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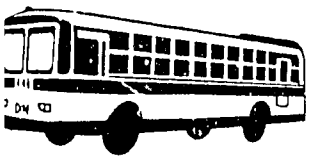

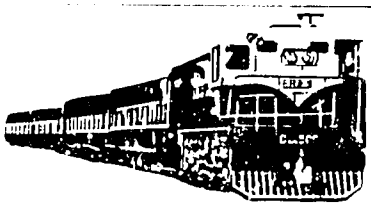

INTERMODAL TRANSPORT STUDY

VOLUME II ANALYSIS OF TRANSPORT MODES

FINAL REPORT

DECEMBER 1985

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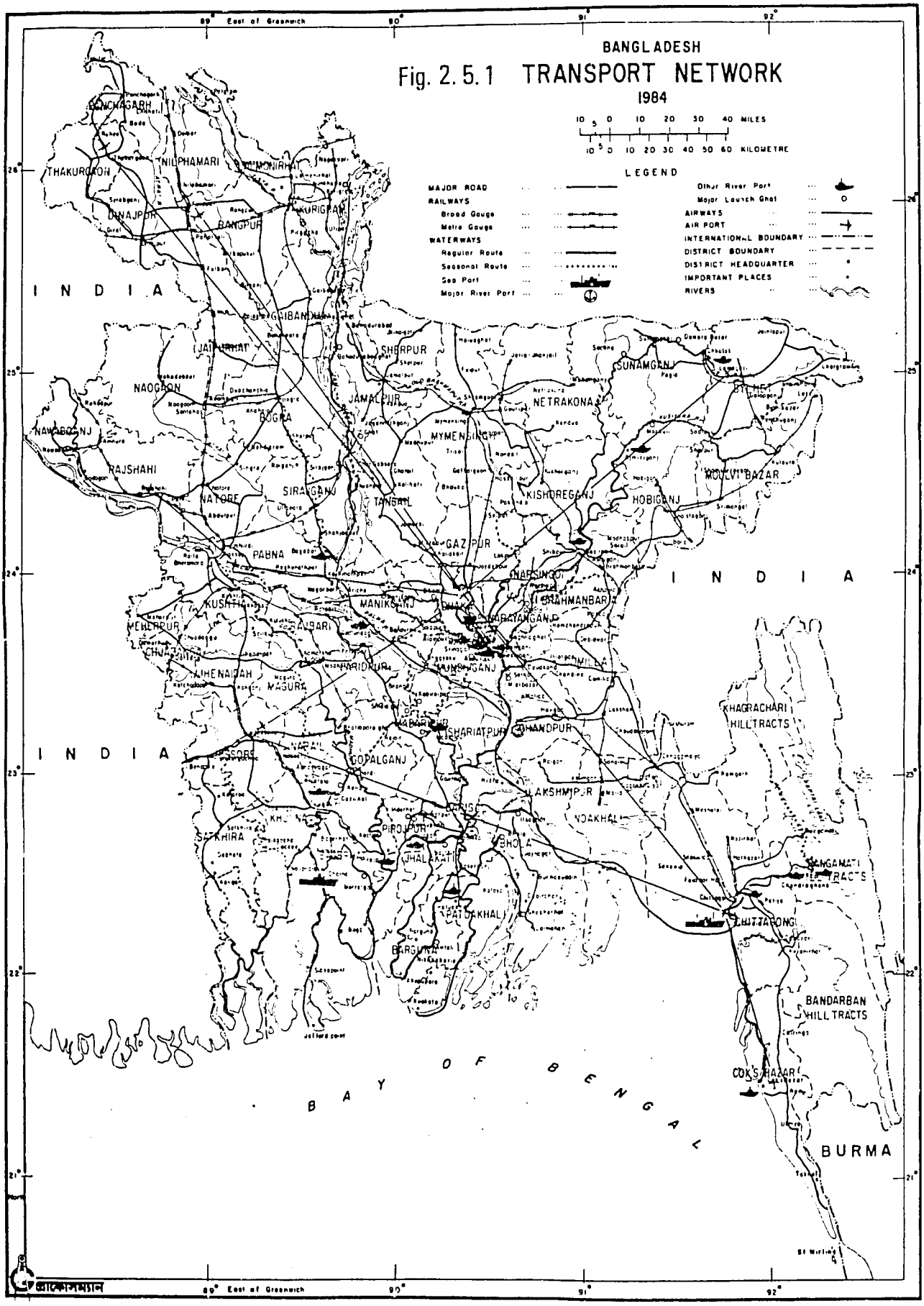
BANGLADESH
Fig. 2.5.1 TRANSPORT NETWORK
1984
10 5 0 10 20 30 40 MILES
10 5 0 10 20 30 40 50 60 KILOMETRE
LEGEND
MAJOR ROAD
RAILWAYS
Broad Gauge
Metre Gauge
WATERWAYS
Regular Route
Seasonal Route
Sea Port
Major River Port
Dinjr River Port
Major Launch Ghat
AIRWAYS
AIR PORT
INTERNATIONAL BOUNDARY
DISTRICT BOUNDARY
DISTRICT HEADQUARTER
IMPORTANT PLACES
RIVERS
East of Greenwich
INDIA
INDIA
INDIA
BAY OF BENGAL
BURMA
PANCHAGARH
THAKURGAON
NILPHAMARI
MONIRHAT
DINAJPUR
RANGPUR
KURIGRAM
GAIBANDHA
JAIPURHAT
NAOGAON
BOGRA
SHERPUR
JAMALPUR
MYMENSINGH
NETRAKONA
SUNAMGANJ
SYLHET
NAWABGANJ
RAJSHAHI
NATORE
SIRAJGANJ
TANGAIL
KISHOREGANJ
HOBIGANJ
MOULVI BAZAR
GAZIPUR
PABNA
NARSINGDI
BRAHMANBARIA
KUSHTIA
MANIKGANJ
DHAKA
NARAYANGANJ
MEHERPUR
CHUADANGA
AIGARI
JHENAIDAH
MAGURA
NARIDRUPA
MUNSHIGANJ
COMILLA
KHAGRACHARI HILL TRACTS
BARISHAL
SHARIATPUR
CHANDPUR
JESSORE
NARAIL
GOPALGANJ
LAKSHMIPUR
NOAKHALI
KHULNA
SATKHIRA
PIROJPUR
JHALAKATI
BHOLA
RANGAMATI HILL TRACTS
CHITTAGONG
PATUAKHALI
BARGUNA
BANDARBAN HILL TRACTS
COX'S BAZAR
ছায়াকোলমান

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CHAPTER 8 RAILWAYS

8.1 Bangladesh Railway Institutional Organization

8.1.1 Introduction

This Intermodal Transport Study did not require a study of the railway management structure, but during the preparation of the Study Report it became clear to the Consultants that a weakness occurs in railway management, and that this could be affecting performance.

The review of management focused on the needs of management to be able to achieve government policy objectives. Management has a situation that is not unique and there are many parallel's in the world. The trains are running despite the "Problems". In fact the 1984 Bangladesh Railway Information Book shows that on one section traffic density averaged 40.93 trains a day, an increase from 37.42 in 1969-70 and on the metre gauge line north of Bairab Bazar freight traffic is higher than 1969-70. Management must maintain this trend.

One interesting point arose that was not part of the study, but may have a direct relationship on the correctness of the management structure at the secretariat level.

The Director General is responsible not only for formulating government policy but is also responsible for the day to day operations of the railway system.

The academic point is that the pressure of the daily events and the cycle of recurring issues would obscure objectivity in defining government policy.

In preparing the following sections this created a lack of clarity in defining who is the issuing authority of Government railway policy and who is the receiving authority for railway management. These are kept as distinct entities to ensure the logic of the process.

8.1.2 Railway Policy and Objectives

Established Governmental policy is that the Railway is to be retained on a "no loss no profit" basis and to provide a 4% return on capital investments, provided by the Government, for depreciation purposes.

This is analogous to the 4% sinking fund used traditionally by British Railways, however it is below the ADB's covenant on rate of return of 7% on revalued and fixed assets.

Government must require the railway organization to keep up with changes in the transportation environment. The traditional approach of waiting for traffic to come to the railway, because it is the only transportation system have passed.

To achieve this policy it is necessary for the Government to establish objectives for Railway operations by:

a) Providing adequate and clear policy directives on commercial operations so that railway management can establish practical plans for future railway investments and operations.

b) Ensuring sufficient foreign exchange to purchase the necessary imported spare parts and technology.

c) Declaring that fraud, waste and abuse of railway property to be a national problem and to directly support eradication.

d) Ensuring that adequate skilled manpower at all management, supervisory, and craft levels are available including expatriates.

Government objectives for the Railways must also be compatible and complementary with Government objectives for the whole transport sector. This was discussed in Volume I.

8.1.3 Government Strategy

The railways provide essential services to Bangladesh and also has an important economic role in the country.

The Government must establish strategies for producing economic and market oriented realities that ensure:

a) Railway management to be business oriented and not a bureaucratic function.

b) Railway management to improve utilization of existing assets rather than fresh procurement and to improve the return on investment employed.

c) Railway management institutes a staff efficiency programme that ensures promotion by merit and not seniority.

8.1.4 Management Objectives

It is perhaps, the most daunting of tasks for any management to hear recounted the "problem" facing Bangladesh Railways. These "Problems" have been repeated in every report submitted by consultants and perhaps these tend to obscure objectivity.

Management has one objective to attain to achieve Government railway policy: To provide transportation by rail for passenger and freight to maximise the benefits to the economy.

These are three parallel routes to this objective

a) Increase revenue

b) Reduce direct costs

c) Increase productivity

In order to achieve the objectives each route must be involved, and all revenue and non-revenue earning departments must have an operational responsibility directly related to the running of trains at the local level of control. This requires a strategic approach.

8.1.5 Management Strategy

The strategy to be used by management has four principles:

a) Management must have good local, middle and senior management, in both technical and financial fields.

b) Management must have operating and marketing styles and procedures to meet changing circumstances. Old techniques used in operations, maintenance, and accounting must be understood to be no longer acceptable.

c) Management must have statistics on performance indicators that are based on realistic data.

d) Management must raise morale at all levels to increase productivity particularly in maintenance.

8.1.6 Issues for Management

Management must have a strategic plan incorporating the four principles outlined in Section 8.1.5. The content of the plan must address these issues

a) Operational control

b) Operational efficiency

c) Effective maintenance

d) Effective marketing

A generalised discussion on the contents of the strategic plan is included in the appendix to this Chapter.

8.1.7 Fraud, Waste and Abuse

The financial loss to the railways by fraud, waste and abuse of railway property is unacceptable and a drain on the national economy.

Fraud is a civil offence and the railways must demand Government leadership in the matter of policy and the direction of civil and police authorities to eradicate fraud.

Waste and abuse are in-house matters which reflect upon the efficiency of local management and supervisors.

Ticket-less travel; theft of goods in transit; theft of wagon-parts; invoicing short weights; are examples of fraudulent practice. Some fraudulent practices, such as theft of railway parts or the unnecessary pulling of communication cords, are dangerous to the public-at-large from the accidents that may result.

Waste occurs with faulty workmanship and inadequate quality control in the use of materials and tools, and can apply equally to office workers as well as artisans.

Abuse is characterized by absenteeism, low output, improper time keeping.

The railway management must commence a programme to be vigorously pursued to:

a) Cure problems causing fraud

b) Prevent frauds occuring

c) Eliminate waste and abuse

The appointment of a Programme Director for the elimination of fraud, waste and abuse is necessary to ensure co-ordination between the Railways, Central Government, Local Government, Police Authorities and Railway Departments.

Fraud, waste and abuse cannot be eradicated without positive action by the Railways and the active support of the Government in the recognition that it is a national problem.

8.1.8 Management Structure

The organization and management structure of the railway has been re-organized four times since 1972. This is an indication that there is an inherent problem in running the Railways.

It is not a part of this study to question the need for an Eastern & Western railway zones, and the approach taken is to accept this as a fact. There is much in its favour and provided that adequate co-ordination between the two zones takes place at operating levels at the Jamuna River crossings, and for any future international transit traffic, the direct reporting structure to the Director General will ensure resolution of problems and friction between the two zones. A special officer charged with the operational responsibility of river crossing working under one of the General Managers will be a distinct improvement in this context.

What is necessary is that the existing system is made to work and that good management practices must be employed.

The decentralised organizational structure makes matrix management a suitable management process. This is described in more detail in appendix section A8.1.1 Operational Control.

Two managerial hierarchy's are created for each zone. A horizontal or "Operational Level" and a vertical or "Seniority Ordinate". The horizontal level is the business team, whilst the vertical is the traditional structure for a railway department. The effectiveness on the operational level is the pressure of performance, and vertically is the pressure of technical competence.

The most important matrix operates at the General Manager's level with all the heads of each department for each zone being responsible to their General Manager for the performance of their discipline. The heads are then responsible to their discipline superiors for technical competence.

This requires no structural re-organization, as it represents only a change in style of operation. The business team approach is discussed in the appendix.

The existing structure must obtain a market oriented outlook. The matrix method places overall responsibility on the General Manager's office to achieve this, and the double measure of performance and competence will pressure the achievements required by the General Manager.

Peripheral marketing operations is also an area for managerial review. Two examples would be to promote the maintenance of private sidings by Bangladesh Railway instead of ending at an artificial limit point, a relic of British railway practice when the traffic came to the railway, so that the railway can regain lost traffic by serving factories directly by main line locomotives, and to expect the local head railway man, usually the Station Master, to promote the railway services and to solicit business to the railway through his station, and to pass on information and data to the Commercial Manager even though the Station Master reports to the Terminal Manager.

8.1.9 Conclusions

It is necessary to avoid the declines in railway traffic caused by self-inflicted wounds due to following past practices which worked under the old conditions. There are new conditions and new challenges to be met. Management must have the competence to carry out the decisions that have to be made.

A matrix management style of operation ensures that a team approach is established especially at the General Manager's level. The link between the marketing and operating groups is obvious and it exists through the team approach at the General Manager level. The interaction between departments must not be vertically oriented and the horizontal interaction at General Manager level must be made to work.

It is at General Manager level that the marketing drive must be concentrated, there is no need for a vertical structure, since the General Manager is responsible to the Director General

Each "problem" facing the railway represents a challenge to be overcome. With a positive attitude promoted by the team approach at the General Manager level, and by the involvement of the people who have

to respond to the challenge, the negativeness created by the "problem" can be overcome. These regular business meetings of the section chiefs creates this necessary collective attitude of positiveness.

Transit traffic and traffic arising from the implementation of industrial development projects must be the direct responsibility of the Railway Division at Ministry level, and the traffic requirements passed through the Director General to the General Managers.

The process of reviewing management in this study kept the tangible "problems" in focus, and there has been no shortage of cures. What appears to be lacking is prevention.

Section 8.7 Operational Issues - 8.7.1 Management, summarises the situation that management has to tackle, and offers a recommendation that assists in determining the necessary strategy.

8.2 Rail Traffic

8.2.1 Introduction

The type and availability of various categories of traffic largely determine the kinds and quantities of rolling stock and motive power, the track structure and maintenance, the system of operation, and the profitability of the system.

This section examines historical trends, based on statistics from the annual reports published by Bangladesh Railways supplemented by data obtained from various published reports.

For the major freight commodities over the period of the Second Five Year Plan there has been a distinct levelling out of the falling traffic loads in about half of the major commodities, but some bulk products expected to be rail hauled like stone, iron & steel and coal have continued to decline.

8.2.2 Freight Traffic

(1) Statistics:

The historical record, using 1969/70 as the benchmark year, for tons carried, ton-kilometres and average lead is shown in Table 8.2.1.

Table 8.2.1 Tonnage Carried and Average Lead

Fiscal year	69/70	73/74	77/78	81/82	82/83	83/84
Freight tons (in millions)	4.89	2.85	3.56	3.23	3.0	2.94
Ton-kilometres (in millions)	1265	603	786	845	814	779
Average freight lead (kms)	259	212	221	262	271*	265

Source: Bangladesh Railways

*This distortion probably due to increased wheat traffic on a long haul basis.

While there has been a down turn in business, the long haul traffic is holding its own and short haul traffic is reducing. This is to be expected with the improvement of roads and an increase in the numbers of trucks registered.

The commodities which generated more than 3% of the tonnage hauled or 3% of earnings is given in table 8.2.2 for three years, 1969/79, 1982/83, and 1983/84.

Table 8.2.2 Traffic Exceeding 3% of Tonnage Hauled or 3% Earnings

Commodity		69/70		82/83		83/84		Comment
Item	Type	% Tonnes	% Taka	% Tonnes	% Taka	% Tonnes	% Taka	
	INDUSTRIAL							
1	Cement	5.98	5.00	2.78	4.26	5.96	7.56	Improvement
6	Fertilizer	4.37	5.01	10.78	11.36	10.07	9.75	Improvement
10	Iron & Steel	3.83	5.05	1.90	2.03	1.60	1.85	
	PETROLEUM							
13	Kerosine Oil	3.96	4.96	0.34	0.44	0.64	0.67	Deterioration
18	Oil Fuel	3.17	2.53	3.39	3.69	2.35	1.94	Fluctuation
	AGRICULTURAL							
11	Jute - raw	13.60	19.69	7.45	10.26	7.76	11.33	Static
23	Paddy	1.48	0.80	3.15	2.19	3.54	2.56	Improvement
24	Rice	9.41	9.54	8.30	6.85	8.20	7.15	Improvement
26	Salt	2.04	3.00	2.17	3.08	4.05	5.22	Improvement
27	Sugar Cane	5.04	0.99	9.96	3.97	8.95	3.47	Improvement
28	Sugar	1.77	1.62	2.61	3.13	1.87	2.32	Fluctuation
32	Wheat	12.80	11.54	28.67	27.56	23.95	24.36	Fluctuation
	MISCELLANEOUS							
34	Other Commodities	10.5	13.89	6.71	13.70	8.61	13.17	Fluctuation

Source: Bangladesh Railways

Table 8.2.3 Traffic Trends: Commodities Exceeding 10,000 Tons per Annum

Commodity				
Item	Type	1980/81	1983/84	% change from 80/81
	INDUSTRIAL			
1	Cement	155	175	+13%
2	Coal	85	40	-53%
6	Fertilizer	338	296	-12%
10	Iron & Steel	47	47	-
12	Jute-Manufactured	26	18	-31%
	PETROLEUM			
13	Kerosine Oil	32	19	-69%
18	Oil-fuel	144	69	-52%
22	Petrol	6	10	+67%
	AGRICULTURAL			
9	Grain & Pulse	83	4	-95%
11	Jute-raw	212	228	+75%
17	Melasses	20	36	+80%
23	Paddy	141	104	-26%
24	Rice	191	241	+26%
26	Salt	102	119	+14%
27	Sugar Cane	360	263	-27%
28	Sugar	32	55	+53%
31	Vegetable Oil	14	10	-29%
32	Wheat	478	704	+47%
	MISCELLANEOUS			
15	Marble & Stone	40	46	+15%
33	Wood	20	23	+15%
34	Other Commodities	240	253	+5%

Source: Bangladesh Railways

This table shows the changes in commodities handled relative to the total traffic, both in weight and earnings terms. Thus the share of iron and steel handled has diminished since 1969/70 as has kerosene oil and oil fuel. However a new market has opened in paddy and salt.

The relative value of different commodities to rail traffic is discussed in Appendix A8.2 from which certain conclusions can be inferred.

a) Whilst the total weight of iron & steel hauled has been reasonably constant since 1980 the rate of return on the traffic in 1983/84 compared with 1969/70 would suggest that the traffic has fallen in value to the railway by perhaps 10% either as a result of inadequate tariffs or a shorter haul.

b) The fall in the value of Kerosene to the railway is about 15% for much similar reasons, but that of fuel oil however has remained constant.

c) The two commodities paddy & salt show increases in tonnage carried and significantly the value of that traffic to the railways has increased 25% for paddy and about 50% for salt.

(2) Trends

A comparison in commodities hauled is valid, and for this examination only tonnages exceeding 10,000 tons are compared, in Table 8.2.3. Traffic Trends.

The very large swings that have occured in principal cargos shows that using short term results can be misleading as the 1980/81 tonnages were 6% below 1979/80 and 8% below 1981/82.

There is a pattern however. In 1980/81 the tonnage of "home grown" food stuffs, items 9, 23 & 37, was higher and the imported foodstuffs was lower. In 1983/84 this trend reversed.

This represents a normal situation in an agriculturally dominated economy but it emphasises the need for the freight traffic to diversify its market so that the effects of a harvest do not disturb too much the traffic pattern. The volatility of the tonnages carried shows the market force of the effects of the harvest. Figure 8.2.1 Comparative earnings percentage was prepared to show the effect of the lack of Market diversity. The individual percentage of commodity earnings are shown for each top ten commodities grouped by rank. These are summated in table A. Table B is the summation by not including the overwhelming bias of the first ranked commodity.

Table B shows a similar spread of commodity items for each year but the 1982/83 year shows that the larger earnings came from fewer commodities.

A	69/70	19.69	33.58	45.12	54.66	59.71	64.72	69.72	74.68	77.68	80.42
	82/83	27.56	41.26	52.62	62.88	69.73	73.99	77.96	81.65	84.78	87.86
	83/84	24.36	37.53	48.86	58.61	66.17	73.22	78.54	82.01	84.57	86.89
B	69/70	—	13.89	25.43	34.97	40.02	45.03	50.03	54.99	57.99	60.73
	82/83	—	13.70	25.06	35.32	42.17	46.43	50.40	54.09	57.22	60.30
	83/84	—	13.17	24.50	34.25	41.81	48.96	54.18	57.65	60.21	62.53

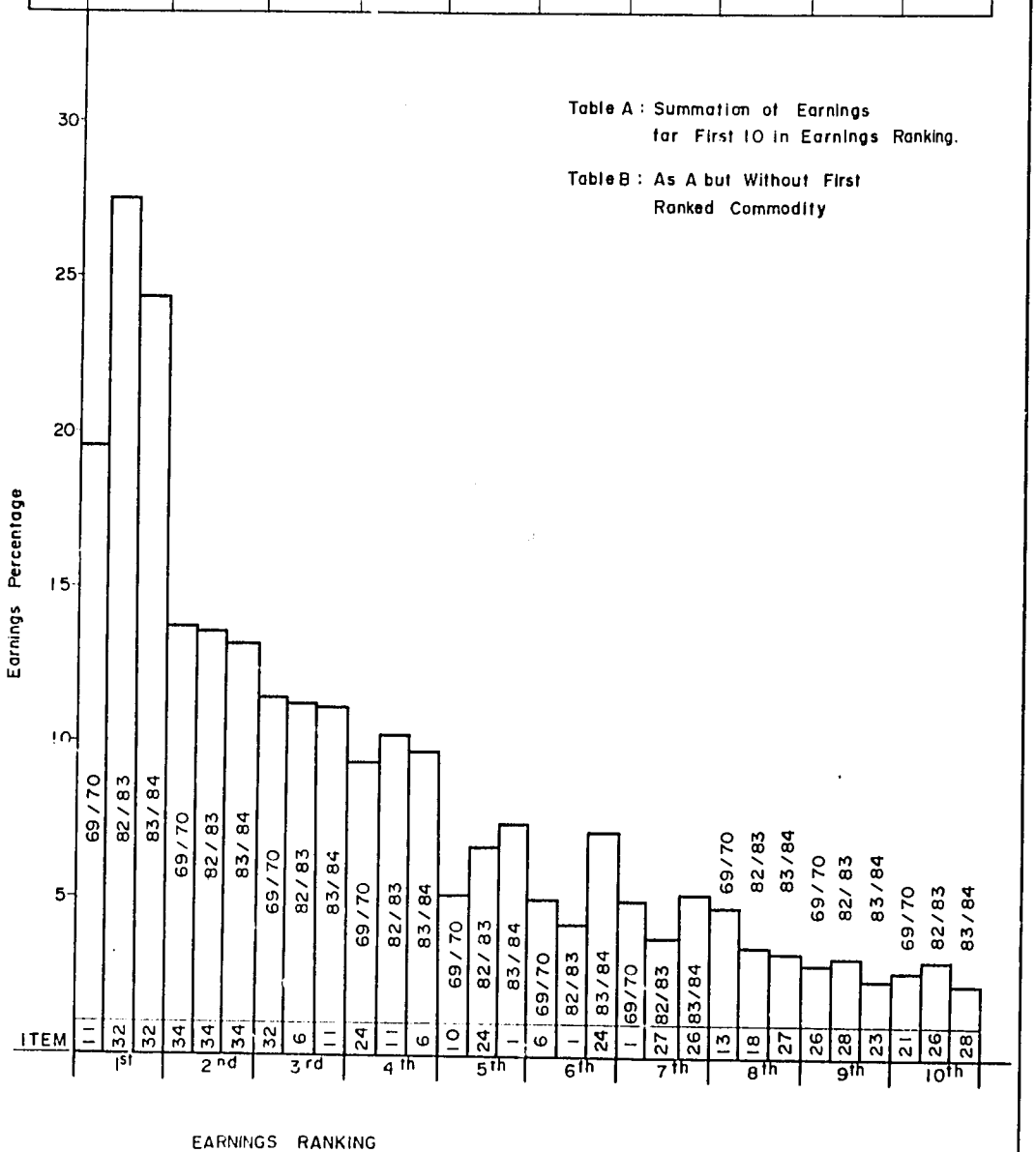


FIG. 8.2.1 COMPARATIVE EARNINGS PERCENTAGES

Item serial number same as Table A8.2.1

The reason for this narrowing of the market is the loss of the short haul and medium distance traffic to other competitors, primarily road haul. However this does not represent the full story as figure 8.2.2 shows. Wheat traffic represents about 25% of the traffic tonnage, the question must be that in supplying wagons for this service, did the railway have to turn away other traffic? There is no indication in terms of traffic share. Figure 8.2.3 based on tons moved suggests that the wheat traffic did take wagons away from other traffic especially in 82/83. This gives the impression that wheat should have exclusive vehicles particularly if the traffic is regular and does not occur only over a very limited period.

Figure 8.2.3 also shows firstly, apart from wheat, there are three major blocks of existing traffic loadings. There is a group in the 200-350 thousand ton range, the second in a 100-200 thousand ton range and a very large group of less than 70 theusand tons. Secondly that apart from wheat the group sugar cane, jute, rice and fertilizer has reduced in tonnage slightly over the past five years. However of the remaining 8 commodities which ranged between 50-150 thousand tons has split into two groups with salt, paddy and cement improving into the 100-200 thousand range, but the remainder, oil fuel, iron and steel, marble and stone, and kerosene have lost ground during the past five years.

It is important to note that the major reductions in tonnage have occured in four major items, jute, rice, cement, and kerosene.

The fall in quantity of jute transported has levelled off in the past five years as has cement. Both kerosene and rice have continued to fall over the past five years, though the 1983/84 figures do suggest that a levelling out has started.

Fertilizer and sugar cane have grown steadily from 1969/70, fertilizer at a rate of 5.6% per annum, and sugar cane at 4%. However both have peaked and are currently declining.

Paddy and salt have increased steadily, paddy at a rate of 8.7% per annum, but currently appears to be lagging for the last two years. Salt is growing consistently at a rate of about 1%.

Of the smaller quantities, iron and steel have levelled off but marble and stone have continued to decline at a constant rate. Oil fuel declined slowly at a constant rate from 1969/70 until 1981/82 since when the decline has been rapid.

(3) Observations

The 1969/70 commodities, cement; fertilizer; jute; kerosene; rice; sugarcane and wheat each comprised traffic of about 4% or more of the total tonnage transported These seven commodities represented 68% of the total traffic carried. Although it can be seen that the tonnage of three of the commodities had increased over 1969/70 the more significant conclusion is that the railway is becoming more reliant on the same commodities and thus narrowing its base of operations.

FIG. 8.2.2 CHANGE IN COMMODITY TRAFFIC PATTERN AS PERCENTAGE OF ANNUAL TRAFFIC (Exceeding 4%)

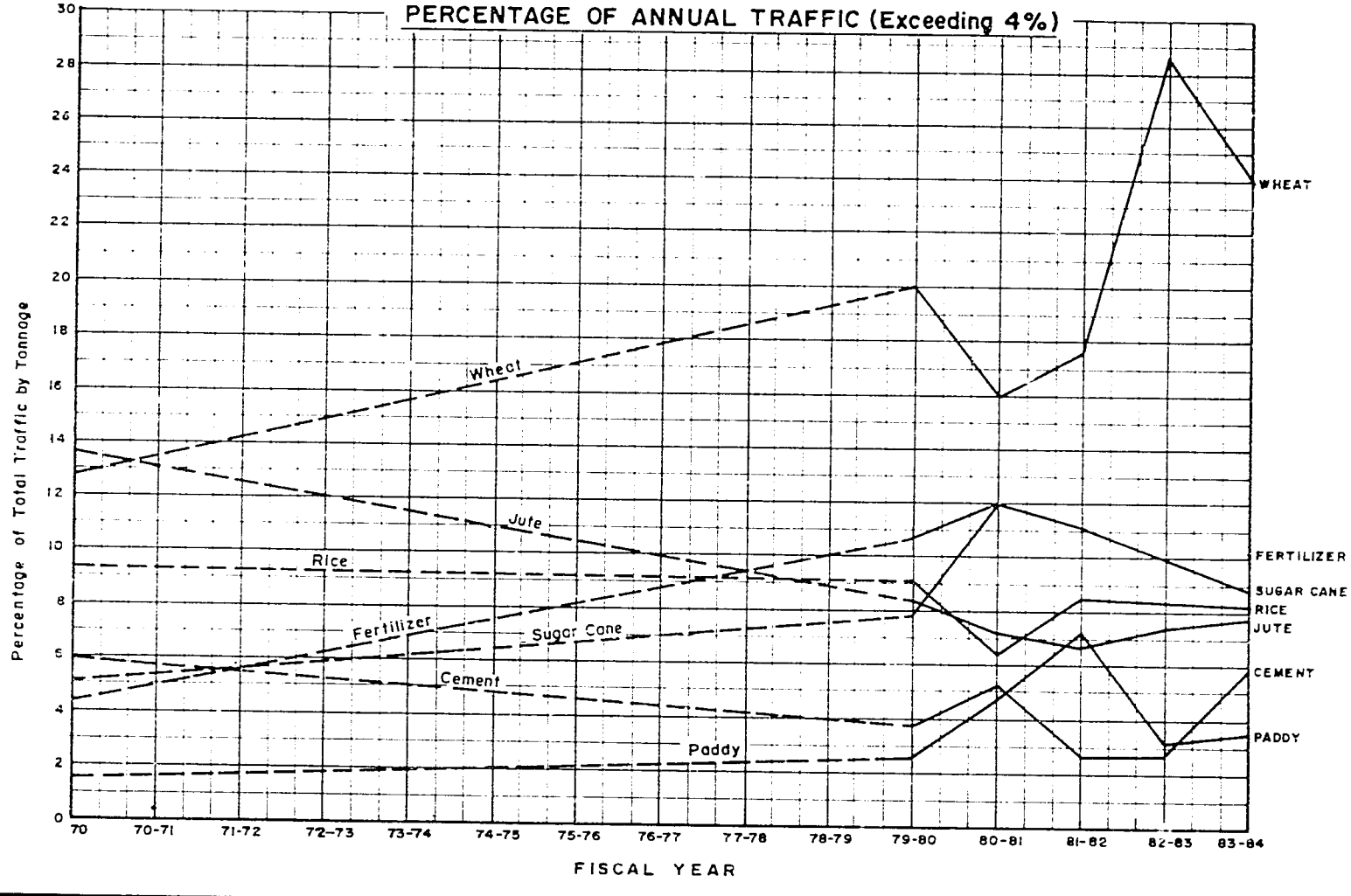
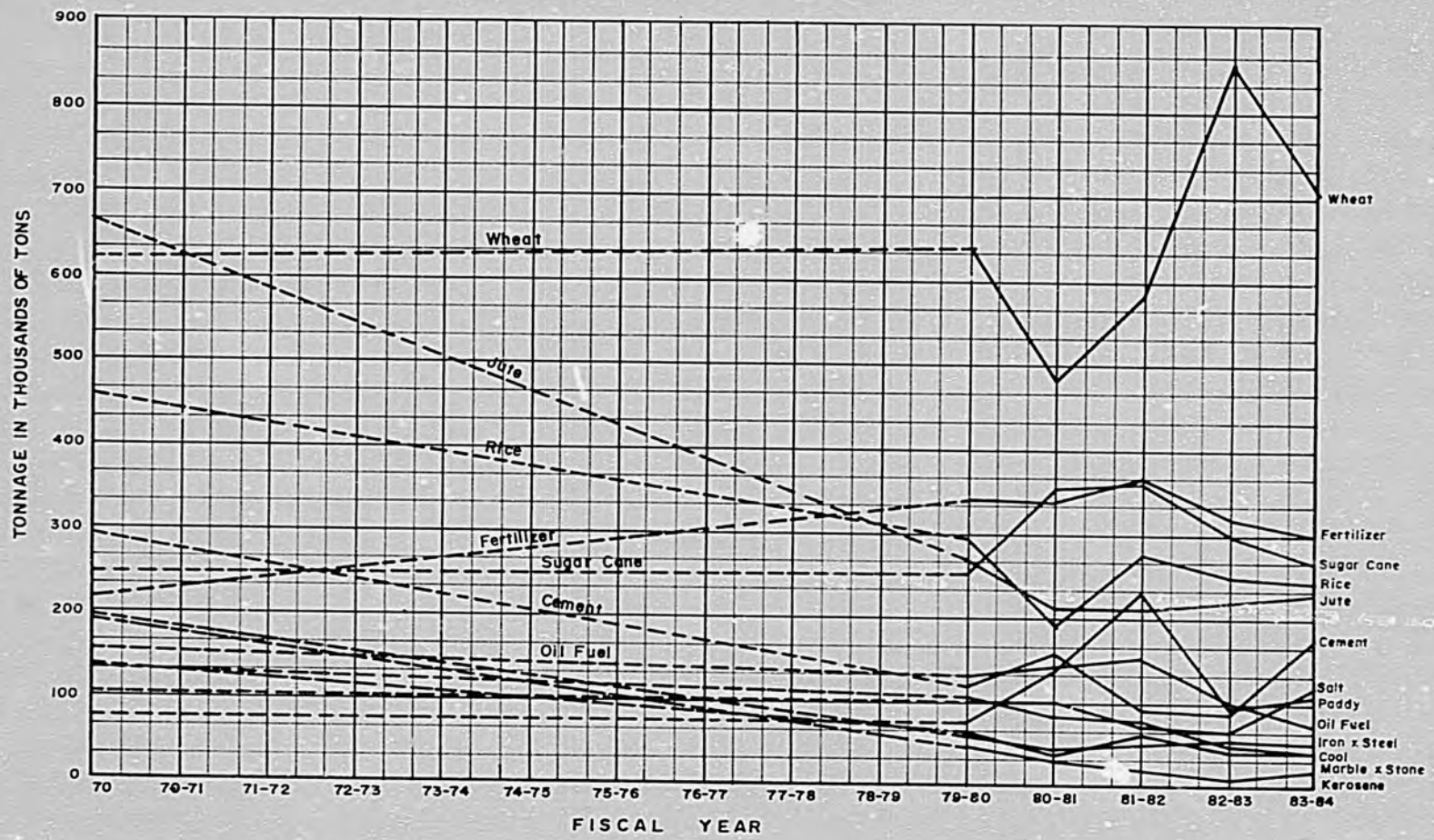


FIG. 8.2, 3 TONNAGE TRANSPORTED OF 13 MAJOR COMMODITIES PER ANNUM.



It is necessary to halt the decline in fertilizer, sugar cane, and rice and to examine the revenue structures as discussed in the appendix. It is far more important to get back to rail the bulk items, iron and steel, marble and stone and petroleum traffic in terms of tonnage especially as these are all identified in Appendix Table A8.1 as having an unsatisfactory revenue structure. This is the aspect of effective marketing discussed in the Appendix A8.1.4.

8.2.3 Passenger Traffic

The railways fulfill an important role for the movement of passengers in Bangladesh. Because of the early influence of rail travel and the population density, the railway acts as a localised transport mode for short distances as well as its more usual role for long distance transport. A daily passenger count in January 1985 is shown in figure 8.2.4.

There have been considerable variations in the number of passenger carried since Independance. In the Bangladesh Transport Survey (BTS), carried out in the aftermath of the war of liberation, it was estimated that ticket paying passengers were only 67% of the total. As law and order were enforced, it would seen that this percentage rose, as, despite a fare increase of some 20% in July 1974, there was an increase in fare paying passengers in 1974/75 of 13.3% over the previous year. There was a similar increase of 13.6% in 1975/76. These increases in passengers can partly be explained by the filling of a latent demand. Indeed, the number of trains run increased by 9.5% between 74/75 and 75/76. A fare increase of 20% in February 1976 resulted in a virtual stagnation in the number of fare paying passengers implying that again ticketless travel was on the increase. A further fare increase in July 1978 of 30% was followed by a sharp decrease in the number of fare paying passengers, followed by a constant level over the next 3 years up to 1981/82. A fare increase in July 1981 of about 20% did not depress the level of fare paying passengers, however, and in the next year there was again a sharp increase of 16.8% presumably because of stricter enforcement of controls against ticketless passengers. It was at this time that the Railway Development Planning Project (RDPP) estimated that ticketless travel had fallen to around 10% of all passengers. Clearly, however, this level has not been maintained, as there was a decrease of 6.3% in the number of fare paying passengers in 1983/84, despite an increase of 4.4% in the number of trains.

A further fare increase in July 1984 is likely to have resulted in an increase in the number of ticketless passengers.

Against this background that a small sample survey was undertaken in January 1985, whilst it would be injudicious to draw conclusions as to the actual level of ticketless travel based on such a small data base, nevertheless, there is strong indication that ticketless travel has increased substantially.

The survey suggested that ticketless travel exceeded 33% on the trains sampled, and the CIDA, using a comparative analysis suggest over 60% on average.

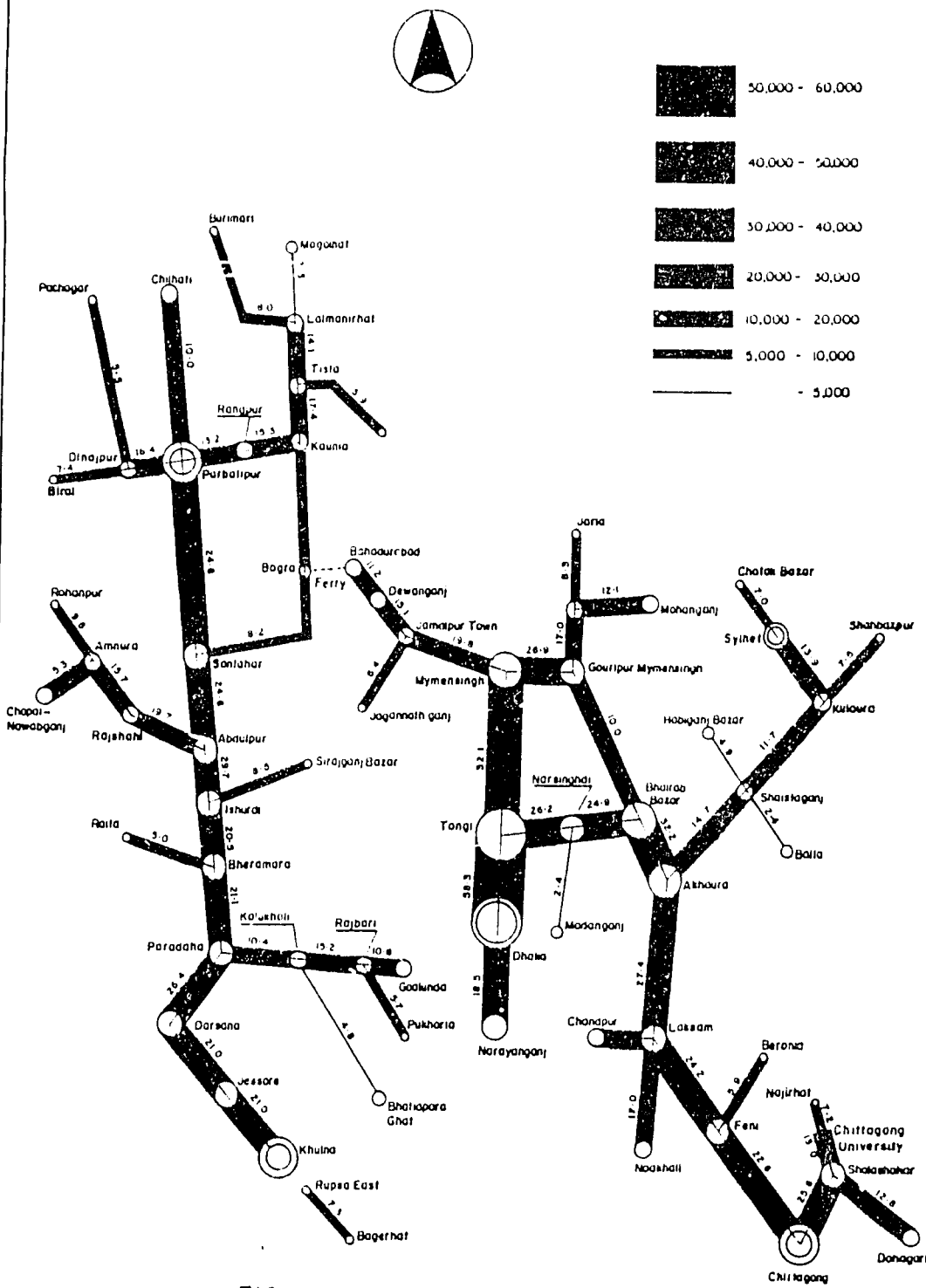


FIG. 8.2. 4

Passenger Movement Per Day (Jan. 1985)

Sovrce : Bangladesh Railways.

Figures in Thousands

Because it is very difficult to assess the percentage of ticketless travel on a year by year basis, an analysis of the railways operating characteristics over the period 1973/74 to 1983/84 has been made. As it is known that load factors are very high on Bangladesh Railways, it would seem resonable to assume that the overall growth of total passenger demand was related to the growth in the supply. In Table 8.2.4 the growth in the number of trains run, total train kilometres and average number of coaches per train together with the average passenger load are given.

Then, assuming that on average the load factor remains constant, an estimate can be made for the total passenger growth rate:

G.R. Passengers = G.R. Train km. + G.R. ave. Coaches - G.R. Pass lead =
= 4.61% + 0.85% - 2.89% = 2.57% p.a.

This growth rate of 2.57% p.a. is clese to the population growth rate of 2.5% p.a. In the RDP report, the consultants noted that the population variable alone produced a very high coefficient of determination, which would confirm these findings.

The wide variation in assessments of ticketless passengers makes a rational basis for actual passengers hard to establish. Nevertheless in this study it is assumed that the percentage of ticketless travellers at the time of the BTS study to be the 33% they estimated, and using a compound growth rate of 2.57%, the estimated total passengers has been calculated, and compared with fare paying passengers in Table 8.2.5.

It can be seen that the estimated total for 1980/81 is 116.3 M which compares with the World Bank's estimate of 116 M (W.B. Transport Section Memorandum). Also, the estimate for ticketless travel in 1982/83 was around 10%, which compares with the 14% estimated in this analysis. In fact the total passengers estimated for 1982/83 by the Revised RDPP, was 119.4 M as compared with the estimated 122.3 M in this analysis.

The estimates of this study are consistent with other studies. This however is based on the B.T.S. original estimate for ticketless travel. Should this have been an under estimate then there would need to be an upward revision of the estimated ticketless travel. Similarly an over-estimation requires a downward revision.

Figure 8.2.5 shows the estimated total passengers and fare paying passengers. It shows how there has been a considerable variation in the percentage of ticketless passengers. This should be interpreted with caution, as it is based on the assumption of steady growth, whereas in reality there is bound to be some variation from one year to the next. It does serve as an indication of the size of the problem, and suggests that following fares increases, without tight control, there will be a rise in ticketless travel.

A survey of passengers trip lengths was carried out to check the average lead, and the survey results are shown in Table 8.2.6. As a disproportionately high sample of long distance trains was taken, the weighted average of express and main trains to total was taken, based on

Table 8.2.4 Bangladesh Railways Passenger Operating Characteristics 1974-83.

Year	Total Trains	Total Train km. (thousands)	Ave. passenger lead (km)	Average Number coaches per train (in 4 wheel equivalent)
1974/75	91034	8547	49.2	16.4
1975/76	99698	9391	47.6	16.2
1976/77	107044	9999	49.1	16.7
1977/78	111506	10324	52.0	16.1
1978/79	119771	11341	53.9	14.9
1979/80	124497	11936	57.8	15.3
1980/81	124442	12144	58.3	15.7
1981/82	128592	12428	59.4	16.6
1982/83	124986	12444	60.8	17.7
1983/84	130545	12826	63.6	17.7
Compound annual growth	4.09% p.a.	4.61% p.a.	2.89% p.a.	0.85% p.a.

Source : Bangladesh Railways

This is the weighted average of passenger and mixed trains on both gauges.

Table 8.2.5 Estimated Total Rail Passengers (1972 - 1983).

