38	0	0	0	0	32	22	0	1594
4 :	335	132	0	0	19	330	9	0	0	0	0	0	0	0	0	0	0	0	20	22	867
5 :	56	0	175	19	0	209	9	0	20	0	12	0	30	0	8	0	0	18	0	0	556
6 :	2004	106	508	330	209	0	35	272	334	285	217	259	672	315	26	74	42	231	107	274	6260
7 :	17	0	0	9	9	35	0	0	0	0	33	21	33	2	12	0	5	9	0	9	194
8 :	33	0	21	0	0	272	0	0	0	0	0	0	0	0	0	0	0	16	0	0	342
9 :	27	0	17	0	20	334	0	0	0	0	0	15	0	0	0	0	0	15	0	14	442
10 :	9	0	0	0	0	285	0	0	0	0	0	0	8	0	0	0	6	0	0	0	308
11 :	45	0	20	0	12	217	33	0	0	0	0	81	105	76	126	6	0	0	11	11	743
12 :	26	0	0	0	0	259	21	0	15	0	81	0	429	97	0	8	6	38	10	10	1000
13 :	208	14	38	0	30	672	33	0	0	8	105	429	0	220	35	13	13	120	73	41	2052
14 :	33	0	0	0	0	315	2	0	0	0	76	97	220	0	0	0	0	24	0	37	804
15 :	10	0	0	0	8	26	12	0	0	0	126	0	35	0	0	0	0	0	0	0	217
16 :	12	0	0	0	0	74	0	0	0	0	6	8	13	0	0	0	8	14	0	14	109
17 :	13	0	0	0	0	42	5	0	0	6	0	6	13	0	0	8	0	19	11	20	143
18 :	32	0	32	0	18	231	9	16	15	0	0	38	120	24	0	14	19	0	160	112	840
19 :	29	0	22	20	0	107	0	0	0	0	11	10	73	0	0	0	11	160	0	39	482
20 :	29	0	0	22	0	274	9	0	14	0	11	10	41	37	0	14	20	112	39	0	632
TOTAL:	3989	858	1594	867	556	6260	194	342	442	308	743	1000	2052	804	217	109	143	840	482	632	44864

Appendix 4.2.3 O-D Tables for Road Transport

1985 INTER-DISTRICT O-D MATRIX OF PASSENGER VEHICLE (VEHICLES/DAY)

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	:TOTAL
1 :	0	115	77	181	1	106	0	1	0	0	0	0	0	0	0	0	0	0	0	0	481
2 :	115	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	119
3 :	77	0	0	0	36	128	3	0	0	2	0	0	0	0	0	0	0	0	0	0	246
4 :	181	0	0	0	5	161	0	0	0	0	0	0	0	0	0	0	0	1	0	0	348
5 :	1	0	36	5	0	92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	134
6 :	106	4	128	161	92	0	151	32	162	178	18	31	29	40	2	34	10	40	21	18	1257
7 :	0	0	3	0	0	151	0	0	0	0	12	34	15	0	0	0	0	1	0	0	216
8 :	1	0	0	0	0	32	0	0	0	36	0	0	0	0	0	0	0	0	0	0	69
9 :	0	0	0	0	0	162	0	0	0	0	0	0	0	0	0	0	0	0	0	0	162
10 :	0	0	2	0	0	178	0	36	0	0	0	0	0	0	0	45	0	0	0	0	261
11 :	0	0	0	0	0	18	12	0	0	0	0	7	12	0	11	0	0	0	0	0	60
12 :	0	0	0	0	0	31	34	0	0	0	7	0	27	47	1	0	0	2	0	0	149
13 :	0	0	0	0	0	29	15	0	0	0	12	27	0	20	11	1	1	1	1	0	118
14 :	0	0	0	0	0	40	0	0	0	0	0	47	20	0	0	0	0	0	0	0	107
15 :	0	0	0	0	0	2	0	0	0	0	11	1	11	0	0	0	0	0	0	0	25
16 :	0	0	0	0	0	34	0	0	0	45	0	0	1	0	0	0	10	20	3	37	150
17 :	0	0	0	0	0	10	0	0	0	0	0	0	1	0	0	10	0	0	0	8	29
18 :	0	0	0	1	0	40	1	0	0	0	0	2	1	0	0	20	0	0	11	6	82
19 :	0	0	0	0	0	21	0	0	0	0	0	0	1	0	0	3	0	11	0	5	41
20 :	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	37	8	6	5	0	74
TOTAL:	481	119	246	348	134	1257	216	69	162	261	60	149	118	107	25	150	29	82	41	74	8256