Year	Estimated Total Passengers (M)	Fare Paying Passengers (M)	Estimated Ticketless Passengers %
1972/73	94.9	63.6	33
1973/74	97.4	72.9	25
1974/75	99.9	82.6	17
1975/76	102.4	93.8	8
1976/77	105.1	94.4	10
1977/78	107.8	96.2	11
1978/79	110.5	89.8	19
1979/80	113.4	88.5	22
1980/81	116.3	89.3	23
1981/82	119.3	90.4	24
1982/83	122.3	105.6	14
1983/84	125.5	98.9	21

Source : 1. Bangladesh Railways

2. Revised RDPP 1983

3. Consultants estimates.

FIG. 8. 2. 5 ESTIMATION OF TOTAL RAIL PASSENGERS INCLUDING TICKETLESS (1972/73 to 1983/84)

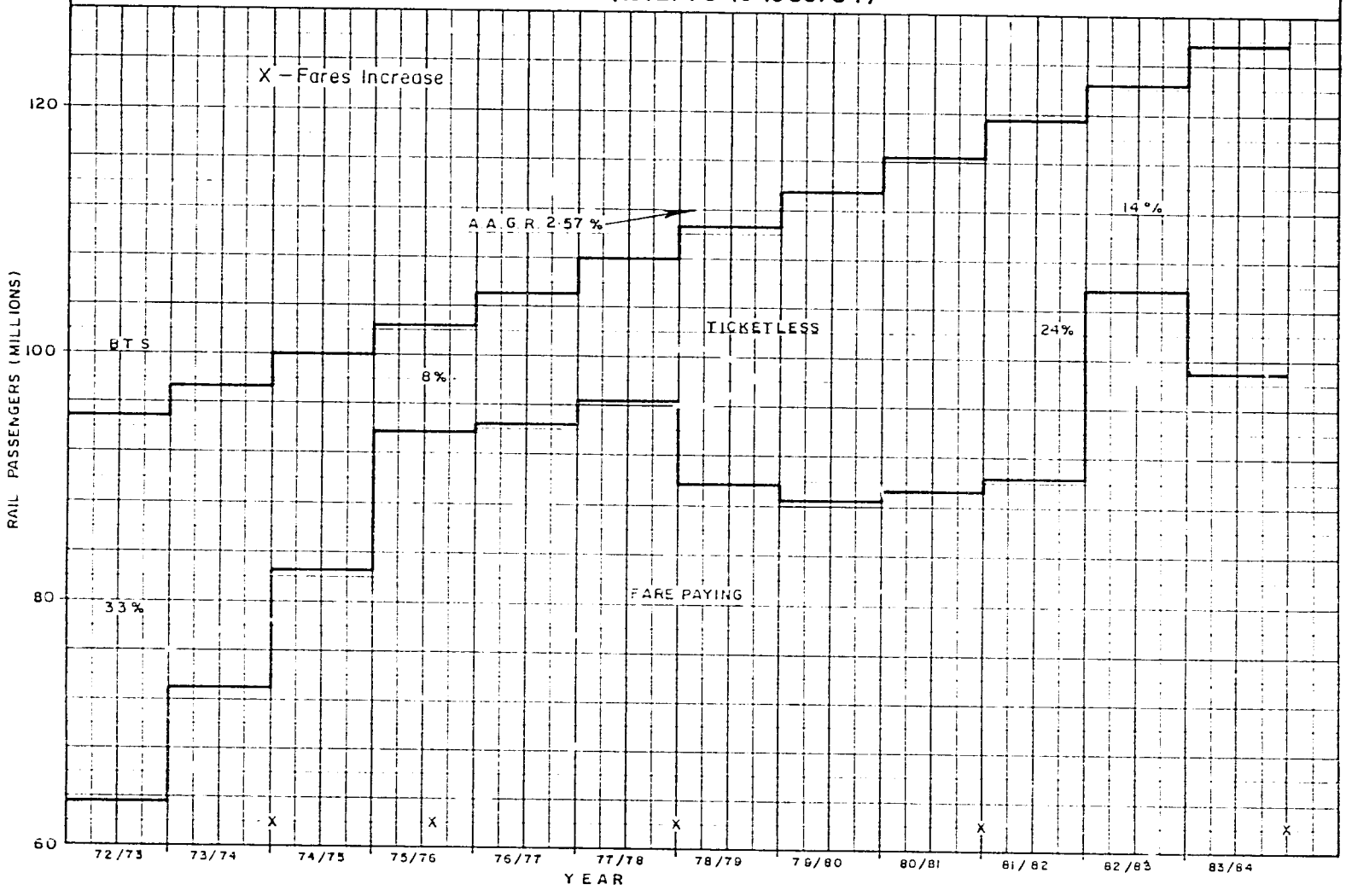


FIGURE 8.2.6 ESTIMATED RAIL PASSENGER - KILOMETRES (1972 -1983)

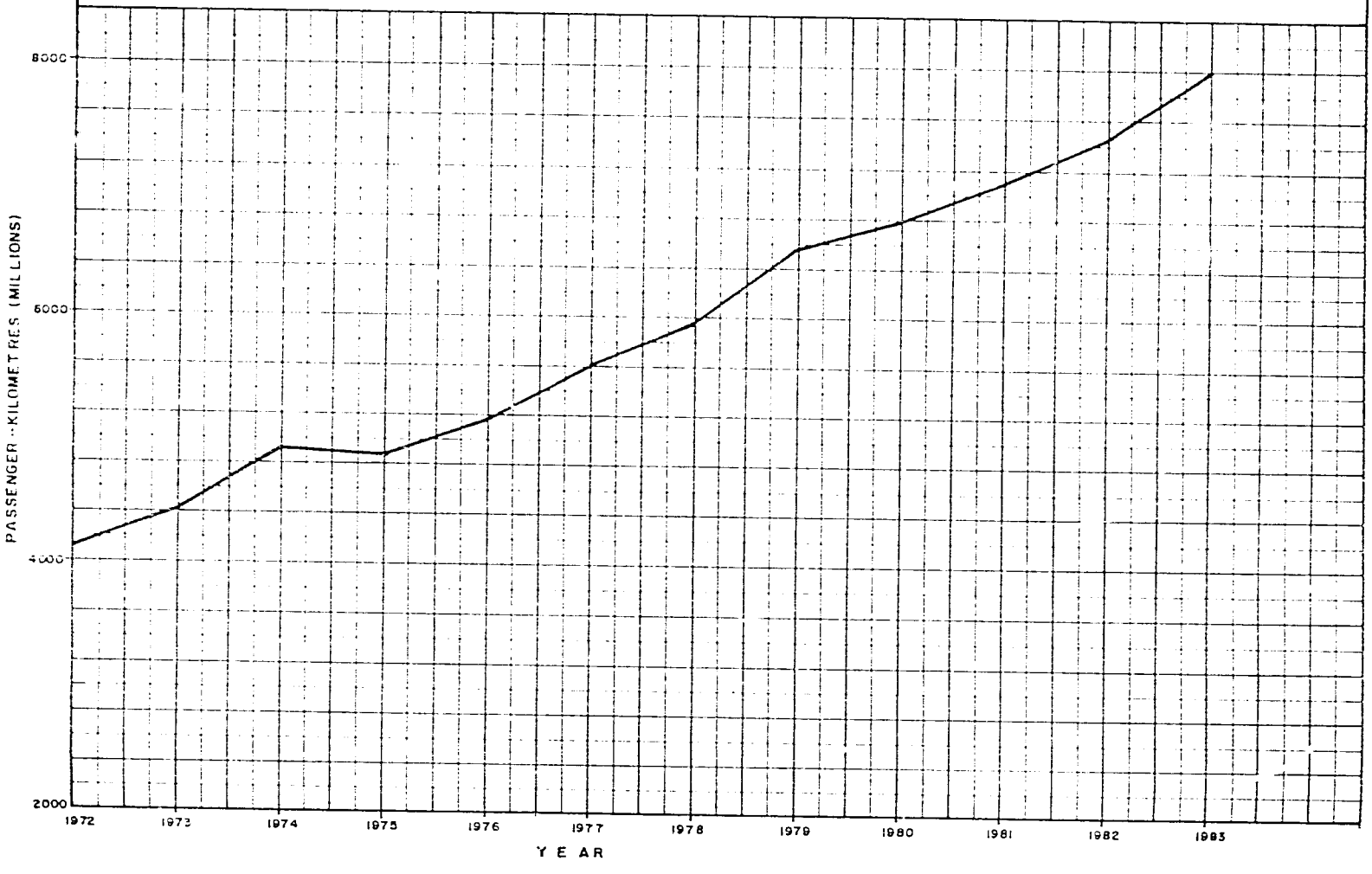


Table 8.2.6 Survey of Average Lead (km) by Rail Passengers

West Zone			East Zone		
Train	Type	Average lead km	Train	Type	Average lead km
Rocket Mail	E	114.1	Karnafuli Super Exp.	E	105.6
N. Bengal Mail	E	172.3	Surma Mail	E	252.9
Drutajan Exp	E	109.9	Balaka Exp	E	92.9
Passenger	L	52.9	Passenger	L	43.1
Drutajane Exp	E	132.0	Passenger	L	43.4
			Passenger	L	42.6
			Ulka Super Exp	E	180.2
Ave.	-	132.1	-	-	182.9
Ave. Local	-	52.9	-	-	43.0
Weighted ave.	-	69.1	-	-	73.2[2]

Source : Consultants survey.

1. The sample is rather small to justify using these figures, accordingly the published figure by Bangladesh Railways of 48.8 km is used.

2. This compares with published 72.9 km for 1983/84.

3. E. Express L. Local

Table 8.2.7 Estimated Total Rail Passengers and Passenger - km, (1972-83)

Year	Est. Total Passengers (millions)	Average Lead km	Est. Total Passenger km (millions)
1972/73	94.9	43.7	4147
1973/74	97.4	45.4	4422
1974/75	99.9	49.2	4915
1975/76	102.4	47.6	4874
1976/77	105.1	49.1	5160
1977/78	107.8	52.0	5606
1978/79	110.5	53.9	5956
1979/80	113.4	57.8	6555
1980/81	116.3	58.3	6780
1981/82	119.3	59.4	7086
1982/83	122.3	60.8	7436
1983/84	125.5	63.6	7982

Source : Bangladesh Railways

Revised RDPP 1983.

Consultants own estimates.

the published timetable. This resulted in the average leads shown in the Table 8.2.7. It should be noted that the sample for Broad Gauge was not very large, particularly for local trains. There is thus no intention to modify Bangladesh Railways own reported average lead.

Using the estimate of total passengers and average lead, the estimated passenger kilometres on the railway is shown in Table 8.2.6. There is no evidence to suggest that ticketless travellers have different average leads and thus the same percentage as passengers applies to the passenger kilometre estimates. The growth of passenger - kilometres is shown in Figure 8.2.6 for the period 1972-1983.

8.2.4 Capacity for growth

(1) Line Capacity

Figure 8.2.7 shows the total daily number of train movements on each major route of the system. Also shown is the estimated spare capacity of each section.

This figure shows that there is ample capacity for expansion of traffic on the existing system without increasing track or line capacity. It is probable that minor track layout changes can be made to improve train operations.

It is therefore possible to consider improving operating techniques as an adjunct to improved communications about to be undertaken. Improved communications do not in themselves produce an improvement in operations, this can only be derived from improved techniques with communications being the means of implementing the improvements.

(2) Marketing

The railway has geographical advantage over other competing systems as a result of early development, and whilst these advantages are being lost in the south they are still holding in the East and North west.

Table 8.2.8 presents the shortest route matrix between district centres, showing the distance advantage held by the railway.

The advantage must be exploited by marketing. The traditional traffic flow is from North to South for exports, but with future development coming into the Northwest the potential for East West traffic increases.

Marketing must press for operational improvements at the ferry. The completion of the Jamuna bridge will break the Southeast to Northwest monopoly of the railway, and ferry delays will accentuate the process of market capture by road transport.

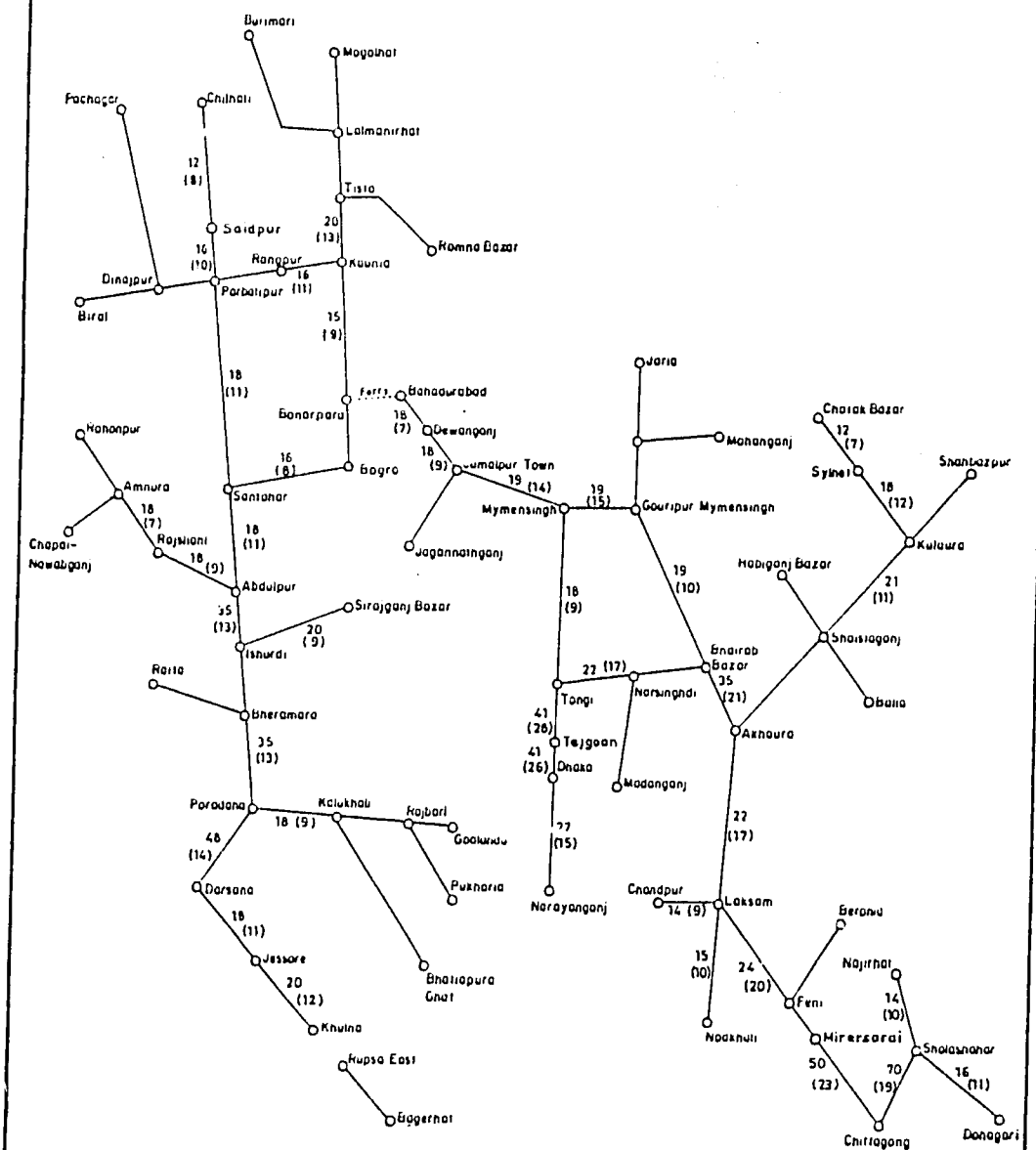
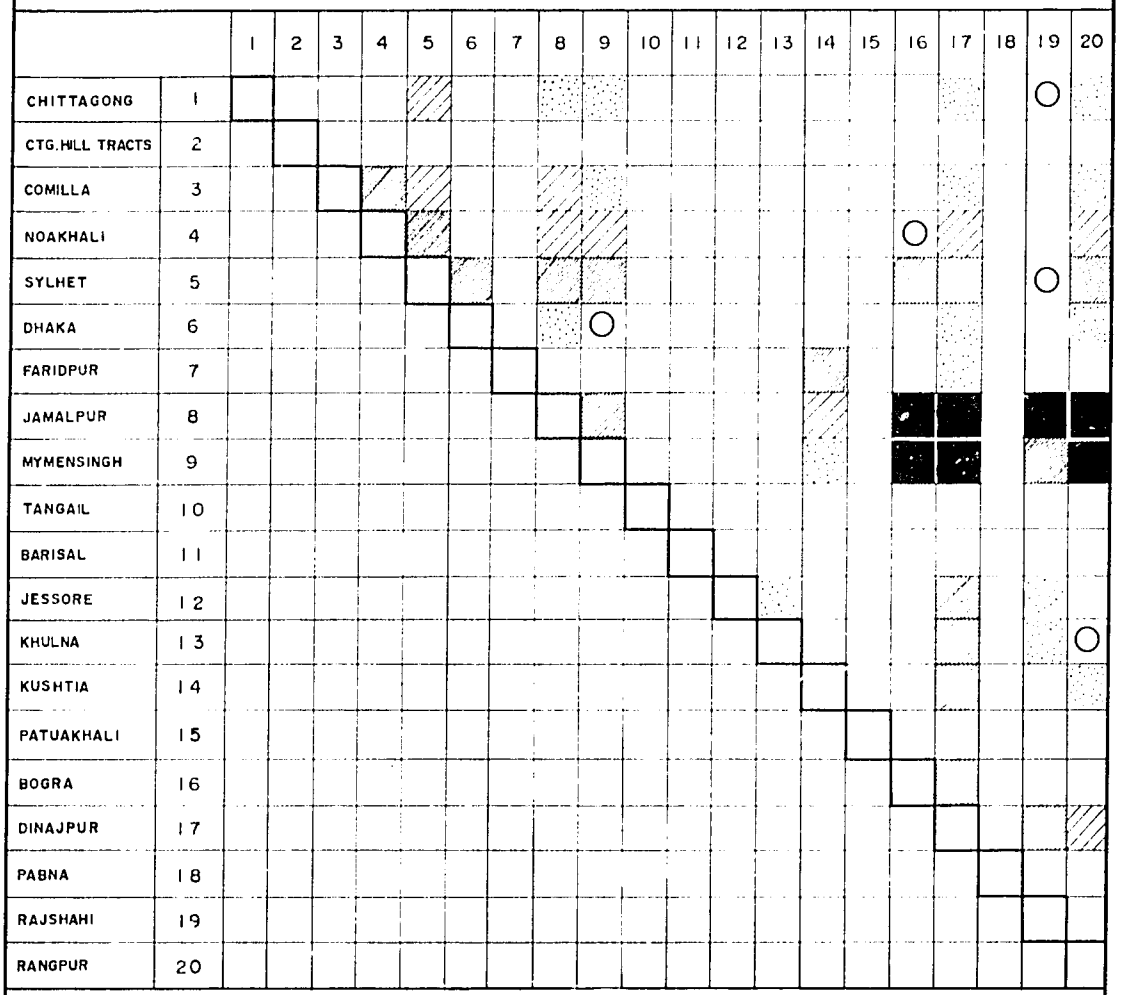


Figure 8.2. 7

Line Capacity of Bangladesh Railway 1984/85
(Figure in Bracket is Surplus)



KEY :

- Same as Road Distance
- Rail Shorter by 20-50%
- 0-10% Shorter by Rail
- Rail Shorter by More Than 50%
- 10-20% Shorter by Rail

Table 8.2.8 SHORTEST DISTANCE BY RAIL MATRIX

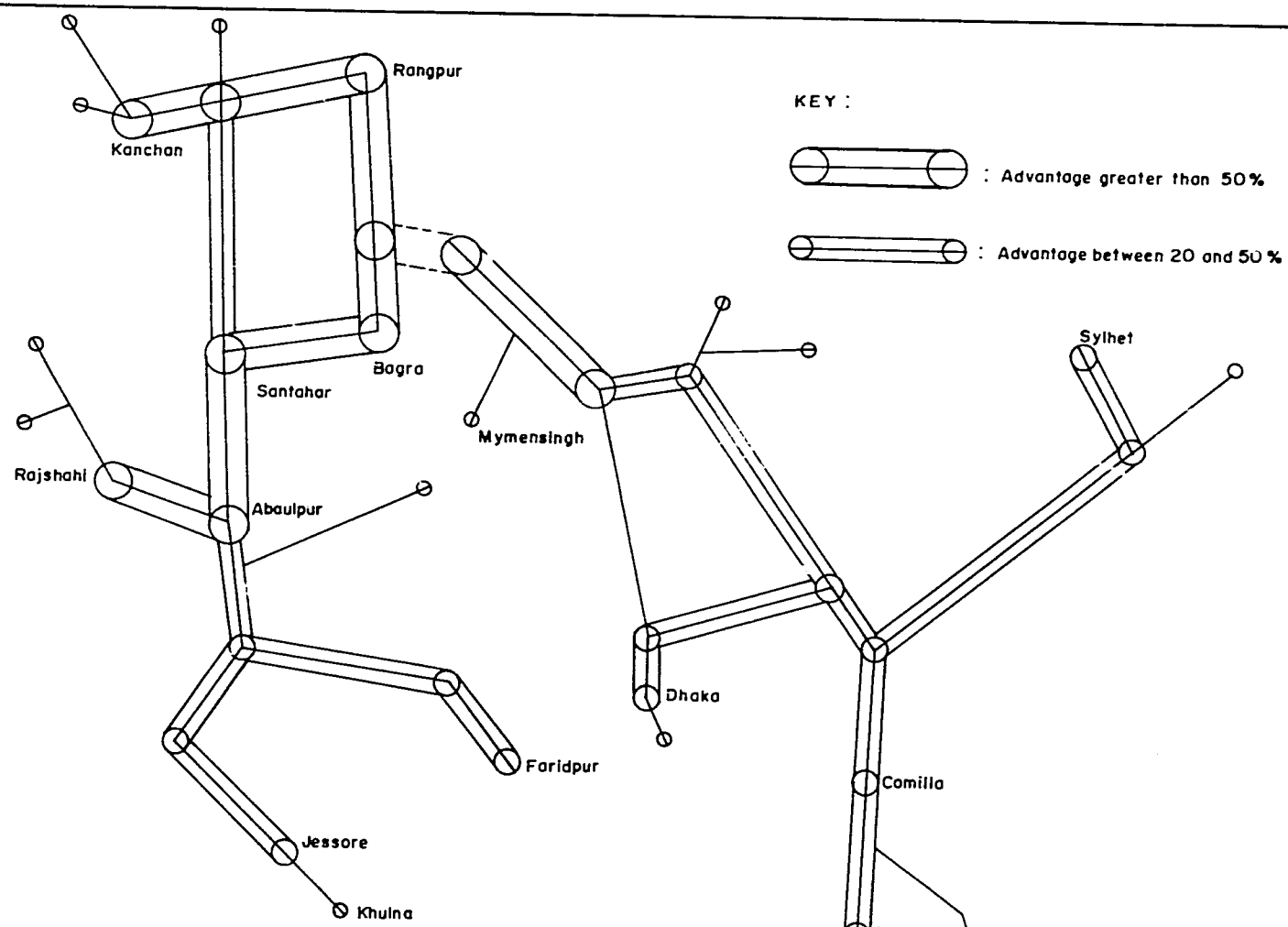


Figure 8 . 2. 8 Rail Routes between District Centres with distance advantage over Competing modes

(3) Change in Commodity

Examination of the freight traffic in the Second Five Year Plan shows room for optimism. There is a pattern of turn round in many commodities suggesting that rail traffic is an attractive transportation mode. The continued decline in some traditional railway hauled commodities, which are low value bulk items where speed and security are not important, suggests that competing transport modes are taking the traffic.

Containers do not threaten the railway and whilst this is discussed in another chapter, it is appropriate to point out that these are a change in commodity that will influence traffic patterns.

The traditional railway operating and commercial practices is based on old British practice which no longer applies, and in Africa in particular railway administrations are changing their philosophies to adapt the railway to new traffic requirements.

The coal and quarry deposits in the Northwest give opportunity for block train operations as examples of modern railway operations. New markets will not necessarily generate a new type of commodity, but it should develop a new method of handling the commodity and new operating procedures.

Section 8.2.2 showed that the proportions of the commodity mix were changing and that the shake-out in the commodities most suited for rail traffic was slowing. Management and marketing must examine these causes and derive conclusions to increase the rail freight traffic.

8.3 Rail Performance

8.3.1 Introduction

The historical approach is used to analyse the performance of the railway in utilizing rolling stock. This data was obtained from the published railway statistics.

The Second Bangladesh Railway Project Appraisal (BRPA) P.31 was used to obtain data for comparison purposes. Table 8.3.1 shows the updated performance index with units converted into metric standards. The comments made in BRPA P.31 remain valid, with improvements in the availability of broad gauge rolling stock. On the metre gauge, availability of locomotives and rolling stock has improved slightly but the freight wagon stock shows a severe slump.

Performance index item 1 is a measure of operational efficiency. The results have attained the 82/83 forecast but major improvements for the 84/85 target are optimistic, and an increase in utilization is needed.

Items 2, 3 & 4 represent the efficiency of the M & E maintenance programme, and the withdrawal of condemned stock and introduction of new stock. The premature withdrawal of stock and the introduction of new will distort these indices.

Index 5 is a measure of utilization and an increasing figure is a measure of increased utilization resulting from maintenance and operating efficiences.

Index 6 is a similar index for wagons available for service. This downward trend indicates either a falling demand or an increase in the numbers of wagons available for use.

Indices 7 and 8 indicate the utilization of locomotives. The downward trend shows either an increase in the number of locomotives available for use or a reduction in the numbers of trains run. These reduced numbers do indicate a considerable under-utilization of locomotives.

The indicators suggest, and this is limited by the accuracy of the published data as is discussed in the next section, that there is an operating inefficiency in the freight traffic. Wagon turnround must be reduced. If there is a shortage of freight wagons the terminal times must be reduced, since the length of haul is small.

This is an operating matter. It is accepted that derailments and floods can disrupt traffic and consequently delays occur to wagons in transit, but the duration of these events is short and has only small statistical significance over the whole system.

It should be noted that if the published data on rolling stock is not accurate this will show that the stock is available for traffic and hence indicates an operating deficiency rather than an availability or maintenance deficiency.

Table 8.3.1 Comparative Statement of Performance Indices of Bangladesh Railways

Performance Index	RDPP TARGETS		ACTUAL RESULTS					
	82/83	84/85	69/70	79/80	80/81	81/82	82/83	83/84
1. Wagon Turn round (Stock in use for revenue earning traffic)	BG 20	12.5	Open 45.4	33.9	30	14.4	17.4	17.0
			Cov. 8.5	17.7	16.2	16.9	14.0	15.0
	MG 20	14.0	Open 21.2	23.3	32.3	28.2	23.3	16.2
			Cov. 10.2	23.7	25.9	22.5	19.1	17.6
2. % Diesel locos available. (Total number owned-number due to be condemned)	BG 80	82	NA	NA	NA	85	77	80
	MG 78	86	NA	NA	NA	77	74	72
3. Ditto Passenger Coaches	BG 80	90	NA	NA	NA	74	82	85
	MG 78	87.5	NA	NA	NA	65	88	84
4. Ditto Freight Wagons	BG 81	88.5	NA	NA	NA	75	95	87
	MG 79	85	NA	NA	NA	75	97	67
5. Passenger Vehicle km Per vehicle day on line	BG 224	241	243	195	198	190	204	220
	MG 179	209	211	154	159	166	167	171
6. Net tonne kms Per wagon-day	BG 222	245	229	183	173	162	142	154
	MG 165	320	190	150	136	146	146	121
7. Diesel loco kms Per Engine-day on line	BG 333	362	378	285	232	206	192	183
	MG 206	217	214	192	177	169	171	155
8. Ditto in use (Freight service)	BG 277	291	307	254	198	169	163	151
	MG 196	203	203	187	175	166	163	155

Source: Bangladesh Railways

8.3.2 Freight traffic

The two indicators that are a measure of the efficiency of railway freight operations are the wagon kms per wagon day and the tonne kms per wagon day.

Tables 8.3.2 and 8.3.3 are two different approaches to determine the average number of wagons available for service. Comparison between the tables should show a close similarity. There is close similarity in 1969/79 but these has been an increasing divergence since, and in 1983/84 the disparity is 3%.

Table 8.3.2 Daily Average Number of Wagons in Use (in Terms of 4 Wheelers)

(based on kilometres)

Year	Broad Gauge				Metre Gauge			
	Wagon km/yr. x10^6	Wagon km/day x10^3	daily run/wagon	Wagons in use	Wagon km/yr. x10^6	Wagon km/day x10^3	daily run	Wagons in use
69/70	35,082	96,115	24.5	3923	144,028	394,597	29.3	13,467
74/75	20,741	58,824	17.5	3247	56,024	153,490	13.0	11,807
75/76	22,959	62,901	18.0	3495	59,171	162,112	14.7	11,028
76/77	20,006	54,811	15.1	3630	55,997	153,290	13.9	11,028
77/78	21,235	58,178	15.3	3802	56,691	155,318	14.0	11,094
78/79	20,416	55,934	15.2	3680	61,088	167,364	15.5	10,797
79/80	21,287	58,320	15.7	3715	61,667	168,951	15.6	10,830
80/81	19,042	52,170	14.8	3525	56,438	154,625	13.7	11,286
81/82	20,506	56,181	14.6	3848	68,079	186,518	16.3	11,443
82/83	20,067	54,978	13.2	4165	67,296	184,373	16.7	11,040
83/84	19,045	52,178	14.7	3550	65,300	178,904	14.2	12,599

Source: Bangladesh Railways
Consultants Calculations

Table 8.3.3 Daily Average Number of Wagons (in Terms of 4 Wheelers)

(based on Tonne-kilometres)

Year	Tonne-kms/ yr. x10^6	Tonne kms/day x10^3	Tonne kms per wagon	Wagons in use	Tonne kms/yr. x10^6	Tonne kms/day x10^3	Tonne kms/ wagon day	Wagons in use
69/70	327,170	896,356	229	3914	937,893	2,570	190	13,524
74/75	207,024	567,189	178	3186	416,224	1,140	96	11,878
75/76	262,636	719,551	208	3459	484,393	1,327	119	11,152
76/77	249,730	684,192	188	3639	462,701	1,268	114	11,120
77/78	284,920	780,603	204	3826	501,174	1,373	123	11,163
78/79	273,310	748,795	204	3670	565,163	1,548	142	10,904
79/80	252,470	691,699	183	3780	602,251	1,650	150	11,000
80/81	224-278	614,460	173	3552	562,369	1,541	136	11,329
81/82	228,987	627,362	162	3872	615,493	1,686	146	11,550
82/83	217,043	594,638	142	4188	596,827	1,635	146	11,200
83/84	205,004	561,655	154	3647	573,623	1,572	121	12,988

Source: Bangladesh Railways
Consultants Calculations

(1) System data

Figure 8.3.1 gives the aggregate for freight traffic performance. In this and subsequent graphs the plots are put on to one sheet for comparative purposes only. The vertical scales differ and consequently direct comparison of slopes is not possible.

BRPA made observations based on 81/82 results, and so these are now extended to include 82/83 & 83/84 published data.

The average haul has remained high and, on overall performance, is ranging in the 260 to 270 km range. However the tonne-kilometres, tonnage moved and wagons loaded are tending to fall. These are disturbing trends and indicate a loss in the market. The increase in length of haul shows that the short haul market has been lost to competition.

(2) Broad gauge data

The aggregate does not represent the particular and Figure 8.3.2 shows the broad gauge statistics. The traffic peaked in 1977/78 and has fallen sharply in all parameters. The wagon turn-round time has improved with about 24 to 26 movements a year a steady improvement since 1979/80. The tonne-kms have fallen an average of 4.2% each year, the tonnage has fallen at 4.6% per year and the wagons loaded at 3.5% per year. The length of haul has remained in the 185 to 200 km range for the past 5 fiscal years.

Table 8.3.4 gives the average tons per wagon in terms of 4 wheelers for the past 10 years and the benchmark year. This shows that in 1977/78 the average wagon load peaked and has since declined steadily.

(3) Metre gauge data

The metre gauge performance does not have the same pattern, as the down turn in traffic has not occured so obviously, except that the number of wagons loaded is falling slightly at about 1%. The tonnage carried was slightly less and tonne-kilometres about average. The tonne-kilometres have increased slightly over the same six year period with the increase in the length of haul.

The fluctuations in traffic over the six year period. 77/78 to 83/84 show an erratic pattern from which any conclusion is judgemental. At best the metre gauge traffic has held its own but the indicators for 82/83 and 83/84 are negative.

Average tonnes per wagon in terms of 4 wheelers in table 8.3.4 shows the same pattern as the broad gauge but the loading crested in 1981/82, three years later. This trend continues.

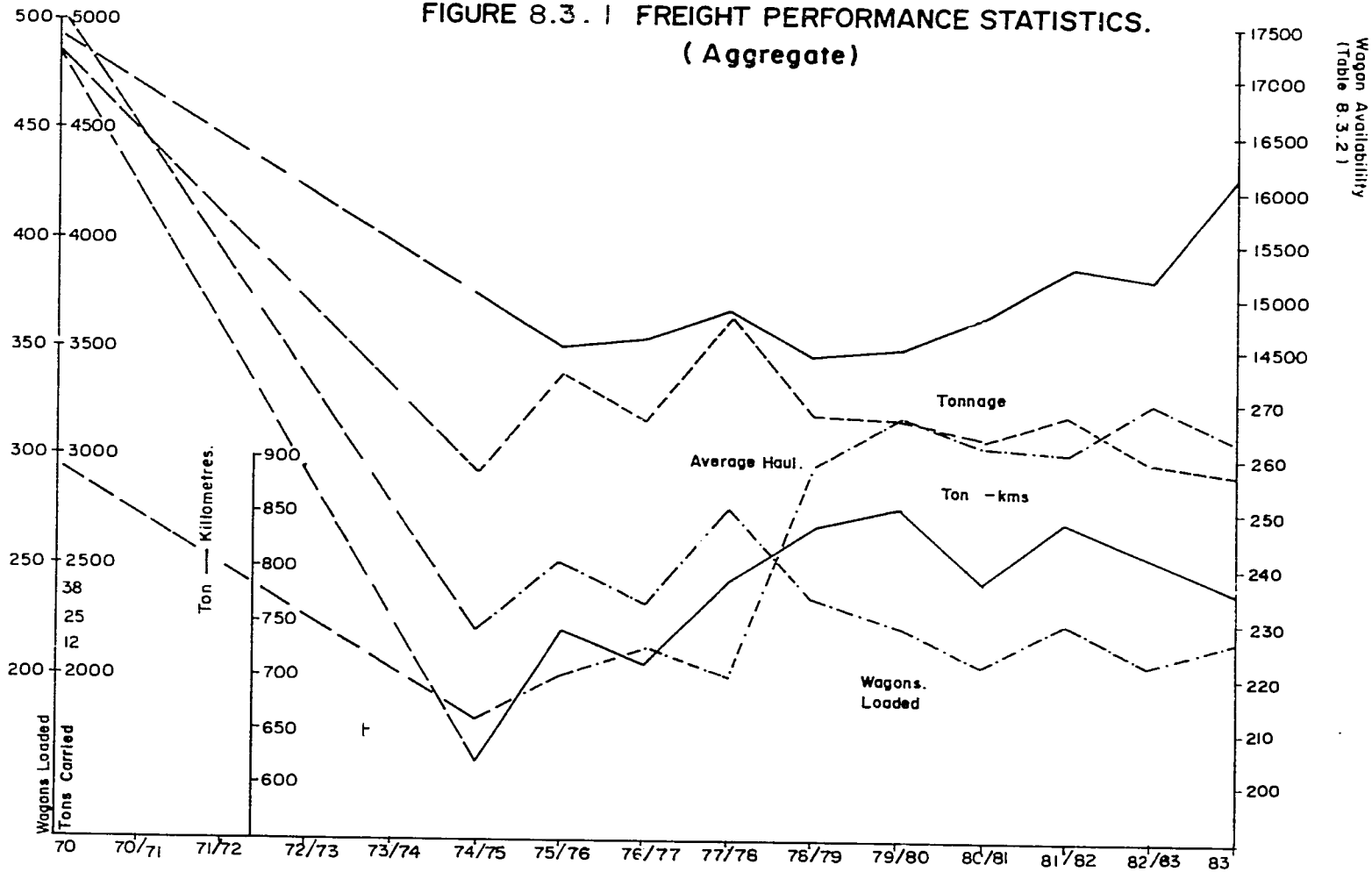


FIGURE 8.3.1 FREIGHT PERFORMANCE STATISTICS.
(Aggregate)

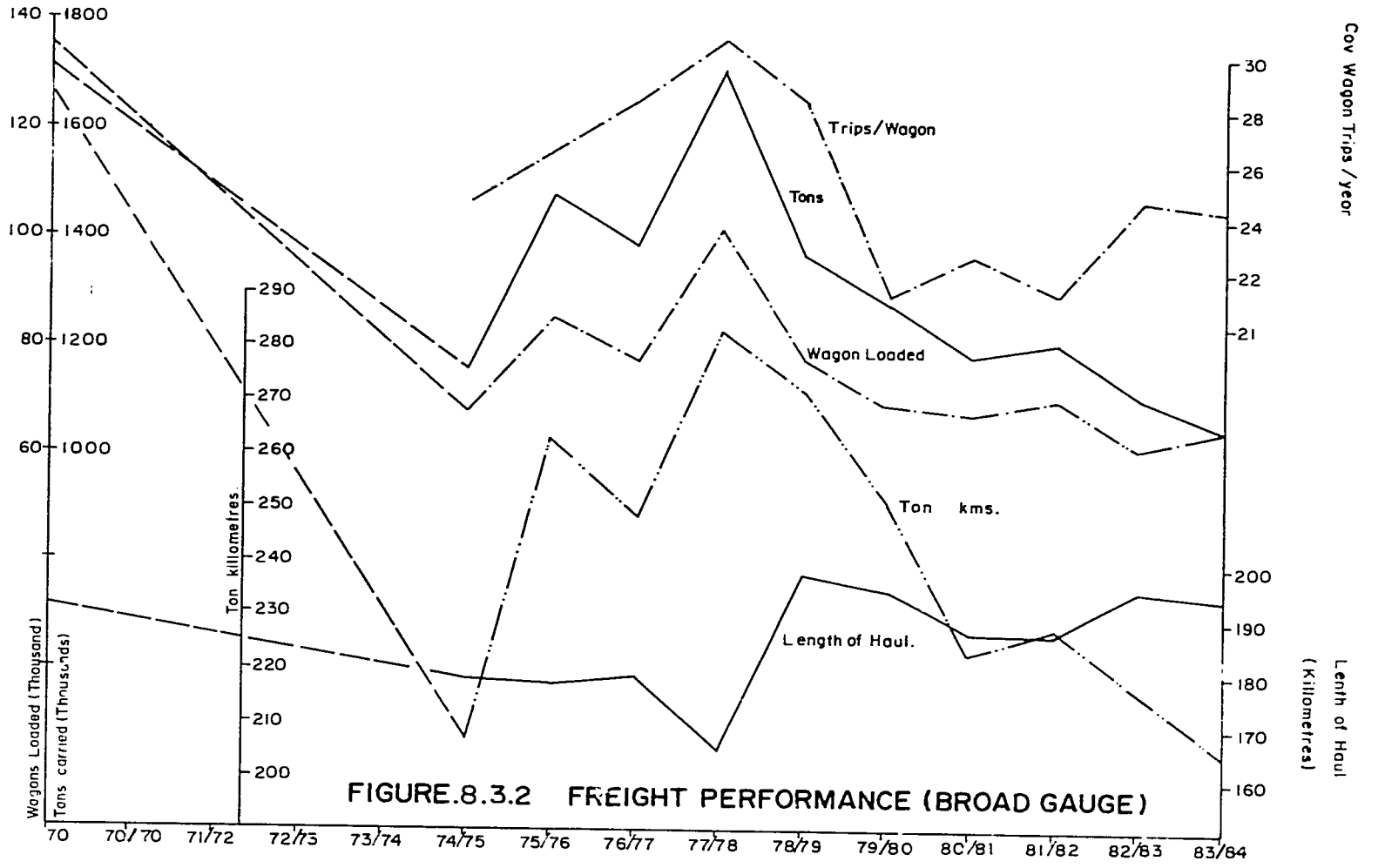


FIGURE.8.3.2 FREIGHT PERFORMANCE (BROAD GAUGE)

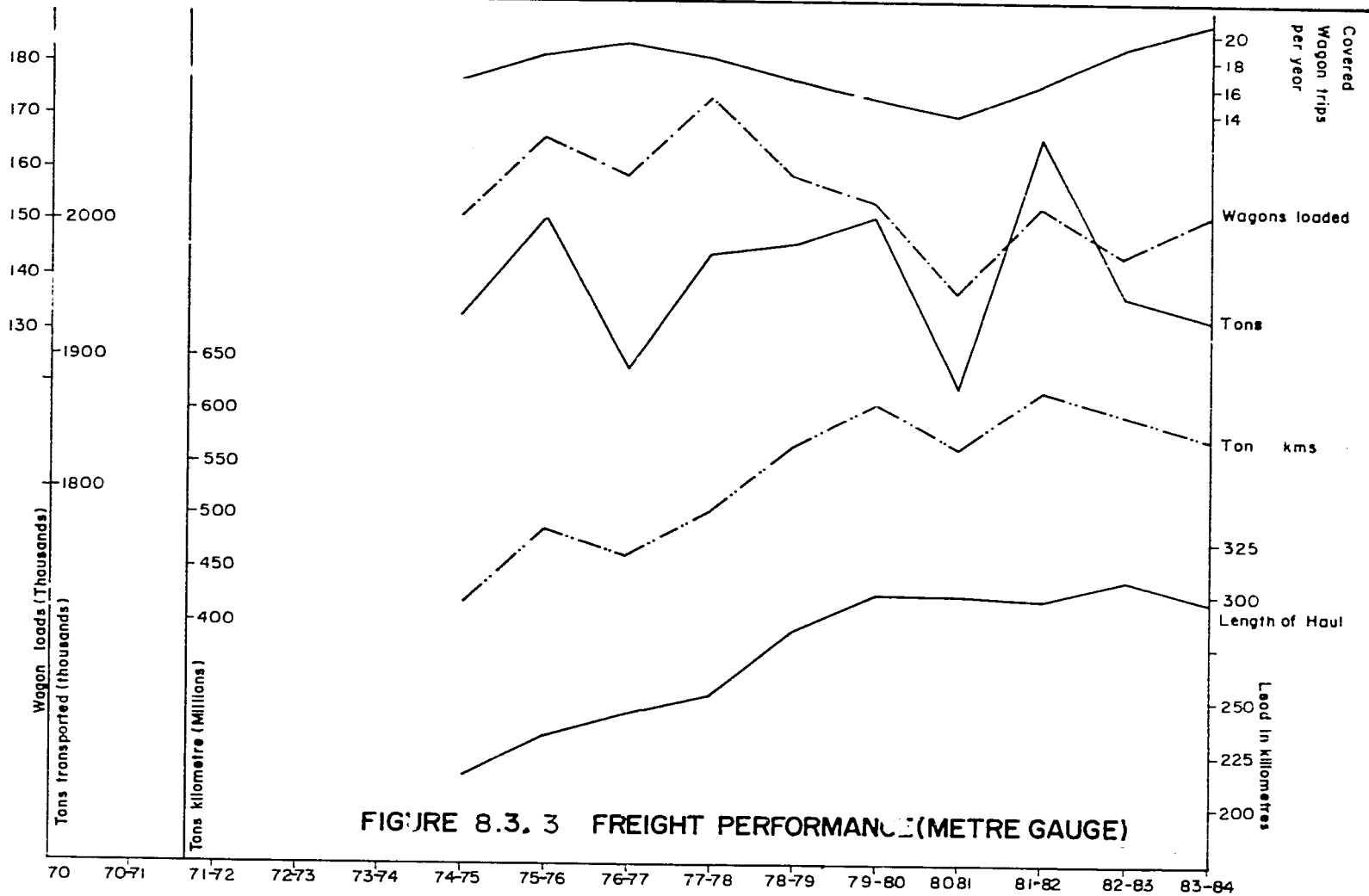


FIGURE 8.3.3 FREIGHT PERFORMANCE (METRE GAUGE)

Table 8.3.4 Average Wagon Loads (in Terms 4 Wheels)

Year	Broad Gauge			Metre Gauge		
	Ton kms/yr x 10^3	Wagon kms/yr x 10^3	Tonnes/wagon	Tonne kms/yr x 10^3	Wagon kms/yr x 10^3	Tons/wagon
1969/70	327,170	35,082	9.33	937,893	144,028	6.51
1974/75	207,024	20,741	9.98	416,224	56,024	7.43
1975/76	262,636	22,959	11.44	484,393	59,171	8.19
1976/77	249,730	20,006	12.48	462,701	55,997	8.26
1977/78	284,920	21,235	13.42	501,174	56,691	8.84
1978/79	273,310	20,416	13.39	565,163	61,088	9.25
1979/80	252,470	21,287	11.86	602,251	61,667	9.77
1980/81	224,278	19,042	11.78	562,369	56,438	9.96
1981/82	228,987	20,506	11.17	61[illegible],493	68,079	9.04
1982/83	217,043	20,067	10.82	596,827	67,296	8.87
1983/84	205,004	19,045	10.76	573,623	65,300	8.78

Source: Bangladesh Railways
Consultants Calculations

Table 8.3.5 Availability of Wagons (in 4 Wheel Units)
(Based on Table 8.3.2)

Year	69/70	74/75	75/76	76/77	77/78	78/79	79/80	80/31	81/82	82/83	83/84
BG on Stock	4,632	4,314	4,645	4,786	4,645	4,566	4,443	4,445	4,772	5,045	4,839
Wagons in use	3,923	3,247	3,495	4,630	3,802	3,680	3,715	3,535	3,848	4,165	3,550
%	84.7	75.3	75.2	75.8	81.9	80.6	83.6	79.3	80.6	82.6	73.4
MG on Stock	14,984	13,428	14,258	14,219	14,079	14,019	14,011	14,921	15,126	15,151	15,053
Wagons in use	13,467	11,807	11,028	11,028	11,094	10,797	10,830	11,286	11,443	11,040	12,599
%	89.9	87.9	77.3	77.6	78.8	77.0	77.3	75.6	75.7	72.9	83.7

Source: Bangladesh Railways
Consultants Calculations

(4) Observations

The Report Review Committee on Overall Operational Efficiency of Bangladesh Railway (RCOE) page 10 shows that the railway is turning away traffic because of the inability to supply wagons.

However the published statistics when converted back into available wagons used each day on average gives a different picture of an adequate wagon supply. See Table 8.3.5 which is based on published statistics and the lower value of availability shown in table 8.3.1. There are adequate numbers of wagons in use, when comparing the 69/70 figures, 38.45% less traffic is carried in 7.12% fewer wagons. This comparison is shown in Table 8.3.6.

Table 8.3.6 Comparison 1983/84 with 1969/70 (in 4 Wheel Units)

(1) SYSTEM

	Wagons owned	Tonne kms hauled x 10^3	Wagons used
1969/70	19,616	1,265,063	17,396 (88.7%)
1983/84	19,892	778,627	16,149 (81.2%)
Increase %	1.4%	-	-
Decrease %	-	38.45%	7.12%

(2) BROAD GAUGE

	Wagons owned	Tonne kms hauled x 10^3	Wagons used
1969/70	4,632	327,170	3,923
1983/84	4,839	205,004	3,550
Increase %	4.47%	-	-
Decrease %	-	37.34%	9.51%

(3) METRE GAUGE

	Wagons owned	Tonne kms hauled x 10^3	Wagons used
1969/70	14,984	937,893	13,467
1983/84	15,035	573,623	12,599
Increase %	0.34%	-	-
Decrease %	-	38.84	6.45%

Source: Bangladesh Railways
Consultants Calculations

Operational factors not the number of wagons held for repairs result in this downtrend.

Table 8.3.7 shows the number of times a year each covered van is loaded for traffic. The 83/84 Broad gauge is 56.6% of the 69/70 figure and 57.8% for the metre gauge. This is a factor of operational efficiency.

Table 8.3.7 Average Number Trips per Year
(Covered Wagon)

Year	1969 /70	1974 /75	1975 /76	1976 /77	1977 /78	1978 /79	1979 /80	1980 /81	1981 /82	1982 /83	1983 /84
Broad gauge Turnround	8.5	15.0	13.9	13.0	12.0	15.0	17.7	16.2	16.9	14.8	15.0
Trips	42.9	24.3	26.3	28.1	30.4	24.3	20.6	22.5	21.6	24.7	24.3
Metre gauge Turnround	10.2	21.9	19.5	18.7	20.0	21.6	23.7	25.9	22.5	19.1	17.6
Trips	35.8	16.7	18.7	19.5	18.3	16.9	15.4	14.1	16.2	19.1	20.7

Table 8.3.8 Average Terminal Time
(Metre Gauge)

Year	1969/70	1982/83	1983/84
Average freight train speed (kms/hr)	13.49	10.44	9.72
Average length of haul for system (kms)	259.3	271.5	264.9
Average trip time (days)	0.80	1.08	1.13
Average turn round (days)	10.20	19.1	17.02
Balance (Terminal Time)	9.40	18.02	16.09

Terminal time is a matter of management control of operations and a much tighter control of wagon use is needed to reduce the terminal time. These tables include train delays in train trip time, thus terminal time is idle time under load either at destination or at origin as well as loading and unloading time. Table 8.3.8 shows the terminal time analysis.

Idle time under load is fraud waste and abuse discussed in Section 8.1.7.

8.3.3 Passenger travel

Figure 8.3.4 shows the passenger train statistics over the past 10 year period.

The number of passenger trains run is increasing slowly after steady growth until 74/75. Broad gauge declined in 82/83. It should be noted that the total passenger-kms is still increasing.

The number of trains that can be run is limited by either track capacity, or locomotives and rolling stock availability. Rolling stock

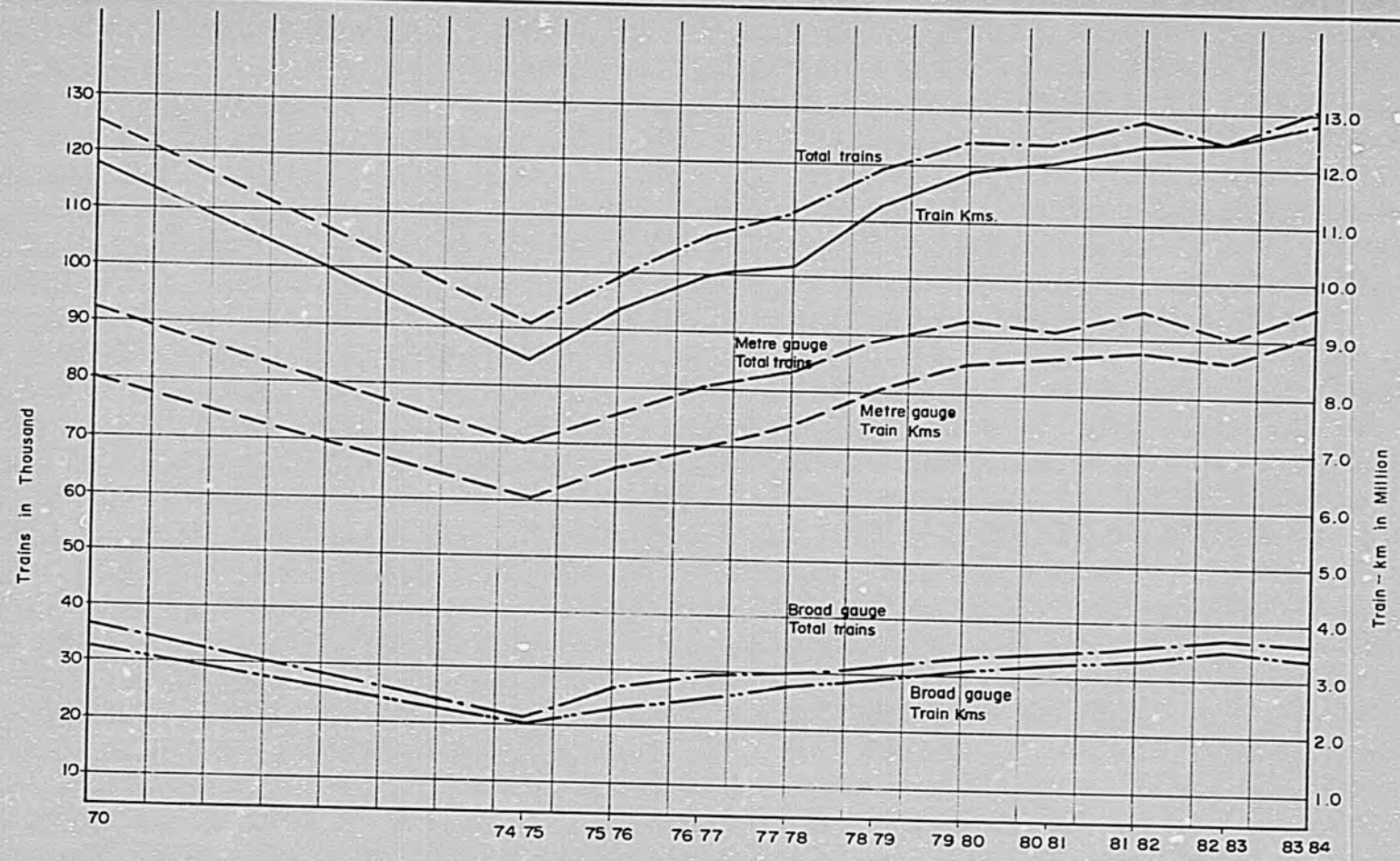


FIG. 8.3. 4 Passenger Train Statistics

availability is discussed later. The line capacity discussed in section 8.2 has sufficient spare capacity on all sections for a significant increase in traffic.

The total number of passenger trains run had by 1979/80 virtually returned to the 1967/70 number, but the average increase over the years 80/81 to 83/84 is:

Broad gauge = 1.84% per annum.
Metre gauge = 1.00% per annum

Train Kilometres:

Broad gauge = 1.84% per annum.
Metre gauge = 1.73% per annum.

Figure 8.3.5 gives the passenger statistics

Over the same four year period the number of passengers increased

Broad gauge: 1.96%
Metre gauge: 3.28%

and the passenger kilometres increased

Broad gauge = 3.85%
Metre gauge = 6.27%

The increase in passengers and the increase in the number of trains run are not in sequence, and hence there is a relative reduction in the number of seats available over 1969/70.

The passenger statistic results for paid fares are mixed in that the ACC and II Class passenger totals are falling whilst I and III Class passengers are increasing. This increase in I Class is only a fraction in total numbers of the average loss each year from the II Class. III Class is increasing by more than 1 million passengers a year on average.

Figure 8.3.6 shows the results for the six year period 77/78 to 83/84, from which the average over the period is

ACC Class : -7.7% per annum
II Class : -6.1% per annum
I Class : +1.67% per annum
III Class : +1.8% per annum

Figure 8.3.7 shows the length of lead for each class. The ACC Class has stabilized at about 300 kilometres, and I Class is climbing steadily.

(1) Overcrowding

These statistics only apply to fare paying passengers, and consequently are considerably below the actual number of people travelling on a train.

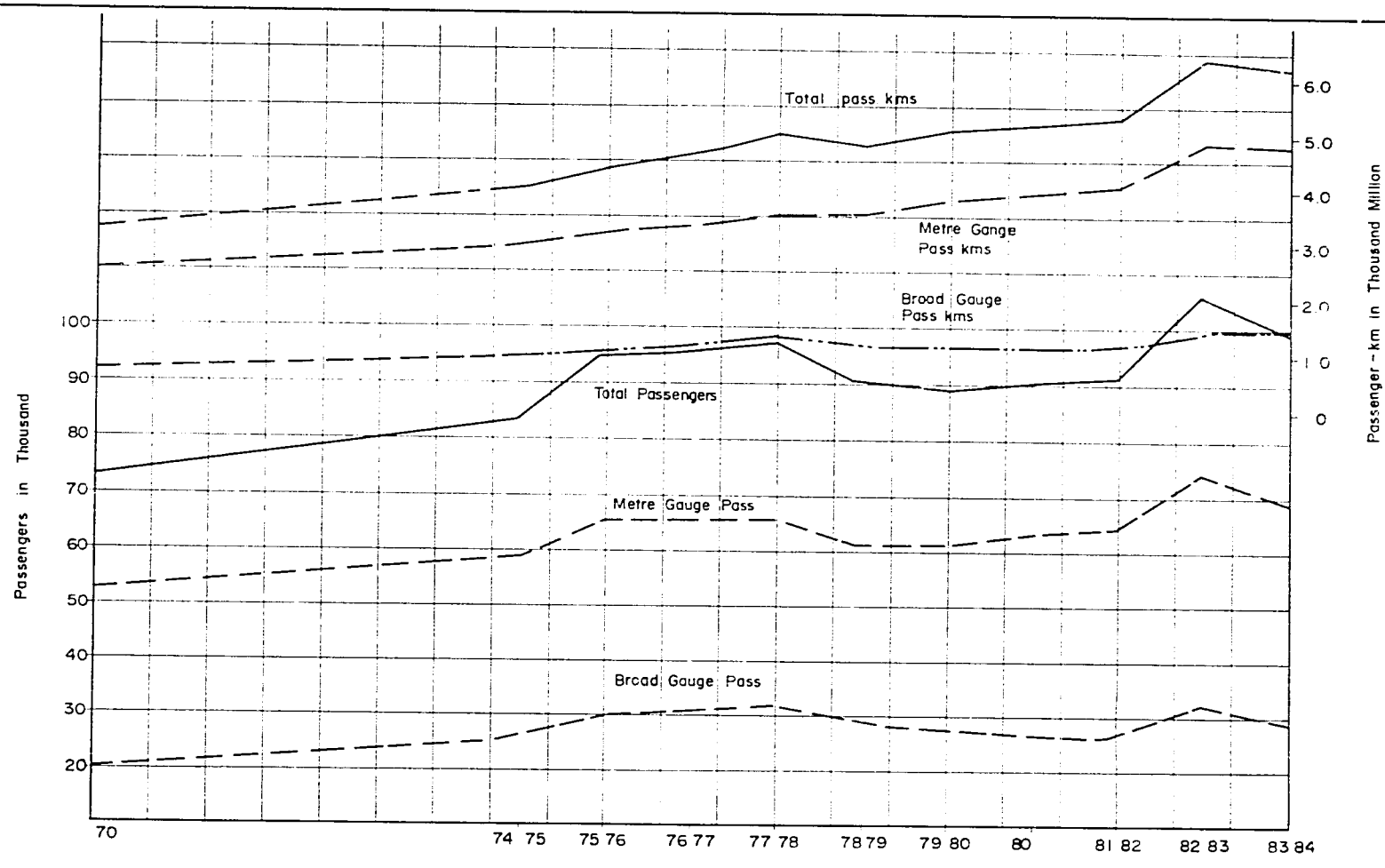
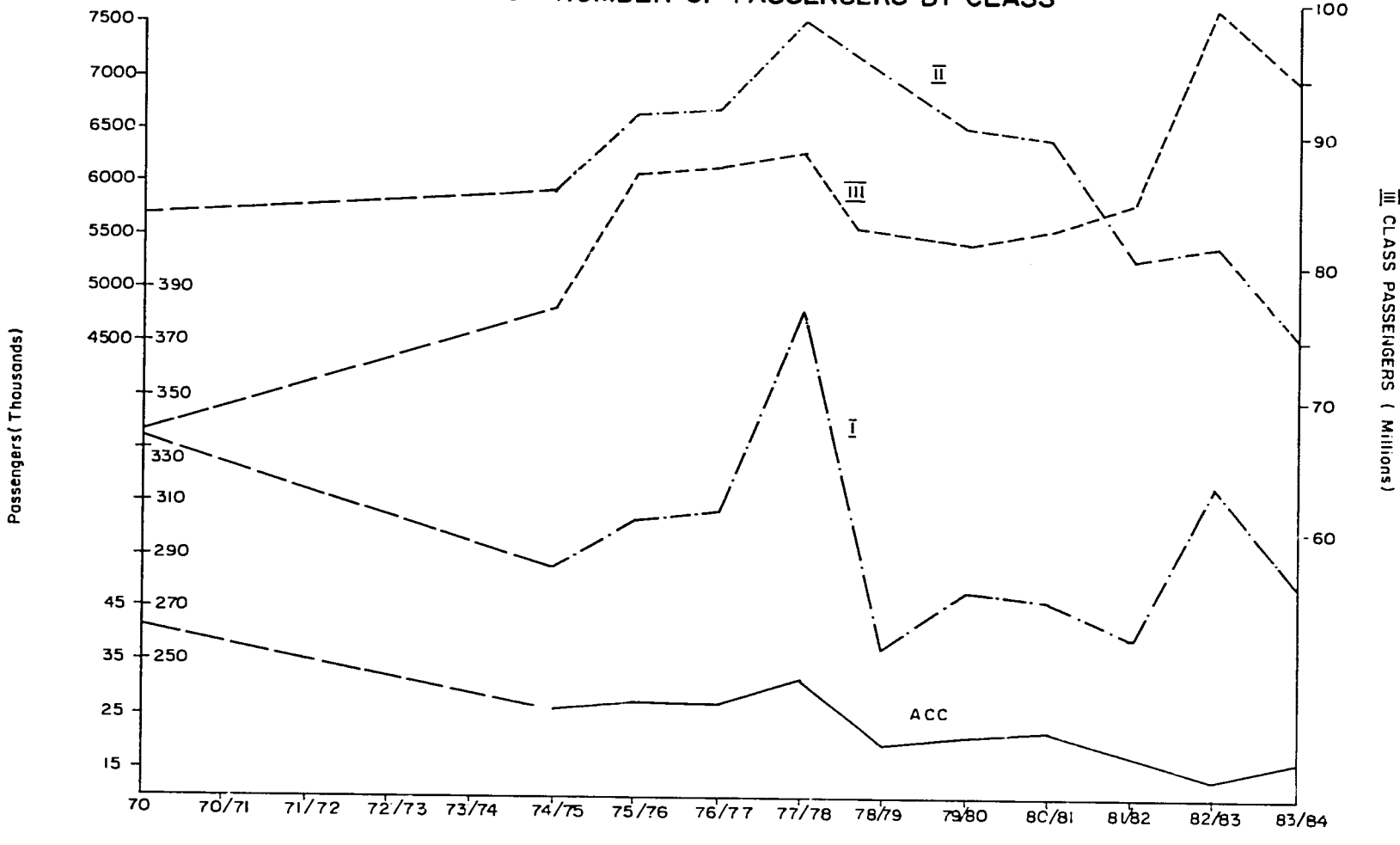


FIG 8.3.5 PASSENGER STATISTICS .

FIG. 8.3. 6 NUMBER OF PASSENGERS BY CLASS



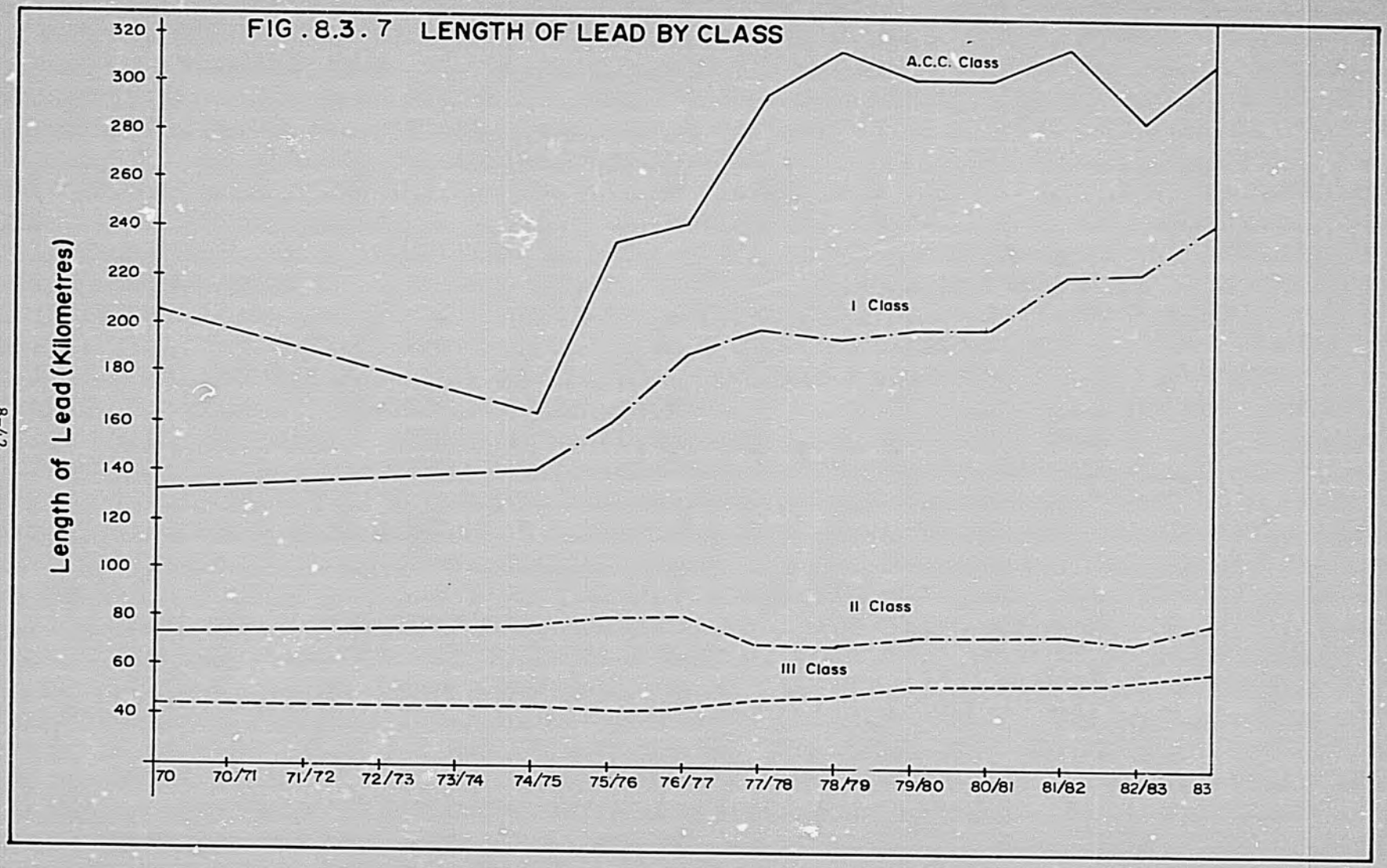


FIG. 8.3.7 LENGTH OF LEAD BY CLASS
Length of Lead (Kilometres)
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
A.C.C. Class
I Class
II Class
III Class
70
70/71
71/72
72/73
73/74
74/75
75/76
76/77
77/78
78/79
79/80
80/81
81/82
82/83
83

a) Various estimates have been made of the number of non-payers, the survey carried out in this study was an indication of the current problem but the sample was too small for conclusions to be taken from it. The passenger counts are given in Tables 8.3.9 and 8.3.10. CIDA Consultants also carried out a study and prepared an estimate of passengers which is given in Table 8.3.11. The fact remains that these is severe over-loading and this is a serious problem facing passenger operations. RCOE pages 16 to 19 discusses the question of carriage availability in January of 1982, and suggests that only about 60% of the stock was available for use. Further, out of the two divisions examined, 86 vehicles out of the 818 allotted had not been received by the Division (10.5%). 252 carriages had damage and were awaiting repair or sending to the shops. The carriages available represents 30.8% of the total allotment or 35.4% of the coaches actually received.

The III Class represents the bulk of the travellers and so by using the data on pages 18 & 19 of RCOE and considering only the coaches type ST, T & TLR for this purpose. Table 8.3.12 was prepared. This shows that a total of 59.5% of the rolling stock for III Class passengers is not available from the 5 depots considered.

It is shown in Section 8.6.3 that there are not sufficient carriages available for fare-paying passengers.

(2) Time keeping

The time table is based on various factors controlling train speed and assumes a normal journey time with certain allowances for recovery of lost time over long distances.

The factors are: passenger behaviour; locomotive condition; track condition and communications. There is also the discipline and work ethic of the railway staff.

a) Passenger behaviour is predominately due to the pulling of the emergency cord. With ticketless passengers this could be considered as likely outside a secure station so that ticketless passengers can disembark outside the station.

b) Track, bridges and locomotive condition is function of maintenance.

c) Signalling and communications must be reliable and free from any business other than train control.

d) Discipline and work ethic is a management function, and after maintenance has been improved, the effect is still dependent upon discipline and work ethics which ensures the safe and speedy working of trains.

Table 8.3.13 gives the published annual punctuality percentages. The effect of upgrading the metre gauge is having desired results, and whilst the results are better than 1969/70 however it is still below a satisfactory level.

Table 8.3.9 Passenger Survey East Zone

Date of Survey	Station	Name of check station	Name of train	Type off train	No. of CV per train (A)	Total No. of passengers per train (B)	Av. No. of passenger per CV (B/A)	Total of seating capacity	% of Loading factor
7.1.85	Dhaka-Chittagong	Comilla	13-up/ 14-dn	Express	10	1352	135	568	I 140 II 220 III 270
7.1.85	Chittagong-Dhaka	Brahma-nbaria	3-up/ 4-dn	-do-	11	1678	153	638	I 170 II 280 III 280
8.1.85	Dhaka-Tongi	Tongi	DBM/ 1-up	Local	4	595	149	246	II 230 III 240
10.1.85	Sylhet-Shahabazpur	Mangala Bazar	SKS-2dn	-do-	4	693	173	238	II 360 III 270
10.1.85	Sylhet-Dhaka	Sylhet	10-dn	Express	11	1043	95	474	I 250 II 130 III 230
12.1.85	Mymensingh-Bhairab Bazar	Gouri-pur	MBb-2dn	Local	4	633	158	252	II 170 III 280
13.1.85	Mymensingh-Dhaka	Mymen-singh	66-dn	Express	6	1190	198	390	II 280 III 320

Source: Consultants Survey

Table 8.3.10 Passenger Survey West Zone (Lower Case)

Date of survey	Station	Name of check station	Name of train	Type of train	No. of CV per train (A)	Total No. of passengers per train (B)	Av No. of passenger per CV (B/A)	Total of seating capacity	% of Loading factor
12.1.85	Bonarpara-Khulna-Parbatipur	Bonar-para	8-dn	Express	7	998	143	412	I 250 II 230 III 240
13.1.85	Santahar-Bonarpara	Bogra	19-up	-do-	7	934	133	422	I 240 II 140 III 230
13.1.85	Santahar-Bonarpara	Bogra	93-up	Local	4	1404	351	241	II 440 III 760
15.1.85	Goalandaghat-	Kushtia	26-dn	Express	7	1272	182	535	I 240 II 260 III 240
16.1.85	Khulna-Parbatipur	Chaua-danga	23-up	-do-	6	1412	235	445	I 300 II 220 III 320

Source: Consultants survey

Table 8.3.11 Paid and Ticketless Travel Analysis

BASIS		PAID PASSENGERS		COACHING VEHICLE ON LINE				CAPACITY OF 3RD CLASS CARRIAGES		PAID PASSENGERS		TOTAL RIDERS	UNPAID PASSENGERS		
		ALL CLASSES	III CLASS	ALL CLASSES	MG III CLASS	BG III CLASS	MG & BG III CLASS	RATED CAPACITY	PRACTICAL CAPACITY						
		PAID PASSENGER MILES 000'S	PAID PASSENGER MILES (%)	COACHING VEHICLE MILES	51% OF COACHING VEHICLES (660/1289)	59% OF COACHING VEHICLES (260/440)	90% AVAILABILITY	WEIGHTED AVERAGE (ALL TYPES)	BEFORE ACUTE CONGESTION	PER AVAILABLE CARRIAGE MILE	PERCENT PRACTICAL CAPACITY	CONSULTANT SAMPLE	PER AVAILABLE CARRIAGE MILE	PERCENT OF TOTAL RIDERS	PERCENT OF PRACTICAL CAPACITY
MG	1969–70	1,566,292	1,342,300 (85.7%)	95,859	48,900		44,000	SEATED 66 STANDING NIL TOTAL 66	– 100 – 50 – 150	31	21%	–	–	–	–
MG	1982–83	3,050,409	2,821,600 (92.5%)	94,672	48,300		43,500	SEATED 66 STANDING NIL TOTAL 66	– 100 – 50 – 150	65	43%	>150 USE 170	105	62%	70%
BG	1969–70	480,034	411,400 (85.7%)	38,707		22,800	20,500	SEATED 78 STANDING NIL TOTAL 78	– 115 – 55 – 170	20	12%	–	–	–	–
BG	1982–83	943,223	872,500 (92.5%)	43,216		25,500	22,900	SEATED 78 STANDING NIL TOTAL 78	– 115 – 55 – 170	38	22%	<170 USE 150	112	75%	66%
MG	INCREASE (DECREASE) 69-70 1982-83	95%	110%	(1%)	(1%)		(1%)			110					
BG	INCREASE (DECREASE) 69-70 1982-83	96%	112%	12%		12%	11%			90%					

Source: CIDA

Table 8.3.12 Analysis of III Class Coaches at 5 Depots on 31.1.82

	ST	T	TLR	Totals
Chittagong	19	118	45	
Chandpur	19	52	14	
Dhaka	23	118	49	
Mymensingh	14	41	14	
Sylhet	6	17	4	
Total allocated	81	346	126	553
Not received	11	35	26	
Total available	70	311	100	
Less damaged	1	16	5	
Total	69	295	95	
Less stopped for repairs	34	62	34	
Effectives	35	233	61	329
% Effective	43%	67%	48%	59.5%

Source: DRPP Consultants

Table 8.3.13 Passenger Train Punctuality

	Mail and express trains		Other passenger trains		Mixed trains	
	BG	MG	BG	MG	BG	MG
1969 - 70	90.5	72.4	89.9	69.4	91.9	88.6
1974 - 75	90.0	77.0	80.5	68.0	79.0	74.6
1975 - 76	93.1	77.5	83.4	67.3	74.1	75.2
1976 - 77	84.3	76.0	73.7	67.3	75.6	72.0
1977 - 78	75.8	67.5	95.6	61.2	57.5	63.6
1978 - 79	78.7	75.6	77.8	66.8	56.9	69.6
1979 - 80	72.3	75.0	72.7	63.6	68.5	68.0
1980 - 81	66.2	63.5	65.3	54.3	64.6	61.4
1981 - 82	77.1	75.3	70.8	65.0	70.8	71.6
1982 - 83	83.2	80.6	73.7	73.9	75.2	75.0
1983 - 84	79.1	81.7	64.0	80.3	71.5	81.2

Source: Bangladesh Railways

(3) Train accidents

The 1983/84 total of incidents is the lowest in ten years. Unfortunately the accidents involving passengers was the highest over the same period, however, Railway employees killed and injured is reducing, even so the total is still high.

Analysis of the accidents is given in Table 8.3.14.

Whilst the technical faults are related with levels of maintenance there is a high number of accidents due to human error. This is a measure of performance of discipline, and therefore reflects on management.

Table 8.3.14 Analysis of Accidents

	1981 / 82	1982 / 83	1983 / 84
Due to Human error	68	114	84
Due to Technical faults	83	75	81
Miscellaneous	48	13	6
Total	109	202	171

Source: Bangladesh Railways

(4) Observations

Overcrowding is a prominent phenomena of most railways in South Asia. It is accentuated by ticket-less travel and shortage of available rolling stock.

a) Primarily the trains are too short. The 4, 6 & 7 coach trains recorded in the survey Tables 8.3.9 and 8.3.10 were excessively loaded. This probably increases the number of ticket-less passengers, a cause and effect situation.

In addition, I Class and III Class passengers are increasing.

In approximate numbers, I Class 30,000 journeys a year and III Class 1,000,000 journeys a year. II Class journeys are falling about 275,000 per year and of course this additionally provides more standing space and reduces the pressure.

It is significant that the number of fare paid passengers and passenger kms have been increasing steadily since 1969/70, about 90% to 1983/84 but these have had to be accomodated in only about 9% more trains and train-kms, the major increase being on the East zone, see figure 8.3.5.

This is further verified as the coaching vehicle-kms have only increased 38% since 1969/70 of which only 2% has been on the Metre gauge.

b) Ticket sales. Section 8.1.7 requires government assistance to promote the eradication of fraud, waste and abuse. This cannot succeed to reduce ticket-less travel unless passengers can purchase tickets easily.

Bangladesh Railways local services are providing a Mass Transit. Unless the ticket offices are able to quickly and efficiently sell tickets to all joining passengers, ticketless travel will flourish. The old methods used 50-60 years ago are unable to meet todays demand, they were not designed to do so.

It is not possible to enforce ticketing requirements when purchase is cumbersome and outdated. Every procedure and every station should be examined to ensure an improved ticket selling arrangement.

The paper currency of Bangladesh may not be suitable for ticket vending machines but additional windows or ticket booths, and tickets that can be issued from machines for the local services, can all be introduced and will rapidly repay the cost of the installation and training.

The method of selling tickets should be critically examined, there can be no improvement in revenue from ticket sales if the increased demand is to be frustrated by out of date ticket procedures.

c) The improved daily vehicle-kilometres shows that management has adopted recommended operating practices proposed by other consultants. However there is still room for improvement as the vehicle-kilometres per day for Broad gauge was 220 in 1983/84 as opposed to 243 in 1969/70 The metre gauge figures are 171 and 211 respectively. Higher utilization must be made by reducing the number of vehicles held in reserve for casualty replacements.

8.3.4 Diesel locomotives

(1) Availability

A locomotive represents the largest item of capital cost amongst the rolling stock and it is therefore necessary to utilize it to the maximum extent possible.

The utilization of locomotives depends on the availability of the locomotives relative to the stock owned. The first parameter is the percentage available on-line i.e., after deductions for locomotives withdrawn from stock. The second is the percentage in use i.e., after deductions for withdrawals, and those under or awaiting repairs.

Table 8.3.15 gives the calculated numbers of revenue earning diesel locomotives on-line and in-use for broad gauge and metre gauge derived from the published statistics and then expresses the availability as there are variations with the published data.

(2) Performance

In order to establish performance relative to 1969/70 it is necessary to establish the numbers of revenue earning trains a day on average. The figures in Table 8.3.16 have been rounded off.

Table 8.3.16 Average Number of Steam and Diesel Hauled Train per Day

	Broad gauge				Metre gauge			
	Pass trains	Goods	Total trains	Trains per day	Pass trains	Goods	Total trains	Trains/ day
69/70	33011	6440	39451	108.1		30517	123293	337.8
74/75	21022	5709	26731	73.2	70012	13533	82545	228.9
75/76	23913	6018	29931	82.0	75785	14524	90309	247.4
77/78	27977	5621	33598	85.7	80710	13787	94497	258.9
78/79	30007	5360	35367	96.9	89764	16169	105933	290.2
79/80	31492	5645	37137	101.7	93005	17206	110211	301.9
80/81	32974	5623	38597	105.7	91468	16924	108392	297.0
81/82	33554	5772	39326	107.7	95038	19968	115006	315.1
82/83	34090	4893	38983	106.8	90896	18898	109794	300.8
83/84	33810	5157	38967	106.8	96735	16953	113688	311.4

Table 8.3.15 Diesel Locomotive Availability in Revenue Traffic

Year	Pass Train kms/yr	Freight train kms/yr	Total train kms/yr	Total kms/ day	Engine kms on-line	No. of locos on-line	Engine kms/day in use	No. of locos in use	Locos owned	% on-line	% in use relative to on-line
	x10³	x10³	x10³	A	B	A/B=C	D	A/D=E	F	C/F x 100	E/C x 100
BROAD GAUGE											
1969/70	2194	252	2446	6701	378	18	415	16	18	100	88.8
1974/75	2253	250	2503	6857	249	28	307	22	32	87.5	68.75
1975/76	2449	298	2747	7526	262	29	323	23	32	90.6	79.3
1976/77	2654	250	2904	7956	274	29	351	23	32	90.6	79.3
1977/78	2692	229	2921	8002	274	29	346	23	32	90.6	79.3
1978/79	2845	267	3112	8526	291	29	361	24	32	90.6	82.75
1979/80	3082	275	3357	9197	285	32	361	25	44	72.7	78.13
1980/81	3400	290	3690	10110	232	46	304	33	52	88.5	71.2
1981/82	3571	351	3922	10745	206	52	290	37	64	81.3	71.2
1982/83	3776	418	4194	11490	192	60	274	42	70	78.9	70.0
1983/84	3688	423	4111	11263	183	62	270	42	76	82.0	67.7
METRE GAUGE											
1969/70	6191	1899	8090	22164	214	104	272	81	125	83.2	77.9
1974/75	5877	980	6857	18786	153	123	253	74	141	87.2	60.2
1975/76	6289	921	7210	19753	161	123	261	76	141	87.2	61.8
1976/77	6581	763	7344	20120	164	123	270	75	141	87.2	61.0
1977/78	6978	821	7799	21367	172	124	285	75	135	91.8	60.5
1978/79	7675	966	8641	23674	185	130	287	82	148	87.8	63.1
1979/80	8251	1027	9278	25419	192	132	295	86	148	89.2	65.1
1980/81	8468	1004	9472	25951	177	147	285	91	188	78.2	61.9
1981/82	8713	1255	9968	27310	169	162	269	102	189	85.7	63.0
1982/83	8646	1259	9905	27137	171	159	261	104	226	70.4	65.4
1983/84	9138	1213	10351	28359	155	183	251	113	223	82.0	61.7

Source: Bangladesh Railways
Consultants Calculations

In 1969/70 49.6% broad gauge trains were diesel hauled as were 65.5% of the metre gauge.

In 1983/84 these were 99.9% and 98.4% respectively.

Broad Gauge

In 1969/70 16 diesels hauled 49.6% of 108.1 trains

In 1983/84 106.8 trains would require $\frac{106.8}{108.1} \times \frac{16}{0.496} \times 0.999$

$= 31.8$ say $= 32$ locomotives

Metre Gauge

In 1969/70 81 diesels hauled 65.5% of 337.8 trains

In 1983/84 311.4 trains would require $\frac{311.4}{337.8} \times \frac{81}{0.655} \times 0.984$

$= 112.17$ Say 113 locomotives

These figures from Tables 8.3.15 and 8.3.16 both as percentages available and the numbers required for traffic are at variance with statistics. However in regard to locomotive requirements the traffic pattern has changed considerably and the conclusion on locomotive requirements based on 1969/70 is not correct except as an indicator of performance.

(3) Locomotive Mix.

a) It is estimated in Table 8.3.15 that 42 broad gauge locomotives are in use daily for revenue traffic. This is disturbing as the whole locomotive fleet is relatively new.

Table 8.3.17 shows a distribution of the existing locomotives on the 31st December 1984 based on 75% availability. Taking out non-revenue requirements (9 locomotives) 45 locomotives are available as opposed to 42 calculated from statistical data.

With a broad gauge fleet of 73 locomotives (3 are condemned) and with an availability of 85%, a total of 62 locomotives should be in-use daily. This, with an allowance for locomotives in reserve is adequate for the timetable requirements. However with only 42 locomotives actually in service there is a serious shortfall in performance and it is necessary to get the two older locomotives classes into a higher state maintenance.

The locomotive mix of 20 shunting locomotives to 53 others is a reasonable mix for the duties performed. There is a large gap in the types of locomotives, however, and there would appear to be a need for 1,000-1,500HP transfer locomotives to replace the HHD class on passenger, transfer and ballast trains when new locomotives are obtained.

Table 8.3.17 Timetable Requirements for Locomotives on December 31, 1984: Broad Gauge Only

On line locomotive requirement	"ON LINE" in service locomotives							Locomotive shortfall	
	Locomotive class	HHD1	ALU 20	MLU 20	BDE 25	JDE 25			
	Tractive effort	>24,000	65,600	65,600	65,500	60,480			
	Gross horsepower	500	2,150	2,150	2,250	2,600	133,000		
	Average HP/unit						1,800		
	Availability							Main-line locomotives	Small locomotives
	Best quarter of 1983	>80%	77%	75%	92%	76%	80%		
∇	Last half of 1983	72%	77%	67%	88%	71%	75%		
31	For current psgr. links	5	9	9	4	4	31	-	-
1	For assigned shuttle service	1	-	-	-	-	1	-	-
5	*For current ballast and departmental trains	4	-	-	-	-	4*	-	1
8	For special and seasonal trains	-	4	1	-	-	5	3	-
12	*For shunters	5	-	-	-	-	5*	-	7
14	For current goods demand	-	-	-	5	5	10	4	-
71(75%)	Sub-total	15	13	10	9	9	56	7	8
24(25%)	Unavailable	5	4	4	3	3	19	2	3
95	Required / Available	20	17	14	12	12	75	9	11

Source: CIDA * Not in revenue earning traffic

b) The metre gauge lines have a reverse situation. Except for JDE Class and some of the MLU 10's all the new locomotives are shunting or transfer types. This puts a heavy strain on the existing fleet of main line locomotives, and suggests an over working of the new locomotives. Table 8.3.18 shows a total of 144 locomotives are required for revenue services which at 85% availability gives a requirement of 168 locomotives and 191 at 75%. It is obvious that the two classes GMU-10 & GEU 14 must be brought into regular line service to produce a more equitable mix of locomotives.

The working timetable requires 144 locomotives in use for revenue service, and 44 for shunting and ballast trains, which at 85% availability gives 222 locomotives.

The CIDA report as shown in Table 8.3.18 estimates a requirement for 30 additional locomotives to meet the timetable requirements at 75% availability. However the locomotive split between the two zones gives an allocation of 50 in-service locomotives out of 53 for the West, and 116 out of 135 for the East. The traffic split for the West Zone is 26% freight and 22% of the passenger traffic but yet has 30% of the locomotives. This represents a serious imbalance and a transfer of locomotives to the East Zone is essential, particularly for freight where only 50% of the required locomotives are assigned.

Schedule re-arrangements are necessary and a critical review of requirements will ease the situation.

It is interesting to note that apart from 6 Class GMU10 the West is entirely HHD Class locomotives, but only 2 HHD Class locomotives are in the East. Rationalization is suggested so that all the HHD locomotives including broad gauge are then in one Zone, and hence stores and spares are contained in one organization. Similarly for the GMU10's.

c) A critical look at locomotive mix and performance must be made to ensure that the link requirements and duties to be performed are compatible with the locomotive capabilities and performance characteristics. This is an operational management task and should be undertaken by questioning every assumption. Apart from shunting locomotives basically all locomotives are geared as general purpose locomotives, and therefore the use of a locomotive in passenger or freight should be determined by need and not by assignment. A flexibility in working is necessary.

A rational look at the timetable in relation to the traffic is necessary. The assumption has been made that more locomotives are needed to operate the timetable, but even with 85% availability the timetable cannot be operated with the existing fleet. It is clear that the timetable is not correct under these conditions, and until there has been a major review and rationalization of the timetable to meet the changing traffic pattern the requirement for extra locomotives cannot be substrated on the basis of the existing timetable.

Table 8.3.18 Timetable Requirements for Locomotives on December 31, 1984:

ON-LINE LOCOMOTIVES REQUIREMENT			"ON-LINE" IN – SERVICE LOCOMOTIVE (EXCEPT RAIL DIESEL CARS)																			SHORT-FALL	
			LOCOMOTIVE CLASS	EEU		HHD1		HHD2		GMU10		DE1/DE2		GEU14		MLU/MLW		JDE		TOTAL DIESEL			
			TRACTIVE EFFORT (lbs)	24,000		<24,000		<40,000		40,000		33,000		47,500		47,500		47,500					
			GROSS HORSEPOWER	550		500		800		950		1,125		1,380		1,380		1,350		212,000			
			AVERAGE HP/UNIT																	975			
			AVAILABILITY BEST QUARTER OF 1983 / LAST QUARTER OF 1983	84% / 82%		≧80% / ≧72%		≧80% / ≧72%		83% / 76%		87% / 83%		(SAY) 82% / 77%		82% / 77%		83% / 80%		83% / 75%		MAIN LINE / SMALL	MAIN LINE / SMALL
E	W	TOTAL	ZONE E - EAST, W - WEST	E	W	E	W	E	W	E	W	E	W	E	W	E	W	E	W	E	W	E	W
70	23	93	FOR CURRENT PASSENGER LINKS (EXCEPT RAIL DIESEL LINKS)	–	–	–	–	–	23	16	–	19	–	–	–	23	–	12	–	0	23	/	/
6	1	7	FOR ASSIGNED SHUTTLE SERVICES (WAY FREIGHT)	6	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	6	1	/	/
8	3	11*	FOR CURRENT BALLAST AND DEPARTMENTAL TRAINS	–	–	–	3	–	–	–	–	8	–	–	–	–	–	–	–	8	3*	/	/
3	3	6	FOR SPECIAL TRAINS (MILITARY, FOOD, SUGAR CANE ETC.)	–	–	–	1	–	1	2	–	–	–	–	–	–	–	–	–	2	2	1 /	1 /
22	11	33*	FOR SHUNTERS	13	–	2	10	–	–	2	–	–	–	–	–	–	–	–	–	17	10*	5 /	1 /
26	12	38	FOR CURRENT GOODS DEMAND	–	–	–	–	–	5	2	6	1	–	5	–	3	–	2	–	13	11	13 /	1 /
135	53	188	SUBTOTAL (75%)	19		17		29		28		28		5		26		14		116	50	13 / 6	3 /
43	17	60	PLUS UNAVAILABLE (SHORTFALL) (25%)	6		5		9		9		9		2		8		4		37	15	5 / 2	1 /
178	70	248	REQUIRED AVAILABLE	25		22		38		37		37		7		34		28		153	65	18 / 8	4 /

Source: CIDA *Not in revenue Earning service

(4) Fuel consumption

Diesel fuel represents the single largest item of locomotive expenses. The 1982/83 average locomotive H.P. in table 8.3.19 shows reduction from the 1969/70 figures when considering the numbers of locomotives on line. Considering installed H.P.

Table 8.3.19 was prepared from data contained in the RDPP (Revision) report and varies slightly with the CIDA data in tables 8.3.17 & 18.

The most useful measure of fuel consumption is the average number of litres of fuel used per 1,000 gross tonne-kilometres, the statistics do not provide this parameter. Whilst operating conditions vary with each country the following results suggest suitable objectives.

India	3.7 - 4.9 litres per 1,000 tonne/kms.
Taiwan	6.2 - 9.3
Nigeria	4.8 - 6.0
U.S.A.	5.6
Canada	3.9

Table 8.3.19 Installed Horse Power

Year considered	Nos. of locos	Installed HP	Total HP	Fleet average
1969/70	38	1125	42750	
	38	950	36100	
	8	1380	11040	
	21	1380	25980	
	18	2150	38700	
	5	400	2000	
	128		156570	1223HP
1982/83	37	1125	41625	
	37	950	35150	
	7	1380	9660	
	34	1380	46920	
	25	550	13750	
	28	1350	37800	
	22	500	11000	
	38	800	30400	
	17	2150	36550	
	14	2150	30100	
	12	2250	27000	
	12	2600	31200	
	20	550	11000	
	303*		362155	1195HP

*Bangladesh year book 302

Source: Bangladesh Railways
CIDA
Consultants Calculations

HP of locomotives on-line from table 8.3.19.

1969/70 = 143 locomotives (only records for 128 available)

$$\text{HP available} = \frac{143}{128} \times 156570 = 174918\text{HP}$$

1983/84 = 229 (withdrawn locomotives not known)

$$\text{HP available} = \frac{299}{303} \times 362155 = 357,374\text{HP}$$

But availability is less (Published data)

1969/70 = (0.91 x 18 + 0.841 x 125) : 143 = 0.850

1983/84 = (0.756 x 76 + 0.793 x 223) : 299 = 0.784

HP available =

1969/70 = 0.850 x 174918 = 148680 HP

1983/84 = 0.784 x 357374 = 280181 HP

tonnes fuel per HP/year

1969/70 27059 - 148680 = 0.182 t/HP

1983/84 43688 - 280181 = 0.156 t/HP

Actual HP in use

$$1969/70 = 156,570 \times \frac{97}{128} = 118,650 \text{ HP}$$

$$1983/84 = \frac{357,374 \times 155}{299} = 185,261 \text{ HP}$$

tonnes fuel per HP/year

1969/70 = 27059 - 118650 = 0.228 t/HP

1983/84 = 43688 - 185261 = 0.236 t/HP

These figures are contradictory but suggest that the actual consumption remains the same.

Driver discipline is important in fuel economy and driver habits can make major contributions to fuel economy such as judicious train handling, avoiding running on low throttle notch, shutting down of engines when detention is to be one hour or more.

Maintenance practices to increase inspections of turbo chargers, fuel injection pumps, injectors and filters will all reduce fuel consumption.

Operating practices to ensure that locomotives with the correct HP/tonne load ratio are provided. Providing footplate inspectors from senior drivers and superannuated staff to monitor driving

habits and to provide guidance to young staff will also assist.

(4) Observations

a) The locomotive fleet contains many new locomotives, 74% of the broad gauge fleet has not reached half life (working life assumed 30 years) and 71% of the metre gauge locomotives.

In order to get the maintenance situation in hand it is necessary to reduce the size of the locomotive fleet in operation each day. This will effectively bring the maintenance requirements down to the achievement level of the workshops, a positive result.

b) The drop in the number of engine hours per locomotive on line and in use, allowing for statistical changes due to locomotive mix when compared with 1969/70, and the reduction in the number of trains run raises anxiety over the efficient use of the locomotives. The number of hours worked per day is based on time off shed to time on shed & is not based on hours working trains.

The timetable must be changed to suit new arrangements and the train patterns and the train diagram must be critically examined to ensure that old wasteful practices are eliminated.

c) Operating practices to improve utilization of rolling stock and locomotives such as:

(i) Segregation of roller bearing wagons and other stock into block trains for single commodities

(ii) Forming trains of high pay-load long distance unit trains

(iii) Optimisation of loads over different sections

(iv) Identification of over-age and unfit wagons, and to avoid mixing with trains of roller bearing stock

(v) More through freight trains to speed up long distance services & reduce intermediate shunting and marshalling.

d) The fuel consumption statistics are encouraging in that they appear to be similar to 1969/70. However these figures must be kept under regular observation and good fuel economy practices maintained, such as low engine idling speeds, and shutting down engine when there is at least one hour before the next movement, a new measurement parameter of litres fuel/1000 gross tnkms maintained. A vigorous locomotive management practice needs to be established to ensure that the locomotives are worked more continuously.

8.3.5 Quality of Service

This subject is one that is difficult to quantify, and consequently subjective to experience or opinion.

The railway provides unprofitable social services in some instances. However, the deterioration of the railway's financial position must be stopped so that the drain on national resources can be halted.

Whilst the railway has lost its premium passenger market to air and road, it provides an important social service for those who cannot afford the faster services. By operating international transfer traffic the railway makes an important foreign exchange earning, and by transporting export goods an indirect contribution is made to the national economy.

An interview survey was held of railway patrons for passenger and freight traffic.

(1) Passenger traffic

A limited survey of rail passenger was carried out to ascertain, among other things, their perception of comfort and the advantage of rail over other modes. People were questioned on trains on a number of routes and a summary of their responses is shown in Table 8.3.20. and analysis of data is in Table 8.3.21.

The sample is small and does not represent the proportions of passengers by class. The convenience offered by rail travel was the predominant response and that the accessibility of the railway was also a contributing factor. Comfort and cost of railway travel were not important factors, but a significant proportion claimed that rail travel was used because they considered the road was bad.

Convenience of rail travel included the following reasons:

(i) Transport of personal baggage

(ii) Suitable for medical patients

(iii) Easier travelling

(iv) Preferance for rail

These are good marketing points to build upon for passenger travel.

Table 8.3.20 Rail Passenger Users Survey

No.	Origin	Destination	Distance km	Time hours	Speed k.p.h	Comfort	Advantage	Other comment
1.	Dhaka	Chittagong	343	6.5	53	1 Good	Most comfort	(2 resp.)
"	Dhaka	Chittagong	343	6.5	53	11 Good	Safer	
"	Dhaka	Chittagong	343	6.5	53	11 Good	Ist time train	
"	Dhaka	Chittagong	343	6.5	53	11 Mod	Easier	
2.	Dhaka	Laksham	190	3.5	54	11 Good	No fare	Rly.staff
3.	Dhaka	Comilla	187	3.0	62	1 Good	Easier	(2 resp.)
4.	Dhaka	Bhariab	85	2.0	43	111 Mod	Near house	
"	Dhaka	Bhariab	85	2.0	43	111 Mod	Only use train	
"	Dhaka	Bhariab	85	2.0	43	111 Mod	Save fare	
5.	Dhaka	Ghorasal	45	1.5	30	111 Mod	Near House	
6.	Dhaka	Sardchar	107	4.5	24	111 Mod	Near House	
7.	Dhaka	Kishorganj	133	6.0	22	11 Good	Road bad	
"	Dhaka	Kishorganj	133	6.0	22	11 Mod	No fare	Rly staff
8.	Dhaka	Norshindi	58	3.0	19	11 Good	Near house	(2 resp)
9.	Dhaka	Mymensingh	116	3.8	31	1 Mod	Road bad	
"	Dhaka	Mymensingh	116	3.8	31	11 Good	Road bad	(3 resp)
"	Dhaka	Mymensingh	116	3.8	31	11 Good	Convenient	
"	Dhaka	Mymensingh	116	3.8	31	111 Good	Best for patient	
"	Dhaka	Mymensingh	116	3.8	31	111 Mod	Save fare	
10.	Dhaka	Tongi	23	0.8	28	1 Good	Road bad	
11.	Dhaka	Bramonbaria	106	2.5	42	111 Mod	Near house	(2 resp)
"	Dhaka	Bramonbaria	106	2.5	42	111 Mod	Save fare	
"	Dhaka	Bramonbaria	106	2.5	42	111 Good	Save fare	
12	Dhaka	Sylhet	311	8.5	37	1 Good	Most comfort	
"	Dhaka	Sylhet	311	8.5	37	11 Good	Most comfort	
"	Dhaka	Sylhet	311	11.0	28	11 Good	Safer	
"	Dhaka	Sylhet	311	11.0	28	11 Good	Road bad	
"	Dhaka	Sylhet	311	11.0	28	11 Good	Easier	
13.	Dhaka	Sreemongal	208	6.0	35	1 Good	Easier	
"	Dhaka	Sreemongal	208	6.0	35	1 Good	Road bad	(2 resp.)
14.	Dhaka	Akhaura	119	4.5	26	111 Good	Save fare	
15.	Dhaka	Khulna	623	24.0	26	1 Mod	Goods carried	(3 resp.)
16.	Dhaka	Sirajganj	212	3.5	61	11 Good	Easier	

Table 8.3.20 Continued

No.	Origin	Destination	Distance km.	Time hours	Speed k.p.h	Comfort	Advantage	Other comment
17.	Dhaka	Poradha	338	8.5	40	11 Mod	Essential by train.	
"	Dhaka	Poradha	338	8.5	40	111 Mod	Better for work	
18.	Dhaka	Jessore	570	11.5	50	1 Mod	Goods carried	
19.	Dhaka	Ishordi	306	6.5	47	111 Mod	Easier	
20.	Dhaka	Chuadanga	368	5.3	70	11 Mod	Not given	
21.	Dhaka	Jaganataganj	196	7.3	27	111 Good	Safer	(2 resp.)
22.	Dhaka	Dinajpur	481	16.7	29	1 Mod	Prefer rail	
23,	Dhaka	Rangpur	414	14.5	29	1 Good	Best for patient	
"	Dhaka	Rangpur	414	14.5	29	1 Mod	Officer transport	
24.	Dhaka	Bhadurabad	224	4.8	47	11 Mod	Easier	(2 resp.)
"	Dhaka	Bhadurabd	224	4.8	67	11 Good	Near house	
25.	Dhaka	Gaibanda	349	10.5	33	111 Mod	Safer	
26.	Dhaka	Banarpara	325	8.5	38	111 Mod	Near house	
"	Dhaka	Banarpara	325	8.5	38	11 Good	Near work	

Source : Consultants Survey.