1985 INTER-DISTRICT O-D MATRIX OF TRUCK (VEHICLES/DAY)

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	:TOTAL
1 :	0	80	160	120	11	201	3	9	4	1	0	0	0	0	0	1	1	0	3	3	597
2 :	80	0	16	16	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120
3 :	160	16	0	0	41	47	0	1	0	0	0	0	0	0	0	0	0	0	0	0	265
4 :	120	16	0	0	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0	1	182
5 :	11	0	41	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75
6 :	201	8	47	45	23	0	7	53	92	78	1	16	13	22	0	10	12	7	10	25	670
7 :	3	0	0	0	0	7	0	0	0	0	16	10	28	0	6	0	1	1	0	3	75
8 :	9	0	1	0	0	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63
9 :	4	0	0	0	0	72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
10 :	1	0	0	0	0	78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79
11 :	0	0	0	0	0	1	16	0	0	0	0	8	1	8	17	1	0	0	0	0	52
12 :	0	0	0	0	0	16	10	0	0	0	8	0	107	8	0	3	0	2	0	0	154
13 :	0	0	0	0	0	13	28	0	0	0	1	107	0	48	0	5	1	20	19	6	248
14 :	0	0	0	0	0	22	0	0	0	0	8	8	48	0	0	0	0	0	0	3	89
15 :	0	0	0	0	0	0	6	0	0	0	17	0	0	0	0	0	0	0	0	0	23
16 :	1	0	0	0	0	10	0	0	0	0	1	3	5	0	0	0	0	5	0	7	32
17 :	1	0	0	0	0	12	1	0	0	0	0	0	1	0	0	0	0	5	0	8	28
18 :	0	0	0	0	0	7	1	0	0	0	0	2	20	0	0	5	5	0	27	19	86
19 :	3	0	0	0	0	10	0	0	0	0	0	0	19	0	0	0	0	27	0	4	63
20 :	3	0	0	1	0	25	3	0	0	0	0	0	6	3	0	7	8	19	4	0	79
TOTAL:	597	120	265	182	75	670	75	63	96	79	52	154	248	89	23	32	28	86	63	79	6152