Table 8.3.21 Analysis of Rail Passenger Users Survey

Advantage over other modes	Comfort good				Comfort Moderate				Total
	I	II	III	Total	I	II	III	Total	
Comfort	3	1	0	4	0	0	0	0	4
Save cost	0	0	2	2	0	0	3	3	5
Safer	0	2	2	4	0	0	1	1	5
Convenient	4	3	1	8	5	4	3	12	20
Accessible	0	4	0	4	0	0	4	4	8
Road bad	3	5	0	7	1	0	2	3	10
Other	0	2	0	2	1	1	1	3	5
	10	17	5	32	7	5	14	26	58

Source: Consultants Survey

3 Passengers in II and III class were travelling within the average lead for their class of travel, hence there is a bias towards long distance travel. The reasons given for rail travel should be considered when framing customer services for the long distance traveller. These services are more than a social service and there is a latent demand for services that represent real value for money, particularly when travellers are prepared to travel more than 300 kms.

Overcrowding was discussed in the passenger traffic section 8.3.3 and reinforcing the trains with additional coaches is essential to improve the image of train travel and the quality of the service.

(2) Freight services

A survey of freight shippers was conducted, covering major shippers of petroleum products, jute products, fertilizer, cerals, iron and cement. The reason for the choice of rail as opposed to alternative modes was requested. The results for shippers who used rail for certain routes in preference to other modes are given in Table 8.3.22. A number of respondents of the origin and route, it was alternative mode, but on examination of the origin and route, it was realized that this meant that there was no feasible alternative, as there was a rail siding to the factory. Thus these have been classed as being chosen for convenience. This sample emphasises the convenience and safety to the products in transit. However the data sheets show up the excessive time in transit, particularly for the Jamuna crossing. This is a matter requiring detailed study of operating procedures, and reinforces the need for a special officer to supervise crossing traffic.

Table 8.3.22 Rail Freight Users Survey

Reason for preference for rail	Survey results for rail	
	Number	%
Saves time	0	0
Saves cost	3	20
Not available on others	0	0
Safer	2	13
Convenient	10	67
Other	0	
	15	100

Source: Consultant survey

(3) Observations

The negative aspects of service quality have been presented in the many reports prepared on the railways and have not been repeated here because they are well known.

Whilst the service quality for passenger traffic is, in the public image, associated with overcrowding, the contribution of freight traffic to the national economic well being is not recognized.

There should be an organized marketing and operations departmental move to promote advertised freight and container services particularly the international connections.

8.4 Costs, Rates and Fares

8.4.1 Introduction

A financial review of the railway system must include marketing and pricing strategies. Accounts must be so organized with the necessary statistics that budgets and performance indicators are based on realistic figures and costs of specific operations identified.

In this section material is obtained from railway statistics and others is developed.

Table 8.4.1 and Figure 8.4.1 show the relationship between expenses and revenue for each fiscal year from 1969/70. 1971/72 was only a part year and has been left out. Depreciation has been deducted from expenses as no deduction was made in 1982/83 and 1983/84. Depreciation has previously been an arbitary deduction and hence the final expenses total has been distorted. As the operating ratio varies widely a moving average has been used to show trends, this clearly shows the increasing loss trend and the expenses/revenue plot shows the dramatic change that occured to revenues in 1982/83.

The downward trend in the operating ratio indicates that the expenses must be held to a predetermined budget level and the revenue increased.

Figure 8.4.2 shows the comparison of the ratios of the largest expense items to the total expenses. Labour and administration costs have been held to a reasonably constant figure against the increasing sum of the maintenance costs has varied widely. This is an erratic performance which may be due to external effects upon the railway, such as excessive maintenance costs due to flood damage, and other disasters.

Until the maintenance condition of the railway has improved the predominance of this work is bound to continue in the expense account. However as discussed earlier there should be no "betterment" item included as these are essentially capital works.

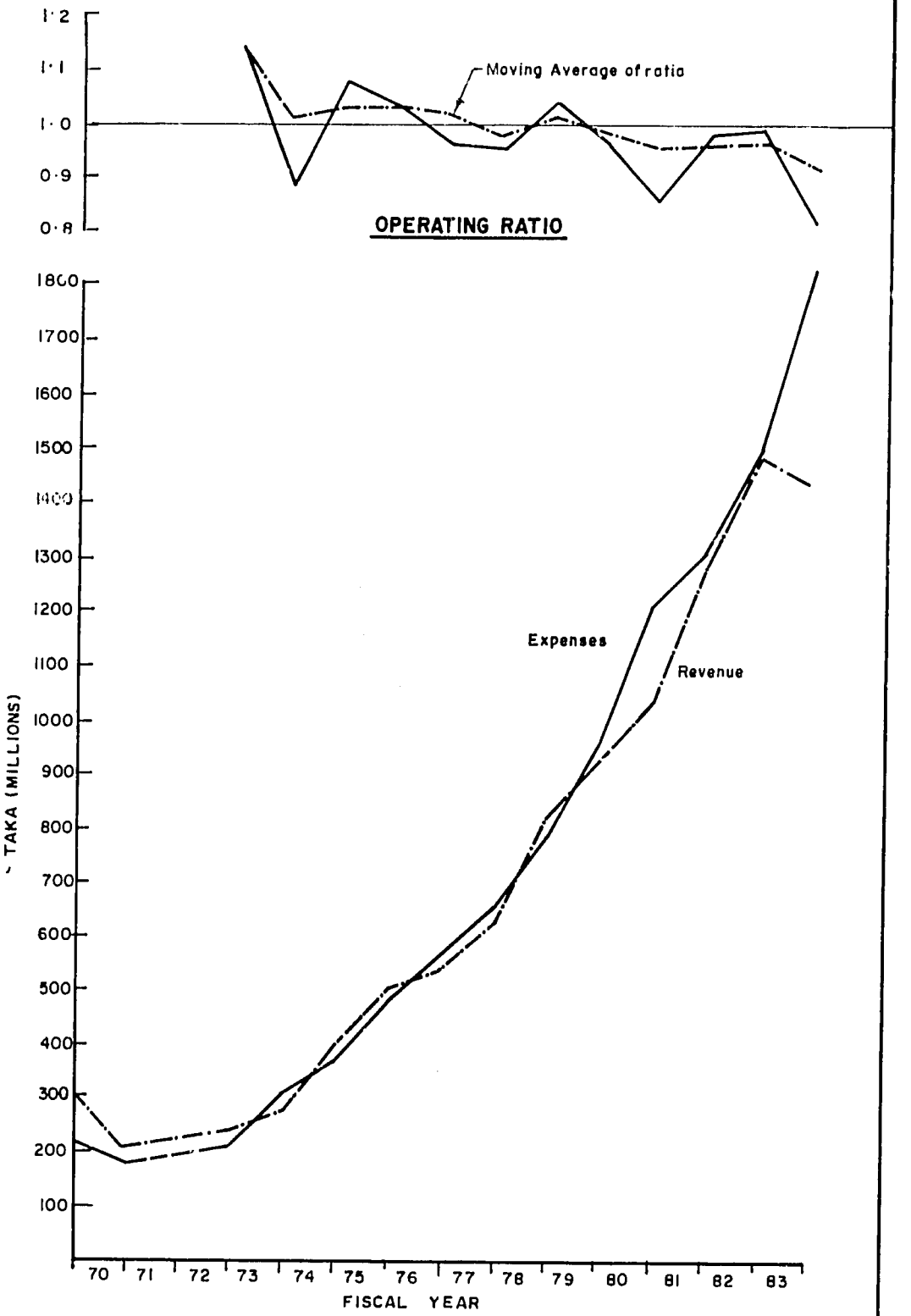


FIG. 8.4.1 REVENUE AND EXPENSES (DEPRECIATION EXCLUDED)

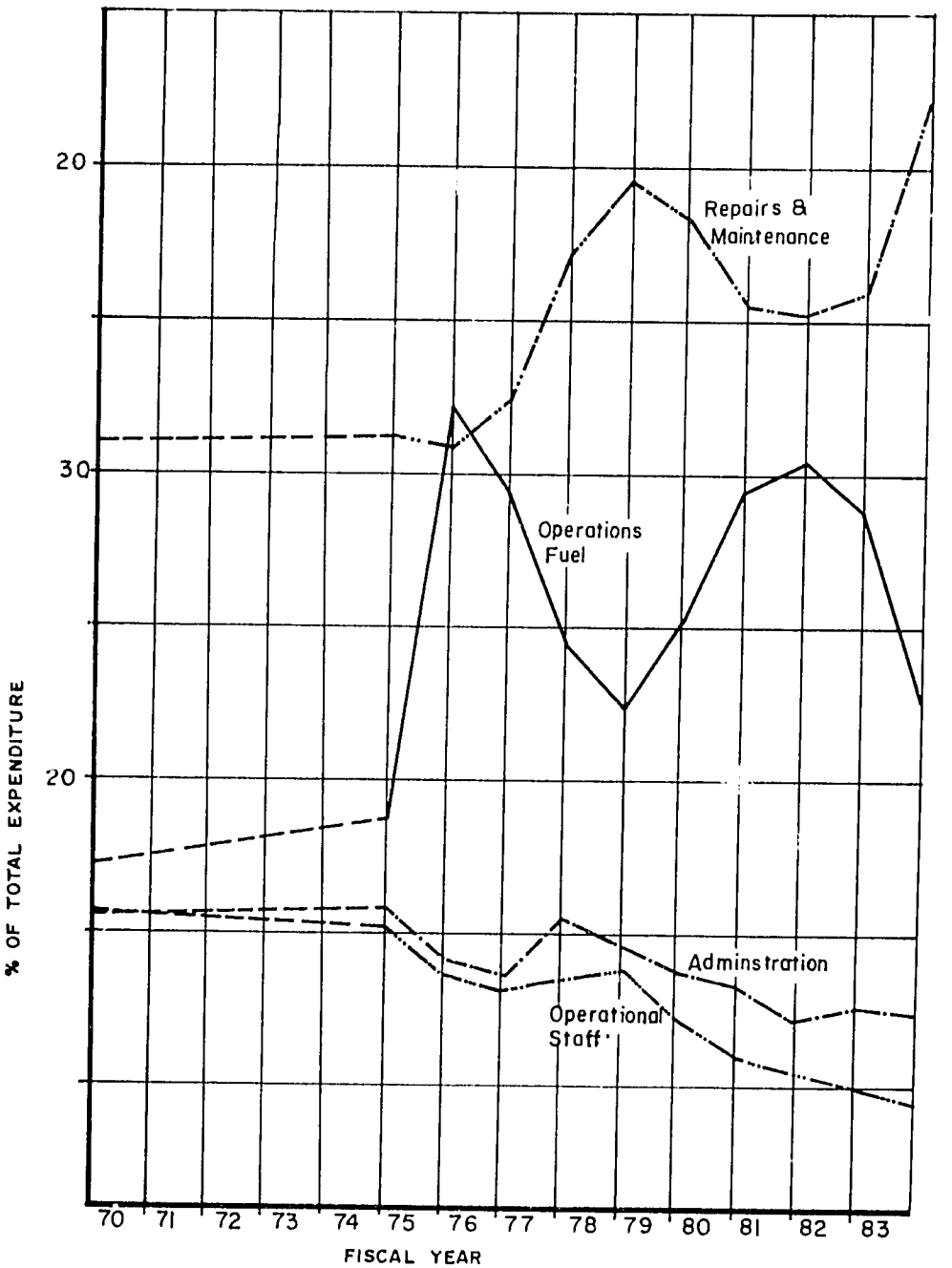


FIGURE 8.4. 2 COMPARISON OF EXPENDITURE ITEMS

Table 8.4.1 Revenue-expenses-operating Ratio

Year	Operating revenue	Operating expenses	Depreciation	Net expenses	Operating ratio
	(A)	(B)	(C)	(B-C)	A/(B-C)
1969/70	303039	252751	30059	222692	1.364
1970/71	202441	210053	31461	178592	1.133
1971/72		PART YEAR			
1972/73	246934	236131	20000	216131	1.143
1973/74	278328	342637	30000	312637	0.890
1974/75	402722	407103	30000	377103	1.077
1975/76	504839	494090	7633	486457	1.038
1976/77	542950	572502	9371	563131	0.964
1977/78	627214	660320	3057	657263	0.954
1978/79	828633	800348	6585	793763	1.044
1979/80	922610	963792	7323	956469	0.965
1980/81	1040784	1227171	8823	1218348	0.854
1981/82	1290204	1317087	9370	1307717	0.987
1982/83	1494607	1502918	-	1502918	0.994
1983/84 (b)	1446050	1782173	-	1782173	0.811

Source: Bangladesh Railways

Revenue can only come from the provision of railway services. Figure 8.4.3 derived from Table 8.4.2 shows the relative cost of rail services against the consumer price index for each fiscal year with 1973/74 taken as the base year.

Two conclusions can be drawn; the income derived from passenger traffic has not kept up with the consumer price index, and that freight traffic has kept well ahead of the index since 1977/78. There is one disturbing trend, the fall in relative value of the freight revenue compared with the C.P.I. in 1983/84.

Figure 8.4.4 derived from table 8.4.3 shows the relative earnings of passenger traffic to the CPI. The revenue from II and III class traffic and the aggregate revenue have failed to keep ahead of the C.P.I. The heavy predominance of III class traffic on aggregate passenger earnings is clearly shown. The effect of fare increases is obvious. The constant short lead of III class travel shows in the distinctive step pattern. This makes the task of increasing the relative value of passenger earnings hard, and would suggest that annual increases in fares are necessary to maintain the relative position of passenger earnings.

In examining the railway revenues the costs of operation must be established, and from which fares and rates can be established.

Table 8.4.2 Relationship of Revenue to C.P.I.

Year	Rev. per pass	Ratio	Rev. per tonne	Ratio	C.P.I. ratio	Rev. per Pass km	Ratio	Rev. per tonne-km	Ratio	C.P.I. Ratio
73/74	1.63	100	41.25	100	100	3.52	100	18.84	100	100
74/75	2.11	129	56.00	136	139	4.16	118	26.0	138	139
75/76	2.18	134	63.44	154	223	4.41	125	28.2	150	223
76/77	2.32	142	74.06	180	195	4.50	129	32.0	170	195
77/78	2.47	152	79.76	193	183	4.57	130	35.0	186	183
78/79	3.34	205	126.95	308	217	5.95	169	47.0	249	217
79/80	3.60	221	139.17	337	236	5.93	168	49.7	264	236
80/81	3.64	223	174.24	422	272	5.92	168	62.9	334	272
81/82	4.61	283	206.22	500	294	7.30	210	74.9	398	294
82/83	4.67	287	253.49	615	339	7.35	208	88.3	469	339
83/84	4.99	306	240.38	583	353	7.39	210	86.6	460	353

Source: Bangladesh Railways BEPP Macro Economic Model

Table 8.4.3 Relationship of Passenger Revenue to C.P.I.

Year	ACC		I		II		III		Gross		CPI	
	Rev. per pass	Ratio	Rev. pass km	Ratio	Rev. pass km	Ratio	Rev. pass km	Ratio	Rev. pass km	Ratio	Value	C.P.I. Ratio
73/74	19.01	100	13.2	100	4.4	100	3.3	100	3.52	100	28.3	100
74/75	27.0	142	16.8	127	3.8	127	3.8	115	4.16	118	39.3	139
75/76	28.7	151	17.2	130	6.0	136	4.0	121	4.41	125	63.0	223
76/77	28.6	150	17.4	132	6.1	139	4.1	124	4.54	129	55.3	195
77/78	26.7	140	17.0	129	6.2	141	4.1	124	4.57	130	51.8	183
78/79	41.4	218	26.7	202	9.0	205	5.3	161	5.95	169	61.3	217
79/80	41.6	219	26.6	202	9.2	209	5.3	161	5.92	168	66.9	236
81/82	40.5	213	26.4	200	9.0	205	5.3	161	5.92	168	76.9	272
82/83	81.1	427	45.1	342	13.0	295	6.4	194	7.33	208	96.0	339
83/84	91.6	482	54.5	413	14.0	318	6.3	191	7.39	210	100	353

Source: Bangladesh Railways
BEPP Macro Economic Model

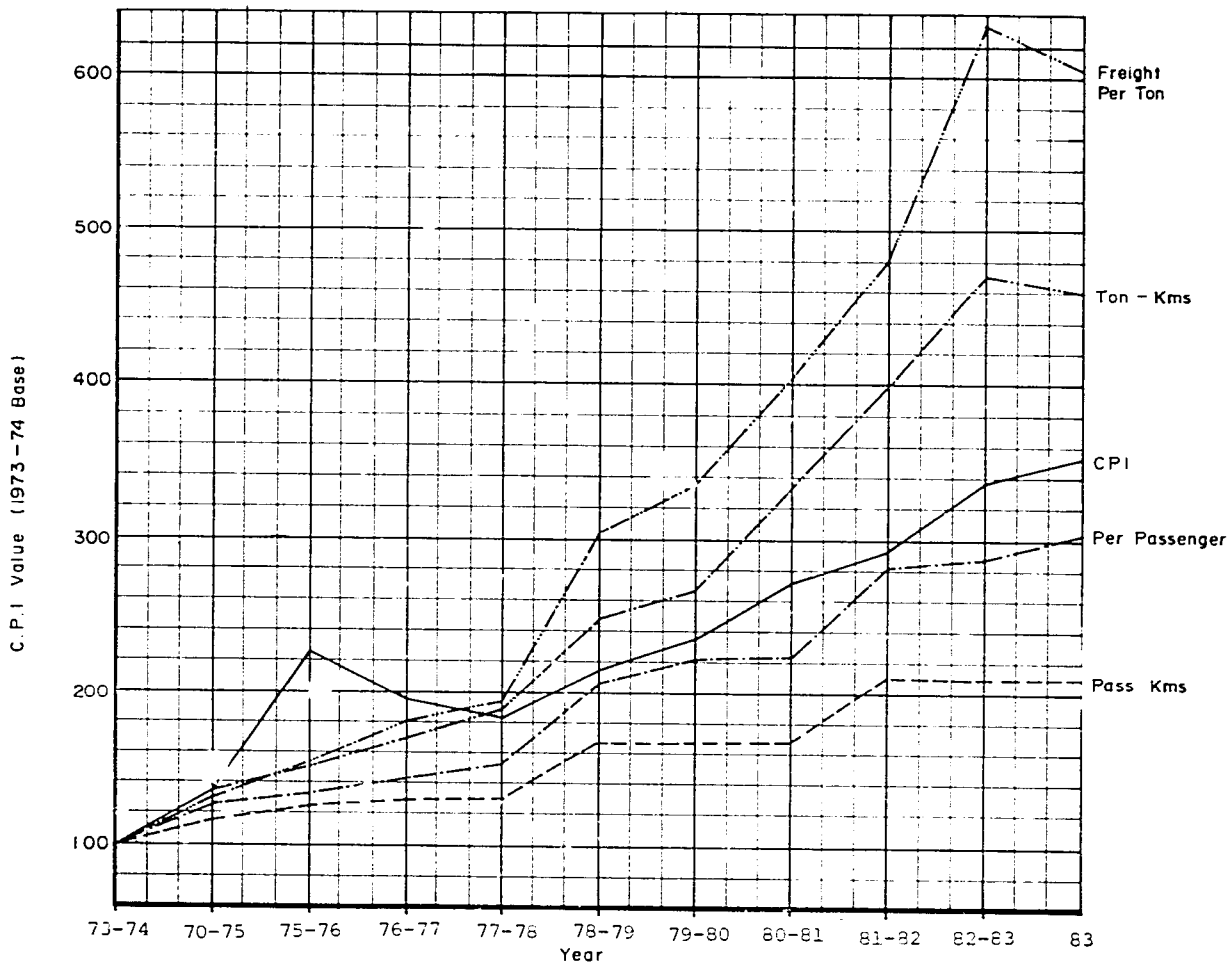


Figure 8.4.3 FREIGHT AND PASSENGER REVENUE RELATIVE TO CPI (1973/74 BASE)

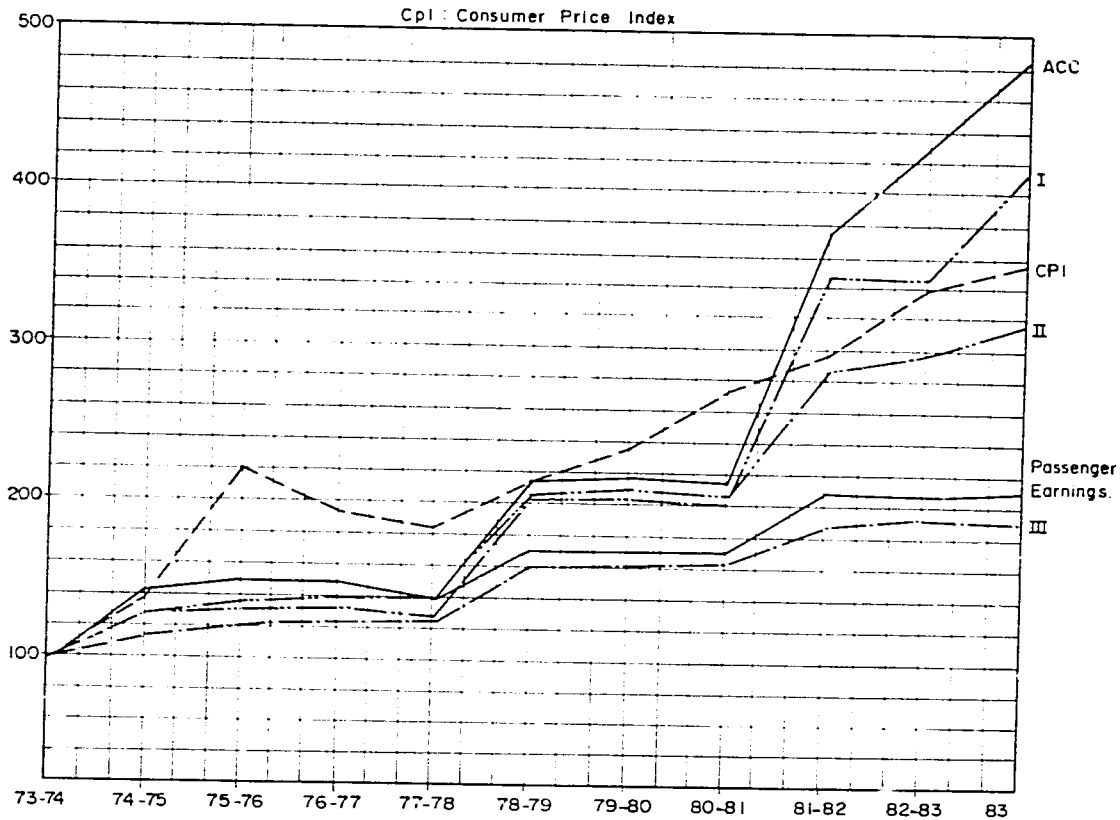


Figure 8.4. 4 REVENUE OF ONE PASS.KM. BY CLASS AND TOTAL RELATIVE TO CPI (1973-74 BASE)

8.4.2 Rail transport operating costs

In 1978 a detailed traffic costing excercise was made based on live data for the Financial Year 1976/77 for which details of actual expenses were available at that time. Detailed distribution of expenses over the different services and the functional groups of operations for 1976/77 were done and expenses required to perform unit functions were established for the metre gauge system, the broad gauge system, and for passenger and freight services. These unit cost data were updated to 1978/79 prices during the Railway Development Planning Project (RDPP) and the results were reported in its Final Report Supplementary Report Volume 1 June, 1980.

An attempt has been made to estimate overall passenger-km and tonne-km costs by means of these unit costs since the detailed derivation of railway unit costs, a complex and time consuming task, outside the scope this study.

The unit costs developed by the RDPP study show unit costs further broken down into working expenses, depreciation and interest. The latter two categories apply to book values and, given the inconsistent accounting practice by BR concerning capital costs, are not applicable for estimating real costs. Therefore, only the unit cost data under the category of working expenses were taken.

For freight transport the total operating cost was calculated as follows:

The operating cost of transporting a wagon load of cargo for the average hauling distance (275 km on the metre gauge and 166 km on the broad gauge in 1983/84) was obtained by taking terminal expenses and marshalling expenses at both ends and multiplying the unit length hauling expense by the average per wagon load of 10.9 tonnes to yield per tonne costs for the two systems. The overall average cost per tonne was obtained by taking the average of the two system weighted by total tonne-km carried by each system (77% of the metre gauge and 23% for the broad gauge in 1983/84).

Table 8.4.4 Freight Service Operating Cost Estimation

	Terminal	Marshalling	Linehaul
Metre Gauge Average Transport Cost Per Wagon			
Working Expenses per Wagon (TK)	2 x 193.5	2 x 49.6	275 x 2.68
Depreciation and Interest (TK)	2 x 59.8	2 x 17.3	275 x 1.35
Broad Gauge Average Transport Cost Per Wagon			
Working Expenses per Wagon (TK)	2 x 111.9	2 x 28.0	116 x 4.46
Depreciation and Interest (TK)	2 x 47.0	2 x 10.7	116 x 1.76

Metre Gauge Cost Per Tonne (10.9 tonne to a Wagon)

		Per Wagon	Per tonne
Working Expenses (TK)	:	525	48.2

Broad Gauge Cost Per Tonne		Per Wagon	Per tonne
Working Expenses (TK)	:	1,020	93.6
Depreciation and interest (TK)	:	807	74 0

Average Cost Per Tonne

from weighted ton-km	:	107.9
Working expenses (TK)	:	54.2

Working Expenses Total

$107.9(TK/tonne) \times 2,939 \times 10^3 = TK\ 317 \times 10^6$

Then the total operating cost (working expense) was obtained by multiplying the overall cost per tonne by the total tonnage carried. The resulting figure was 317 million Taka. The foregoing procedures are shown in Table 8.4.4.

For passenger transport similar procedures were taken. Terminal expenses were included at both ends of the average travel of 63.6 km. and the per kilometre moving expense was multiplied by the distance to get the expense over the distance. The per passenger average trip expenses were then increased by 16% for the metre gauge and 14% for the broad gauge as suggested in the original unit cost tables. The overall per passenger operating cost (working expenses) was obtained by taking the average of the two system weighted by the total passenger km of each system (79% metre gauge and 21% broad gauge). The total passenger service operating cost (working expenses) was then obtained by multiplying the per passenger cost with the total number of passengers in 1983-84. The resulting figure was 639 million Taka. The foregoing procedures are shown in Table 8.4.5.

The estimated total freight service cost and the total passenger service cost of Tk.317 million and Tk.639 million were increased to 1983 levels by applying the general price index of 1.46. The resulting total passenger and freight service cost was Tk.1,396 million which can favourably be compared with the actual non-capital expenditure of BR in 1983-84 of Tk.1,782 million. This total of 1,782 million was divided into passenger and freight service costs in proportion to the above estimated figures. Finally, thus derived service costs were divided by the 1983-84 total output figures. (7,982 million passenger-km and 779 million tonne-km) to yield an average passenger service cost of Tk.0.149 per passenger-km, and an average freight service cost of Tk.0.759 per tonne-km.

Table 8.4.5 Passenger Service Operating Cost Estimation

Average Transport Cost Per Passenger For Average Distance

	Terminal (TK)	Moving (TK)	Other
Metre Gauge			
Working Expenses (TK)	2 x 0.648	63.6 x 0.067	16%
Depreciation and interest (TK)	2 x 0.170	63.6 x 0.017	16%
Broad Gauge			
Working Expenses (TK)	2 x 0.803	63.6 x 0.067	14%
Depreciation and interest (TK)	2 x 0.259	63.6 x 0.032	14%

Average pass-km cost

Working Expenses (TK): 6.46
Depreciation and interest (TK): 1.91

Working Expenses Total

6.46 (Tk./pass) x 98.9 x 10^6 = Tk 639 x 10^6

Whereas the terminal expense, marshalling expense do not in principle vary depending on transport distance, the linehaul expense for the freight service and the moving expense for the passenger service increases as the distance gets longer. Assuming that the relative values of cost components shown in the unit expense data remain stable, the relationship between the tonne-km cost or the passenger-km cost and the transport length (linehaul) was derived from the unit cost data shown in the Railway Development Project Report. The results are shown below in the form of equations.

$$EF = 0.0077 \left(\frac{10653}{L} + 67.7\right),$$

$$EP = 0.0253\left(\frac{86.5}{L} + 4.26\right)$$

Where EF is the operating expenditure per ton of freight, and L is the distance, and EP is the operating expenditure per passenger-km.

8.4.3 Railway rolling stock capital costs

Capital costs of passenger services and freight services were estimated as follows:

The replacement cost of a typical diesel locomotive is in the order of Tk. 25 million. For a freight wagon the replacement cost is in the order of Tk. 750 thousand and for a passenger carriage Tk. 5.3 million. Assuming the economic life of 25 years and 10% scrap value, the capital costs in terms of amortization at 15% interest rate and the interest on the scrap value are Tk. 3,856 thousand, Tk. 116 thousand and

Tk. 817 thousand for a locomotive, a wagon, and a passenger carriage respectively. On the hourly basis they are Tk. 440, Tk. 13.2 and Tk. 93.3 respectively.

The capital costs were allocated on the basis of train operation. However, locomotives and passenger carriages on the one hand and freight wagons on the other require a different approach since wagons are not tied to trains for their entire journey whereas locomotives and carriages normally are.

The average number of units per train in 1983/84 were 1 for locomotives 50.2 for wagons in terms of 4-wheel units, and 18.9 for carriages again in terms of 4-wheel units (BR Year Book). Numbers of wagons and carriages in terms of physical units are 42.2 and 9.5 respectively.

Average daily kilometre by the three types of equipment are shown in the Year Book. Average lengths of freight and passenger train trips were calculated from the total train kilometre and total numbers of train runs. Average turn round days of locomotives and carriages were obtained by dividing the respective average train trip lengths by the published figures of average daily kilometre. The average turn round of wagons was calculated from the annual tonne-km, the average per wagon load, the total number of wagons in use, and the average cargo trip length. From the published figures of average running speeds of freight and passenger trains, average running time lengths for the average train trip lengths were calculated and average terminal time lengths were obtained by subtraction. Wagon trips and freight train trips are independant as indicated by different average this lengths of 265 kms and 47.3 kms. Because of the costing procedure presented here is based on average train movements, a portion of wagon turn round proportionate to the ratio of average trip lengths should be taken. (Remaining portion is attributable to other average trains). By means of multiplying the hourly capital costs with time lengths in terminal and journey the total capital costs were calculated. Table 8.4.6 shows the foregoing procedures alongwith relevant data, and the resulting capital costs per passenger-km or per ton-km at different trip distances. The average number of passengers per train includes ticketless passengers.

It should be noted that in these costing procedures the number of hours attributable to a trip is estimated and used as the basis, not the number of running hours so that non-productive hours are properly taken into account.

Table 8.4.6 Railway Rolling Stock Capital Cost

(1) Basic Data

	Diesel Locomotive	Freight Wagon	Passenger Carriage
Replacement cost (Tk. thousand)	25,000	750	5,300
Life (years)	25	25	25
Amortization at 15% with interest on 10% scrap value	3,856	116	817
Hourly Capital Cost (Tk).	440	13.2	93.3
Average No. per train	1	42.2	9.5
		(includes empty)	
Average daily kilometres: (km)	161	14.3	170
Average train trip (km)	As Train	47.3	94.5

(2) Time Data

	Locomotive		Freight	Passenger
	Freight	Pass.		
Average Train Speed	9.93	30	As Loco	As Loco
Average Turn round (days)	0.293	0.587	17.6	0.556
Average hours per trip (hours)	7.05	14.1	422	13.3
Average terminal hrs/trip	4.76	3.15	28	3.2
Average terminal hrs/trip	2.29	11.0	70.5*	10.1

*Attributable to average train trip

(3) Cost

a) Average per train: Tonnes = 427
Passengers = 1296

b) Passenger Service Cost per passenger-km: (CP)

$$CP = \frac{1}{1296L}\{440(11.0 + \frac{L}{30}) + 93.3(10.1 + \frac{L}{30}) \times 9.5\}$$

$$= \frac{10.6}{L} + 0.034$$

c) Freight service cost per tonne-km: (CF)

$$CF = \frac{1}{427}\{440(2.29 + \frac{L}{9.93}) + 13.2(70.5 + \frac{L}{9.93}) \times 42.2\}$$

$$= \frac{94.3}{L} + 0.235$$

d) These equations are solved for varying values of L and tabulated in Table 8.4.7.

8.4.4 The cost of rail transport

(1) Existing basis

The data obtained in the previous two sub-sections was tabulated in table 8.4.7 and plotted in figures 8.4.5 and 8.4.6 for freight and passenger traffic respectively. These represent the "true costs" for rail transportation at 1985 rates.

(2) Improved train services

Two different conditions were considered. Passenger traffic service will be improved in the future such that a nominal 10% cost reduction would occur in the operating costs by:

- Higher train speeds due to track improvement projects
- Less delays due to improved communication
- Improved locomotive reliability performance
- Improved signalling at important stations
- Improved carriage cleaning facilities
- Improved train departure times
- Improved revenues due to longer trains and less fare dodging.

Freight trains were considered to maintain their line-haul, shunting and transfer times but there would be improved wagon turnround time. This would be a nominal 50% reduction in the time taken between placing a wagon into a siding for loading/unloading and receiving it back into traffic after loading/unloading, at both ends of the trip. Delays in ferry crossings at the Jamuna River are considered to be terminal times and not operating.

These improved rail transport costs are tabulated in Table 8.4.8 and plotted in figures 8.4.7 and 8.4.8 for freight and passenger traffic respectively.

Table 8.4.7 Existing Rail Transport Costs

(1) Operating costs

Distance km	25	50	100	150	200	250	300	350	400
Taka/Tonne-km	3.80	2.16	1.34	1.07	0.93	0.85	0.79	0.76	0.73
Taka/pass - km	0.20	0.15	0.13	0.12	0.12	0.12	0.12	0.11	0.11
(2) Capital costs									
Taka/Tonne-km	4.01	2.12	1.18	0.86	0.71	0.61	0.55	0.50	0.47
Taka/pass - km	0.46	0.25	0.14	0.11	0.09	0.08	0.07	0.06	0.06

Table 8.4.7 Existing Rail Transport Costs (Cont.)

(3) Combined capital and operating costs

Distance km	25	50	100	150	200	250	300	350	400
Taka/Tonne-km	7.81	4.28	2.52	1.93	1.64	1.46	1.34	1.26	1.20
Taka/pass - km	0.66	0.40	0.27	0.23	0.21	0.20	0.19	0.17	0.17

Source: Consultants

Table 8.4.8 Improved Rail Transport Costs

1. Operating costs

Distance km	25	50	100	150	200	250	300	350	400
Taka/Tonne-km	3.80	2.16	1.34	1.07	0.93	0.85	0.79	0.76	0.73
Taka/pass - km	0.18	0.13	0.11	0.11	0.11	0.11	0.11	0.10	0.10
2. Capital costs									
Taka/Tonne-km	2.05	1.14	0.69	0.54	0.46	0.42	0.39	0.36	0.35
Taka/Pass - km	0.46	0.25	0.14	0.11	0.09	0.08	0.07	0.06	0.06
3. Combined capital and operating costs									
Taka/Tonne-km	5.85	3.30	2.03	1.61	1.39	1.27	1.19	1.12	1.08
Taka/Pass - km	0.64	0.38	0.25	0.22	0.20	0.19	0.18	0.16	0.16

Source: Consultants

8.4.5 Freight rates

A graphical plot was made of the freight tariff for two principle commodities obtained from the published tariff's commencing January 1, 1985. This is shown in figure 8.4.9, Table 8.4.9 was obtained from the rail users survey. This corroborated figure 8.4.9 except routes 67, 68, 70 & 72 where the survey price is higher than the plotted graph.

8.4.6 Passenger fares

Actual fare paid was obtained from survey data which is tabulated in Table 8.4.10 and plotted in figure 8.4.10. A secondary plot was made for the ferry across the Jamuna river.

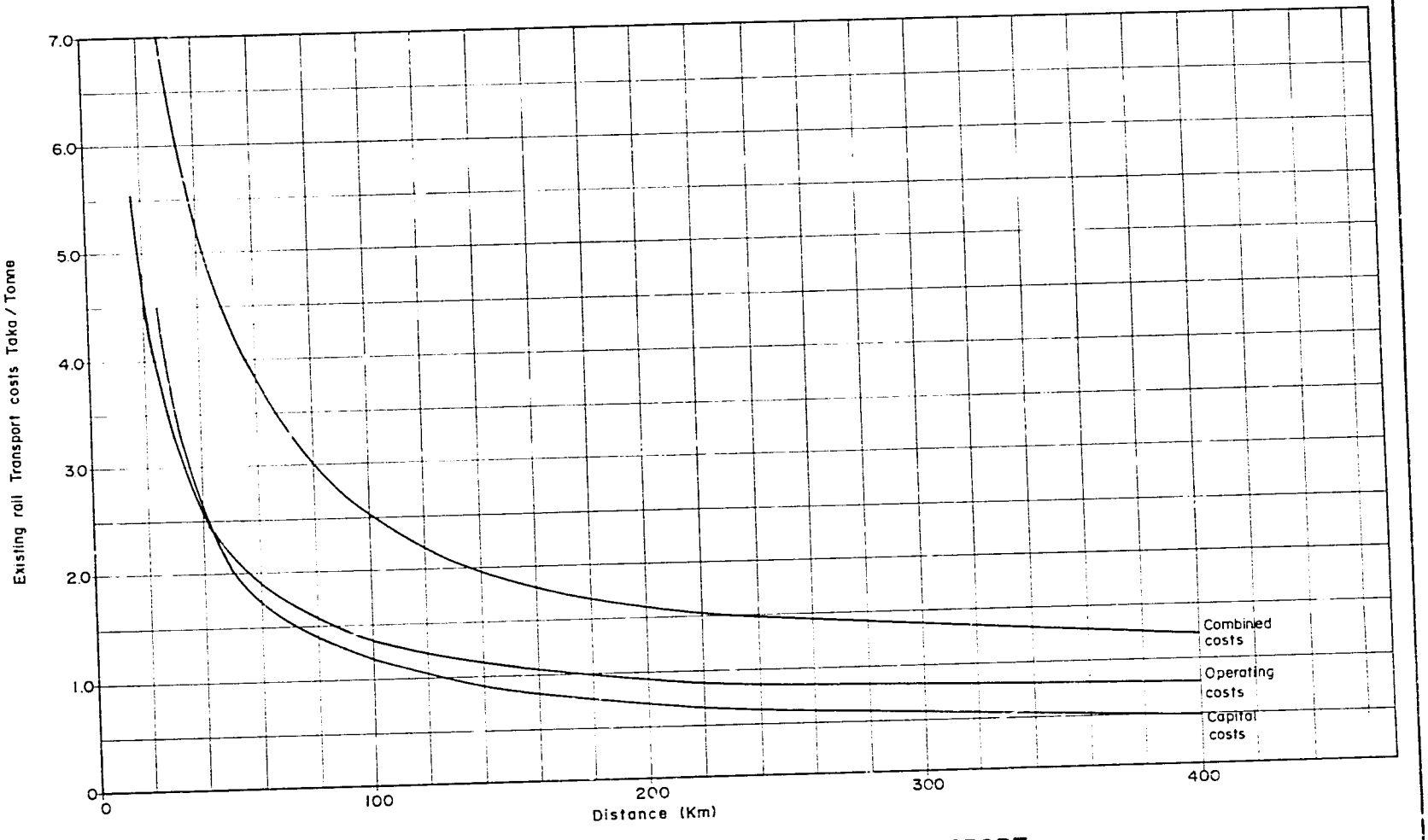
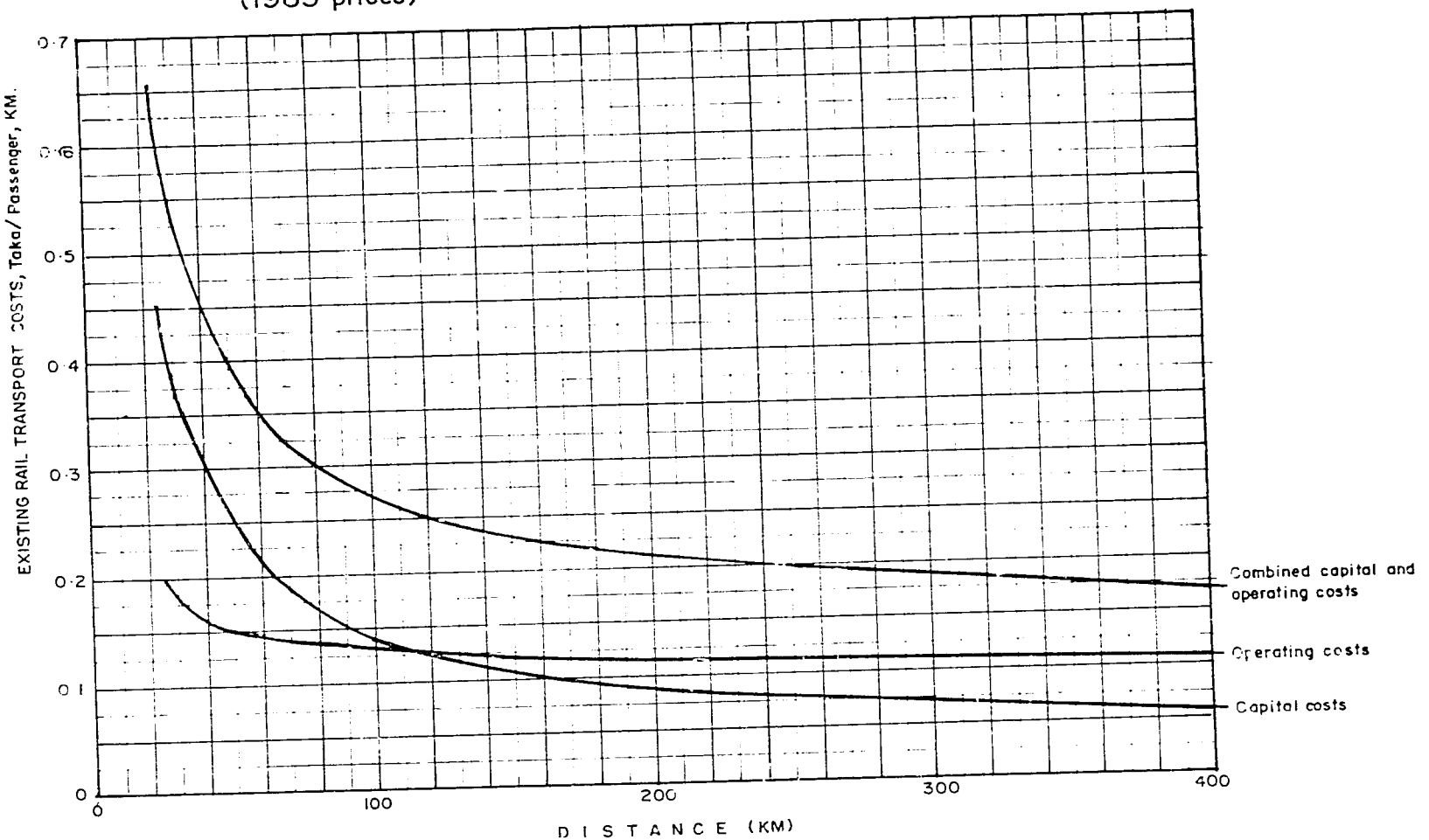


Figure 8.4.5 EXISTING RAIL FREIGHT TRANSPORT CAPITAL AND OPERATING COSTS (1985 PRICES)

FIG. 8.4.5 EXISTING RAIL PASSENGER CAPITAL AND OPERATING COSTS
(1985 prices)



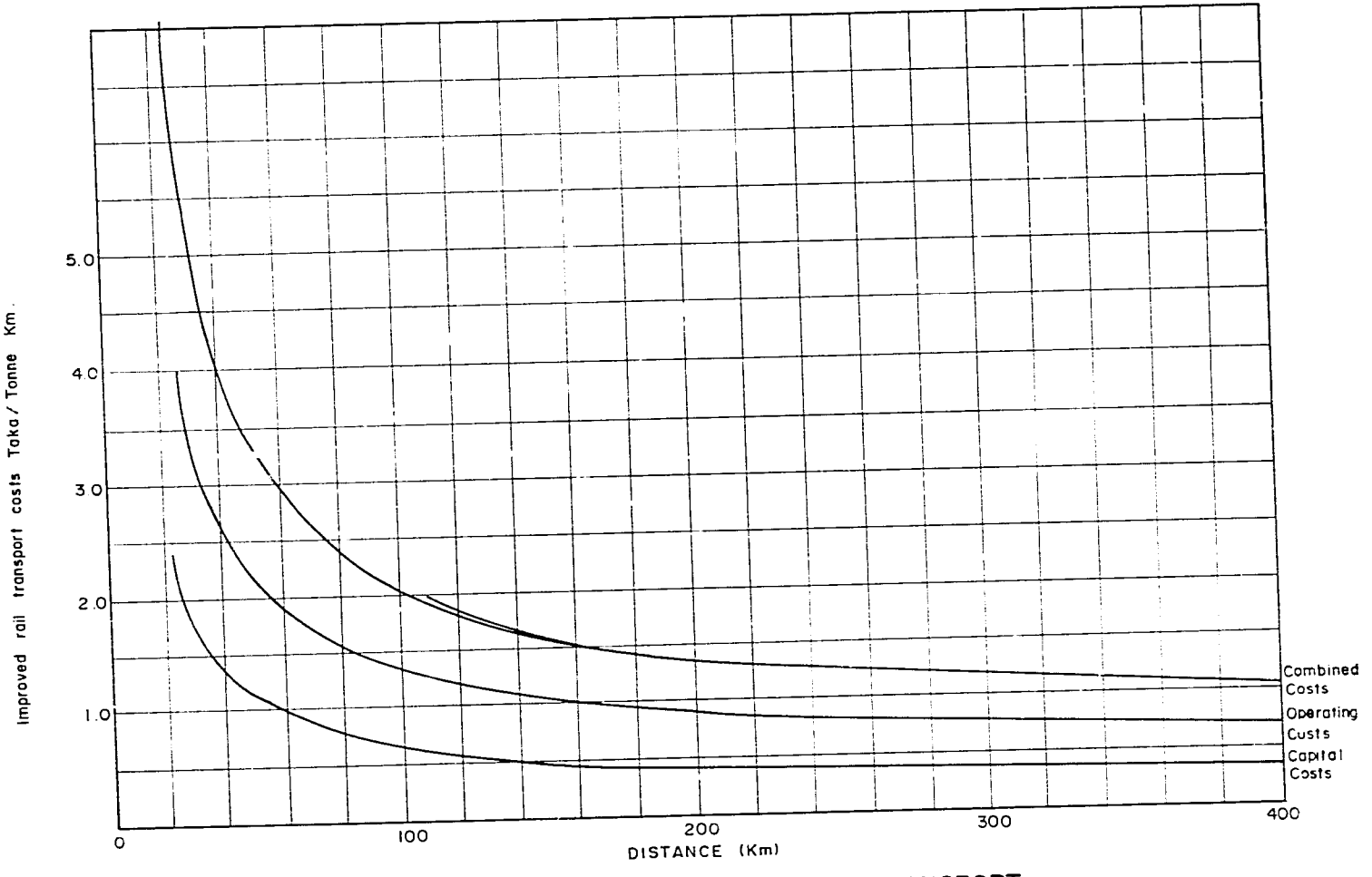


Figure 8.4. 7 IMPROVED RAIL FREIGHT TRANSPORT CAPITAL AND OPERATING COSTS (1985 PRICES)

FIG. 8.4.8 IMPROVED RAIL PASSENGER CAPITAL AND OPERATING COSTS (1985 Prices)

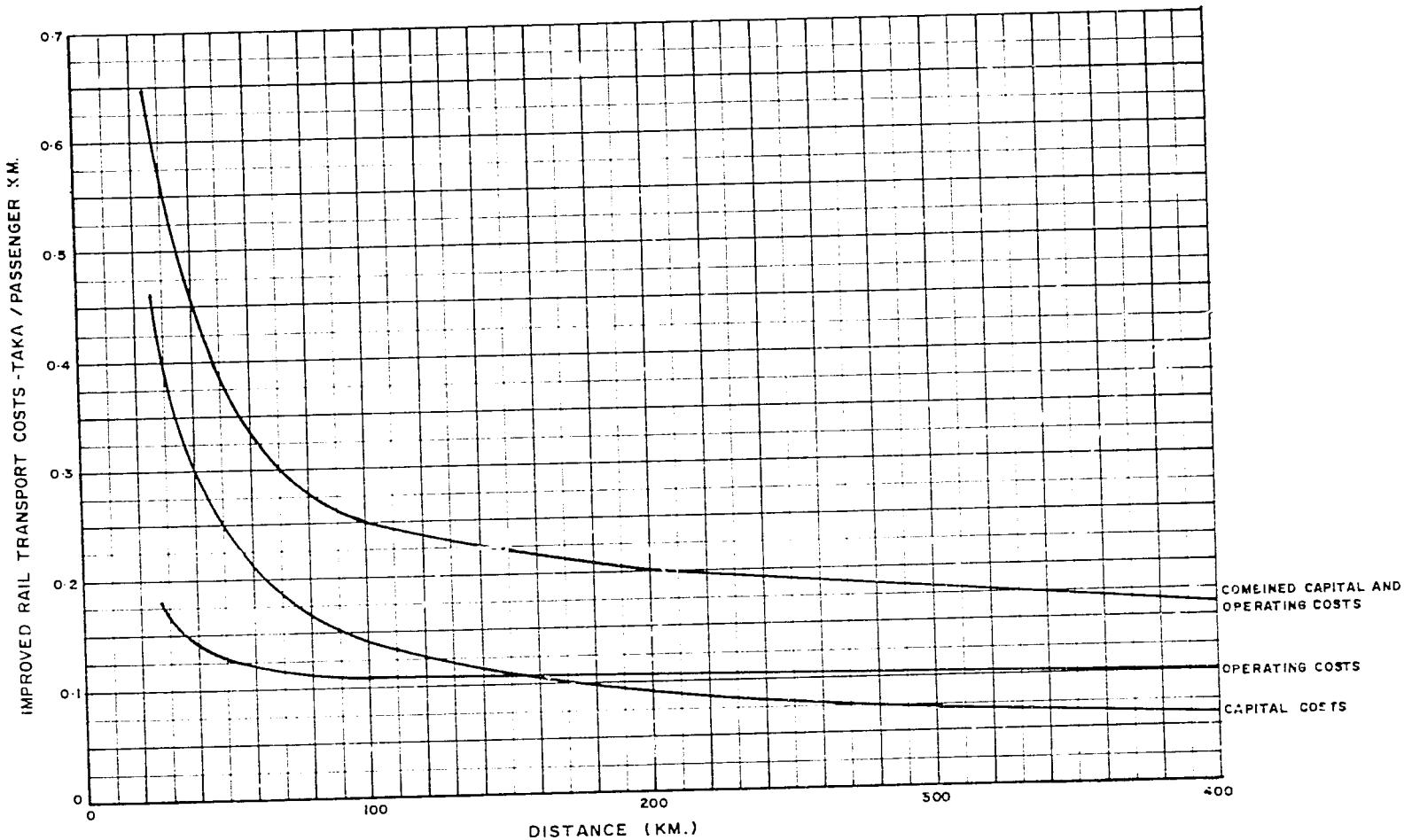
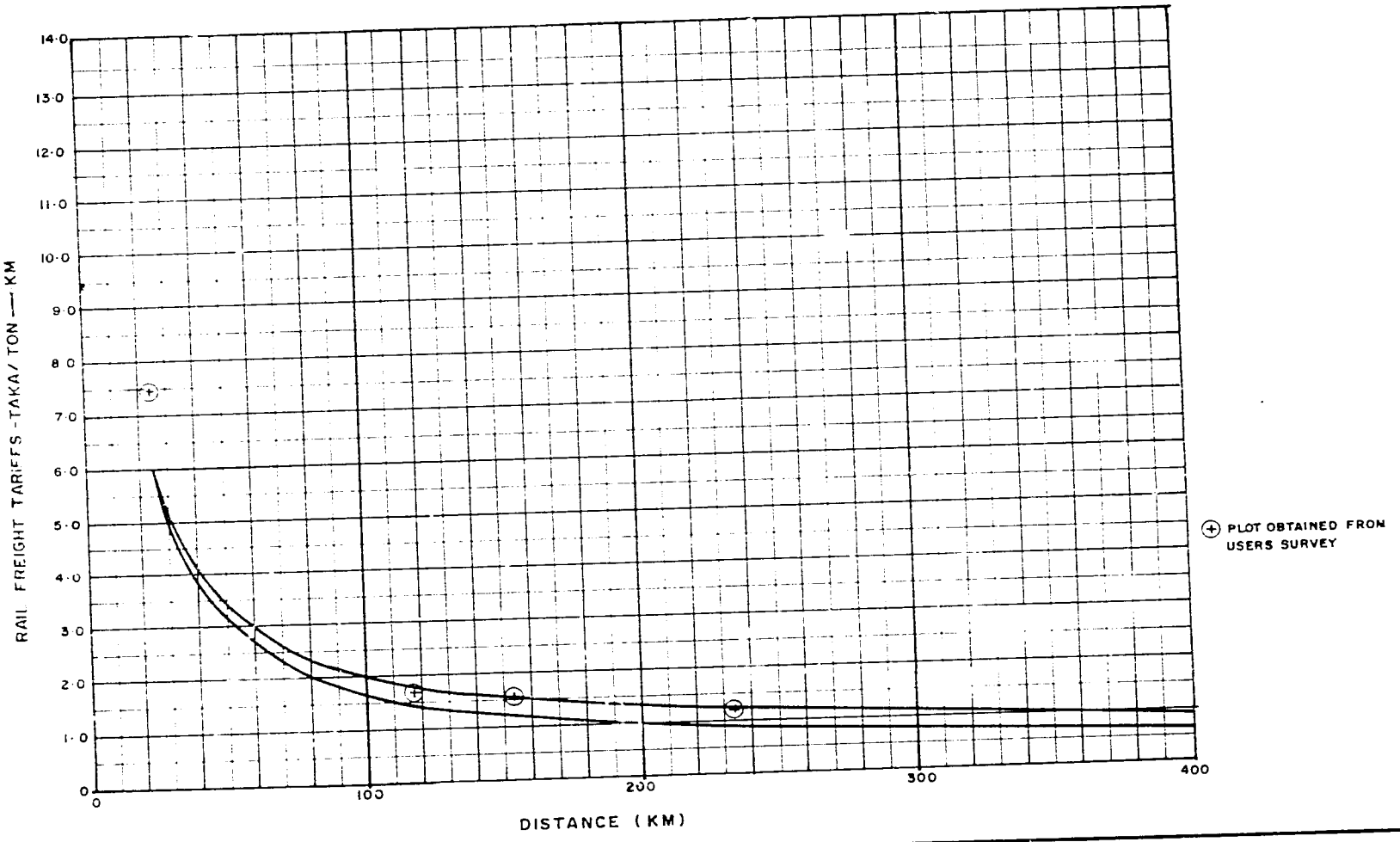


FIGURE 8.4. 9 RAIL FREIGHT TARIFFS-1985 RATES



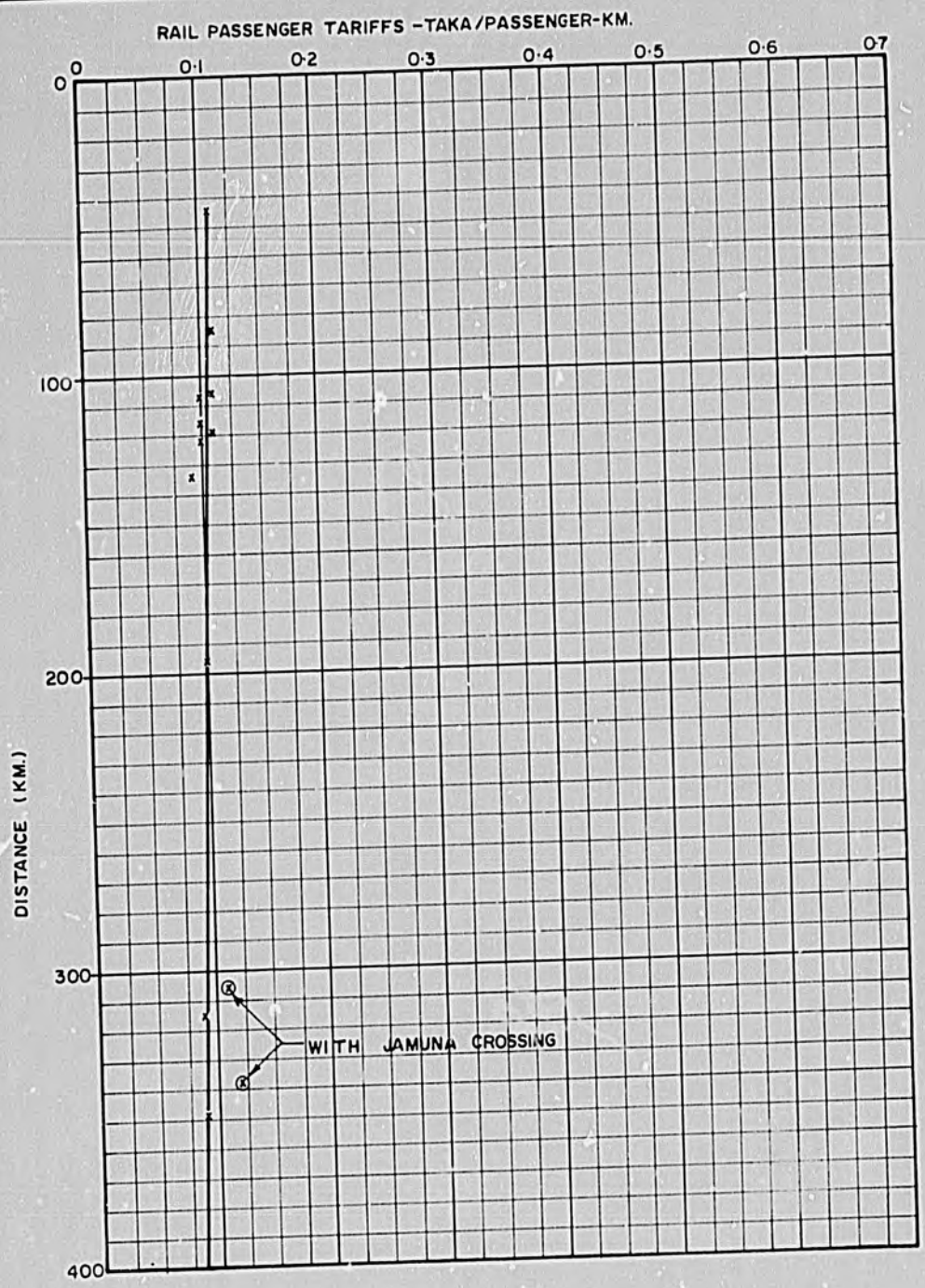


FIGURE 8.4.10 RAIL PASSENGER TARIFFS-1985 RATES
(1985 Prices)

Table 8.4.9 Rail Freight Users Rates Survey

Route	Origin	Destination	Commodity	Distance	Rate Taka/ Tonne	Rate Taka/ Tonne
1.	Dhaka	Chittagong	Wheat	343	260	0.76
1.	Dhaka	Chittagong	Rice	343	260	0.76
1	Dhaka	Chittagong	Iron	343	340	0.99
23	Dhaka	Rangpur	Wheat	414	290	0.70
43	Dhaka	Thakurgaon	Cement	545	390	0.72
44	Dhaka	Kurigram	Salt	422	230	0.55
55	Chittagong	Comilla	Fertilizer	154	194	1.26
64.	Narayanganj	Dinajpur	Fertilizer	497	310	0.62
65	Narayanganj	Rangpur	Jute	429	410	0.96
67	Ashuganj	Feni	Fertilizer	157	241	1.54
68	Ashuganj	Mymensingh	Fertilizer	118	200	1.69
70	Ghorasal	Jamalpur	Fertilizer	233	272	1.17
71	Ghorasal	Mymensingh	Fertilizer	170	212	1.25
72	Fenchuganj	Sylhet	Fertilizer	24	179	7.46
73	Fenchuganj	Dinajpur	Fertilizer	659	378	0.57
74	Fenchuganj	Rangpur	Fertilizer	591	361	0.61

Source: Consultants survey.

Table 8.4.10 Rail Passenger Users Fares Survey

Route No.	Origin	Destination	Class	Distance	Fare Tk/pass	Fare Tk/pass-km.
1	Dhaka	Chittagong	I	343	28[illegible]	0.83
1	Dhaka	Chittagong	II	343	70	0.20
2	Dhaka	Laksam	II	190	44	0.23
3	Dhaka	Comilla	I	187	163	0.87
4.	Dhaka	Bhairab	III	58	9	0.11
5	Dhaka	Ghorasal	III	45	5	0.11
6	Dhaka	Sordchar	III	107	11	0.10
7	Dhaka	Kishorganj	II	133	30	0.23
7	Dhaka	Kishorganj	III	133	13	0.10
8	Dhaka	Narsindi	II	58	13	0.22
9	Dhaka	Mymensingh	I	116	106	0.91
9	Dhaka	Mymensingh	II	116	25	0.22
9	Dhaka	Mymensingh	III	116	12	0.10
10	Dhaka	Tongi	I	23	20	0.87
11	Dhaka	Brahmanbaria	III	106	12	0.11
12	Dhaka	Sylhet	I	311	249	0.80
12	Dhaka	Sylhet	II	311	64	0.21
13	Dhaka	Srimongal	I	208	200	0.96
14	Dhaka	Akhaura	III	119	13	0.11
15	Dhaka	Khulna	I	623	360	0.58
16	Dhaka	Sirajganj	II	212	58	0.27
17	Dhaka	Poradaha	II	338	90	0.27
17	Dhaka	Poradaha	III	338	40	0.12
18	Dhaka	Jessore	I	570	341	0.60
19	Dhaka	Ishurdi	III	306	33	0.11
20	Dhaka	Chuadanga	II	368	96	0.26
21	Dhaka	Jagannathganj	III	196	19	0.10
22	Dhaka	Dinajpur	I	481	309	0.64
23	Dhaka	Rangpur	I	414	285	0.69
24	Dhaka	Bahadurabad	II	224	45	0.20
25	Dhaka	Gaibandha	III	349	31	0.09
26	Dhaka	Bonarpara	III	325	29	0.09
27	Dhaka	Chandpur	II	58	13	0.22

Source : Consultants survey.

8.4.7 Loading and unloading charges

The rates in sub-section 8.4.5 are only the line haul charges involved in transporting the goods from the loading point to unloading point.

To the shipper there are two additional charges to be paid, charges for loading and unloading, which are tabulated in Table 8.4.11. These were obtained from the shippers and also the railways.

8.4.8 Comparison of costs, fares and rates

Figures 8.4.11 and 8.4.12 are plotted from the previous figures of costs and fares in previous sub-sections.

(1) Freight costs and rates

Figure 8.4.11 shows the curve for costs against distance. The tariff charge clearly exceeds the operating cost, but is below the total cost under the existing 1985 operating conditions. Total cost

Table 8.4.11 Rail Freight Loading and Unloading Cost Surveys

	Loading cost TK/Tonne	Unloading Cost TK/Tonne	Comments
Jute	13 - 17	13 - 14	Shippers data
Fertilizer	20 - 30	25 - 35	B.R. data
Fertilizer	8	8	
Wheat	8 - 11	8 - 11	
Rice	8 - 11	8 - 11	
Iron	13	13	
Cement	8	8	

Source: Consultants survey

is the operating cost plus the capital costs. When improved operating conditions exist, i.e. the wagon turnround time is reduced, the costs are reduced as shown by the curve of improved total cost. The benefit to the railway of improved total costs is clearly shown and a small adjustment to jute tariff rates for over 100 km would ensure that all costs are covered by the tariff.

(2) Passenger cost and rates

Figure 8.4.12 is the similar plot of costs and distance for passenger traffic III class only. The graph shows that Rail Traffic does not cover its costs at all distances, especially below 60 km whe the cost curve moves away from the tariff curve. This lead is the average for III class railway traffic. Operating cost curves are sho for the existing conditions and the improved conditions as described

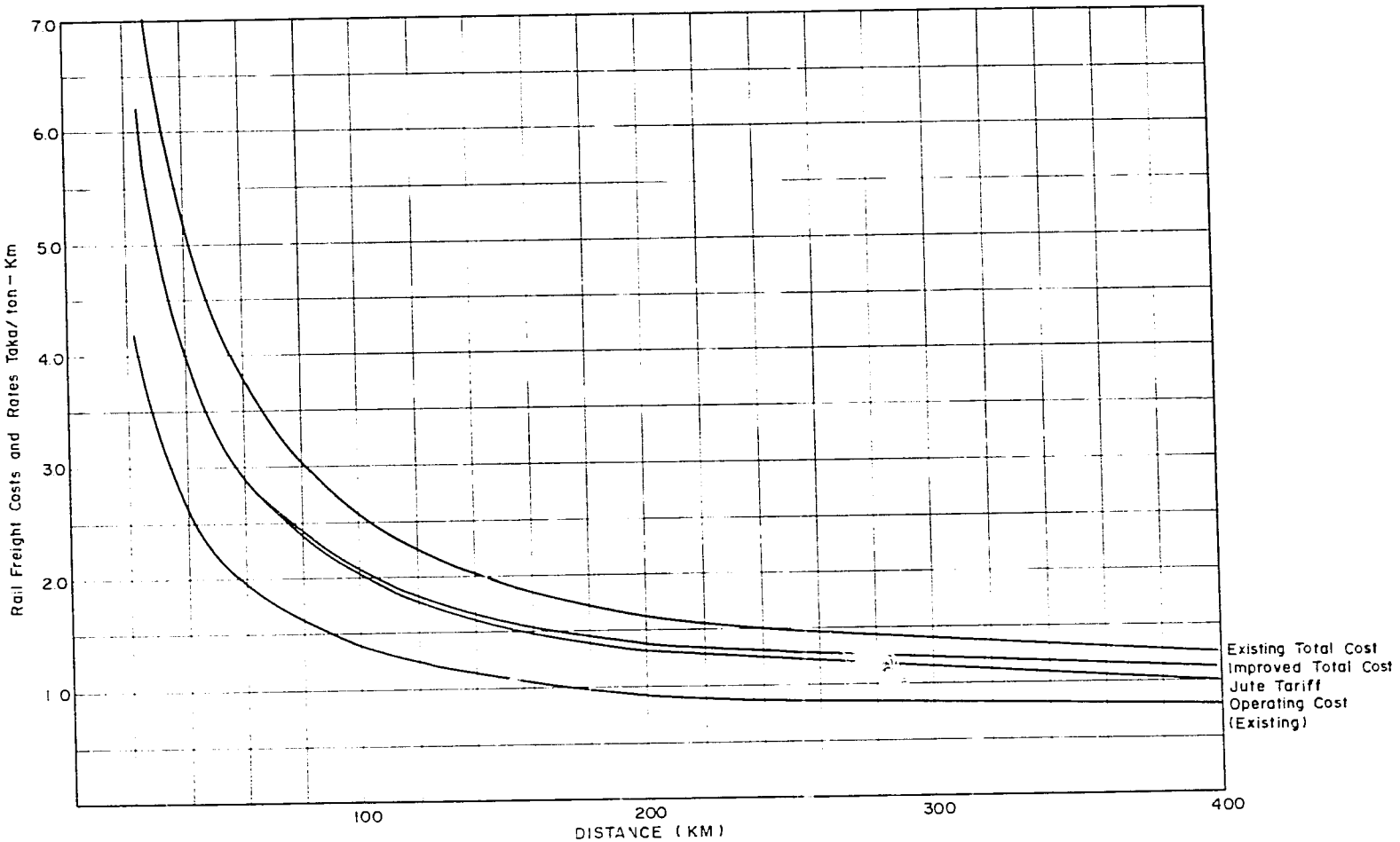
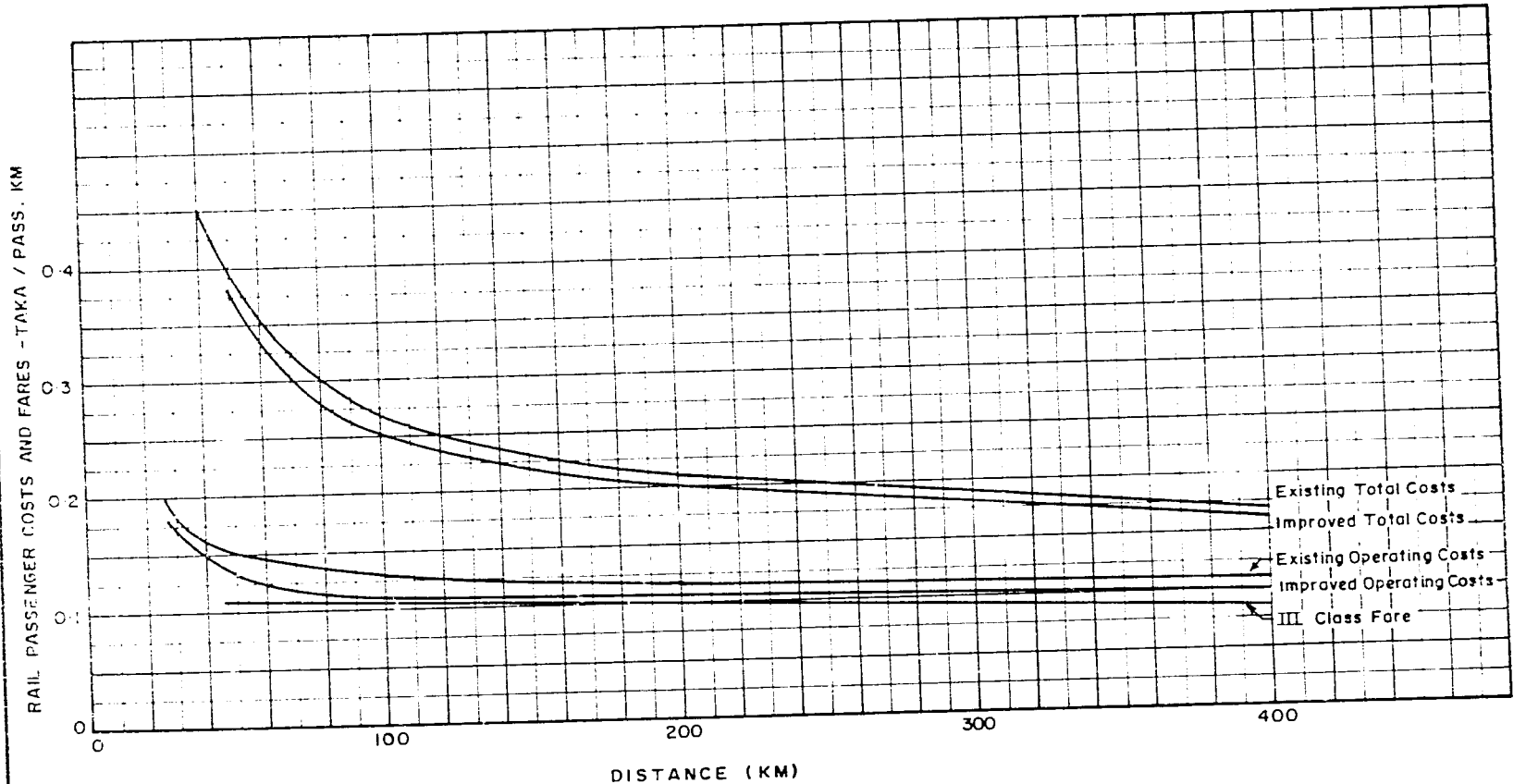


Figure 8.4.11 COMPARISON OF RAIL FREIGHT COSTS AND RATES (1985 PRICES)

FIG. 8.4. 12 COMPARISON OF RAIL PASSENGER COST AND FARES
(1985 Prices)



in sub-section 8.4.4. However when capital costs are included there is a large separation between costs and revenue.

This is a major social consideration for railway policy. Fares for distances less than 100 km must not follow a linear relationship if the cost of the service is to approach the cost of providing the service.

(3) Observations

These curves are meant to represent graphically the financial dilemma the railway is facing, and the advantages that occur by implementing the improvements to management, operations and assets discussed in the various sections in this chapter. The savings that can occur to the national finances and the travelling public by implementing the changes suggested are large and will have a dramatic effect up on the railway activities and policies.

8.5 Infrastructure

8.5.1 Introduction

The Railway Infrastructure discussed in this section comprises five components.

- o Track Structure
- o Bridges
- o Signalling and interlocking
- o Telecommunications
- o Structures and depots

These five elements comprise the largest items of fixed assets by the railway, the replacement costs of which are enormous. The maintenance liability is extensive as the book life and actual life of these assets are lengthy. One common factor in all these assets is age, and that they were constructed for a type of railway service, which has long since disappeared. Whilst the railway is divided into two geographic operating zones, there are two systems in operation the broad gauge in the West and the metre gauge lines in the East and North West. Apart from gauge there is a major difference in that the Broad Gauge is designed for an 18 ton (long) axle load and the metre gauge for an 11.75 ton (long) axle. Metre gauge lines carried the majority of freight traffic and passengers on its 1,912 route kilometres, whereas the broad gauge is only 978 route-kilometres. The majority of the railways were constructed between 1860 and 1915, suffered structural damage during the war of liberation, and years of inadequate maintenance since partition in 1948.

8.5.2 Track structure

Track structure combines all the components of the track above formation level. These components are ballast, sleepers, plates and fastenings and the rails. The whole of this structure has to withstand the loads imposed on it. These are the simple load of the wheel and axle, loads carried, impact from the train motion, vibrations caused by the irregularities of the rail head corrugations, dipped rail joints, lateral forces due to curves and vehicle movements. The earth formation has to withstand these loads without deterioration, and consequently the loads on the formation are related to the sleeper density and the depth of stone ballast under the sleeper. The loads on the sleeper and to a certain extent the spacing of the sleeper are related to the properties of the rail.

(1) Rail

The rail is the primary load support system, and as such has the dominant role in the type and speed of trains.

The track has been well described in the RDPP revised October '83 document, and is included in Appendix A8.3. The track structure requirements are well set out in that document and given normal maintenance on the lightly loaded tracks will attain a 30 to 50 years life for components.

The 90lb BS A rails for Broad Gauge and the 75 lbs BS A rails for the metre gauge are most suitable sections, with the advantage that they are used by other Railway systems in the sub-Continent and South East Asia which will ensure compatible supplies in the future. Rail quality should be to BS 11 normal or UIC 860 grade 70 to ensure International bidding.

The train density is not high, the trains not frequent so that the standards described are adequate. Should there be a change in railway operation such that sections become a Mass Transit type of operation then new track standards will be required to accommodate the higher dynamic loadings.

(2) Sleepers

The annual requirement for sleeper maintenance renewals is 140,000 for both broad & metre gauge inclusive. Being maintenance these should be by local procurement for which about 200,000 per annum can be supplied through the Kanchanger Creosote depot. There is also an annual requirement for crossing timbers. However, timber of suitable quality is not abundant in Bangladesh.

The timber sleeper has an average life of 12 to 15 years and therefore in terms of foreign exchange should not be purchased, indeed on a life cycle cost over say 35 years and at least a 10% residual value the more expensive steel or concrete sleeper is a much better buy.

A concrete sleeper factory is to be established, funded by West Germany, with an output of 75,000 per annum. In addition to establishing the factory, equipment needed to handle the sleepers - which weigh about 8 to the tonne for metre gauge and 6 to the tonne for broad gauge,- has to be obtained and maintained.

Three conditions are forseen for sleeper renewal.

a) Rehabilitation programme. Currently using timber sleepers.

b) Annual maintenance programme of 140,000 sleepers per annum.

c) Arrears of maintenance, about 350,000 sleepers per annum to give system renewal in 18 years. (About 255 kms a year)

The DRPP proposed that 1.87 million sleepers were required by 1989, and that these would have to be imported. This is a "betterment" item for which foreign exchange can be considered.

It is seen that items a) and b) are essentially timber sleepers with about 1/2 million refurbished steel sleepers, and that the item c) is for "long-life" sleepers, of which about 75,000 each year would be concrete made in Bangladesh. The balance would be of other materials for which steel sleepers are the most prudent purchase. Steal sleepers are nestable, Bangladesh Railways has experience and they require less ballast than solid sleepers. In addition there are the additional advantages that the weight is less, the handling techniques are known and no sophisticated machinery is required, they can be hand tamped in addition to machine tamped and can be repaired or reconditioned. Comparative costs expressed as percentages are in Appendix A8.5.

Further with an annual order for many years this would be of considerable interest for a technical co-operation agreement with a Bangladesh steel mills for production in Bangladesh, as the steel required is not a high grade steel. There are also potential export markets within the region. This is a recommended railway service industry for the improvement of private venture capital.

(3) Points and crossings

Points and crossings requirements are for a small but steady supply for renewals and new works and the RDPP suggestions of involving the private sector through technical co-operation, with its regional export potential should be followed through. This would allow turnout designs to be modernised and simplified, reducing the requirements for spare part stock holdings.

(4) Ballast

Ballast is the principle load distributor of the rail loads, and the RDPP recommendation of 200 mm depth of ballast is correct for the track loadings. However for timber and concrete sleepers this is the depth below the underside of the sleeper, with additional stone between the sleepers to keep the sleepers in position. With steel sleepers this 200 mm is the depth from the top of the inside of the sleepers, a saving of about 38% of the total stone volume.

Suitable ballast with a Los Angeles Test rating of less than 35% would be satisfactory for the traffic on Bangladesh Railways, and the comments in the RDPP report are endorsed.

The CIDA report discusses the rehabilitation of the boulder draglines and crusher at Bholaganj river and the ropeway to the rail head at Chatak Bazaar. This is the only ballast source to Bangladesh Railway.

The only other source of ballast is from India which is necessary for the West Zone. Rehabilitation Work in the East Zone is frequently delayed due to lack of ballast, due to the failures in the ballast production.

Much stone is transported by family boats for the construction industry, and these may well provide additional sources of supply, particularly if river dredging works recommended in this Inter Modal Study show the presence of ballast sources.

(5) Fastenings

Fastenings between rail and sleeper fall into two categories:

Maintainable

Fit and forget

Maintable fastenings are elastic spikes, dog spikes, and the various nut and bolt varities using spring steel to provide an elastic fastening to the rail foot are classified under this heading. Maintenance has to be provided to ensure purchase between the fastening and rail.

Fit and forget are fastenings that only require a visual inspection on an irregular basis to ensure train safety. In addition the use of high tensile steel is a detractor to theft as the steel characteristics are not suitable to the local furnaces.

The use of fit and forget fasteners is suitable to Bangladesh Railways who have experience in their use. Whilst saving in maintenance time is not an important factor, the reliability provided is significant to train safety.

(6) Observations

Rehabilitation work has been carried out successfully by the methods described in the RDPP report, and the metre gauge lines work has continued into the 1985/86 year as a carry-over. The condition of the principal broad gauge lines require similar treatment. The working time table No. 35 issued 1st November 1984 lists many temporary and permanent speed restrictions for engineers works and unsatisfactory track layouts and point arrangements. These reduce speeds and efficiency of operations and must be removed so that trains can attract the traffic that they are capable of handling.

Tables 8.5.1, 2 and 3 represent work that has been carried out, with some outstanding items, particularly ballasting still to be performed. This adds urgency to the need to get the ballast plant into a higher standard of maintenance to reduce the use of foreign exchange for track ballast.

The sections of new rail but without adequate ballast must be re-couped with ballast as first priority before the rails are crippled.

8.5.3 Bridges

The RDPP report provides the essential background data on the bridge situation regarding requirements to carryout arrears of maintenance. The nature of the work, whilst strictly maintenance, requires technical input.

It is noted that the design loading for bridges is based on the old BS Standard loading of double headed steam locomotives. A study conducted in Thailand showed that the cost of strengthening bridges was considerably reduced when the old BS153 type RA2 track loading for 15 tonnes was replaced by a modified BS5400 type RU loading based on 15 tonnes. This is based on diesel locomotives. A similar approach for bridge repairs and reconstruction may also produce worth while savings in steel materials and hence cost.

The broad and metre Gauge loading diagrams are very different, the Broad Gauge being BS 18 ton loading and Metre Gauge 12 ton. The requirements of the bridge rehabilitation programme are set out in Table 8.5.4.

Table 8.5.1 Track Rehabilitation Works Executed with The Assistance of Foreign Donors

Serial	Section	Present state of track condition status of track rehabilitation	Action for future planning
1.	Dhaka-Chittagong (428 track km)	This section was rehabilitated under the assistance of ADB and the work was completed in June 1982. The condition of the track is good.	Nil
2.	Akhaura-Sylhet	This section is being rehabilitated under the assistance of CIDA and SFD; so far 137 kms out of 177 kms of track on this section has been completed.	Nil
3.	Bhairab Bazar Jamalpur-Dewanganj Bazar, Bonarpara Kaunia-Parbatipur	Rehabilitation of these sections is now under execution with the assistance of CIDA and SFD; The work of this scheme has been taken in hand in 1982-83.	Nil
4.	Khulna-Parbatipur	Rehabilitation with funds provided by ADB.	Nil

Table 8.5.2 Track Rehabilitation Works Carried Out without Any Foreign Assistance

(Additional Work Outstanding)

METRE GAUGE

Serial No.	Section	Present status of rehabilitation work	Action for future planning
1.	Dhaka-Narayanganj (16 kms)	Section was renewed in 1978-79 with new 75 lb. 'A' rails and new wooden sleepers and has 75 mm of ballast cushion.	Nil
2.	Tongi Mymensingh (105 kms)	Section has been renewed with 1978-79 with new 75 lb. 'A' rails and new wooden sleepers and the works completed in 1981-82.	The section requires stone ballasting 4.8km recouped.
3.	Sholashahar-Dohazari (40 kms)	Section has been renewed with second hand 60 lb. 'R' rails and new wooden sleepers and works completed in 1982-83.	The section requires stone ballasting.
4.	Shamganj-Garia Jhanjail (21 kms)	Section has been renewed with second hand 60 lb.'R' rails and new wooden sleepers and the work completed in 1982-83.	- do -
5.	Shaistaganj-Habiganj (23 kms)	Section has b-en renewed with second hand 60 lb.'R' rails and new wooden sleepers and the work completed in 1979-80.	Nil

Table 8.5.2 Track Rehabilitation Works Carried Out without Any Foreign Assistance (cont'd)

Serial	Section	Present state of track condition status of track rehabilitations	Action for future planning
6.	Kurigram-Tista (23 kms)	Section has been renewed with second hand 60 lb.'A' and new wooden sleepers and the work completed in 1982-83.	Nil
7.	Lalmonirhat-Burimari (84 kms)	Renewal of this section with econd hand 60 lb.'R' rails and new wooden sleepers is in progress and 16 kms, completed in 1983-84.	Nil
8.	Bylhet-Chhatak (34 kms)	3.2 kms renewed with new 75 lb.'A' rails and 6.4 kms new wooden sleepers in 1983-84.	
9.	Foujderhat-Chittagong port yard	11 kms with second hand 60'A' rails and new wooden sleepers was renewed.	Nil
10.		(i) 16 kms of Laksam-Noakhali (ii) 9 kms of Feni-Belonia (iii) 10 kms of Chittagong-Nazirhat were carried out with second hand 60 lb.'R' rails and new wooden sleepers.	Laksam-Noakhali section 4.8 kms, Laksam-Cha section 4.8 kms, and Sholoshahar-Nazirha section 4.8 kms has recouped.

Table 8.5.3 Track Rehabilitation Works Carried Out without Any Foreign Assistance

(Additional Work Outstanding)

BROAD GAUGE

Serial No.	Section	Present status of rehabilitation work	Action for future planning
1.	Ishurdi-Serajganj (80 kms)	Section has been renewed in 1977-78 to 1981-82 with new 90 lb.'A' rails and new wooden sleepers.	The section requires stone ballasting 16.1 kms has been recouped.
2.	Poradaha-Gualondo (17 kms)	Section has renewed in 1979-80 with new 90 lbs.'A' rails and new wooden sleepers.	The section requires stone ballasting.
3.	Abdulpur-Rajshahi	Section has renewed in 1983-84 with new 90 lbs.'A' rails and new wooden sleepers.	- do -
4.	Amnura-Chapai Nawabganj	Section has been renewed in 1983-84 with second hand 90BS rails and new wooden sleepers.	- do -
5	Khulna-Jessore (56 kms)	Section has been renewed in 1979-80 new 90 lbs.'A' rails and new wooden sleepers.	- do -
6.	Shantahar-Parbatipur (96 kms)	Section has been renewed 14 kms with new 90 lbs.'A' rails and new wooden sleepers at different spots in 1979-80.	- do -
7.	Rupsha-Bagerhat (32 kms)	Section has been renewed 16 kms with 90 lbs. second hand rails and new wooden sleepers in 1984.	- do -

Table 8.5.4 Status of Rehabilitation of Bridges

Section	Short Span			Long Span		
	No. of bridges to be rehabilitied	No. of bridges under the assistance of CIDA	No. of bridges to be rehabilitated under BR resources	No. of bridges to be rehabilitated	No. of bridges under the assistance of CIDA	No. of bridges to be rehabilitated under BR resources
East Zone						
Akhaura-Chhatak Bazar	133	112	21	1	1	Nil
Bhairab Bazar-Dewanganj Bazar	36	25	11	1	1	Nil
Bonarpara-Parbatipur	35	25	10	Nil	Nil	Nil
Total :	204	162	42	2	2	Nil
West Zone						
Khulna-Parbatipur	49	14	35	3	3	Nil
Grand Total	253	176	77	5	5	Nil

Table 8.5.5 Short Span Bridges

METRE GAUGE

Section	No. of bridges	Total No. of spans
Akhaura - Chatak Bazar	133	298
Bhairab Bazar - Dewanganj Bazar	36	62
Bonarpara - Kaunia-Parbatipur	35	62
Total:	204	422

Table 8.5.6 Through Span Bridges

METRE GAUGE

Section		No. of bridges
Akhaura-Chhatak Bazar		5
Bhairab Bazar - Dewanganj Bazar		Nil
Bonarpara-Kaunia-Parbatipur		3
Total:		8

Table 8.5.7 Long Span Bridges

METRE GAUGE

Section	No. of bridges
Akhaura - Chhatak Bazar	1
Bhairab Bazar - Dewanganj Bazar	1
Bonarpara - Kaunia - Parbatipur	Nil
Total:	2

(1) Metre gauge

The Southern Section between Dhaka and Chittagong has been completed, but the Main line to the North and East of Bhairab Bazar still remains to be completed.

Short Span bridges to be rehabilitated are shown in Table 8.5.5.

Out of the 422 Spans, 326 are affected by the rehabilitation works.

These bridges are overstressed under the BS 12t loading in the primary structural members. Included in the short span bridges are 8 through girder or truss girder bridges that were either over stressed or exceeded fatigue limits.

This work is being carried out by Bangladesh Railways under a rehabilitation/replacement programme supervised by a technical aid programme provided by the Canadian Government.

Long Span bridge rehabilitation has been completed by a Canadian Contractor working with Bangladesh Contractors as shown in Table 8.5.7.

(2) Broad gauge

The bridge condition on the broad gauge is better than that of the metre gauge and only 49 bridges between Khulna and Parbatipur require rehabilitation or reconstruction. Three long span bridges required maintenance which has been completed under the Canadian Aid Programme. 14 short span bridges are also financed by CIDA.

These bridges are summarized in Table 8.5.4.

(3) Observations

The needs of the railway have been previously identified and a programme instituted to raise the safety level, though the use of loans and grants to carryout arrears of maintenance is questionable and an organized maintenance system of inspection, reporting and repairs must be maintained to ensure that this situation does not occur again. The use of such funds for reconstruction or major structural repairs is correct, when the necessary skills or materials exceeds the Railways capacity.

An investigation into a revised loading gauge may help in reducing reconstruction costs, but has no value when carrying out repairs to coroded members, unless significant replacement of members is involved.

The CIDA rehabilitation programme received a performance set back when the short span bridge programme was changed from fabrication at Saidpur workshops to the new shops at Chittagong logistically this would be reasonable except that experienced fabricators were not available in Chittagong. It is necessary for the West Zone workshops at Saidpur to carry out the West Zone rehabilitation fabrication.

8.5.4 Signalling and interlocking

This subject is perhaps typical for all recepient nations dependant in many cases upon foreign aid for capital purchases. A hetergeneous collection of material from the two original railway organisations, and consequently of considerable age, coupled with modern sophisticated equipment following different international standards.

However these modern installations have all been superimposed on an organization that does not have the training facilities to provide technicians and craftsmen to keep the systems in operation.

The working time tables contain many notices and warnings to train crews concerning signals, badly sited signals, and other operational safety requirements, to show that trains have to slow down or even stop because of the signal or interlocking arrangement.

In 1984 the train accidents that occured due to human errors or technical failures of signalling equipment or the handling of signalling and block instruments amounted to 65 incidents-
and one case of fouling an obstruction. There were 26 cases of train crews causing an incident by failing to observe signals. These alone amounted to 38% of the total train accidents.

(1) Relay interlocking:

Automatic and electrically operated signals and points enhances train operations by permitting increased speeds and reliability. This type of equipment is needed on busy rail sections where conflicting movements can frequently occur, increasing the need for safety in operations.

Relay interlocking of Ishurdi and Santahar stations on the broad gauge and modification to relay interlocking at four stations, Barotakia, Mirsarai, Mastangar and Chinkin Astana on Dhaka-Chittagong M.G. section are in progress, and nearing completion. The modifications were necessary to change from the existing single line system to a two line system following track doubling work.

Whilst relay interlocking exists at many places, there are several stations where the number of traffic movements indicates that safety and operations will be improved by the use of relay interlocking. Ten stations have been so identified on both metre and broad gauge sections. These are Kulaura, Jamalpur, Shaistaganj, Sholashahar, Jhautala, Bonarpara, Kaunia, Rajbari, Santahar goods and Poradaha.

(2) Mechanical interlocking

This provides a method of mechanically controlling signals and throwing switches and is the traditional method of signalling. It is used where the number of train movements is small but additional security is necessary.

Bangladesh Railways has a big need to upgrade these facilities by reconditioning and purchase however, the sources of supply are becoming more limited, but the traffic does not warrant electric relay interlocking.

The lines and stations concerned are:

- o 13 stations between Mymensingh and Dewanganj Bazar
- o Abdulpur - Amnura section
- o Teesta, Darsana, Lalmonirhat and Narayanganj stations
- o Double-wire interlocking of 9 stations between Kaunia and Bonarpara (exclusive)
- o Double-wire interlocking of 8 stations on Jagati-Belgachi section.

(3) Block instruments

A basic requirement of train signalling is to ensure that only one train is in a section at one time and this has to be agreed by the signalmen at both ends of the section. The instruments used are termed Block Instruments and provide the necessary safety provisions for trains to enter a section. These sections can extend from one station to the next, or on a tertiary branch line can extend the full length of the branch. In order to increase capacity on a line the number of sections must be increased, by installing block instruments.

8.5.5 Telecommunications

Communications is the basic tool for control of any operation, and the lack of good communications becomes an excuse for poor performance. The improvements needed in management function and control require good communications to be fully effective.

(1) Land lines:

The basic method of communication for signalling purposes are the telephone wires pole mounted alongside every railway line. These are for station to station communication and for operation of the block instruments, consequently are the backbone of railway operations.

Whilst the land line may be replaced by buried cables or fibre-optics, the system of physically connecting two stations remains.

Building upon this network is the framework of telephone lines from centre to centre by-passing the smaller stations, but basically dependant upon a pair of uninsulated wires strung on poles.

All the landlines and exchange instruments are owned and maintained by T and T Dept. The staff required for the exclusive lines operated by the railway are paid for by the railways. This system may be satisfactory when efficiency rates exceed 90%, and though the actual rate is disputed, it is much below this figure and railway services suffer. Split responsibilities on safety are no guarantee of performance.

T and T has recently installed new PABX's in major centres and leased new lines to the railways, but whilst these result in improved access, nothing is gained unless the maintenance standard is raised.

In September 1982 a government committee found that there was no alternative to the continued lease of T&T lines. As long as the train service is of low density this can be accepted provided the low quality of service can be accepted by the public. However should the train service pattern change then the railways will have to consider exclusive services through CTC control of operations.

As a component of the second ADB railway project Norway is financing the establishment of a railway owned, operated and maintained cable network. This will be on a systemwide basis using fibre-optics based based on digital technology.

(2) Radio links

In order to overcome the land line inefficiencies the railway leased HF channels from T&T and installed some 40 sets in a network to improve control However there were problems of operation, control and maintenance and by 1980 there were considerable deficiencies in this system, as most transmission is by morse code.

In addition the railway uses the T&T VHF/UHF links, but these must eventually connect into the landline system with its attendant failures. There have been suggestions that these exclusive lines are also being used for non-railway purposes. The efficiency of this system was estimated as 60% in the RDPP report.

The result has been no tangible improvement in communications as shown by the continued drop in performance indices.

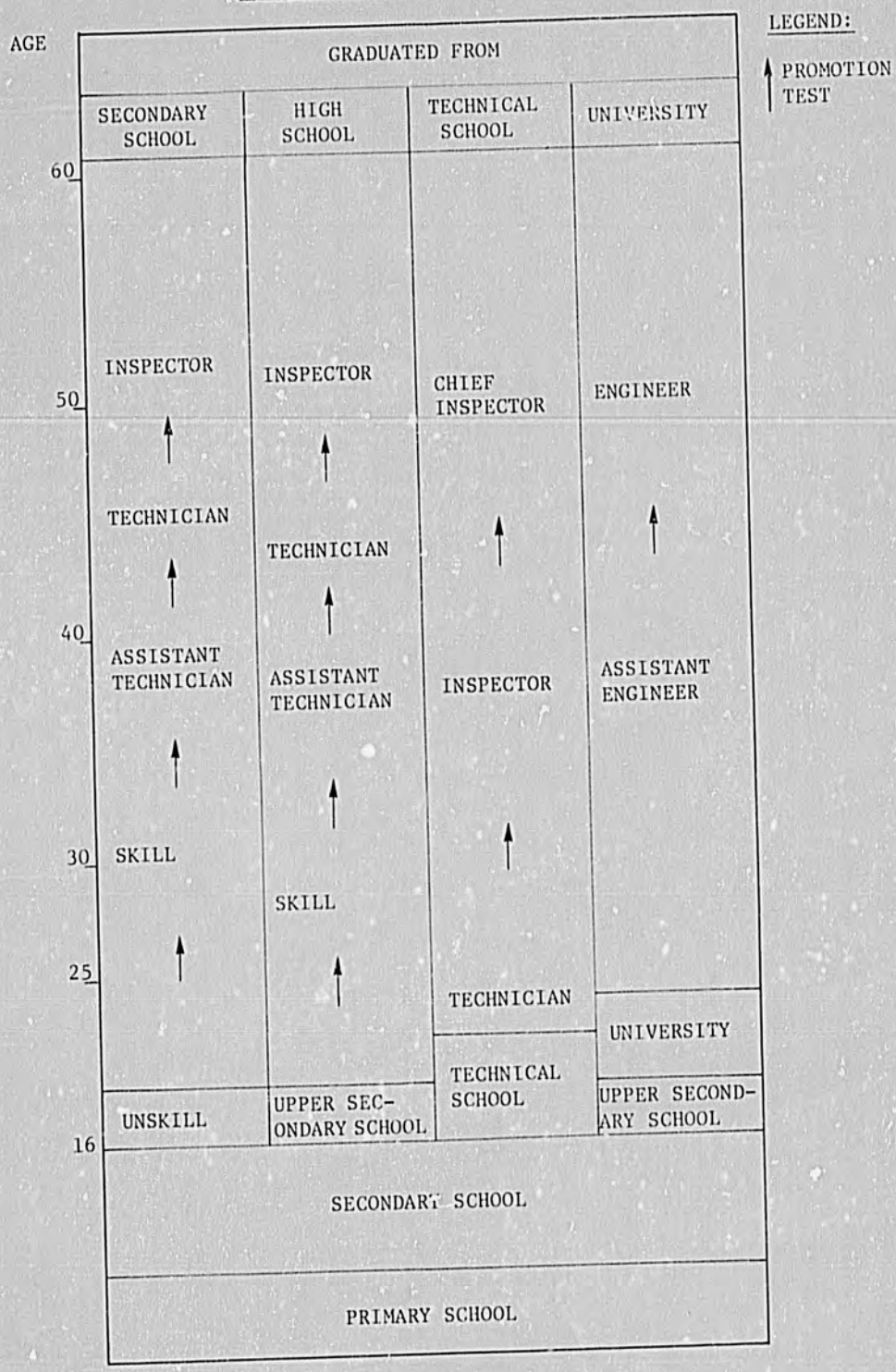
(3) Ancilliary equipment

In addition to control equipment the railways also own information equipment such as Public Address systems at principal railway stations and portable radio sets. Additional portable radio equipment will be necessary if the train service patterns change, increasing the need for more local control of operations, and installation of telex machines or facsimile machines at important railway centres to enhance the speed of information transmission.