1990 INTER-DISTRICT O-D MATRIX OF PASSENGER VEHICLE (VEHICLES/DAY)

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	:TOTAL
1 :	0	133	98	255	10	142	9	9	0	0	0	9	8	0	0	0	0	9	6	0	688
2 :	133	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	146
3 :	98	0	0	0	52	166	11	0	9	10	0	9	8	0	0	0	0	9	6	0	378
4 :	255	0	0	0	16	239	0	0	0	0	0	0	8	0	0	0	0	10	0	0	528
5 :	10	0	52	16	0	130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	208
6 :	142	13	166	239	130	0	194	46	218	227	27	53	38	78	8	57	13	66	20	35	1770
7 :	9	0	11	0	0	194	0	0	0	0	19	53	22	0	0	0	0	10	6	0	324
8 :	9	0	0	0	0	46	0	0	0	47	0	0	0	0	0	0	0	0	0	0	102
9 :	0	0	9	0	0	218	0	0	0	0	0	9	0	0	0	0	0	0	0	0	236
10 :	0	0	10	0	0	227	0	47	0	0	0	0	8	0	0	68	0	0	0	0	360
11 :	0	0	0	0	0	27	19	0	0	0	0	16	17	0	11	0	0	0	0	0	90
12 :	9	0	9	0	0	53	53	0	9	0	16	0	38	96	7	0	0	12	0	0	302
13 :	8	0	8	8	0	38	22	0	0	8	17	38	0	35	11	9	6	9	6	8	231
14 :	0	0	0	0	0	78	0	0	0	0	0	96	35	0	0	0	0	9	0	0	218
15 :	0	0	0	0	0	8	0	0	0	0	11	7	11	0	0	0	0	0	0	0	37
16 :	0	0	0	0	0	57	0	0	0	68	0	0	9	0	0	0	14	39	8	66	261
17 :	0	0	0	0	0	13	0	0	0	0	0	0	6	0	0	14	0	6	4	12	55
18 :	9	0	9	10	0	66	10	0	0	0	0	12	9	9	0	39	6	0	14	18	211
19 :	6	0	6	0	0	20	6	0	0	0	0	0	6	0	0	8	4	14	0	10	80
20 :	0	0	0	0	0	35	0	0	0	0	0	0	8	0	0	66	12	18	10	0	149
TOTAL:	688	146	378	528	208	1770	324	102	236	360	90	302	231	218	37	261	55	211	80	149	12748

1990 INTER-DISTRICT O-D MATRIX OF TRUCK (VEHICLES/DAY)

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	:TOTAL
1 :	0	70	180	124	13	225	8	14	10	8	6	8	9	8	0	6	5	7	8	9	718
2 :	70	0	23	21	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	130
3 :	180	23	0	0	36	71	0	9	8	0	0	0	0	0	0	0	0	7	7	0	341
4 :	124	21	0	0	7	62	6	0	0	0	0	0	0	0	0	0	0	0	7	7	234
5 :	13	0	36	7	0	23	5	0	6	0	0	0	7	0	0	0	0	0	0	0	97
6 :	225	16	71	62	23	0	12	55	81	80	7	28	22	36	0	11	9	14	15	28	795
7 :	8	0	0	6	5	12	0	0	0	0	8	11	20	0	11	0	4	6	0	6	97
8 :	14	0	9	0	0	55	0	0	0	0	0	0	0	0	0	0	0	6	0	0	84
9 :	10	0	8	0	6	81	0	0	0	0	0	7	0	0	0	0	0	6	0	6	124
10 :	8	0	0	0	0	80	0	0	0	0	0	0	7	0	0	0	4	0	0	0	99
11 :	6	0	0	0	0	7	8	0	0	0	0	9	6	9	16	4	0	0	5	5	75
12 :	8	0	0	0	0	28	11	0	7	0	9	0	104	17	0	7	4	8	6	7	216
13 :	9	0	0	0	7	22	20	0	0	7	6	104	0	55	0	7	5	21	18	11	292
14 :	8	0	0	0	0	36	0	0	0	0	9	17	55	0	0	0	0	7	0	9	141
15 :	0	0	0	0	0	0	11	0	0	0	16	0	0	0	0	0	0	0	0	0	27
16 :	6	0	0	0	0	11	0	0	0	0	4	7	7	0	0	0	3	6	0	7	51
17 :	5	0	0	0	0	9	4	0	0	4	0	4	5	0	0	3	0	5	4	5	48
18 :	7	0	7	0	0	14	6	6	6	0	0	8	21	7	0	6	5	0	20	16	129
19 :	8	0	7	7	0	15	0	0	0	0	5	6	18	0	0	0	4	20	0	7	97
20 :	9	0	0	7	0	28	6	0	6	0	5	7	11	9	0	7	5	16	7	0	123
TOTAL:	718	130	341	234	97	795	97	84	124	99	75	216	292	141	27	51	48	129	97	123	7836