(4) Maintenance and training

Equipment purchased by the railways signalling and telecommunications departments are sophisticated and require maintenance. Many components can be repaired or have faulty parts replaced. Without the ability to maintain, replacement is the only way to keep equipment in operation. This is expensive in foreign exchange.

Table 8.5.8 Training and Promotion for Signalling and Telecommunications Staff



If the railway cannot maintain its own equipment in suitable workshops then the private sector must be involved through a technical co-operation agreement with the supplier.

Training of staff is absolutely essential from operators to supervisors. Whilst initial training is provided by suppliers to the first staff to operate equipment it is necessary that all subsequent operators receive equal training, otherwise the efficiency of the operation will deteriorate. When new equipment is installed to replace old equipment the previous equipment operator has to "unlearn" the old procedures, for new procedures can vary widely with the old and familiar.

The organization for signalling and telecommunications is differently arranged because of the inherantly different nature of the work. Signal engineering requiring more site work and telecommunications more inside work than the other.

The signalling section being basically Division based, and the telecommunications zone based, again reflecting the more direct relationship of the signalling with train running.

Table 8.5.8 suggests a method of recruiting for the potential leaders of the railway signalling and telecommunications staff showing the four lines of approach basically open to the four levels of education. There is no reason why suitably qualified personnel cannot obtain higher promotion than that shown for their entry level. The age shown against the rank is an indication of the upper age limit at the time of the promotion.

Training and education are important especially in the electronic fields and learning "in-service" is not enough.

Self improvement classes from labourers to inspectors are necessary, together with literacy classes for the unskilled labourers are an essential part of training. These classes should be taught by technicians or senior staff and are to impart the technical requirements of the work actually carried out by the students in their work and also the additional skills they need for promotion.

These classes are in addition to any training undertaken through a railway training college.

8.5.6 Observations on signalling and telecommunications

These two subjects have been dealt with separately as they are different disciplines. However in relation to the local level of train operations they are interdependant.

This sub-section makes observations upon the inter-relationship and the changing relationship between train operations, signalling and communications.

(1) Operations

Signalling requirements form the backbone of train operations and rail safety. It is necessary that these perform to the loads put on them.

The increasing number of passenger trains increases the need for safety and the need to be able to operate these trains at advertised schedules. Trains must make crossings on single lines at the advertised place at the correct time. To do this the proper equipment fully maintained must be provided. When communications or signals fail trains stop until it has been determined beyond all doubt that it is safe to proceed.

The capacity of a section of line is dependent upon; travel time, and time for signalling purposes. At this time there is ample spare capacity in the line sections (Figure 8.2.7). These would allow in general traffic to increase by one-half to two thirds before track capacity is limited by signalling restrictions.

(2) Signalling

The principle used in this report is that signalling improvements must be concentrated on the major stations with large interlockings, where incidents to trains and delays due to signalling inadequacies are unacceptable.

Line section signalling improvements are required when traffic reaches 80% of the line capacity. When traffic reaches to 110% of the original line capacity (before signalling improvements) is there a case for track doubling. This however is extremely expensive as not only does the track and structures have to be increased, but also, the signalling.

To delay the need for track doubling signalling efficiency can be increased by:

a) Instituting tokenless block working

b) Colour light signals

c) Machine operated switch machines

d) Reduction of section length by opening block or signal stations with crossing loops

e) Radio communications

The modernization of the railway signalling system is possible with a higher degree of safety by the use of radio for block signalling and the installation of tokenless block working. This does not have to be achieved with upgrading from semaphone to colour light signals. Many single line branches in Japan use radio in connection with semaphore signalling.

(3) Communications

The existing landline system is under the control and maintenance of others. This intolerable situation is being rectified by the optic cable system to be paid, installed, operated and maintained by the railway. Intended to link each station in the system it is not clear

at this time if there will be dedicated lines for the operation of block instruments between stations.

The use of radio communications is usually connected with electrical or electro-mechanical signalling through a central panel and an electrical interlock to prevent a conflicting movement being set up.

An alternative approach, most suitable for the less densely trafficked lines and particularly the longer branch lines, is to remove all signals, and to institute "Radio Tokens". Now proved in the U.K. be both operationally and commercially successful in transforming the profitability of uneconomic lines. This permits the working of trains under the orders of contral directly to train drivers by radio code and eliminates the need for signals and signal frames. This frees station staff from signal duties to perform the necessary ticket sales.

The commissioning of the optic cable system will increase the potential for train service improvements and the new approach of replacing block instruments. The use of radio provides operationally acceptable alternatives.

(4) Conclusions

Improved contral of train operations is possible by changes to the existing methods. Communications are to be improved to enhance the existing token system, which is well understood in Bangladesh. The introduction of improvements must be geared to the requirements of Bangladesh and suitable to the needs and capabilities of the Railway.

8.5.7 Structures and depots

Part of the railway infrastructure are the fixed assets such as offices and stations.

This subject is not discussed in this report as a separate subject and where relevant is addressed under other sub-headings.

The railway has plans to rebuild certain stations, and to build hospitals, offices and accomodation, particularly in the West Zone, but this matter is outside the immediate scope of an intermodal transport study.

There is a strong case to build offices for operational and managerial efficiency reasons in the West zone under governmental decentralization policies where this will assist in raising productivity. This matter was reviewed in Volume I of this study.

8.6 Rollingstock, Workshops and Ferries

The rollingstock of the railway divides itself primarily into four groups; locomotives, passenger vehicles, freight vehicles, and self propelled equipment. This last item is specialized equipment used by the engineering departments, and is not discussed.

The quantities of rollingstock are discussed in this section together with the requirements of the workshops both for rollingstock and the engineering department.

8.6.1 Freight wagons

A study has not been made on present wagon requirements, as the wagon turnround is excessive which distorts the overall requirements. Turnround must be reduced to about 8 days if there is no Jamuna river crossing and 10 days with the crossing. This assessment is based on the State Railway of Thailand's 1984 performance where 5.25 million tons were hauled with 8,485 wagons in use.

The largest factor is the terminal time which includes loaded wagons idle in the sidings waiting for locomotive power either for main-line haul or for shunting into loading or unloading sidings.

A 50% improvement in terminal time is shown in Section 8.4 to be vital to the economic well being of the railway, and consequently on the requirements of the wagon fleet.

(1) Optimum fleet size

Table 8.6.1 Number of Wagons Required shows the effect on the wagon fleet size if terminal time can be reduced to 50% based on 1983/84 statistics.

This is based on averages and therefore does not represent the maximum number of vehicles required under peak traffic operations. Taking out the specialized wagons is an attempt to adjust for this factor. The final figures indicate that a wagon fleet of just under 3000 wagons for broad gauge and about 7500 for metre gauge are required. This gives a total fleet size of 10,500 wagons in terms of 4 wheelers.

Calculating the tonne-kms per wagon day based on 1983/84 results is given in table 8.6.2. Wagon Performance.

The calculation of the tonne-kms per wagon day on line shows the efficiency that can be achieved by a reduced travel time.

(2) Wagon retirements

Figure 8.6.1 gives the age histogram for wagons based on 1982. Using as a basis, that in 1985 the actual wagon fleet was the 1983/84 total minus the 950 over age wagons, and thence with wagons retiring at the age of 45 years, it is not until 1993 that the wagon fleet size drops below the requirements for 1985 traffic. This is shown in table 8.6.3. Retirement Programme.

Table 8.6.1 Number of Wagons Required
(In Terms of 4-wheel Vehicles)

Factor	Broad Gauge	Metre Gauge
1983/84 Tonnes-km p.a.	205×10^6	573×10^6
1983/84 Turnround	15 days	17.6 days
Average speed kph	10.65 kph	9.72 kph
Average lead kms	194.5 km	298 km
Hence Av. Trip time (days)	0.75 (Say 1 day)	1.27 (Say 1.3 days)
Hence Terminal time	14 days	16.3 days
Allow 50% improvement	7 days	8 days
Hence improved turnround	8 days	9.5 days (say)
1983/84 wagons loaded (p.a)	65,952	151,720
Hence wagons loaded (p.a)	180.7	415.6
Hence wagons under load each day	(180.7 x 8) 1446	(415.6 x 9.5) 3949
1983/84 ratio of loaded wagons to empty wagons per train	29.2/44.2	41.7/52.1
Hence:	1:1.51	1:1.25
Hence wagons on line	2184	4937
Add 1983/84 wagon availability	6.8%	5.4%
Hence wagon fleet	2333	5206
Add 1983/84 special traffic wagons (oil, molasses, fertilizer)	495	1444
Add specialized wagons (flats excl. departmental)	80	762
Minimum Fleet	2908 say 3,000	7412 say 7,500

Source: Bangladesh Railways
Consultants Calculations

Table 8.6.2 Wagon Performance
(Based on 1983/84 Results)

Factor	BG	MG
1983/84 tonne kms. per annum	205 x 10^6	573 x 10^6
1983/84 tonne kms per day	561,644	1,569,863
tonne kms/wagon day		
with BG 2184 wagons on line	257	
3000 wagons (94% effective)	175	
1983/84 result	154	
Wagon fleet on line for 1969/70 performance of 229 tonne-kms	2453	
with MG 4937 wagons on line		318
7500 wagons (94% effective)		198
1983/84 result		121
Wagon fleet on line for 1969/70 performance of 190 tonne-kms		8263

Source: Consultants

Tonne-kms per wagon day (Broad & metre gauges combined)

$$1983/84 \text{ average} = \frac{154 \times 3872 + 121 \times 9667}{13539} = 130$$

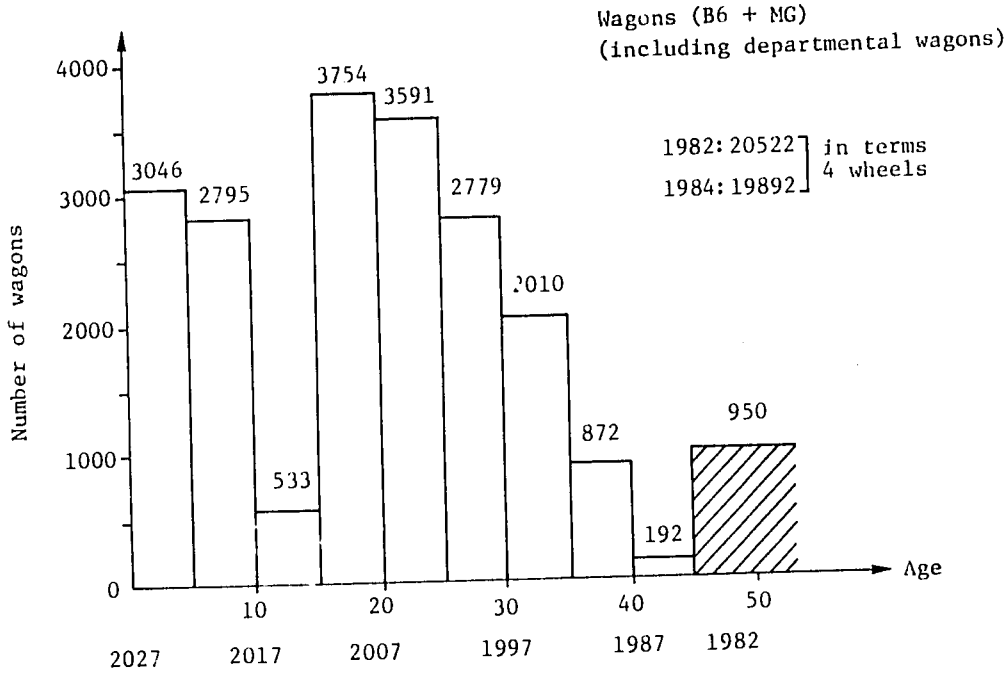
$$2000/01 \text{ based on } 1969/70 = \frac{229 \times (4632 \times 0.939) + 190 \times (14984 \times 0.919)}{(4632 \times 0.939 + 14984 \times 0.919)}$$

$$= 199.4 \text{ say } 200$$

50% improved service with 10500 wagons (94% effective) Table 8.6.3.

$$= \frac{561,644 + 1,569,863}{10,500 \times 94} = \underline{\underline{216}}$$

Figure 8.6.1 Histogram of Wagon Age (Based on 1982)



Source: JICA Study

Table 8.6.3 Retirement Programme (Ignoring Departmental Vehicles)

Fleet size 1984	19,152	
Retire 950 for 1985	18,202	
Retire 192 for 1987		18,010
Retire 872 for 1992		17,138
Pro-rata for 1990	17,487	
Retire 2010 for 1997		15,128
Pro-rata for 1995	15,932	
Retire 2779 for 2007		12,349
Pro-rata for 2000	13,460	

Source: Consultants

Many factors are involved in determining wagon life as they are subject to excessive abuse. Corrosion and cracking are the most common long term defects. Wagon costs must be closely monitored, as each wagon will have different working lives. Decisions on withdrawing wagons from service must be based on an historical cost basis, and the JICA study offers an empirical approach.

(3) Future requirements

The growth in the GDP and the railway share of traffic determines the need for a wagon fleet size. However this does not provide for wagon mix, and specialized services require dedicated wagons which are outside the general service wagon requirements.

It is probable that an increase in dedicated wagons will occur as industry becomes established and traffic patterns become firm. Container flat wagons are a typical example.

Table 8.6.4 gives the projected traffic demand for the next three five year plans.

Table 8.6.4 Projected Freight Traffic

Year	Tonnes	Tonne-kms
1983-84	2.94×10^6	779×10^6
1985-86	2.82×10^6	748×10^6
1990-91	4.1×10^6	$1,087 \times 10^6$
1995-96	6.0×10^6	$1,590 \times 10^6$
2000-01	9.3×10^6	$2,465 \times 10^6$

The broad gauge tonne kms per wagon day are higher than the metre gauge but with fewer wagons. Consequently in considering the

size of the new wagon fleet the average basis is used. Traffic is considered on a systemwide basis and broad and metre gauges are not separately identified.

In Table 8.6.5 the wagon fleet is calculated for four conditions:

The Case I scenario is to achieve 200 tonne kms per wagon day by the end of the Fifth Five Year Plan.

Case II is to achieve 200-tonne kms the end of the Third Five Year Plan and to maintain this standard. Case II is the 1969/70 benchmark year standard.

Case III is the requirements to meet the 50% improved terminal time of 216 tonne-kms per wagon day.

Case IV is when no improvements are achieved but wagons are procured to satisfy demand. In which case it would be impossible as the wagon saturation would overwhelm the capacity to haul the wagons and to maintain them.

The first priority is to get the metre gauge performance up to broad gauge of 190 tonne-kms per wagon day. This would give a wagon requirement of 16,085 in 1990, and then target 200 in 1995 and 216 in 2000.

This would give a requirement for wagons shown in Table 8.6.6. Additions to wagon fleet. (Target Plan)

Table 8.6.5 Wagon Fleet Size

Factor	1985/86	1990/91	1995/96	2000/01
Case I				
Tonnes carried per annum	2.82×10^6	4.10×10^6	6.0×10^6	9.3×10^6
Tonnes carried (per day)	7,726	11,233	16,438	25,480
Tonne-kms per annum	778×10^6	$1,087 \times 10^6$	$1,590 \times 10^6$	$2,465 \times 10^6$
Tonne-kms per day	2.05×10^6	2.98×10^6	4.36×10^6	6.75×10^6
Target tonne-kms/wagon day	130	150	175	200
Required wagons	15,769	19,867	24,914	33,750
add 6% unserviceable	1,007	1,268	1,590	2,154
Total Fleet	16,776	21,135	26,504	35,904
Case II				
Average for 1969/70	200	200	200	
Required wagons	10,250	14,900	21,800	as above
add 6% unserviceable	654	951	1,391	
Total Fleet	10,904	15,851	23,191	35,904
Case III				
But 50% improved terminal time is	216	216	216	216
Required wagons	9,491	13,797	20,186	31,250
add 6% unserviceable	605	880	1,288	1,995
Total Fleet	10,096	14,678	21,474	33,245
Case IV				
"Do Nothing" Scenario	130	130	130	130
Required wagons	15,769	22,923	33,539	51,923
add 6.0% unserviceable	1,007	1,463	2,140	3,314
Total Fleet	16,776	24,386	35,680	55,237

Source: Consultants

Table 8.6.6 Additions to Wagon Fleet

	1985 Data	Third Five Year Plan	Fourth Five Year Plan	Fifth Five Year Plan
Tonne-kms per wagon day	130	190	200	216
Wagons required	16,776	16,685	23,191	33,245
Wagons "under 45"	18,202	17,487	15,932	13,460
Extra wagons required	Nil	Nil	7,259	19,785
Wagons to be purchased this plan period	Nil	Nil	7,259	12,526
"Do Nothing" wagon requirements	16,715	24,386	35,680	55,237
Extra wagons required	-	6,899	19,748	41,777
Increase	-	6,899	12,849	22,029

Source: Consultants

d) Examine quickly and implement CIDA recommendations for anti-theft measures.

(i) Use of composition brake blocks

(ii) Use of high tensile steel

(iii) Use of more bogie wagons

(iv) Replace brass bearings with roller bearings

(4) Conclusions

Figure 8.6.2 plots the wagon requirements against the traffic demand for various levels of efficiency in vehicle-kms per wagon day in service.

On this graph are also plotted the "pre-85" stock still in service and two curves of potential wagon requirements. One is the "do-nothing" scenario, i.e. the wagons required at 1983/84 levels of performance, the other is the optimum requirement of purchases to haul the traffic with an increasing efficiency.

The "Optimum" solution is based on progressive improvement with identified targets of achievement.

The first target is to bring up the metre gauge performance to existing 1983/84 broad gauge standards i.e. to achieve 190 vehicle-kms per wagon day, and then to target the 200 and 216 vehicle-kms per wagon day.

This approach requires no wagon procurement during the Third Five Year Plan. Procurement after 1995 depends upon rate of growth of traffic and the level of efficiency achieved.

Figure 8.6.2 confirms the importance vehicle turnround in determining the number of wagons in the fleet.

This confirms the need to increase wagon availability, and the following measures are recommended.

a) Institute the fraud waste and abuse eradication programme outlined in Section 8.1.

b) Institute the Terminal Manager assignment given in Appendix A8.1.2(2).

c) Appoint a Jumuna Crossing Officer as described in Sub-Section 8.1.8.

d) Examine quickly and implement CIDA recommendations for anti-theft measures.

   (i) Use of composition brake blocks

   (ii) Use of high tensile steel in brake components.

   (iii) Use of more bogie wagons

   (iv) Replace brass bearings with roller bearings

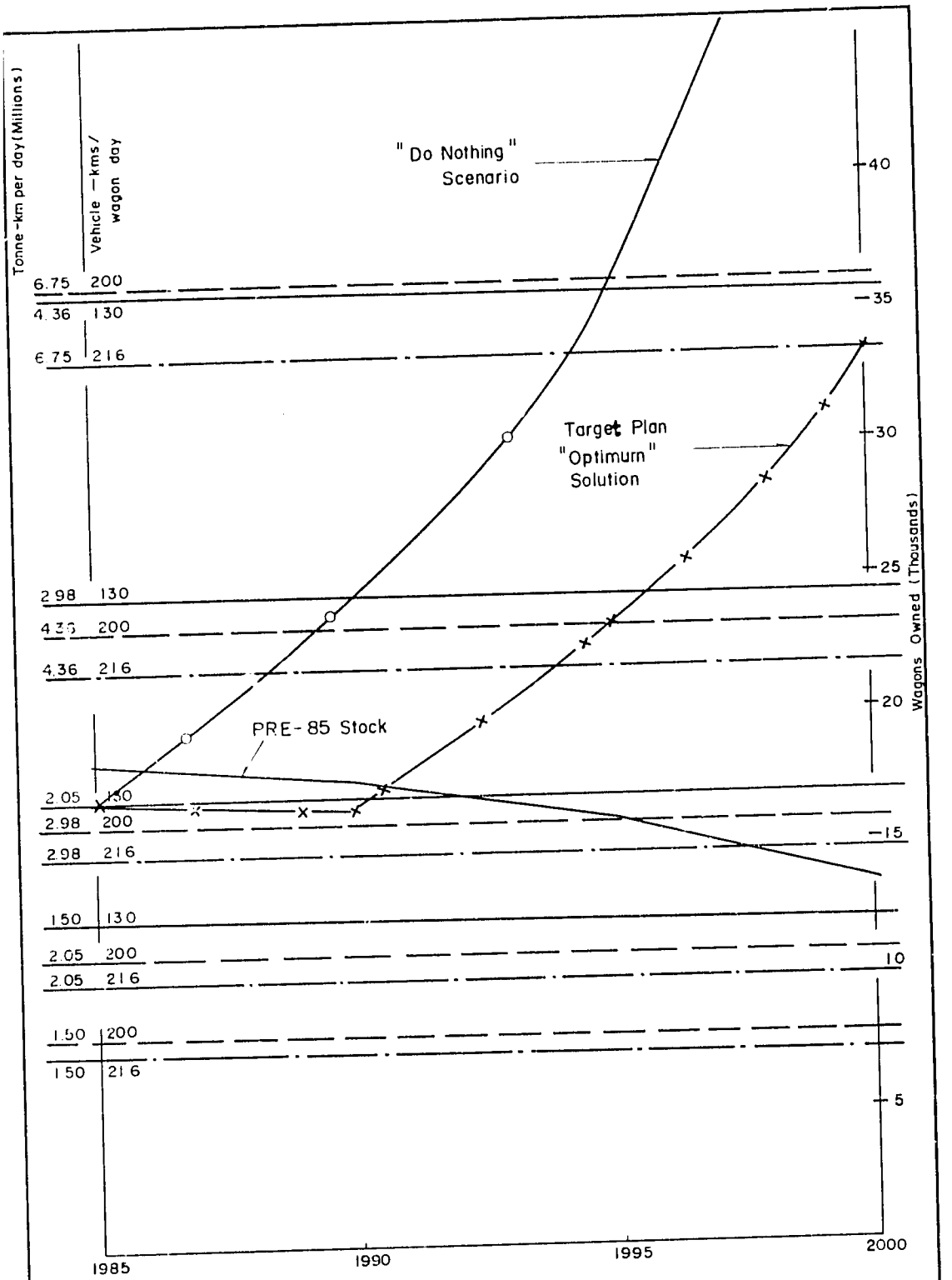


Figure 8.6.2 WAGONS REQUIRED FOR TRAFFIC POTENTIAL AND EFFICIENCY

8.6.2 Passenger carriages

The requirements for passenger coaches is made more complex by the number of passengers who ride the roof, locomotive running plate and cling on wherever they can.

Certain facts are documented.

A. Coaching vehicle-kilometres:

1969/70 216.563 x 10^3: 1983/84 229,345 x 10^3. (+5.9%)

B. Passenger train kilometres:

1969/70 11,794 x 10^3: 1983/84 12,826 x 10^3. (+8.7%)

C. Passengers:

1969/70 72,885 x 10^3: 1983/84 98,872 x 10^3. (+35.7%)

D. Passenger kilometres:

1969/70 3,316,993 x 10^3: 1983/84 6,283,508. (+89.4%)

E. Numbers of passenger trains: (inc. mixed):

1969/70 125,787: 1983/84 130,545. (+3.8%)

F. Carriages per train (A/B):

1969/70 18.36: 1983/84 17.88. (-2.6%)

Source: Bangladesh Railways.

Summarizing these facts the scenario is described as:

In 1983/84 36% more passengers travelled 89% more passenger-kilometres, than in 1969/70, were carried in 4% more trains of 2.5% fewer carriages for an increase of 6% in vehicle-kilometres and 9% in train-kilometres.

(1) Passenger traffic

Table 8.6.7 gives projected passenger growth.

Table 8.6.7 Predicted Passenger Traffic (Per Annum)

Year	Passengers	Pass-kms.
1983-84	125.9 x 10^6	8,000 x 10^6
1985-86	132.5 x 10^6	8,428 x 10^6
1990-91	158.1 x 10^6	10,055 x 10^6
1995-92	189.6 x 10^6	12,059 x 10^6
2000-01	232.9 x 10^6	14,812 x 10^6

Source: Consultants
Note: 1983/83 represents paid passengers plus estimated 27.3% ticketless passengers.

A factor to be taken into consideration is the primary objective to provide bench-mark year standards of travel.

Basing the average seating capacity per coach on 1969/70 standards: (III Class only considered)

Factor	BG	MG
Seats per carriage 1969/70	104	68
Carriage Total	275	890
1983/84 (T) and (TS) ratio to whole fleet	0.64	0.58

Source: Bangladesh Railways

Average seats per coach in 1969/70

$$= \frac{(104 \times 275 \times 0.64) + (68 \times 890 \times 0.58)}{(275 \times 0.64) + (890 \times 0.58)}$$

= 77 seats per carriage for II & III

To arrive at AAC & I Class seats, it was assumed there would be 30 seats per coach. This would permit for dining cars and sleeping cars and other low density vehicles.

A further factor to be considered is that it is estimated that 80% of passengers and 40% of passenger-kms are short intra-district trips. This is considered to remain unchanged.

Short intra-district trips are considered to be only undertaken by Class II and III passengers. This is presented in table 8.6.8 Estimated passenger traffic.

Table 8.6.8 Estimated Intra-district Passenger Traffic (Per Annum)

Year	Passengers	Intra-district	Pass-kms	Intra-district
1983/84	125.9×10^6	100.7×10^6	$8,000 \times 10^6$	$3,200 \times 10^6$
1985/86	132.5×10^6	106.0×10^6	$8,428 \times 10^6$	$3,371 \times 10^6$
1990/91	158.1×10^6	126.5×10^6	$10,055 \times 10^6$	$4,022 \times 10^6$
1995/96	189.6×10^6	151.7×10^6	$12,059 \times 10^6$	$4,824 \times 10^6$
2000/01	232.9×10^6	186.3×10^6	$14,812 \times 10^6$	$5,925 \times 10^6$

Source: Consultants

However Class II & III passengers are also carried on long distance trains. It is assumed that the percentage of ACC & I Class passengers remains unchanged during the period.

Table 8.6.9 Percentage Share of Passengers by Class of Travel

Year	ACC+I	II	III
69/70	0.5	7.84	91.6
74/75	0.38	7.24	92.4
75/76	0.36	7.06	92.6
76/77	0.33	7.12	92.5
77/88	0.43	7.88	91.7
78/79	0.30	7.85	91.9
79/80	0.34	7.37	92.3
80/81	0.34	7.21	92.5
81/82	0.31	5.89	93.8
82/83	0.31	5.16	94.5
83/84	0.30	4.61	95.1

Source: Bangladesh Railways

The rapid deterioration in share of the Class II traffic raises doubt on its viability in future traffic patterns unless there is value to be provided for the higher face. Recognition is made of diminished role and for the purpose of this exercise Class II and Class III passenger totals are not separated.

Table 8.6.10 Percentage Share of Passenger-kms by Class of Travel

Year	ACC+I	II	III
69/70	1.58	12.7	85.7
74/75	1.11	11.8	87.1
75/76	1.25	12.2	86.6
76/77	1.41	12.0	86.6
77/78	1.74	11.2	87.0
78/79	1.17	10.5	88.3
79/80	1.23	9.5	89.2
80/81	1.21	9.3	89.5
81/82	1.19	7.6	91.2
82/83	1.21	6.3	92.5
83/84	1.19	5.9	93.0

Source: Bangladesh Railways

As in the case for passenger totals Class II and III are not separated for consideration in passenger-kms.

To determine the estimated traffic by class of vehicle the ACC+I is considered as stabilized at 0.33% of passengers and 1.2% for passenger kms.

The total ACC+I traffic is entirely Inter-district consequently 1.736% of Inter-district passengers are ACC+I as are 2.0% of all Inter-district passenger-kms.

Table 8.6.11 gives the estimated passengers and passenger-kms by Class of vehicle for each year considered.

(2) Carriage retirements

The JICA Study shows that about 9% of the carriage fleet is over the theoretical economic age of 35 years. The histogram of age is shown in figure 8.6.3.

The actual carriage fleet considered for 1985 is the total carriage fleet in 1983/84 minus the 148 over-age carriages. The retirements were then calculated on a pro-rata basis. This was then adjusted to represent II & III Class carriages which comprise 85% of the vehicles. This is shown in Table 8.6.12.

The same conditions over retirement of carriages occurs as described for wagons and the historical cost approach is the same. This is recommended in the JICA study.

(3) Future requirements

The ACC+I Class carriages are retired and replaced as necessary to give a constant fleet size of about 140 vehicles.

It is anticipated that through track reconstruction programmes, improved communications and modernized signalling a gain in journey speed of up to 20% can be achieved.

This would assume to occur in stages up to 2000. The effect is to reduce journey time thereby releasing vehicles to work additional trains in the same day. This increases the number of kilometres each day the vehicles run. An important statistic of train operations.

The study has shown a split between Intra-district and inter-district travel.

This split is reflected in the vehicle requirements and the 1983/84 vehicle-kms per carriage on line is used and the assumed vehicle-kms for intra-district is taken as 80% of the average and intra-district taken as 120% of the average. (the same as the passenger-kilometre split of 40/60.)

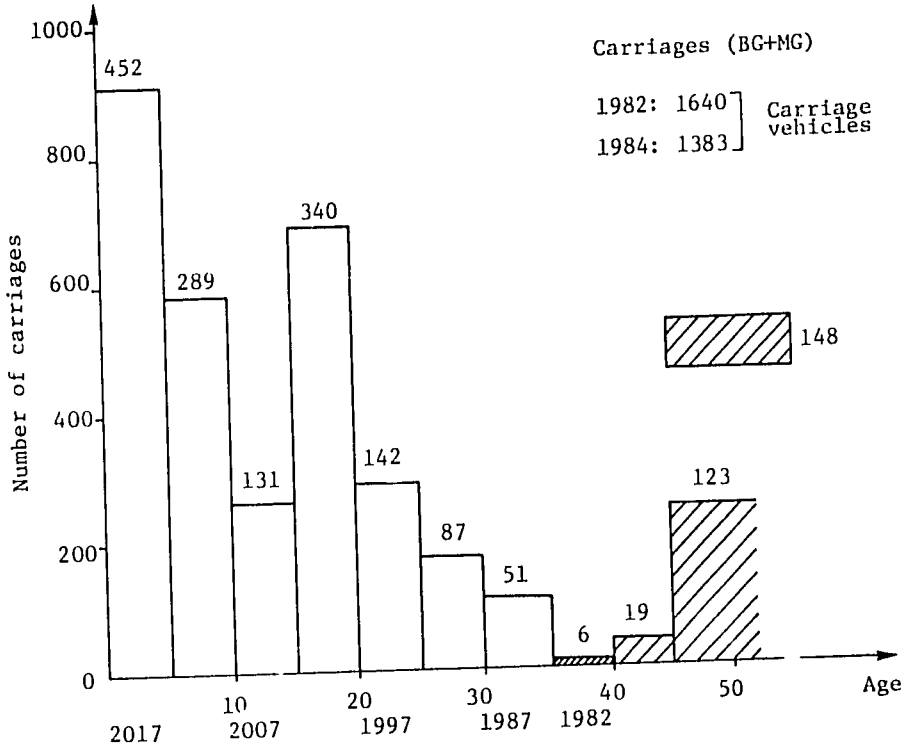
The intention is to raise the average for the whole fleet to 300 km by 2020 in progressive stages as recommended by the JICA study.

Table 8.6.11 Estimated Passenger Traffic by Class of Vehicle (Per Annum)

Year	ACC+I Passengers		II+III Passengers		ACC+I Pass-kms		II+III Pass-kms	
	Intra district	Inter district	Intra district	Inter district	Intra district	Inter district	Intra district	Inter district
1985/86	NIL	437,250	106×10^6	26,062,750	NIL	101.14×10^6	$3,371 \times 10^6$	$4,955.86 \times 10^6$
1990/91	NIL	521,730	126.5×10^6	31,078,270	NIL	120.66×10^6	$4,022 \times 10^6$	$5,912.34 \times 10^6$
1995/96	NIL	625,680	151.7×10^6	37,274,320	NIL	144.71×10^6	$4,824 \times 10^6$	$7,090.29 \times 10^6$
2000/01	NIL	768,570	186.3×10^6	45,831,430	NIL	177.74×10^6	$5,925 \times 10^6$	$8,709.26 \times 10^6$

Source: Consultants

Figure 8.6.3 Histogram of carriage age (Based on 1982)



Source: JICA Study

Table 8.6.12 Retirement Programme (Vehicles in Service)

			85% for II+III
Fleet size 1984	1383		
Retire 148 for 1985	1235		1050
Retire 51 for 1987		1184	
Retire 87 for 1992		1097	
Pro-rata for 1990	1132		962
Retire 142 for 1997		955	
Pro-rata for 1995	1012		860
Retire 340 for 2002		615	
Pro-rata for 2000	751		638

Source: Consultants

The values shown in Table 8.6.13 are used.

Table 8.6.13 Target Vehicle-kms Per Vehicle Day on Line (II+III Class)

Factor	1983/84	1985/86	1990/91	1995/96	2000/01
Av. km per vehicle	182	187	220	250	282
Intra-district	164	168	198	225	254
Intra-district	200	206	242	275	310

Source: Consultants

a) Intra-district travel

The values of Table 8.6.13 are put into Table 8.6.14 and the coaching vehicle requirements are calculated.

At present there is a disparity between broad and metre gauges vehicle kms per day, and particular attention must be paid to bringing the metre gauge up to broad gauge standards.

Table 8.6.14 shows a progressive reduction in load factor from 150% to 95% and an improvement in vehicle availability over the three five year plans. The 150% load factor is obtained from the 122% factor from fare-paid passengers (see Section C) and 27.3% Non-fare paying passengers rounded to 150%.

Table 8.6.14 II and III Class Carriages for Intra-district Travel

	Factor	1983/84*	1985/86	1990/91	1995/96	2000/01
A	Systemwide passenger per day Class II + III	275,043	290,411	346,573	415,616	510,411
B	Systemwide pass-kms per day Class II + III	$8,767 \times 10^3$	$9,236 \times 10^3$	$11,019 \times 10^3$	$13,216 \times 10^3$	$16,233 \times 10^3$
C	Av. Number of seats/carriage	77	77	77	77	77
D	Load factor	1.5	1.5	1.25	1.0	0.95
E	Vehicle-kms per day (Table 8.6.13)	154	168	198	225	254
F	Passenger-kms/day/vehicle on line	18,942	19,404	19,058	17,325	18,580
G	Ineffective stock	0.15	0.15	0.14	0.135	0.13
H	Required No. of vehicles [(B/F(I-G)]	545	560	672	882	1,004

Source: Consultants
*Includes estimated ticket-less passengers

Table 8.6.15 II & III Class Carriages for Inter-district Travel

	Factor	1983/84*	1985/86	1990/91	1995/96	2000/01
A	Systemwide passenger per day Class II + III	68,761	71,405	85,146	102,121	125,566
B	Systemwide pass-kms per day Class II + III	$13,151 \times 10^3$	$13,578 \times 10^3$	$16,198 \times 10^3$	$19,425 \times 10^3$	$23,861 \times 10^3$
C	Av. Number of seats/carriage	77	77	77	77	77
D	Load factor	1.5	1.5	1.25	1.0	0.95
E	Vehicle-kms per day (Table 8.6.13)	200	206	242	275	310
F	Passenger-kms/day/vehicle on line (CxDxE)	23,100	23,793	23,293	21,175	22,677
G	Ineffective stock	0.15	0.15	0.14	0.135	0.13
H	Required No. of vehicles [B/F(I G)]	670	671	809	1,061	1,209

Source: Consultants
*Includes estimated ticket-less passengers

b) Intra-district travel

Table 8.6.15 for II and III class travel shows the critical effect that vehicle-kilometres per day have on vehicle requirements. This factor is considered important for long distance trains. A typical journey such as train 33, takes 13.20 hrs between Chittagong and Narayanganj. 10% speed up gives 10.38 hrs. With 3 hrs terminal time this rake can do the return trip in 24 hrs elapsed time, giving vehicle kms of 336.96 x 2 = 674 vehicle kms per day.

This advantage is given to the train vehicles only, but the average vehicle-kms are considered over the whole fleet available for use. It is therefore necessary to improve the kilometre per day performance for all coaching vehicles in use and to reduce the number of vehicles held as spare to a practical minimum.

Table 8.6.16 gives a similar table for ACC+I Classes based on the same format. However the calculation does not include an occupancy factor which is assumed as shown in the Table. The increase in passengers is accommodated by a higher occupancy ratio.

Table 8.6.16 ACC+I Class Vehicles for Intra-district Travel

Factor	1983/84	1985/86	1990/91	1995/96	2000/01
System wide passenger per day Class ACC+I	808	1,198	1,430	1,714	2,106
Systemwide pass-kms per day ACC+I	204,151	277,095	330,575	396,466	486,959
Av. Number of seats/ seats/carriage	30	30	30	30	30
Load factor	20%	25%	30%	30%	30%
Vehicle-kms per day	300	300	350	400	450
Passenger-kms per day per vehicle on line	1,800	2,250	3,150	3,600	4,050
Ineffective stock	15%	15%	14%	13.5%	13%
Required No. of vehicles	130	142	120	125	136

Source: Consultants

c) Summary

(i) Case ACC+I passengers require a consistent fleet of about the same size as the existing fleet.

(ii) The vehicle requirements to releave overcrowding as well as obtaining higher utilization are summarized in Table 8.6.17 for II and III Class travel.

Table 8.6.17 II and III Class Vehicle Requirements

Year	Intra-district	Inter-district	Total
1983/84	545	670	1,215
1985/86	560	671	1,231
1990/91	672	809	1,481
1995/96	882	1,061	1,943
2000/01	1,004	1,209	2.213

Source: Consultants

(iii) Spare stock for casualties, delays, specials and extra trains are included as the vehicle-kms per day is for all vehicles available for use.

d) Vehicle requirements

It is clear that an major purchases of ACC and 1 Class vehicles are required during the three five year plants. It is that refurnishing of vehicles or a very limited purchase may be required but only as replacements.

For Class II and III carriages there is a need for additional vehicles. Not only as replacements but also to satisfy the increasing demand for travel. The requirements are given in Table 8.6.18.

Table 8.6.18 Vehicles Required

Factor	1985/86	1990/91	1995/96	2000/01
Pre-1985 stock	1,050	962	860	638
Required fleet	1,231	1,481	1,943	2,213
Increase	181	519	1,083	1,575
Increase over previous	181	338	564	492

Source: Consultants

In 2000 a fleet of 2213 vehicles is required of which 638 are "pre-85" stock i.e. older than 15 years.

This represents an "ideal" situation where overcrowding is progressively reduced at the sametime as efficiency is increased.

These are two other conditions to consider, both extremes.

(i) The "Do Nothing" Scenarico where carriages are purchased to releave overcrowding, but there is no improvement in efficiency over 1983/84.

(ii) The "minimum" situation where there is no improvement in the overcrowding, but the efficiency in utilization increases as in the ideal situation.

The "Do Nothing" Scenario is set out in Table 8.6.19, and the "minimum" Scenario in Table 8.6.20.

Table 8.6.19 II+III Class Requirements on "Do Nothing Scenario

Factor	1983/84*	1985/86	1990/91	1995/96	2000/01
Systemwide passenger per day Class II+III	343,804	361,816	431,721	517,738	635,976
Systemwide pass-kms per day Class II+III	$21,656 \times 10^3$	$22,813 \times 10^3$	$27,218 \times 10^3$	$32,642 \times 10^3$	$40,694 \times 10^3$
Av. Number of seats/carriage	77	77	77	77	77
Load factor	1.5	1.5	1.25	1.0	0.95
Vehicle-kms/day	182	182	182	182	182
Passenger-kms/day/ vehicle on line	21,021	21,021	17,518	14,014	13,313
Ineffective stock	0.15	0.15	0.15	0.15	0.15
Required No. of vehicles	1,212	1,277	1,828	2,740	3,596

Source: Consultants
*Includes estimated ticket-less passengers

Table 8.6.20 II+III Class Requirements on the "Minimum" Scenario

Factor	1985/86	1990/91	1995/96	2000/01
Systemwide passenger per day	361,816	431,721	517,738	635,976
Systemwide pass-kms per day	$22,813 \times 10^3$	$27,218 \times 10^3$	$32,642 \times 10^3$	$40,694 \times 10^3$
Av. Number seats/carriage	77	77	77	77
Load factor	1.5	1.5	1.5	1.5
Vehicle-kms/day	187	220	250	282
Pass-kms/day/vehicle on line	21,599	25,410	28,875	32,571
Ineffective stock	0.15	0.14	0.135	0.13
Required No. of vehicles	1,242	1,246	1,307	1,436
"Pre-85" stock	1,050	962	860	638
Increase	192	284	447	798

Source: Consultants

Figure 8.6.4 sets out graphically the three conditions in Tables 8.6.18, 19, and 20, together with the "Pre-85" fleet from Table 8.6.12.

The figure also shows that the existing fleet is not capable of handling the traffic requirements. Using the actual fare-paid passengers it can be shown that to give each a seat in 1983/84 1,214 carriages would be required, but only 1,176 existed and 15% of these were not available. This represents a 122% load factor from fare-paying customers.

(4) Conclusions

A vehicle fleet of 2,213 Class II and III vehicles have been identified together with 140 ACC+I Class vehicles.

Two other scenarios for the Class II+III requirements have been developed, which shows the extremes that could be considered.

This has been developed into a diagram of requirements and procurements in Figure 8.6.5.

The "ideal" situation has 442 vehicles procured in the Third Five Year Plan. This leaves a shortfall of 77 vehicles in 1990. 150 vehicles are refurnished in Railway workshops during the Fourth Plan and 266 imported. The railway factory commences production in 1992 geared to produce 100 a year, 50 in the first year, 75 the second and thence 100 a year, the 225 available in 1995 together with the procurement and shortfall. The railway factory producing 100 a year satisfies the future requirements to 2000.

The "minimum" condition shows that the 442 imported in the Third Five Year Plan gives a small but diminishing relief to overcrowding in 1988, 89 and 90 but the railway factory coming on stream helps to releave the overcrowding slightly but progressively.

It is emphasized that improved performances in vehicle-kms per day and an increase in availability are the preminent factors in reducing overcrowding shown particularly in the Figures 8.6.5.

To achieve the required results of improved vehicle-kms per vehicle day on line it is necessary to carry out reforms to existing practices:

a) Introduce new coaches into long distance service as complete rakes replacing existing rakes.

b) Cascade replaced rakes into existing train service to bring all rakes up to link strength.

c) Increase train lengths up to locomotive limitations, loop length limitations, or braking capacity limitations.

d) Increase link utilization by timetable changes to increase the daily kilometres worked by each carriage link.

e) Only when all four items have been carried out is there justification to increase the number of links and introduce new train services.

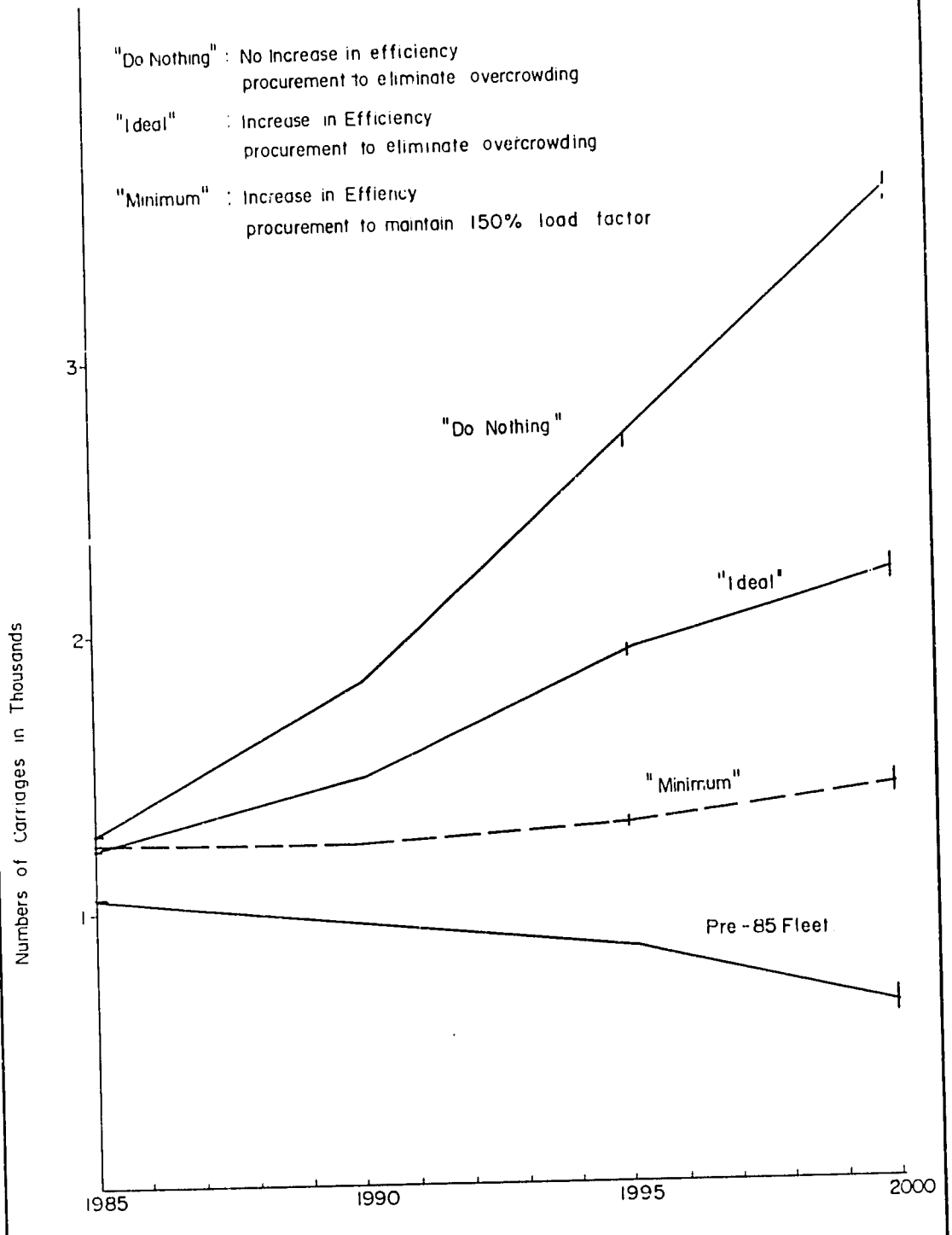


Figure 8.6.4 CARRIAGE REQUIREMENTS (CLASS II & III)

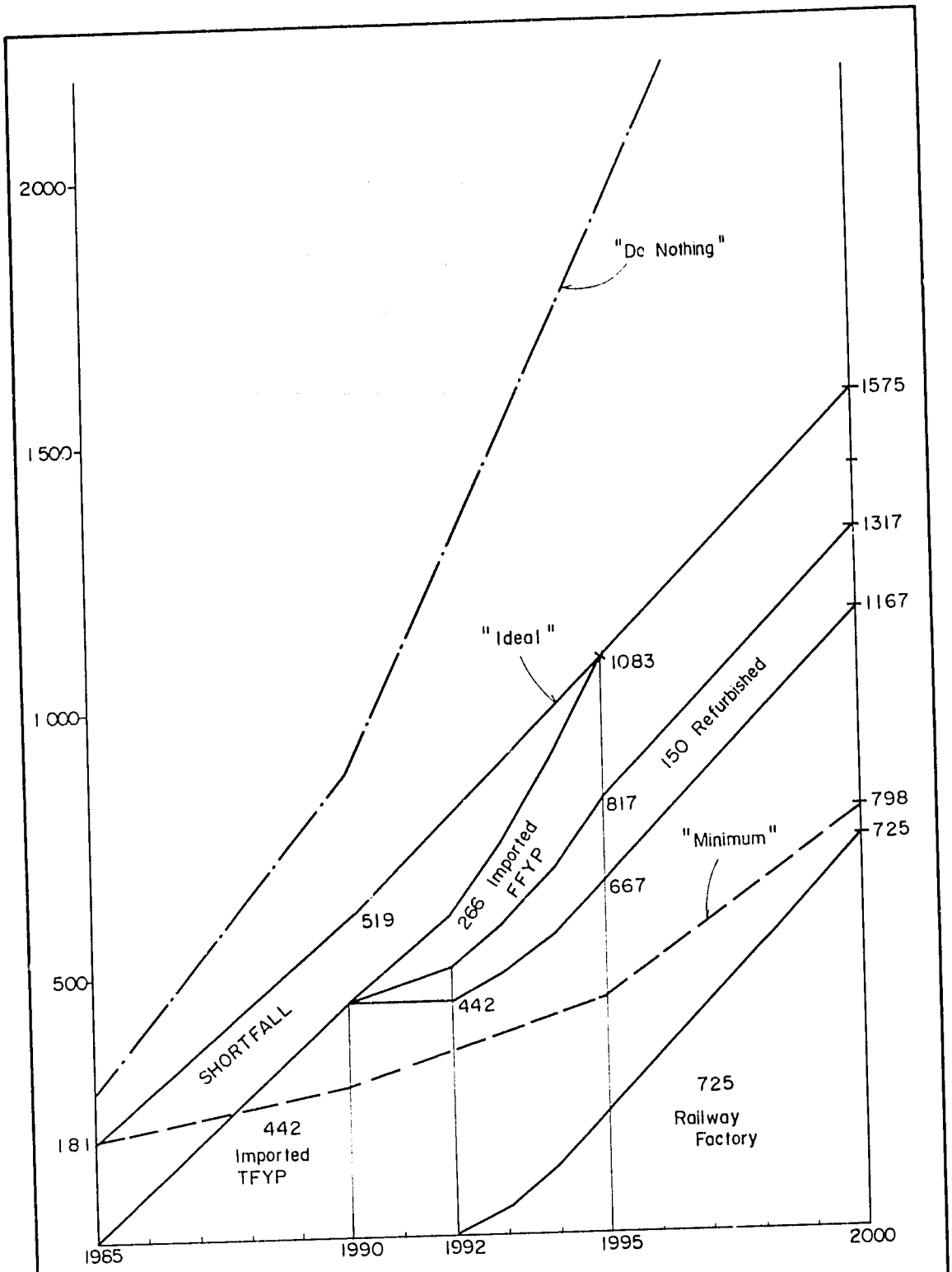


Figure 8.6.5 CARRIAGE PROCUREMENT

This is the contribution of the operating department to the service improvement but enhanced traffic operations also requires improved track, communications and mechanical maintenance.