2000 INTER-DISTRICT O-D MATRIX OF PASSENGER VEHICLE (VEHICLES/DAY)

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	:TOTAL
1 :	0	412	231	492	12	351	10	11	0	0	0	10	10	0	0	0	0	10	9	0	1558
2 :	412	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	437
3 :	231	0	0	0	106	432	16	0	10	13	0	10	9	0	0	0	0	10	8	0	845
4 :	492	0	0	0	21	503	0	0	0	0	0	0	10	0	0	0	0	12	0	0	1038
5 :	12	0	106	21	0	289	0	0	0	0	0	0	0	0	0	0	0	0	0	0	428
6 :	351	25	432	503	289	0	455	111	495	487	56	121	92	189	14	144	40	160	69	73	4106
7 :	10	0	16	0	0	455	0	0	0	0	33	107	42	0	0	0	0	13	9	0	685
8 :	11	0	0	0	0	111	0	0	0	92	0	0	0	0	0	0	0	0	0	0	214
9 :	0	0	10	0	0	495	0	0	0	0	0	10	0	0	0	0	0	0	0	0	515
10 :	0	0	13	0	0	487	0	92	0	0	0	0	9	0	0	140	0	0	0	0	741
11 :	0	0	0	0	0	56	33	0	0	0	0	28	33	0	27	0	0	0	0	0	177
12 :	10	0	10	0	0	121	107	0	10	0	28	0	85	217	11	0	0	16	0	0	615
13 :	10	0	9	10	0	92	42	0	0	9	33	85	0	78	28	13	11	11	0	10	450
14 :	0	0	0	0	0	189	0	0	0	0	0	217	78	0	0	0	0	11	0	0	495
15 :	0	0	0	0	0	14	0	0	0	0	27	11	28	0	0	0	0	0	0	0	80
16 :	0	0	0	0	0	144	0	0	0	140	0	0	13	0	0	0	44	90	18	150	599
17 :	0	0	0	0	0	40	0	0	0	0	0	0	11	0	0	44	0	9	8	33	145
18 :	10	0	10	12	0	160	13	0	0	0	0	16	11	11	0	90	9	0	42	30	414
19 :	9	0	8	0	0	69	9	0	0	0	0	0	9	0	0	18	8	42	0	23	195
20 :	0	0	0	0	0	73	0	0	0	0	0	0	10	0	0	150	33	30	23	0	319
TOTAL:	1558	437	845	1038	428	4106	685	214	515	741	177	615	450	495	80	599	145	414	195	319	28112

2000 INTER-DISTRICT O-D MATRIX OF TRUCK (VEHICLES/DAY)

ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	:TOTAL
1 :	0	195	288	201	23	429	12	21	13	10	8	10	9	9	0	9	8	9	13	13	1280
2 :	195	0	47	44	0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	318
3 :	288	47	0	0	66	112	0	10	9	0	0	0	0	0	0	0	0	9	8	0	549
4 :	201	44	0	0	8	99	8	0	0	0	0	0	0	0	0	0	0	0	8	9	377
5 :	23	0	66	8	0	47	7	0	7	0	0	0	7	0	0	0	0	0	0	0	165
6 :	429	32	112	99	47	0	22	106	164	148	9	53	30	73	0	26	28	25	29	56	1488
7 :	12	0	0	8	7	22	0	0	0	0	22	26	38	0	16	0	7	10	0	11	179
8 :	21	0	10	0	0	106	0	0	0	0	0	0	0	0	0	0	0	8	0	0	145
9 :	13	0	9	0	7	164	0	0	0	0	0	8	0	0	0	0	0	7	0	7	215
10 :	10	0	0	0	0	148	0	0	0	0	0	0	8	0	0	0	6	0	0	0	172
11 :	8	0	0	0	0	9	22	0	0	0	0	19	8	20	27	7	0	0	7	6	133
12 :	10	0	0	0	0	53	26	0	8	0	19	0	186	33	0	14	7	13	9	8	386
13 :	9	0	0	0	7	30	38	0	0	6	8	186	0	96	0	13	7	36	32	15	485
14 :	9	0	0	0	0	73	0	0	0	0	20	33	96	0	0	0	0	9	0	15	255
15 :	0	0	0	0	0	0	16	0	0	0	27	0	0	0	0	0	0	0	0	0	43
16 :	9	0	0	0	0	26	0	0	0	0	7	14	13	0	0	0	6	14	0	16	105
17 :	8	0	0	0	0	28	7	0	0	6	0	7	7	0	0	6	0	13	6	17	105
18 :	9	0	9	0	0	25	10	8	7	0	0	13	36	9	0	14	13	0	55	39	247
19 :	13	0	8	8	0	29	0	0	0	0	7	9	32	0	0	0	6	55	0	13	180
20 :	13	0	0	9	0	56	11	0	7	0	6	8	15	15	0	16	17	39	13	0	225
TOTAL:	1280	318	549	377	165	1488	179	145	215	172	133	386	485	255	43	105	105	247	180	225	14104