In addition the fraud waste and abuse eradication programme must be implemented and the passengers must have easy access and procedures to purchase train tickets.

8.6.3 Locomotives

The locomotive performance is discussed in Section 8.3 Rail Performance and in this section locomotive requirements are examined.

(1) Replacement locomotives

Figures 8.6.6 & 7 is a histogram of the locomotive fleet age for both broad and metre gauge.

In preparing these histograms it has been considered that the economic life of a main-line locomotive is 35-40 years. By the latter date the whole class has been withdrawn. For shunting and transfer locomotives the economic life is assumed to be 25-30 years.

A half-life refit is assumed to occur at about half the upper limit of economic life.

The terminology (half life refit) normally means that the locomotive is subject to a complete refurbishing at mid life (say 15-20 years) during which all equipment is stripped out of the locomotive and refurbished and replaced where necessary. Also the body and bogie structure is checked for cracks etc., and the whole is then repainted and tested before re-entry into service.

These offer a planning tool for the purposes of locomotive replacement purchases for a whole class of locomotives, however, individual locomotives will not necessarily conform as events will dictate refits and scrapping.

Tables 8.6.21 and 8.6.22 show the fleet situation by locomotive 8 class in five year periods.

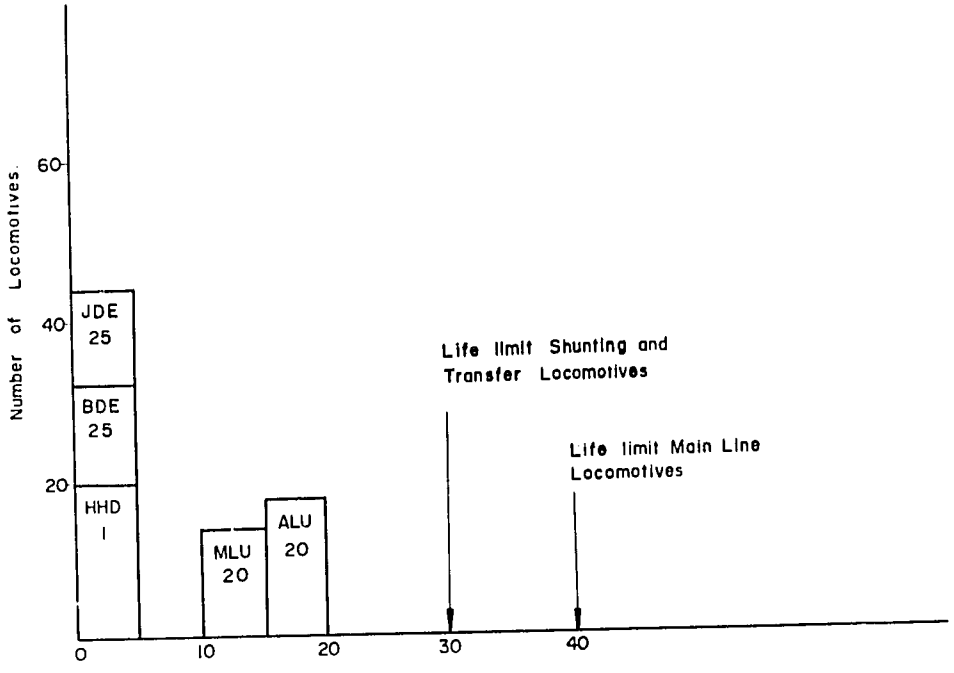
From these tables Figures 8.6.8, 9 and 10 were prepared to show requirements for refits and replacements.

Sub-section 8.3.4(2) showed that 32 revenue earning locomotives on the broad gauge and 113 on the metre gauge are required each day to maintain the 1969/70 diesel locomotive performance. However to base locomotive requirements on this parameter alone is not completely correct as the timetable requirements shown in Table 8.3.17 requires a fleet of 54 locomotives in revenue earning traffic each day for broad gauge traffic and 188 for metre gauge traffic.

a) Metre gauge

The metre gauge has a total of 5 shunting and 76 mainline and transfer locomotives to be withdrawn over the next 10 year period. commencing 1985. These replacements are themselves due for replacement in 2015-2020 for smaller locomotives and 2025-2030 for mainline locomotives.

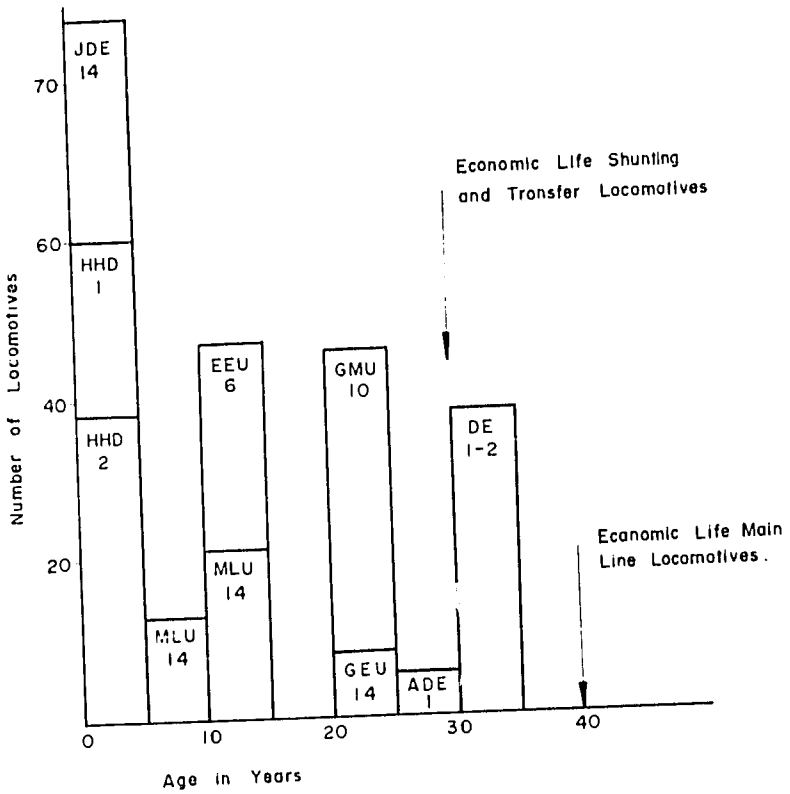
Considering major refits these would occur between 2000 and 2005 for shunting locomotives purchased 1985 to 2000 and 2005-2010 for mainline locomotives.



Year for fleer scrap					
2025	2015	2005	1995	1985	Main Line Locos
2015	2005	1995	1985		Shunting and Transfer
Year for refit					
2005	1995	1985			Main Line Locos
1995	1985				Shunting and Transfer

Figure 8.6.6 BROAD GAUGE LOCOMOTIVE AGE HISTOGRAM

Source : Bangladesh Railways.



Year for fleet Scrap					
2025	2015	2005	1995	1985	Main Line Locomotives
2015	2005	1995	1985		Shunting and Transfer
Year for Refit					
2005	1995	1985			Main Line Locos
1995	1985				Shunting and Transfer

Figure 8.6.7 METRE GAUGE LOCOMOTIVE AGE HISTOGRAM

Source : Bangladesh Railways

Table 8.6.21 Broad Gauge Locomotives (Refits and Withdrawals)

Year Group	Locomotives		Action
	Class	Class size	
1985-1990	ALU20	18	Refits commence
1990-1995	MLU20	14	Refits commence
1995-2000	HHD1	20	Refits commence
2000-2005	BDE25	12 } 24	Refits commence
	JDE25	12	Refits commence
2005-2010	ALU20	18	Withdrawals in progress
2010-2015	MLU20	14	Withdrawals in progress
	HHD1	20	Withdrawals in progress
2015-2020	-	-	
2020-2025	BDE25	12	Withdrawals in progress
	JDE25	12	Withdrawals in progress

Source: Consultants

Table 8.6.22 Metre Gauge Locomotives (Refits and Withdrawals)

Year Group	Locomotives		Action
	Class	Class size	
1985-1990	ADE1	5	Withdrawals in progress
	EEU6	26	Refits commence
1990-1995	DE1-2	38 } 76	Withdrawals in progress
	GMU10	38	Withdrawals in progress
	MLU14	21	Refits commence
1995-2000	MLU14	13 } -73	Refits commence
	HHD1	22	Refits commence
	HHD2	38	Refits commence
2000-2005	GEU14	8 }	Withdrawals in progress
	EEU6	26	Withdrawals in progress
	JDE14	18	Refits commence
2005-2010	-	-	
2010-2015	HHD1	22 } -81	Withdrawals in progress
	HHD2	38	Withdrawals in progress
	MLU14	21	Withdrawals in progress
2015-2020	MLU14	13	Withdrawals in progress
2020-2025	JDE14	18	Withdrawals in progress

Source: Consultants

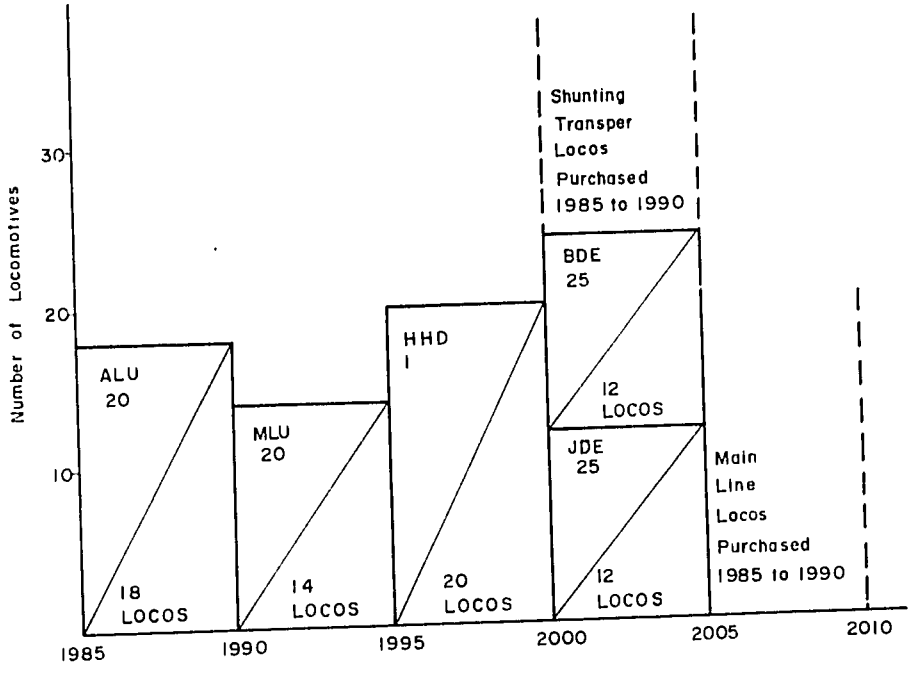


FIG .8.6.8 BROAD GANGE HISTOGRAM FOR REFITS

Source : Consultants

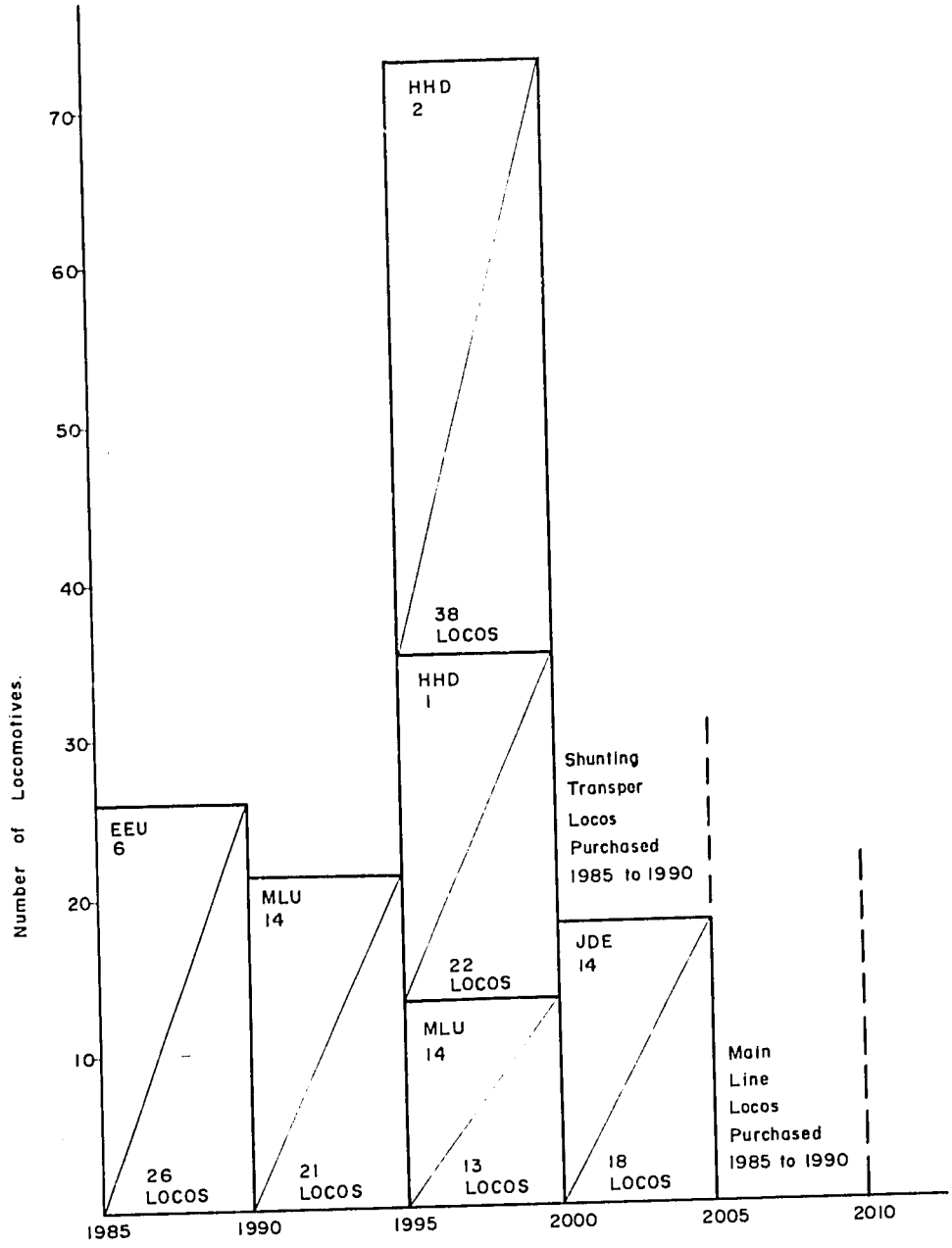


Figure : 8.6.9 METRE GAUGE HISTOGRAM FOR REFITS

Source : Consultants

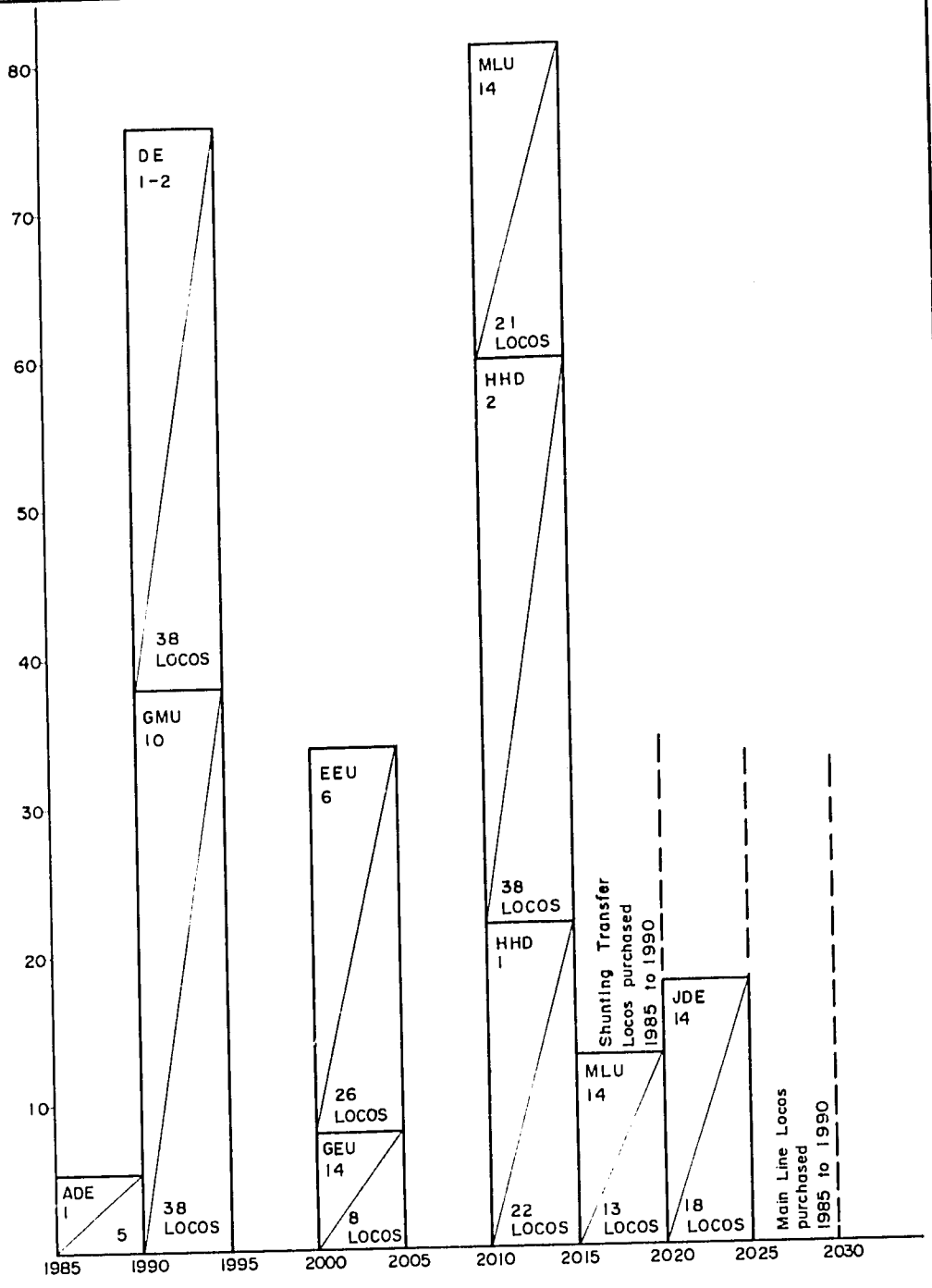


Figure 8.6.10 METRE GANGE WITHDRAWAL OF LOCOMOTIVES

Source : Consultants

The fallacy of large purchases of locomotives in any one five year period shows up in figures 8.6.7; 8.6.9; and 8.6.10. Between 1980 and 1985, 78 locomotives were purchased, and using the parameters assumed for refits and economic life the 60 shunting and transfer locomotives are due for refit at the same time as the 13 MLU's delivered in 1978, and are due for withdrawal at the same time as 21 of the newer MLU's.

Table 8.3.18 indicates that there is a shortfall of 6 shunting locomotives and hence replacement of the ADE-1 class of 5 locomotives would be in order. This would complete the shunting locomotive requirements until 2015-2020 for traffic at the present levels.

However 1990-95 brings the 76 locos of classes DE1-2 and GMU10 to the end of their economic life. The availability of these locomotives is average but the effects of large purchases of locomotives is obvious in the irregular pattern of the histograms. The future load for refits must be taken into consideration. The 76 locomotives should be replaced over a period of 15 years, at an overall rate of 30 locomotives in each five year period.

The desirable metre gauge replacement programme is given below, but new broad gauge locomotives are required which alter this pattern (See Sub-section 8.6.3(3)

1985-1990	5	(Replacing ADE1)
	25	(Replacing DE1-2)
1990-1995	13	(Replacing DE1-2)
	17	(Replacing GMU10)
1995-2000	21	(Replacing GMU10)
	9	(Commencing replacement EEU-6)

It is suggested that the new locomotives are cascaded in at a rate of 6 a year and the older locomotives cascaded out commencing 18 months after the first new locomotive is accepted for service. This will also enable locomotives with a potentially longer economic life than assumed to remain in service longer thus providing the additional locomotives that increasing traffic will require over the next 3 five year plans. This method also permits the mix of locomotive types to be kept in proportion, and also for a locomotive standardization policy to be implemented. This procedure will also enable shunting type locomotives to be taken off revenue traffic trips and replaced by transfer type locomotives.

b) Broad guage

None of the arguments for metre gauge apply to the broad gauge, where the immediate need is to cover the ALU 20 class locomotives as they go through refits by 1990. With three locomotives each year undergoing refit at least one and probably two at times will be unavailable. This is an ongoing situation as a similar number are required to undergo refit in 1990-95 and also 1995-2000. No replacements are required but additional locomotives are needed.

(2) New locomotives

The CIDA report states that additional locomotives are required to achieve the timetable, 20 for broad gauge and 30 for metre gauge. But this timetable is based on present uneconomic performances.

An example of uneconomic services is on the Kalukhali Bhatiaparaghat line. This service requires 3 HHD locomotives working links 5A x 5B takes 10 hours to travel 72 kms each way for an average daily locomotives, yet uses only two rakes of coaching stock. There appears to be a rationalization required in the train schedule and speeds. It is appreciated that track conditions may limit maximum speeds, but there appears to be surplus locomotive capacity. This is only one example where low locomotive utilization is pulling down performance figures.

a) Broad gauge

The broad gauge, without a need for replacement locomotives, has no cascade process for rationalization and consequently additional locomotive purchases must be considered.

The existing fleet lacks mixed traffic locomotives and 1000-1500HP locomotives capable of working over tracks in a poor condition of maintenance. A total of 9 such locomotives considered necessary. This is the number of main line locomotives required in the CIDA report, which uses the timetable as justification for the increase with a 75% availability. The primary function of the 9 locomotives is to relieve the shunting locomotives from passenger duties and to supplement goods traffic.

b) Metre gauge

The metre gauge is to cover replacements by a cascade system of introductions and withdrawals. It must be noted however that by the year 2000 the locomotive fleet will be essentially the same size as 1985, but the interval will permit programmes for traffic rationalization, train re-scheduling, and other improvements for raising productivity to be implemented. A larger locomotive fleet may not be necessary.

(3) Locomotive requirements

The situation for Bangladesh locomotive requirements is not as simple as the process described, as there is tremendous pressure for passenger transportation, an influx of new locomotives will add to the pressure to supplement passenger traffic in place of their designated requirements of moving the more profitable freight traffic.

Bangladesh Railways needs time to be able to bring up its maintenance facilities to be capable of handling the existing locomotive fleet before adding to the maintenence requirements by a larger fleet.

A major factor to be faced is the prohibitive cost of spare parts accentuated by Customs Duties. This is well documented in the CIDA report Subsection 3.3.3 and Appendix F.

a) Replacement locomotives

The Third Five Year Plan is fully justified in replacing the 5 Shunting Locomotives Class ADE-1 of the metre gauge.

The question remains on the balance of the metre gauge locomotives. It must be appreciated that the DE-1 and 2 Classes with the GMU-10's together represent 35% of the metre gauge fleet and will be life expined by 2000 (CIDA report 2005). The CIDA report recommends that 5 locomotives will be withdrawn by 1990, but this only defers the question of replacements to a later period.

The actual metre gauge replacement programme modifies the outlined proposal in 8.6.3.3 to:

1985-1990	21 metre gauge (Replacement of 5 AD-1 and 16 DE1-2)
1990-1995	30 metre gauge (Replacement of 22 DE1-2 and 8 GMU-10)
1995-2000	30 metre gauge (Replacement of 30 GMU-10)

The shunting locomotives ADE-1 are best replaced by 800HP-1000HP locomotives to release shunting locomotives from shuttle and transfer links.

b) Additional locomotives

The broad gauge locomotive fleet has a need to relieve shunting locomotives from passenger duties.

This has economic advantage, as when diesel locomotives perform tasks for which they are not designed the maintenance tasks and requirements are increased. The 9 broad gauge mixed traffic locomotives are recommended.

However the traffic projections show that there will be significant increases in traffic, and significant numbers of rolling stock have to be purchased to accomodate the traffic. This was discussed in Sub-Sections 8.6.1 and 8.6.2.

(i) Freight traffic

The 1983/84 Statistics are used as a base for estimating future locomotive requirements.

Tonne-kms hauled:	2.13×10^6 per day
Number of freight trains:	60.6 per day
Tonne kms per train:	35,150
Wagon tonne-kms/day:	130
Locomotive availability:	73.5%

Table 8.6.6 shows target tonne-kms per day to increase efficiency it is also assumed that the number of wagons per train cannot be increased, and Table 8.6.5 gives the tonne-kms per

day of traffic to be hauled.

Then in Table 8.6.23 the required numbers of trains per day is calculated.

Table 8.6.23 Required freight trains per day

	1983/84	1985/86	1990/91	1995/96	2000/01
Target tonne-kms/day	130	130	190	200	216
Factor over 1983/84	1.00	1.00	1.46	1.538	1.662
Tonne-kms/train	35,150	35,150	51,319	54,061	58,419
Daily tonne-kms	2.16×10^6	2.05×10^6	2.98×10^6	4.36×10^6	6.75×10^6
Trains/day	60.6	58.3	58.1	80.6	115.6

ii) Passenger traffic

Likewise the 1983/84 statistics are used, but ticket-less passengers must be included, as the projected passenger figures for 1985 onwards in Table 8.6.7 are for total passengers i.e., including ticket-less.

Ticketed passenger-kms	:	$17,215 \times 10^3$ per day
Estimated ticket-less pass-kms	:	$4,703 \times 10^3$ per day
Total passenger-kms	:	$21,918 \times 10^3$ per day
Number of passenger trains	:	357.6 per day
Passenger-kms per train	:	61,286
Vehicle kms per day	:	182
Locomotive availability	:	73.5%

Table 8.6.13 shows target vehicle-kms per day to increase efficiency. It is also assumed that in 1990 trains would be strengthed by 10% and another 10% in 1995, before running of additional trains.

Thus Table 8.6.24 the required numbers of trains per day is calculated first at 150% load factor, and then at the targetted load factors.

Table 8.6.24 Required number of passenger trains per day

	1983/84	1985/86	1990/91	1995/96	2000/01
Target vehicle-kms/day	182	187	220	250	282
Factor over 1983/84	1.00	1.03	1.21	1.37	1.55
Increase carriages 10% 1990 & 1995	1.00	1.03	1.33	1.64	1.86
Pass-kms per train	61,286	63,125	81,510	100,509	113,992
Daily pass-kms	21.92×10^6	23.1×10^6	27.5×10^6	33.0×10^6	40.6×10^6
Trains per day at 150% load factor	357.6	365.9	337.4	328.3	356.2
Passenger load factor	1.5	1.5	1.25	1.0	0.95
Factor over 1983/84	1.0	1.0	0.83	0.67	0.63
Trains per day	357.6	365.9	406.5	490.0	565.4

Source: Consultants.

iii) Total trains

The total number of trains run ignoring engineers and departmental trains is obtained from Table 8.6.25.

Table 8.6.25 Total trains per day

	1983/84	1985/86	1990/91	1995/96	2000/01
Freight trains	60.6	58.3	58.1	80.6	115.6
Passenger trains	357.6	365.9	337.4	328.3	356.2
Sub-Total	418.2	424.2	395.5	408.9	471.8
Field to reduce over crowding	NIL	NIL	69.1	161.7	209.2
	418.2	424.2	464.6	570.6	681.0

Source: Consultants

Table 8.6.25 does not include any improvement in locomotive utilizations in 1983 418.2 trains were hauled by 220 locomotives or 1.90 trains per locomotive day. But utilization can be raised by increased train speeds arising from improved track, signalling and communications profects.

This is included in Table 8.6.26 which shows the numbers of locomotives required under three conditi

Table 8.6.26 Required number of locomotives in service per day

	1983/84	1985/86	1990/91	1995/96	2000/01
Sub-Total trains (Table 8.6.24)	418.2	424.2	395.5	408.9	471.8
Locomotives in use	220	220	-	-	-
Trains per loco per day	1.90	1.90	1.90	1.90	1.90
Required locos per day (A)	-	-	203	215	248
Loco utilization increased 5% in 1990/1995/2000	-	-	2.00	2.09	2.19
Required locos per day (B)	-	-	198	196	216
Load factor	1.5	1.5	1.25	1.0	0.95
Relative to 1983/84	1.0	1.0	0.83	0.67	0.63
Total trains (Table 8.6.24)	-	-	464.6	570.6	681.0
Utilization	-	-	2.03	2.09	2.19
Required locos per day (C)	-	-	232	273	311

Source: Consultants.

Table 8.6.27 Total locomotive fleet

Condition	Fleet size								
	190	200	210	215	220	230	250	270	310
Required locos in daily service									
73.5% avail (1983/84)	259	272	286	293	299	313	340	367	422
75.0% avail (CIDA)	253	267	280	287	293	307	333	360	413
85.0% target	224	235	247	253	259	271	294	318	365

Source: Consultants
Additional locomotives to be procured for requirements to the right of the heavy line.

A. Improved vehicle performances, but no improved locomotive utilization or overcrowding relief.

B. Improved vehicle and locomotive performances, but no relief to overcrowding.

C. Overcrowding relief and improved vehicle and locomotive performances.

These locomotives are required in daily service, Table 8.6.27 shows the effect of availability in the size of the total fleet. There are 299 locomotives in service currently, with 9 additional to be purchased in the Third Five Year Plan. Hence any number in excess of 308 represents additional procurements.

(4) Conclusions

The various conditions for locomotive requirements are summarized in Figure 8.6.11.

This figure shows that with improved vehicle and locomotive performances the existing locomotive fleet is adequate, provided that the 150% load factor is accepted.

The figure clearly shows the impact of releaving overcrowding, the demand for locomotives increases dramatically.

The figure also shows the effect that improved availability has on reducing the required size of the locomotive fleet.

The conclusions are that no additional locomotives other than the 9 recommended are required in the Third Five Year Plan. Future locomotive requiremen's are based on the achievement of performance targets and the average fleet availability, and the reduction of overcrowding.

(5) Natural gas fuel

A request for information on the use of Natural Gas for fuel was examined in Japan and Europe. Whilst some years ago the matter (in principle) was proposed but the technology did not exist.

Two forms of Natural Gas, as Liquid Natural Gas (LNG) and Compressed Natural Gas (CNG) were considered, however the problems encountered at that time were based on fuel storage, either in tanks on the locomotive, or in the equivalent of a steam locomotives tender. The problems associated with BLEV (Boiling Liquid Explosive Vapour) leakage seemed to inhibit the use of LNG as fuel. The haulage of LNG in railway tank cars is common, but a railway plant near the depot will be required for the volume necessary for locomotive use.

CNG has better prospects and currently is under examination in Europe. However whilst the costs of compressing the gas are lower and handling is easier, the fuel occupies more volume per BTU thus giving a more limited range.

It is believed that there used to be small shunting locomotives working in gas works in the UK, 60 to 70 years ago, using the town gas produced from coal, to shunt wagons in the works. The locomotives had very limited range & topping up the tanks was frequent.

This would suggest that such a fueled locomotive on Bangladesh Railways would have only limited application.

However this fuel for commercial application, other than a substitute for petrol in cars, is being examined in Europe and whilst there is currently no requirements for such a fueled locomotive, in 15 to 20 years when a major fleet modernization is required the results of the study may indicate suitable railway applications.

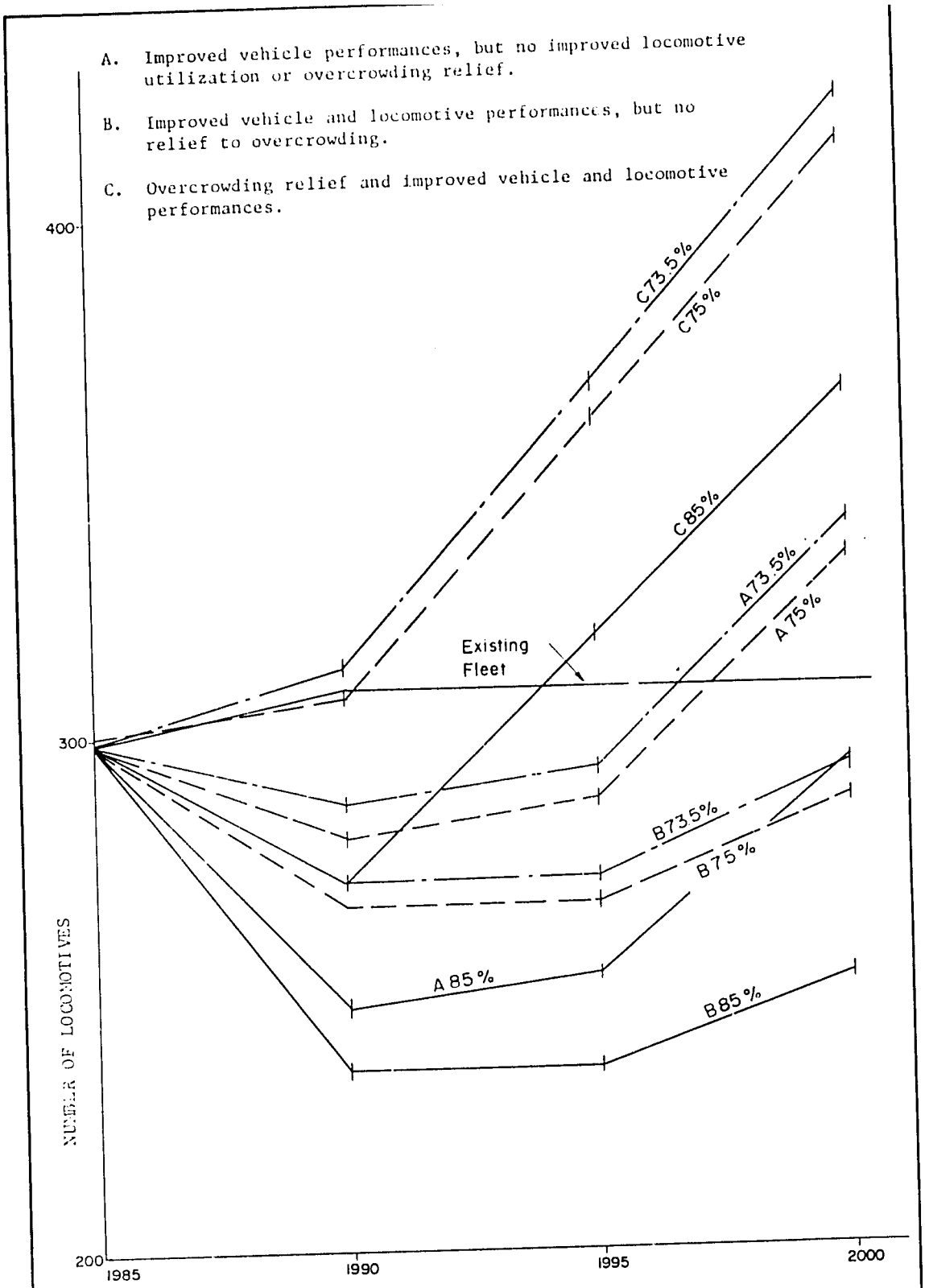


Fig 8.6.11 LOCOMOTIVE FLEET SIZE (IMPROVED PERFORMANCE)

8.6.4 Workshops and depots

Each department has its own workshops, civil engineering and signalling in addition to the mechanical workshops for rolling stock. Much of the information is obtained from the CIDA report and JICA Study supplemented by the consultants observations.

(1) Engineering workshop

Civil Engineering workshops exist in Saidpur, where old and antiquated equipment is installed. The output of switch and crossings being about 50 a year. A modern shop has been established at Chittagong, which has facilities for manufacturing metre gauge track components.

a) Saidpur

The CIDA report gives a good status report. Work performed at the Saidpur civil shops consists of the fabrication of small bridge sections (usually up to 6 m long), repair of bridge sections, fabrication and repair of water tanks, manufacture of points and crossings, building push trolleys and repairing small machines such as air compressors, electric welders and other motorized equipment.

In the bridge fabrication shop the overhead crane has been unserviceable for years and material is now handled manually.

Points and crossings are manufactured in one of the shops and for this operation there is one 18' planer, one 10' planer and a rail bender. The planers are very old and production is low and of poor quality. Considerable scope exists to modernize these workshops and other improvements include better lighting, modern machines for making templets, drafting room equipment, pipe sets, hand tools and a secure lock-up for small materials and tools.

b) Chittagong

The old railway engineering shops at Chittagong have been upgraded to provide bridge fabrication facilities for the Metre gauge rehabilitation projects. However the CIDA report notes that there are deficiencies.

There are two adjacent building available but redesign and rearrangement of shop areas, including a connection between the two buildings to aid material flow, is necessary to provide for an efficient production operation. There is a lack of material handling equipment such as a yard crane, gantry cranes and overhead cranes. Other tools and equipment required include a radial drill, pallet truck, heavy duty platform truck, pneumatic tools and an air compressor with lines to working areas. A forklift is available when replacement parts are available.

c) Comments

The external applications outside the railway system suggests that these workshops can, with an injection of private venture capital and professional management, make these workshops a successful venture. A modern well managed permanent would have export potential to the sub-continent way shop would have export potential to the sub-continent as well as South East Asia.

The Chittagong shops lack trained skills which is hampering the current bridge programme on the metre gauge. The fact that the railway possess trained capability in steel structural fabrication provides marketing opportunities to supply the RHD, civil and international contractors with fabricated steelwork. The refurbishing of steel sleepers, and potential manufacture also provide commercial activities with export potential.

Commercialization with private venture capital has considerable opportunity to market successfully and a technical co cooperation agreement between the private sector and the Railways, together with export potential of the products is an attractive opportunity.

(2) Signalling workshop

There is a signal workshop of long standing in Chittagong but the equipment is old and inadequate for the maintenance task of the mechanical systems.

The budget proposals have an item for constructing and equiping a west zone signalling workshop.

The RDPP report makes a strong request for a modern extension and equipment and training facilities and this is endorsed. This facility should not be part of the general training school, but should be solely for "hands on" learning and training, of the necessary skills to maintain equipment.

The signalling and communication disciplines are becoming more advanced in both electrical and electronic engineering requirements. This is rapidly moving out of the sphere of experience of the skills of the staff.

This type of facility presents a good opportunity for private venture capital to invest in the workshops to manage and operate a high standard radio and electronic repair and maintenance depot. Commercial opportunities to obtain maintenance & repair contracts with non-railway organizations will increase the attractiveness of the investment. Certain safeguards on railway equipment priorities would of course be necessary.

(3) Locomotive depots

Locomotive inspections and minor repairs are carried out at locomotive depots. Most of these depots, of which there are 23, are

designed for steam locomotive inspection with inadequate and dirty facilities. 12 depots are for diesel locomotive shed maintenance.

The turnround of locomotives is essential to the smooth operation of the timetable and the ability to carry out preventative maintenance at the correct time is a key factor in achieving this, and good conditions are essential for maintaining standards.

The CIDA reports suggests that CPGY running shed is upgraded under CIDA funding to provide a model to other depots of North American standards. This means, paint, clean up, additional electrical outlets, air, steam and assured running shed maintenance schedule spares.

The locomotive maintenance performed on shed is:

Schedule A	Daily inspection
Schedule B	Fortnightly inspection
Schedule C	30-day inspection
Schedule D	90-day inspection
Schedule E	180-day inspection

it is essential that these scheduled inspections are carried out to improve locomotive performance to attain the higher standards of the increased traffic and availability requirements.

The CIDA recommendation has considerable merit as it would provide a practical outlet for the CIDA financed training programme. In addition the shed has allocated to it the older GM Units which are due for refit and also the locomotives working out of CPGY shed are also supposed to be dedicated (by agreement under the most recent ADB railway loan) to the goods traffic assignments.

(4) Mechanical workshops

Perhaps the largest weakness of the whole system are the facilities available to the Mechanical Engineer to maintain the fleet of rolling stock.

The October 1983 RDPP report lists the equipment that is required to improve the output of Pahartali and Saidpur Workshops.

The locomotive inspection workshops are Saidpur Workshop (for a few steam locomotives), Parbatipur Workshop (for both MG and BG locomotives), Dhaka Workshop (for MG locomotives), and Pahartali Workshop (for MG locomotives).

Ishurdi shed has been upgraded to provide workshop facilities and all Alco engined broad gauge locomotives (Bombardier, MLW, Hitachi and Alco), will be transferred the new upgraded running shed. The CIDA financed equipment ordered for delivery to Parbatipur should be transferred to Ishurdi. There will be a requirement for equipment such as heavy lift machinery that cannot be transferred from Parbatipur.

The workshop facilities have to provide facilities for two schedules.

Schedule F 1-year repair cycle
Schedule G 2-year repair cycle

The workshops must be able to handle the locomotive fleet requirements for scheduled repair cycles. The broad gauge has a current fleet of 76 locomotives and nine to purchased in the Third Five year plan making a total of 85 locomotives.

The broad gauge workshops must have the capability to repair each year 43 locomotives undergoing Schedule F and 42 undergoing Schedule G. This is 7 locomotives each month, between 1990 and 2000. Should traffic increase and additional locomotives be required every 12 locomotives increase the workshop requirement by one locomotive per month.

The metre gauge locomotive stock will comprise 222 locomotives 1985-90 falling to 213 in 1990. This number may be increased as traffic develops beyond rationalization improvements.

This means that each month the three metre gauge workshops have a minimum of 18.5 locomotives undergoing Schedule F and Schedule G maintenance. This number increases as the need for additional locomotives increase.

a) Backshop

The backshop under construction at Parbatipur for locomotive half-life refits and heavy maintenance cycles is essential if the railway reduces the demands for new stock by carrying out work with its own work force. This facility will prevent the premature replacement of expensive store items by the reconditioning and fine tuning of the locomotive equipment.

The work to be carried out is

Schedule H 4-year repair cycle
Schedule I 8-year repair cycle
Schedule J 16-year repair cycle (Half life refit)

The demands on this backshop are severe as the locomotive fleet is in dire need of major refits.

Table 8.6.28 gives the annual requirements

Table 8.6.28 Schedule half-life refits (Schedule J)

	BG	MG	Total	Average per annum
1985 - 1990	18	26	44	9
1990 - 1995	14	21	35	7
1995 - 2000	20	73	93	19

This is in addition to the schedules H and I which requires one quarter of the total locomotive fleet to work through the backshop each year.

The indication is that an additional backshop be opened in the East zone and this should be made available for private venture capital involvement and management with authority to undertake large diesel engine overhaul commercially to support the railway facilities.

It is doubtful if the East zone can afford the time that is lost in transferring equipment across the Jamuna River.

b) Summary

The locomotive fleet has exceeded the capacity for adequate maintenance. The programme in the TFYP will reduce the unavoidable neglect of maintenance. However the major increase in traffic predicted indicates that the locomotive fleet will be extended by the end of the Fifth five year plan.

This expansion of the locomotive fleet must be phased in with expansion of workshops and additional backshop facilities.

(5) Carriage and wagon depots

These are the major stabling locations for rolling stock, and must be capable of carrying out running repairs to stock without withdrawing the vehicles from service. The carriage depots at Chittagong, Parbatipur, Khulna and Mymensingh need to be upgraded, as described in RDPP report. These depots will assist in maintaining an image of railway service by keeping rolling stock clean and in working order likewise the goods depots at 10 busy locations on both Broad and metre gauges are required to maintain the vehicles in good running order. This will increase their availability as minor repairs can be carried out without having to be sent to workshops.

a) Carriages

Eighteen stations in the MG section and eight in the BG section are equipped with Carriage and Wagon depots.

The workshops Saidpur Workshop (for both MG and BG carriages) and Pahartali Workshop (for MG carriages) are in charge of inspecting carriages.

Saidpur Workshop assembles carriages by importing the underframe, bogie, electrical parts, etc. Pahartali Workshop was assembling carriages but no longer does so, and is now responsible for maintenance.

Routine inspections and periodic inspections (with cycles under one year) are conducted at the Carriages & Wagons Depots (C & W Depots). Periodic inspections having greater than a one-year cycle are conducted at the workshops. The inspection and maintenance schedules are:

Schedule A Daily inspection
Schedule B Quarterly inspection

At the workshops the maintenance cycle is:

	LE (Lift and enamel)	POH (Periodical overhaul)
Steel carriage	18 months	6 years
Other coaching Steel vehicles	2 years	6 years

Figure 8.6.10 shows the new vehicle requirements but maintenance has to be performed on the whole fleet including departmental vehicles. The whole vehicle stock is shown in Table 8.6.29.

Table 8.6.29 Size of vehicle fleet ("ideal" solution)

	Existing	II + III	ACC + I	OCV*	Totals
1985	1,050		142	368	1,560
1985-90	962	442	120	370	1,894
1990-95	860	1,083	125	380	2,448
1995-2000	638	1,575	136	400	2,749

Source: Consultants
OCV: Other coaching vehicles assumed. 1983/84 stock levels maintained

Table 8.6.30 Carriage workshop requirements (per year)

Year	L.E.		P.O.H.	
	Carrs.	OCV	Carrs.	OCV
1985-90	1,010	184	254	61
1990-95	1,386	190	45	63
1995-2000	1,574	200	392	66

Source: Consultants

This is evidence of the need for adequate maintenance capacity.

b) Wagons

The depots and the workshops in charge of the maintenance of wagons are the same as those for carriages.

Pahartali Workshop was assembling goods wagons but no longer does so.

Routine inspections and periodic inspections (with cycles under one year) are conducted at the depots. Periodic inspections having more than a one-year clcle are conducted at the workshops. The inspection and maintenance cycle is:

at the depot:

Daily inspection
6-month inspection (Repacking)

at the workshop:

The schedules are for periodic inspections.

Nonstandard wagon	2 years
Standard wagon	3 years

Table 8.6.8 gave the wagon requirements, and the numbers of wagons that have to pass through the workshops are large.

The workshop requirements for repairs are estimated on an annual basis based on the 3 year inspection

1985-90	5,829 p.a.
1990-95	7,730 p.a.
1995-2000	11,081 p.a.

c) Summary

The major refit and renovation of rolling stock is also necessary. Whilst most necessary repairs are carried out at the workshop inspection there will occur at least one major refit during the vehicle's life similar to the locomotive refit, assuming this to occur at 15 year intervals then facilities are required for 126 carriage vehicles in 1985-90 rising to 197 in the year 2000. Similar facilities for 20 year intervals of wagons will need 831 wagons in 1985-90 and 1656 in the year 2000.

d) Observations

There is a distinct possibility that the work load assigned to the workshops, in all departments, exceeds the capacity of the workshop to perform. This is not only in terms of the work, i.e. back log and normal maintenance, but in the size of the fleet, signal systems or engineering works owned or performed by the railway. The amount of increase in output needed for normal scheduled maintenance has been assessed at 15 to 20% for locomotives, at least 10% for coaches, and a very large increase in wagons.