Appendix 6.4.2 A

Economic Internal Rate of Return

1) New Construction or Existing Road Improvement

Benefits of new road construction or improvement of existing road comprising arterial routes come primarily from savings in vehicle oprating costs due to better road surface and higher operating speed. Other factors such as shorter travel time for passengers and goods are ignored since they are insignificant relative to the VOC savings.

Difference in vehicle operating costs by road surface conditions is shown in the RRMP Report of June 1984. Assuming existing country average surface roughness of 4,750 mm/km, roughness before the improvement of 6,250 mm/km and improved surface roughness of 2,000 mm/km, and the reduction in vehicle running cost was estimated at 29% using the data given in the report. The improvement in travel speed was estimated at 50%. For the average trip lengths of 170 km for trucks and 148 km for buses changes in per vehicle-km cost were calculated as shown in Table 6.4.2 A. Changes in overall average per vehicle-km cost were then calculated.

The annual benefit in the nth year from present year due to the construction of a new road, B in Taka, is:

$$B = 365 \times ADT \times (1+g)^{n} \times (VOCO \times DISO - VOCO \times DISN)$$

Where ADT is the existing ADT expected to use the new road, g is the traffic growth rate, VOCO and VOCN are vehicle operating costs per vehicle-km for a composite average vehicle on the old route and on the new route respectively, and DISO and DISN are route distances for the old and new routes respectively.

The annual benefit due to the improvement of an existing road, B in Taka, is:

$$B = 365 \times ADT \times (1+g)^{n} \times (VOCO-VOCN) \times DISO$$

Where symbols are the same as the above.

Generated traffic is ignored because of teh subject roads being national or regional highways.

Table 6.4.2 A Vehicle Operating Cost Estimates

Assumptions

Existing country average surface roughness	4,750 mm/km
Existing surface roughness of subject section	5,750 mm/km
Improved surface roughness	2,000 mm/km
Vehicle running cost increase over agerage	1.35
Vehicle running cost reduction	0.26
Average running speed improvement	50%

VOC Comparison

	Truck		Bus	
Average trip length (km)	170		148	
	Existing	Improved	Existing	Improved
Economic variable cost (Tk/km)	5.82	4.30	8.44	6.24
Runing Speed (kph)	30	45	30	45
Running hours for ave. dist. (hrs)	5.67	3.78	4.93	3.29
Total hours for ave. dist. (hrs)	13.3	11.41	13.4	11.8
Per hour fixed cost (Tk/hr)	38.6	38.6	23.0	23.0
Economic fixed cost (Tk/km)	3.02	2.59	2.08	1.83
Economic total cost (Tk/km)	8.84	6.89	10.52	8.07

Traffic Average		Cost (Tk/Veh./km)					
		Existing			Improved		
	Composition(%)	Running	Fixed	Total	Running	Fixed	Total
Trucks	49	5.82	3.02	8.84	4.30	2.59	6.89
Buses	25	8.44	2.08	10.52	6.24	1.83	8.07
Pickups	1	3.51	1.83	5.34	2.59	1.57	4.16
Minibuses	12	5.09	1.26	6.35	3.17	1.11	4.28
Jeeps	4	3.20	2.32	5.52	2.37	1.96	4.33
Cars	9	4.77	4.91	9.68	3.52	3.18	6.70
Overall	100	6.17	2.70	8.87	4.4[illegible]	2.24	6.73

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A table of shadow price factors which convert financial costs to economic costs published by Planning Commission indicates that the factor for highway construction should be 0.64. Assuming the two year construction period and a discount rate of 15% the first year rate of return, FYRR, can be calculated as; FYRR = B/(1.236 x 0.64 x CF),

Where CF is the total per km financial cost of the project.

When the shape of the project benefit stream over years is similar among a group of projects, the economic internal rate of return is highly correlated to the first year rate of return. In the case of highway projects the benefit stream is mostly monotonously increasing similar to the traffic growth rate within a type of highway or road and within a region. A regression analysis was carried out against FYRR and EIRR of 30 projects shown in the aforementioned report and the following regression equation was obtained with a correlation coefficient of 0.966.

$$EIRR = 1.025 \times FYRR + 10.4$$

Where EIRR and FYRR are in percent. The traffic growth rates for the above projects were around 6% per annum, which is a little lower than the growth rates adopted in this study (7.9%).

Combining the results of the benefit estimation, the FYRR calculation, and the above regression equation, the relationship among the financial construction cost, ADT and the EIRR was obtained as shown below in an equation for the case of improvement of existing roads.

$$(EIRR - 10.4) \times CF = 0.118 \times 10^{6} \times ADT$$

Figure 6.4.1 shows the above relationship in a graphical form. Given the construction cost and ADT, this chart can be used to obtain the order-of-magnitude level of EIRR.

2) Bridge Construction Replacing Ferry Services

Two feasibility study reports concerning bridge construction in Bangladesh were recently published. One is the Feasibility Study on Meghna-Gumti Bridge Construction Project Final Report, March 1985, JICA, and the other the ODA Bridge Feasibility Study Final Report, July 1985, ODA. The former is a study for two major prestressed concrete girder bridges and the latter deals with 7 unit construction bridges in various parts of the country. Out of the latter's seven three are intended to replace existing ferry services.

Since the design adopted in the former is not one generally applicable in Bangladesh, the construction costs presented the latter were examined. Figure 6.4.2 A shows the relatilnship between the crossing length and the economic construction cost using standard unit construction steel superstructure. The relationship can be expressed by the following equation:

$$C = 0.19 \times L - 9.0$$

Where C is the economic construction cost in million Tk. and L is the crossing length in meters.

Major part of benefit by replacing ferry service with bridge comes from the savings in time cost of vehicles no longer required in and waiting ferry and the cost of ferry service itself.

By the former study it is found that the average crossing time per vehicle at the Meghna crossing was 45 minutes. In the latter study queueing theory was applied to estimated the average crossing time with results ranging 13 to 31 minutes. The author of the latter report, however, concluded that the actual average should be much higher due to irregularities in the real world.

The average time cost of a vehicle was calculated at Tk. 44.5 per working hour, and the average total cost of a vehicle Tk. 6.92 per km. Derivation of these vehicle cost estimates are described in Chapter 9.

Therefore, when the average crossing time is 45 minutes or 22.5 vehicle, the cost saving accrued to vehicles per year. BT, is:

$$BT = (0.75/N-(L/1000/V)) \times 44.5 - 6.92 \times L/1000 \times T \times 365$$

Where L is the crossing distance, V is the tra running speed in km/hour, T is the traffic volume in vehicles/day, and N = 1 when the crossing time is 45 minutes and N = 2 when 22.5 minutes.

The ODA study relied on the JICA study concerning ferry costs and it was decided that ferry costs presented in the JICA report be used in this study as well. Relevant data are shown in Table 6.4.2 A. Assuming that the fleet size and direct ferry operating cost are proportionate to the crossing length, L, and that the total operation is proportionate to traffic, the ferry service cost per year, FC (economic), can be approximated by the following equation:

$$FC = (0.0299 \times L + 7.69) \times T \times 365 \times N \text{ Taka/year}$$

Assuming that 80% and 20% of the total construction cost are required in the first and the second years of construction respectively, and the benefits start to materialize from the third year the first year rate of return (FYRR) can be expressed as follow under the discount rate of 15% per year.

$$FYRR = 0.7561 \times (FC + BT)/(0.9739 \times C)$$

Table 6.4.2 B summarizes the results of calcualtions for various L, T, and N. If benefit stream is one of uniformly increasing type, then the economic internal rate of return (EIRR) can be directly obtained from FYRR. Figure 6.4.2 B shows the case of benefit growth rate of 6% per year. Figure 6.4. in Chapter 6 shows estimated EIRR for bridges with various crossing length and traffic levels.

Table 6.4.2 B Meghna Ferry Operating Costs (1984)

Meghna Ferry

Distance (m)	825
Average Daily Traffic (1984)	1,468
Average loading/unloading time (minute)	20
Average Sailing time (minute)	8
Direct ferry operating cost (Taka 000/year)	7,298
Terminal (Taka 000/year)	2,219
General Administration (Tk 000/year)	1,903
Operation (Taka 000/year)	5,915

Source: Feasibility study on Meghna, Meghna-Gumti Bridges Construction Project "Final Report", March 1985, JICA.

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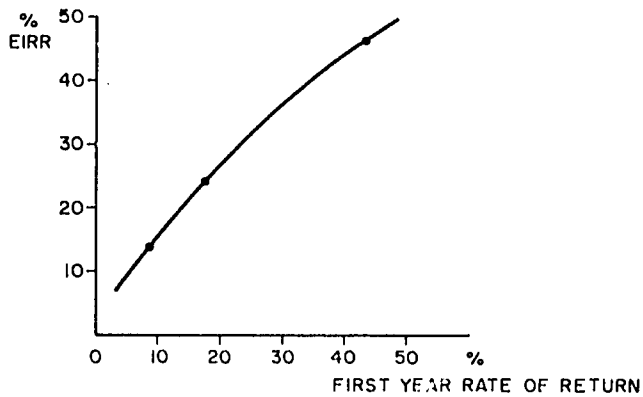

FIGURE 6.4.2 B FYRR AND EIRR

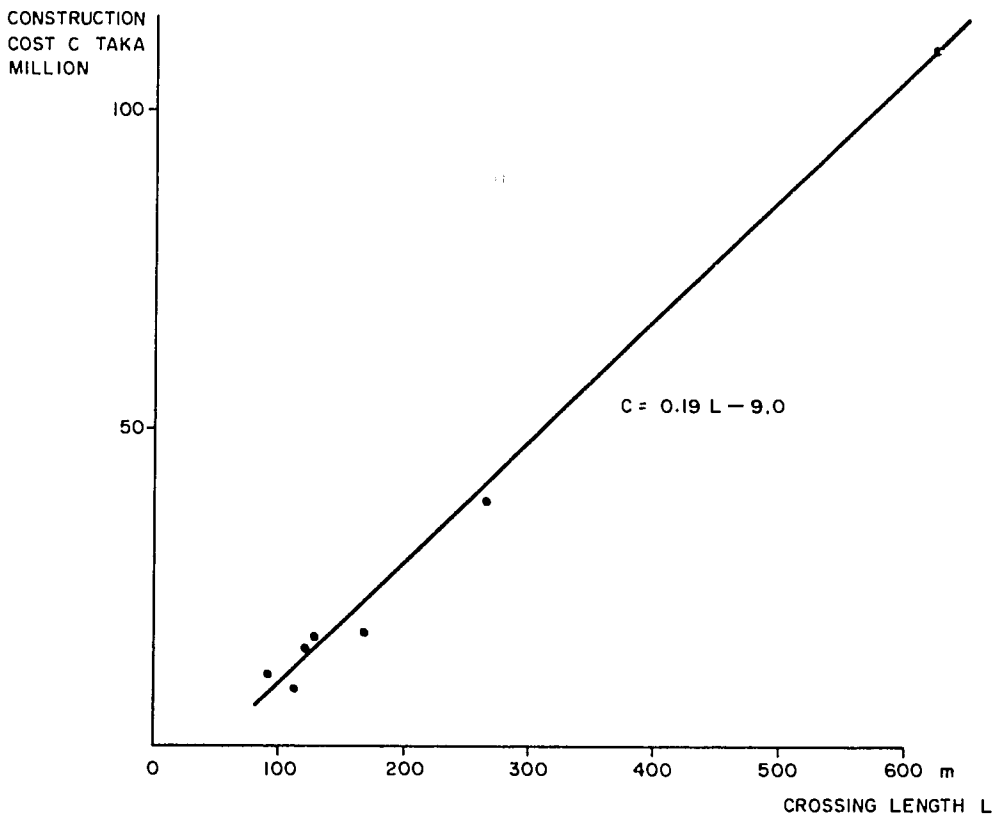

FIGURE 6.4.2 A ECONOMIC CONSTRUCTION COST OF STANDARD STEEL TRUSS UNIT CONSTRUCTION BRIDGES

SOURCE : ODA BRIDGE FEASIBILITY STUDY, RHD, 1985

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Table 6.4.2 C Bridge Cost and First Year Benefit

		Crossing Length (m)					
		100		300		500	
Construction Cost (million Tk)		9.74		46.8		83.8	
Mean Time Loss/Veh.							
	(minutes)	45	22.5	45	22.5	45	22.5
First Year	ADT						
Benefit	200	2.40	1.89	2.65	2.15	2.9	2.41
(million Tk)	400	4.79	3.80	5.30	4.30	5.8	4.81
	1000	12.0	9.49	13.3	10.8	14.5	12.0
	1500	18.0	14.2	19.9	16.1	21.8	18.1
FYRR (%)	200	24.6	19.4	5.7	4.6	3.5	2.9
	400	49.2	39.0	11.3	9.2	6.9	5.7
	100	122.	97.4	28.3	23.0	17.3	14.4
	1500	185.	146.	42.5	34.5	26.0	21.5

Source: Consultants

Appendix 6.4.4 Economic First Year Benefit of Water Transport Projects

Cost Savings Due to Reduction in Turn Round Time;

Current coaster operations suffer from long turn round time and resulting low utilization rate. Possible reduction in turn round time is described in Chapter 10 for various stages of operation.

Investment to reduce time required at any of these various stages would result in reduction in the total turn round time and overall transport cost, and thus economic benefit.

Economic costs of coaster operation are shown in Chapter 10. For the average hauling distance of 241 km, the overall average ton-km cost of coaster operation can be expressed as follows:

$$C = 0.224 + 1.508/V + 0.615 \times R,$$

where C is the ton-km cost in Taka,

V is the travel speed in km/h, and

R is the non-sailing days per trip (current average 10.3 days).

In Chapter 10 it is shown that the maximum reduction in non-sailing days is about 45%. Therefore, the possible maximum cost saving by turn round reduction would be in the order of 0.29 Taka/ton-km.

Given the total ton-km transported through a waterway of W ton-km and the investment, I, would result in the reduction in non-sailing days of X%, then the first year benefit, FYB, is;

$$FYB = 0.29 \times X/45 \times W$$

Relationship between EIRR and FYB is shown in Figure 6.4.1, by which rough EIRR can be obtained.

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