A good case has been made in BRPA for increasing the labour force in the workshops through an active training scheme. The list of vacancies is very long, including engineers, and prevents the full deployment of workshop resources.

It must be recognized that workshop machinery and equipment is also needed in the civil engineering and signalling workshops where the backlog and lack of capability is also present. 80% of the equipment is overage and workshops operate at best at about 65% efficiency.

The output through the workshops must be stimulated by

a) Self-improvement classes run by senior staff and superannuated staff.

b) Implement the fraud waste and abuse eradication programme.

c) Implement tighter control over spare parts inventory for timely procurement.

d) Reduce customs tariff on spare parts to increase availability of material.

e) Standardize vehicles to eliminate multi-stock holding by preparation of technical specifications to international standards to which all procurements and grants must conform.

f) Institute a planning and review process to ensure that adequate maintenance facilities exist for the maintenance and overhaul of rolling stock and workshop assets.

(6) Carriage and wagon manufacturing plant (Parbatipur)

The JICA study has shown and established the need for the construction and size of the plant. The carriage output calculation is higher than this study has indicated.

For wagon production the need is greater than the plant capacity requiring some 16,880 wagons (in 4-wheel units) in the first 8 years of production.

The wagon figures are highly dependant upon achievement, and it is on the wagon maintenance that the wagon capacity should be determined.

The plant must be established under some form of technical co-operation agreement with the private capital market. The size of the potential market in Bangladesh and also in the sub-continent and South East Asia for export earnings requires management and organization of the highest competence to attain and maintain the high outputs required.

Because of the nature of the operation the ownership could well devolve upon some multi-national joint venture company promoted to develop and operate railway carriage and wagon production.

At the same time as producing new rolling stock the plant should also undertake the maintenance and rebuilding of carriage and wagons, of the West Zone. Maintenance facilities of the railways are inadequate for the demands placed on the carriage and wagon workshops.

8.6.5 Ferries

(1) Introduction

Bangladesh Railways had 41 marine vessels under its mechanical department at the end of 1983/84.

The fleet consists of 3 passenger steamers, 5 tugs, 7 wagon ferry-barges, 8 flats, one motor boat and 18 other barges and pontoons. Of 3 passenger steamers sanctioned under the rehabilitation programme, one vessel, the M.V. SHEER-E-BANGLA was procured from West Germany and placed in service between Bahadurabad and Tistamukh Ghat in 1976, another vessel "M.V. SUHRAWARDY" procurded from Belgium was placed in service between Jogonnathganj and Sirajganj Ghat and is laid up for repair. The third passenger vessel "M.V. SONARGAON" procured from M/s. Khulna Shipyard Ltd. was placed in service in May, 1983.

(2) Ferry service, Bhadurabad Ghat/Tistamukha Ghat

This railway ferry service over the Jamuna River provides the East-West connection and for the transport of the goods to Nepal and Bhutan via India. About 1280 wagons with 17,500 tons were handled in 1983 and about 2,130 wagons with 38,000 tons in 1984. At present, 3 barges are operating this service. Each barge has 13 rails which can load 39 wagons, its capacity being 600 tons. Each barge does one round trip a day, the fleet daily carrying capacity being 3,600 tons.

The average single voyage time is 8 hours (including waiting) whilst loading/unloading takes 4 hours. Present capacity could be increased about 60% with additional loading ramps. At present, 1 new barge is on order and one 1,070 km tug boat. The power of present tug boats is as follows:

2 x 1,970 KW
2 x 750 KW
1 x 700 KW

The 700 KW is presently used for a small barge that is being replaced by a large barge, and consequently a tug of at least 1,000 KW will be needed.

The BIWTC has an unbalanced fleet of tugs and barges resulting from transport changes, and it may be possible to come to an arrangement over assets and operations to better use the assets.

The ghat lines on both sides of the river are only temporary depending entirely on the river conditions which increases the hazards of traffic movements. The users survey indicated excessive waiting times for crossings, which may indicate river conditions rather than operations.

(3) Jagonnathganj ghat/Sirajgonj ghat

This is a longer ferry service without rail barges. Goods are transported, however as there is a change of gauge from metre to broad gauge & vice versa all goods have to be handled twice, which increases costs and reduces security. Predominately passenger oriented.

Table 8.6.31 Ferryboat transportation

	Banhadurabad Ghat ∿ Tistamukh Ghat			
	Passenger		Freight	
	round trips	passenger	round trips	tonnes
1982	3	Actual record: 4836 Capacity: 5058	2	1530
	Jagannathganj Ghat ∿ Sirajganj Ghat			
	Passenger			
	round trips	passengers		
	2	1494		

Notes: 1. The capacity of the passenger ferryboat is calculated in terms of the 843 passenger-capacity of the Sonargaon-type ferryboats presently used.

2. The number of goods ferryboat trips is not stipulated in the Working Time Table.

Source: JICA Study

8.6.6 Structures and depots

Part of the railway infrastructure of the railway are the fixed assets such as offices and stations.

This subject is not discussed in this report as a separate subject and where relevant is addressed under other sub-headings.

The railway has plans to rebuild certain stations, and to build hospitals offices and accommodation, particularly in the West Zone, but this matter is outside the immediate scope of an intermodal transport study.

The ADB has financed the improvement of locomotive depots and facilities which is an important contribution to improving maintenance standards.

8.7 Operational Issues

The underlying theme of this Chapter has been to raise productivity in the railway sector and to increase the safety of trains. The thrust of the issues are brought out in this section.

8.7.1 Management

(1) Summary

Much new equipment was being invested into the system, but this has not brought any reduction to the problems. In fact there was a situation of diminishing returns. In comparison with other Railway systems there is a surfeit of equipment, and yet the quality of service is in doubt.

This raised the important question of the correctness of the type of service offered by the Railways. The pattern of traffic has been changing, the population growing rapidly, the pattern of life changing, but the railway does not seem to change to meet the new demands placed on it. For the Bangladesh Railways, the railway pattern is becoming a long haul freight with heavy local passenger traffic. But the pattern of rail service does not indicate that changes are being made.

Railway statistics are becoming unreliable, what was accurate to 4/10 of 1% in 1969/70 had become over 3% in 1983. This places doubt on the judgements based on the statistics.

Railway finances make no allowances for depreciation in the accounts. Costs when compared with fares and rates could only be estimated from published data which was of uncertain value. Large amounts of foreign exchange have been put into the railway, but there seems to be no way of evaluating the economic value to the country of the investment.

The costing analysis and the modal split indicate that the railway traffic conditions are going to change dramatically. Further the programmes under way to improve communications, speed-up trains and improve reliability are going to attract more business to the railway.

The existing methods of operation, timetabling and services will be unable to cope with the necessary changes that have to be made.

The old trusted and traditional operational procedures will have to be replaced by new approaches, technologies and management philosophies. Before these changes can occur in the way most suitable to the staff of Bangladesh Railways it is essential that the future requirements of the railway operations are defined.

Management must investigate and determine improved methods of selling tickets and preventing revenue leakage at every station in the system.

This study has indicated the requirements for rolling stock and emphasized that the facilities for maintenance must be adequate for the very large increase in work. Procedures for implementing improvements have been made. But these will have no meaning if the way the railway is run does not change to the requirements of the new situation.

(2) Recommendation

For these reasons it is recommended that a major management consultancy study be undertaken to achieve five broad objectives.

a) To determine the type of railway service to be provided by Bangladesh Railways and to prepare and implement commercial and market oriented policies.

b) To conduct a thorough review of financial procedures and management information services. To include tariff proposals, determine profitability, to recommend levels of subsidy, determine cash flows, and financing requirements.

c) To make recommendations on adapting and redefining the organization structure to match the new requirements set out in 1 and 2.

d) To provide railway operating specialists to review all operating practices and rules and to recommend new practices within the organizational and management structure outlined in 3.

e) To reinstate the computerization of data for Management Information Services and to monitor the performance of the railway for a period of three years to progress to the performance indices of 1969-70. During the monitor period designated Railway Officers will gradually replace the Consultants staff in the assigned duties.

These objectives are not the same as the institutional support proposed in the 29 June 1983 meeting between the Railway Division and the ADB Pre-appraisal mission. A team approach over the full spectrum of the railway structure is considered to be necessary to propose methods of meeting the requirements of passenger and freight traffic.

This consultancy must take place under the Railway Planning Department, and officers from that department will take over from the Consultants to maintain the system.

8.7.2 Rolling stock

Section 8.6 has shown alternatives for management decisions. Rolling stock requirements are more influenced by performance statistics than by traffic demand.

For freight traffic a "wait and see" situation on traffic demand growth will be in order with only special use wagons to be procured or converted. However management must improve wagon statistics to be able

to gain the traffic indicated by the modal split analysis and recommendations.

Passenger traffic decisions for management are entirely focused upon over-crowding. Elimination of over-crowding at the end of the Fifth Five year plan requires the purchase of 777 additional carriages and between 57 and 114 locomotive (depending upon achieved availability) and the maintenance facilities for this additional fleet. The decision on the rate of reduction is the crucial factor in determining fleet size. Again improved utilization of carriages is an essential factor in reduced fleet size.

Locomotive requirements can only follow upon the carriage and wagon decisions. These decisions determine the numbers of trains to be run. This is clearly brought out in Figure 8.6.11 and Table 8.6.25. The "Do Nothing" scenario for wagons and carriages requires 612 locomotives in 2,000 based on 1983 performance.

8.7.3 Workshops and depots

As suggested in the previous sections an inordinate amount of blame for service shortcomings has been placed on failures to maintain the rolling stock.

Whilst there is considerable strength to this argument there has been no attempt to prove that the facilities are capable of maintaining the fleet of rolling stock owned. Achieved outputs are considerably below targets, but the targets themselves do not reflect fleet size.

The solution to a shortage has been to invest in additional stock, which has been to create a larger fleet without reducing the numbers of vehicles in the fleet to a manageable number maintained on a regular scheduled basis. Thus the only advantage of new stock is that the volume of repair work to be performed in the first six months might be less than for older vehicles, and by 2 years after introduction the first lifting and enamelling in shops is required for coaching stock.

In this respect to put the workshops into a semibalance of order and to raise productivity the proposal to have a mechanical workshop consultant is correct and badly needed. The terms of reference must include fleet rationalization based an condition and age, and recommendations for condeming wagons and canibalization of serviceable parts.

In addition the consultancy must make recommendations on the capacity and size of maintenance facilities, backshops and depots to maintain the rolling stock fleet at reasonable standards.

The carriage and wagon plant advocated in the JICA study is needed, however, the capacity does not appear to be correct for the traffic level determined under this study. A reduced carriage production plant is indicated but there would appear to be a greater need for heavy wagon maintenance rather than wagon construction and some rationalization between production and re-building requirements should be considered.

Managements decisions must be made in the context of fleet size and

what degree of reliability management requires from its rolling stock. The size and capacity of the workshops are dependant upon managements decisions on fleet size, and are thus directly related.

Management should also encourage depot managers to improve facilities in their depots as suggested for CPGY depot in the CIDA report.

8.7.4 Signalling and communications

This is the second reason used for poor operational performance of the railway and is discussed in Section 8.5. Improved and maintained communications are essential. The maintenance of equipment will remain in doubt until suitable workshops and training facilities are in existence.

This department will become the "high-tech" unit of the Railway organization as more sophistication and reliability are incorporated into the system. Managements decisions must be oriented to reduced maintenance and easy access to spare parts. The increase in sophistication increases the need for access to spare parts, as a component failure can paralyse whole areas of railway operations.

The recruitment of suitable engineers and technicians is important in this discipline, and is a challenge to management to ensure that staff of the right calibre join the department.

8.7.5 Track work

This is an obvious cause for slow speeds and hence late running, but the working timetable makes allowances to running times and for the speed restrictions. The slow speeds do however provide a cause for complaints of service quality. The precedent of the Chittagong-Dhaka main-line improvement works has set a required standard and this work must continue through all main line sections of the railway to enhance productivity and safety.

Ballasting remains, and will continue to be, a problem of both supply and delivery. Alternative sources of supply must be examined and developed, as discussed in Section 8.5.

This report does not recommend the use of concrete sleepers at this time for Bangladesh Railways as explained. Management's decisions on trackwork upgrading and renovation have the important relationship with achieving the 5% increments in train speed necessary to raise locomotive utilization and train turnround.

8.7.6 Containers

The Railways should capitalize on their current advantage of being the only system capable of handling containers to inland destinations. The handling of containers by Inland Water Transport is under investigation by the World Bank, and the private operators of that sector will provide considerable commercial alternatives to clients, which will be

to the railway's disadvantage. The railway has the ability to transport containers, and should promote the potential of establishing an "Inland Port" at Dhaka for a customs area to stuff and unstuff containers.

Handling containers always presents problems away from ports where there is specialized equipment. Many railways cannot justify expensive fixed equipment for relatively few containers. The railways should take note of the "liner-crane" development in the U.K. This is a bogie wagon capable of train speeds or being self propelled, with hydraulic powered container handling gear which can be used at container depots or wayside stations to off-load containers at a rate of 10-15 units an hour, either on to road chassis, on to itself, or on to the ground. The value of this equipment is that it travels with the container train and avoids the specialized fixed equipment. This opens up the use of containers as an internal transportation system in place of traditional covered vans. The off-loading of the containers immediately frees the chassis for revenue traffic. The containers can be small, the 3 m x 3 m x 2.5 m boxes of Japan's transportation system are easily used for rail and road transfer.

Containers are also a change in commodity hauled and full respect to this must be marketed and competed for as vigorously as any other commodity. International containers are handled by shipping agents for the Steamer Lines conveying them. The railway's will have to compete to get the traffic.

The use of Railway land in central Dhaka is a unique advantage to establish the container depot, suitable for rail from Chittagong. Management must exploit this advantage.

8.7.7 Privatization

The largest weakness of the railway organization has been in maintenance and the ready supply of manufactured components.

The introduction of private capital into particular areas of railway activities, and the use of professional management to provide the necessary productivity is not a new concept. However the railways function is transportation and the removal of ancillary areas of inadequate performance will add to the probabilities of improved performance.

The obvious non-transportation activities suitable for privatisation are in:

- Workshop overhauls for vehicles and locomotives
- Permanent way component manufacture
- Communication equipment workshops
- Manufacture rolling stock
- Steelwork fabrication
- Ballast supply

In order to attract the right type of companies and capital the railway must be prepared to sanction activities outside exclusive

Bangladesh Railway business. Subject to safeguards of Bangladesh Railway interests and a reliable payment system the introduction of private ventures has much to offer the railways and the people in Bangladesh who would gain economically.

CHAPTER 9 ROAD AND ROAD TRANSPORT

9.1 Road and Road Transport Institutional Organisation

Roads and Road Transport Division, Ministry of Communication is responsible for overall construction and maintenance of all arterial roads and national highways. Besides, it supplements transportation services to big cities and most of the district headquarters. The Division does not directly involve with the above stated functions rather it delineates policies to its three functionaries Viz. (i) Roads and Highway Department (ii) Bangladesh Road Transport Corporation (BRTC) and (iii) Directorate of Road Transport Maintenance for necessary action.

9.1.1 Roads and Highway Department

The Department upkeeps the existing roads fit for traffic movement. In each financial year the Department takes up improvement and upgradation works of various existing roads on the basis of its resource allocations. Construction of new roads including the bridges and culverts is done by RHD. Improvement of ferry services also lie with it. Construction of feeder roads has temporarily been vested with RHD till the Upazilla Parishads are fully equipped with manpower and facilities.

The existing organizational framework of the RHD is shown in Fig. 9.1.1.

9.1.2 Bangladesh Road Transport Corporation (BRTC)

BRTC was primarily created to help mitigate the transportation problems of the major cities of the country. Public transportation needs are, by and large, met by vehicles owned by other than Government organisations. To mitigate the sufferings of the passengers, BRTC brought many vehicles on the road to meet the growing demand of public transport. BRTC's effort was to supplement the transport needs, in the one hand, and to ensure minimum standard of comfort and safety of passengers on the other. Its fleet interconnect most of the district headquarters. BRTC has a Bus and a Truck Division.

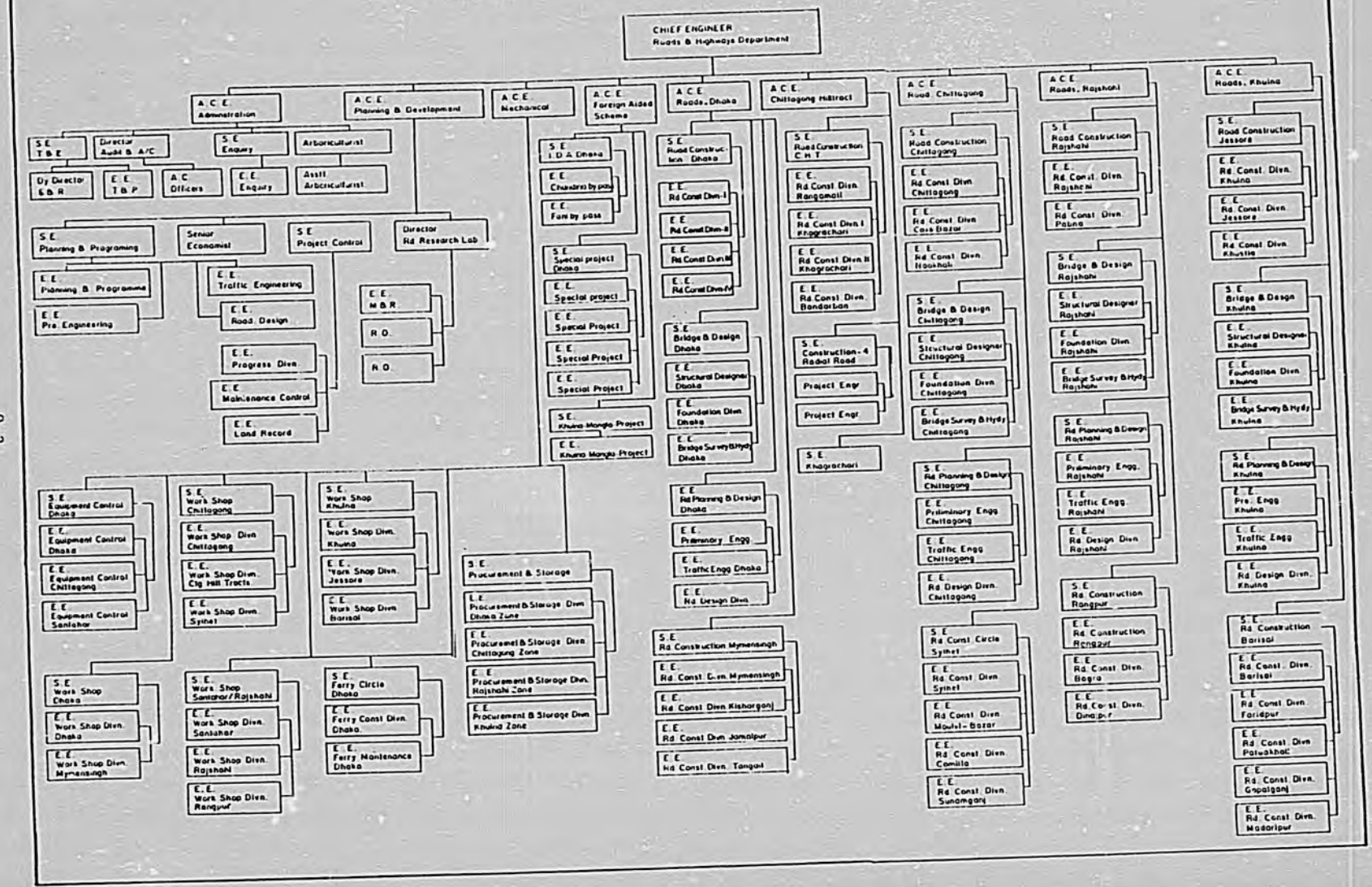
It has a good number of depots, sub-depots and station located in suitable places of the country to cover the important district routes. Its central workshop takes care of major repair of BRTC buses and trucks. BRTC's training centre conducts frequent training for Drivers and Mechanics. Construction of city bus terminals and passengershades has also been entrusted to BRTC. It occasionally arranges procurement of vehicles for replacement and expansion purposes.

9.1.3 Directorate of Road Transport Maintenance

The Directorate is more or less a technical directorate to advise the Government on the technical aspects of Motor Vehicles. It advises the Government on the framing of Motor vehicles ordinance, its amand-

ments, adherence of Motor Vehicle Rules and Regulations, etc. Proposal for acquisition of vehicles are first scrutinized and examined by this Directorate before the actual procurement takes place. Pre-registration inspection of motor vehicles and issuance of fitness certificate are performed by the Directorate. The Directorate is involved in respect of Driving Licence issued to individual drivers. The Directorate examines the nature of repair works and give clearance of repair of all Government vehicles.

FIG 9 1 1 ORGANISATION CHART OF ROADS & HIGHWAYS DEPARTMENT



9.2 Road Traffic

9.2.1 Traffic survey

Several traffic surveys have been conducted under road improvement projects since the BTS's survey in 1971, while RHD has been carrying out traffic counts throughout the country for several years. After review of these traffic data, the Consultants found that no suitable origin-destination matrix for the analysis of goods and passenger movements for the whole country is available in the previous studies.

The Consultants, therefore, decided to carry out supplementary surveys in order to meet the requirements of this study and to update and crosscheck the existing traffic data.

The scope of traffic survey was limited due to budgetary constraints. However, maximum effort has been done for the selection of survey methods and utilization of the existing data collected.

The following supplementary surveys were conducted in January and February 1985.

- Traffic count surveys
- Goods (Trucks) movement surveys
  - Axle load surveys
  - Commodity surveys
  - Origin-destination (O-D) interviews surveys
  - Interview surveys for Truck loading
- Passenger movement surveys
  - O-D survey
- Travel speed surveys.

(1) Details of traffic surveys conducted

a) Location

12 stations were selected for the traffic counts and O-D surveys in the arterial road network of the whole country, while a total of 6 key stations was selected for the axile load surveys. The locations of survey stations are shown in Fig. 9.2.1.

b) Date and periods

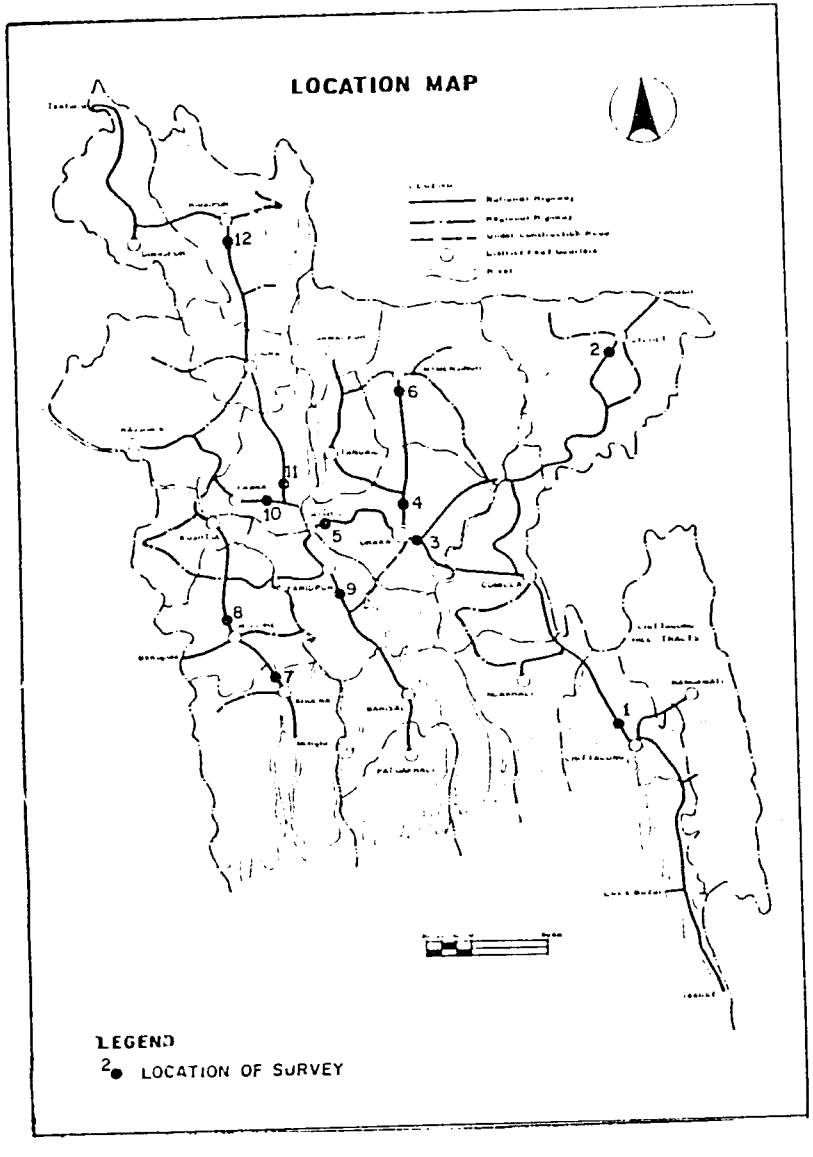
Table 9.2.1 shows the date and time of surveys. 24 hour surveys were conducted at each station.

c) Types of vehicle classified

The vehicular traffic was classified as follows according to the survey purposes

- Traffic count survey

  (1) Truck/Tanker/Tractor, (2) Bus, (3) Minibus.



LIST OF TRAFFIC SURVEY STATION

	NO.	DISTRICT	LOCATION	TRAFFIC SURVEY			
				COUNT	AXLE-LOAD	O-D (BOUND)	
Bangladesh	1	CHITTAGONG	Barabkunda	O	★	O	DHAKA
	2	SYLHET	Sylhet	O		O	DHAKA
	3	DHAKA	Before Kachpur Bridge	O	★	O	CHITTAGONG
	4	DHAKA	Before Joydebpur Junc	O	★	O	MYMENSINGH
	5	DHAKA	New Ferry Terminal	O		O	AGOTHA
	6	MYMENSINGH	Outside of City Boundary	O		O	DHAKA
West Bangladesh	7	KHULNA	Daulatpur	O	★	O	JESSORE
	8	JESSORE	4 mile from town to Jhenkida	O		O	JHENAIDA
	9	FARIDPUR	Sadar	O	★	O	BARISAL
	10	PABNA	Nagarbari – Pabna	O		O	PABNA
	11	PABNA	Kashinathpur – Pabna	O	★	O	RANGPUR
	12	RANGPUR	Outside of city Boundary	O		O	BOGRA

FIG. 9.2.1 LOCATION OF TRAFFIC SURVEY
JAN -FEB 1985

(4) Jeep/Station wagon, (5) Car/Taxi,
(6) Auto Rickshaw (3 wheel) (7) Motor Cycle,
(8) Non-motor Vehicle.

- O-D Survey for Goods Movement

  (1) Truck, (2) Tanker, (3) Tractor, (4) Trailer.

- O-D Survey for passenger Movement

  (1) Bus, (2) Minibus, (3) Jeep/Station wagon,
  (4) Car/Taxi.

d) Classification of commodities

The commodities carried by trucks are classified by inter viewers as follows;

(1) Foodgrain, (2) Jute and jute goods, (3) Fertilizer,
(4) Cement, (5) Coal, (6) Shingle, Boulders, (7) Petroleum,
(8) Iron and steel, (9) Others, (10) Empty.

e) Survey form

The survey form used for the freight and passenger movement survey is shown in APPENDIX 9.1.

Table 9.2.1 Date and Time of Traffic Survey

Station No.	Location	Survey	Date & Time
1	Chittagong	C.AL.OD	15 Jan (11:00) - 16 Jan (11:00)
2	Sylhet	C.OD	19 Jan (11:00) - 20 Jan (11:00)
3	Kachpur	C.AL.OD	9 Jan (11:00) - 10 Jan (11:00)
4	Joydevpur	C.AL.OD	7 Jan (11:00) - 8 Jan (11:00)
5	Aricha	C.OD	12 Jan (11:00) - 13 Jan (11:00)
6	Mymensingh	C.OD	22 Jan (11:00) - 23 Jan (11:00)
7	Khulna	C.AL.OD	9 Feb (10:00) - 10 Feb (10:00)
8	Jessore	C.OD	10 Feb (14:00) - 11 Feb (14:00)
9	Faridpur	C.AL.OD	12 Feb (10:00) - 13 Feb (10:00)
10	Nagarbari	C.OD	6 Feb (14:00) - 7 Feb (14:00)
11	Kashinathpur	C.AL.OD	5 Feb (10:00) - 6 Feb (10:00)
12	Rangpur	C.OD	3 Feb (10:00) - 3 Feb (10:00)

Remarks : C : Count Survey
AL : Axle - Load Survey
OD : Origin - Destination Survey.

(2) Existing traffic characteristics

a) Traffic volumes and vehicle composition

The results of the traffic count survey are presented in Table 9.2.2, and Fig. 9.2.2 shows the composition of traffic passing the 12 count stations in the 1985 dry season survey.

The survey station 1 (Chittagong) and 4 (Kachpur) recorded high traffic volumes and truck traffic occupies about 50% of the total traffic. This indicates that Dhaka - Chittagong Highway is the major road in Bangladesh. The average traffic volumes in the East is much higher than in West Bangladesh.

As shown in Fig. 9.2.2 heavy vehicles consists of trucks, tanker, tractor and buses constitute nearly 70% of the total traffic. (average of all survey stations). The percentage of heavy vehicles in Bangladesh seems to be higher than in other countries in Asia. This is due to its low per capita income and low car ownership.

Bus traffic including minibuses comprises more than 30% of total traffic (average of all survey stations). This in indicates that the bus is a major passenger trip mode, persons who can use a car being very limited.

b) Night time traffic

Night traffic in Bangladesh is mainly made up of trucks. The night traffic ratio of truck is 22% of the 24 hours traffic range. (weighted average of all survey stations).

These traffic characteristics have not been changed much since BTS survey in 1971. The night traffic ratio of trucks gradually increased.

Table 9.2.3 shows the details of night traffic ratio of trucks, buses and cars at 12 survey stations.

TABLE 9.2.2 **SUMMARY OF DAILY TRAFFIC VOLUME (ALL STATIONS)**

NO	STATIONS	TRAFFIC VOLUME (VEH / DAY)							SEASONALITY FACTOR From Ferry Record	A A D T (VEH.)
		TRUCK TANKER TRACTOR	BUSES	MINI-BUS	JEEP/STATION WAGON	CAR/TAXI	A RICKSHOW (3WHEEL)	MOTOR VEHICLE TOTAL		
1	CHITTAGONG	2447	564	97	184	431	866	4589	1.04 (2)	4410
2	SYLHET	345	379	449	36	114	1076	2399	1.07 (3)	2240
3	KASHPUR	1836	1204	491	164	520	169	4384	1.04 (2)	4220
4	JOYDEVPUR	1234	857	662	267	358	113	3491	1.04 (2)	3360
5	ARICHA	569	560	72	46	80	5	1332	1.08 (1)	1230
6	MYMENSINGH	368	193	164	46	40	1	812	1.04 (2)	780
7	KHULNA	980	329	165	84	117	39	1714	1.07 (4)	1600
8	JESSORE	812	378	62	86	37	9	1386	1.07 (4)	1300
9	FARIDPUR	294	245	21	87	25	5	677	1.07 (4)	630
10	NAGARBARI	295	198	63	23	26	1	606	1.08 (1)	560
11	KASHINATHPUR	460	175	93	37	34	1	795	1.08 (1)	740
12	RANGPUR	530	137	55	36	35	—	793	1.08 (1)	730

SURVEYED JAN - FEB 1985

REMARKS : * Seasonality factors are taken from Fig 9.2.3.

(1) Jamuna Ferry (2) Meghna Ferry (3) Sherpur Ferry (4) Kamarkhali Ferry

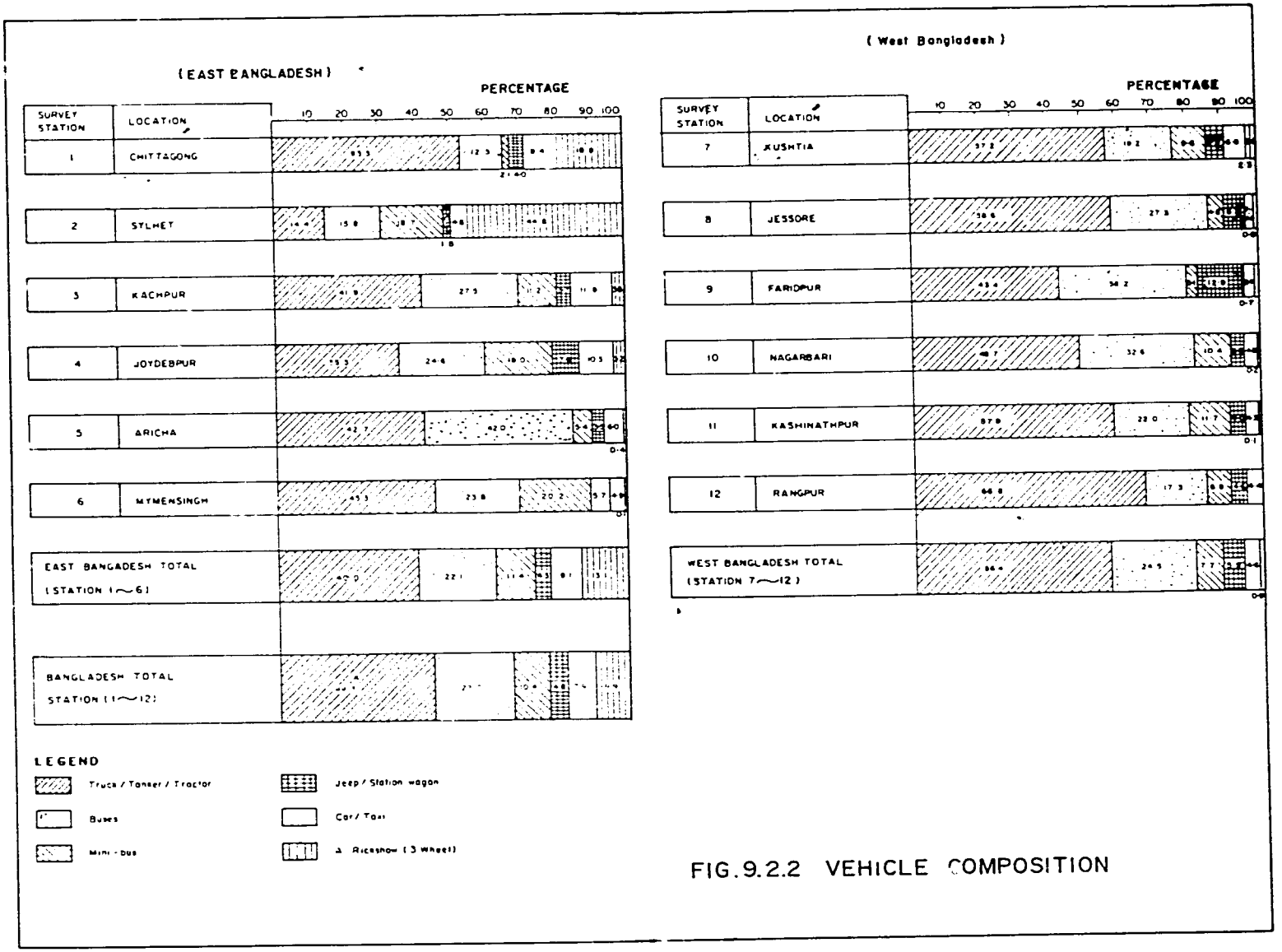


FIG.9.2.2 VEHICLE COMPOSITION

Table 9.2.3 Night Traffic Ratio (22:00 - 6:00)

Survey station	*1 Trucks Traffic volume (1)	*4 Night Traffic Ratio (%) (2)	*2 Buses (1)	*2 Buses (2)	*3 Cars (1)	*3 Cars (2)	Total (1)	Total (2)
1	2,447	25.3	661	6.7	1,481	7.2	4,589	16.8
2	345	15.1	8 828	4.0	1,226	3.0	2,399	5.1
3	1,836	26.0	1,695	5.0	853	8.2	4,384	14.4
4	1,234	25.6	1,519	2.6	738	1.4	3,491	10.5
5	569	26.5	632	15.7	131	13.0	1,332	19.7
6	368	15.2	357	0.6	87	4.6	812	7.5
(East Bangladesh Average)	6,799	(24.6%)	5,692	(5.3%)	4,516	(5.4%)	17,007	(13.0%)
Survey station	Traffic volume (1)	Night Traffic Ratio (%) (2)	(1)	(2)	(1)	(2)	(1)	(2)
7	980	14.2	494	7.3	240	4.6	1,714	10.9
8	812	16.1	440	18.2	134	5.3	1,386	17.0
9	294	14.3	266	7.5	117	5.1	677	10.0
10	295	12.5	261	17.6	50	8.0	606	13.5
11	460	20.7	268	23.9	67	7.5	795	20.6
12	530	25.8	192	3.6	71	4.2	793	18.5
(West Bangladesh Average)	3,371	(17.2%)	1,921	(13.2%)	679	(5.3%)	5,971	(14.8%)
(National Average)	10,170	(22.1%)	7,613	(7.3%)	5,195	(5.4%)	22,978	(13.5%)

Remarks
*1 Trucks include Tankers and Tractors
*2 Buses include minibuses
*3 Cars include Jeep, Station Wagon, Taxi and Auto-rickshaw
*4 Night Traffic Ratio : % of 24/hr. traffic.

Source: Its survey in Jan/Feb 1985

Table 9.2.4 Comparison of Night Traffic Ratio in Other Survey

Survey	Year	Night Traffic Ratio (%) Trucks	Buses	Cars
* 1) BTS	1973	15.0	4.8	5.0
* 2) PCI Survey	1979	17.4	1.5	4.3
ITS Survey	1985	22.1	7.3	5.4

Remarks :

* 1) BTS PART 3, Basic data - Road and Road Transport

* 2) Bangladesh Road Maintenance Improvement and Rehabilitation Project. (Ref No.6)

c) Seasonal traffic variation

Since no monthly traffic records are obtainable from the RHD traffic surveys which have been carried out at irregular times from 1968 to 1984, seasonal variation factors of road traffic were taken from the records of ferries which have been operated by RHD and BIWTC.

BTS also tried to analyse the seasonal variation pattern using the records of traffic crossing ferries, however, they could find no clear seasonal pattern for a long term guide due to many disturbing factors in the traffic record during that period in 1969-73.

The Consultants tried to analyse the seasonal variations by the ferry records. Fig. 9.2.3 shows various seasonal variation factors which were calculated from the past five years monthly records of representative ferries in the arterial road network. The plotted points shown in Fig. 9.2.3 means the factor calculated based on the averaged monthly ferry traffic volume during 1979-85.

In case of Jamuna Ferry, dry season traffic is some 12% higher than the average traffic.

d) Traffic maps

Fig. 9.2.4 shows the estimated AADT on the existing RHD arterial road network in 1980 and 1985.

The AADT values shown were estimated using the new data from the traffic count surveys conducted in January and February, 1985, and together with the selected RHD's old count data (total of 65 points).

The RHD data were updated referring the average annual growth rates of ferry record during past five years 1979-84 shown in Fig. 9.2.9.

The Consultants attempted to find a growth pattern of traffic from the RHD record. However no realistic growth pattern of traffic was found due to irregular observations. Therefore, it was decided to use the average annual growth rate (AAGR) of the major ferry traffic record as the updating factor for the preparation of 1980 and 1985 traffic maps.

The following growth rates were applied for the updating calculation.

Area		Estimated AAGR (%)
Dhaka	- Chittagong	8.0
Dhaka	- Sylhet	6.0
Dhaka	- Aricha	8.0
Dhaulatdia	- Khulna	6.0
Nagarbari	- Dinajpur	8.0
Urban Area (Dhaka & Chittagong)		12.0

while, the seasonal variation factors shown in Fig. 9.2.3 were employed for the AADT estimation.

The details of the estimated AADT in 1985 are shown in APPENDIX 9.4.

e) Growth of traffic

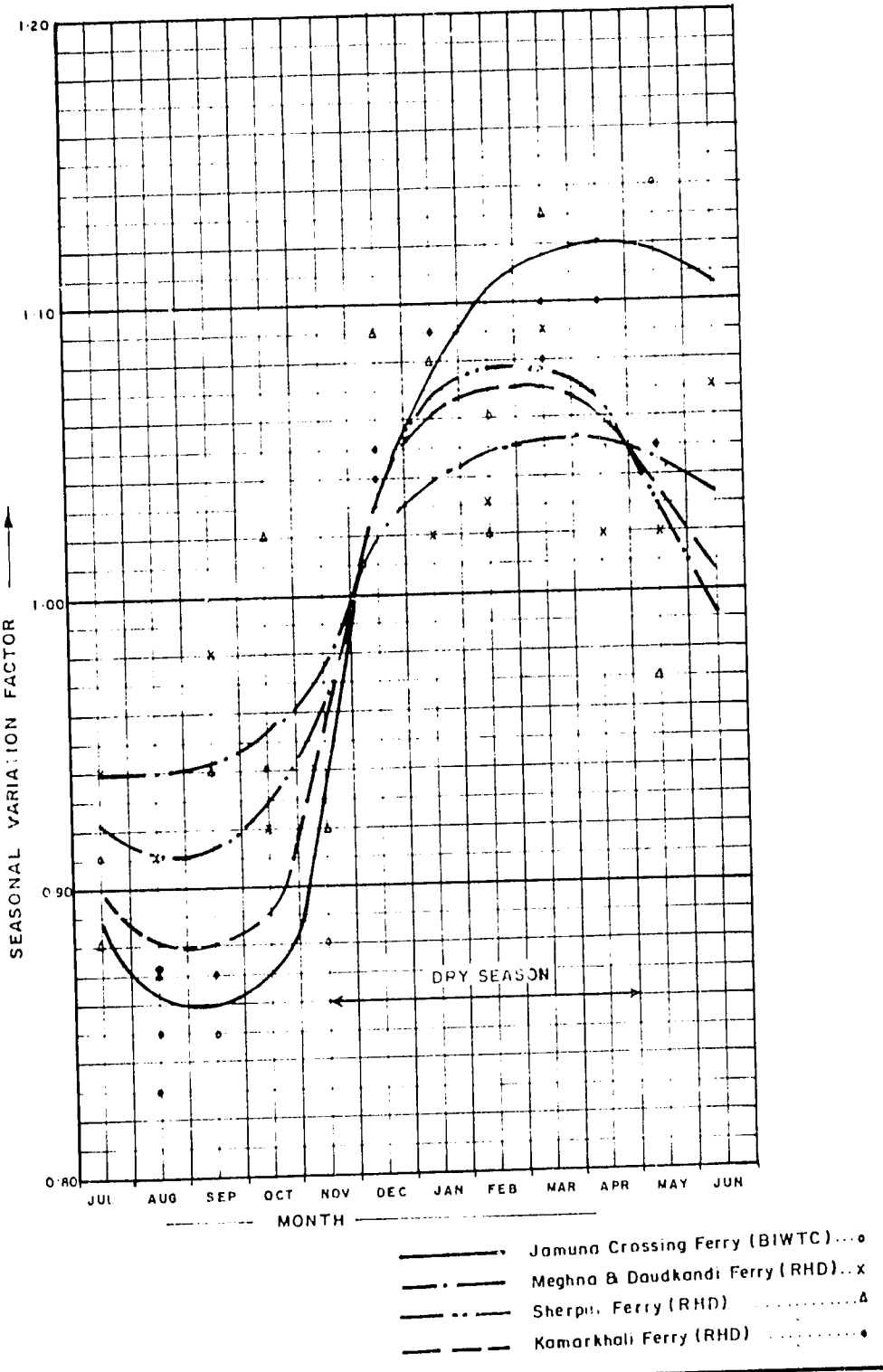
Compared with the estimated AADT of the major arterial road network between 1980 and 1985, the overall average growth rate in the country during past five years indicates about 8.3% per annual as shown in Table 9.2.5.

Table 9.2.5 Growth of Traffic 1980-85 on Existing RHD Arterial Road Network

Area	AADT 1980	AADT 1985	Average Annual Growth Rate
East Bangladesh	730	1,070	7.9%
West Bangladesh	400	600	8.4%
National Average	570	850	8.3%

Source: Consultants Calculations

FIG 9.2.3 SEASONAL VARIATION FACTOR OF ROAD TRAFFIC JUDGED BY MONTHLY FERRY TRAFFIC RECORD BETWEEN 1979-84



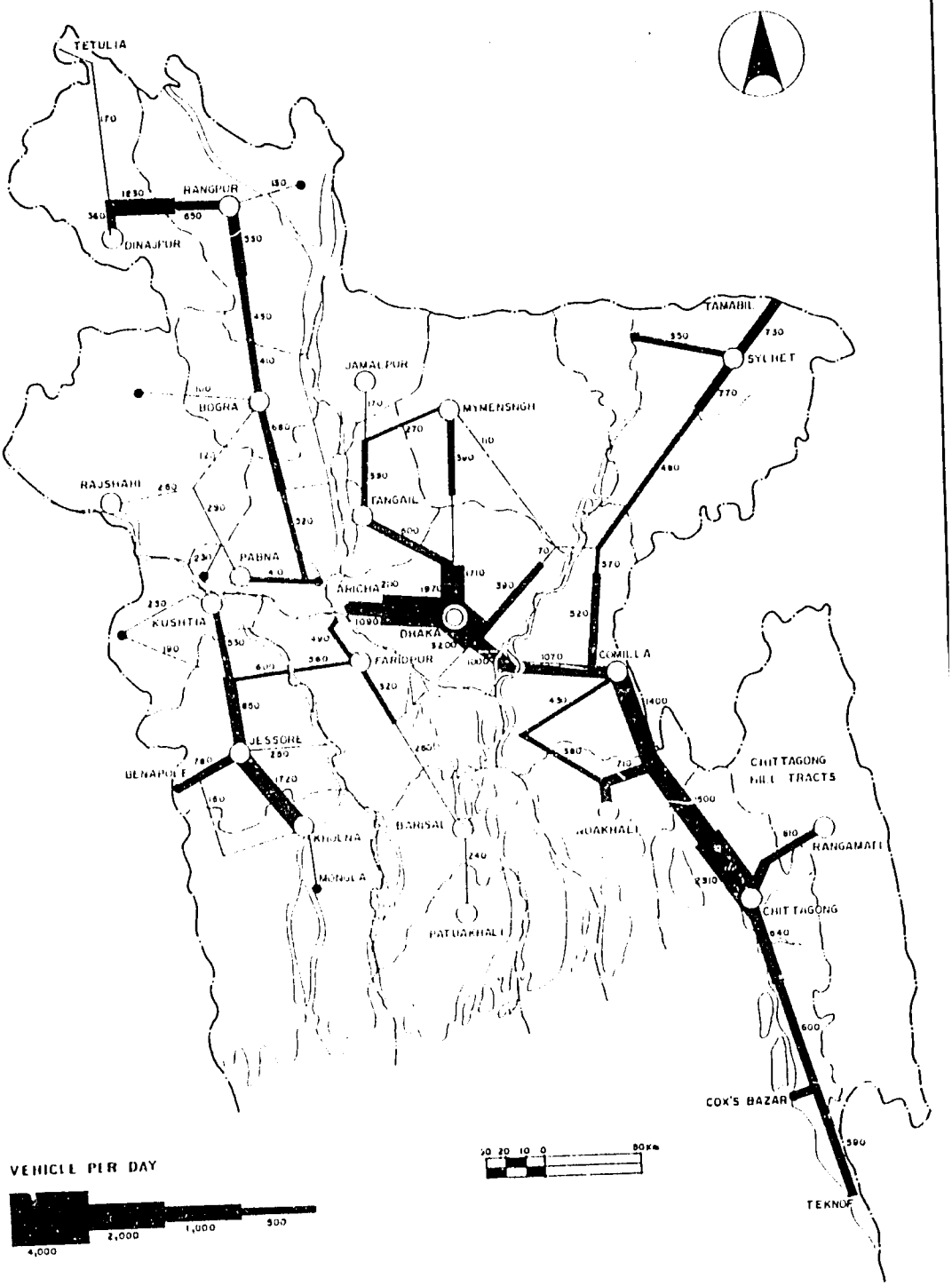


FIG 9.2.4A ESTIMATED AADT ON THE EXISTING ARTERIAL ROAD NETWORK, 1980

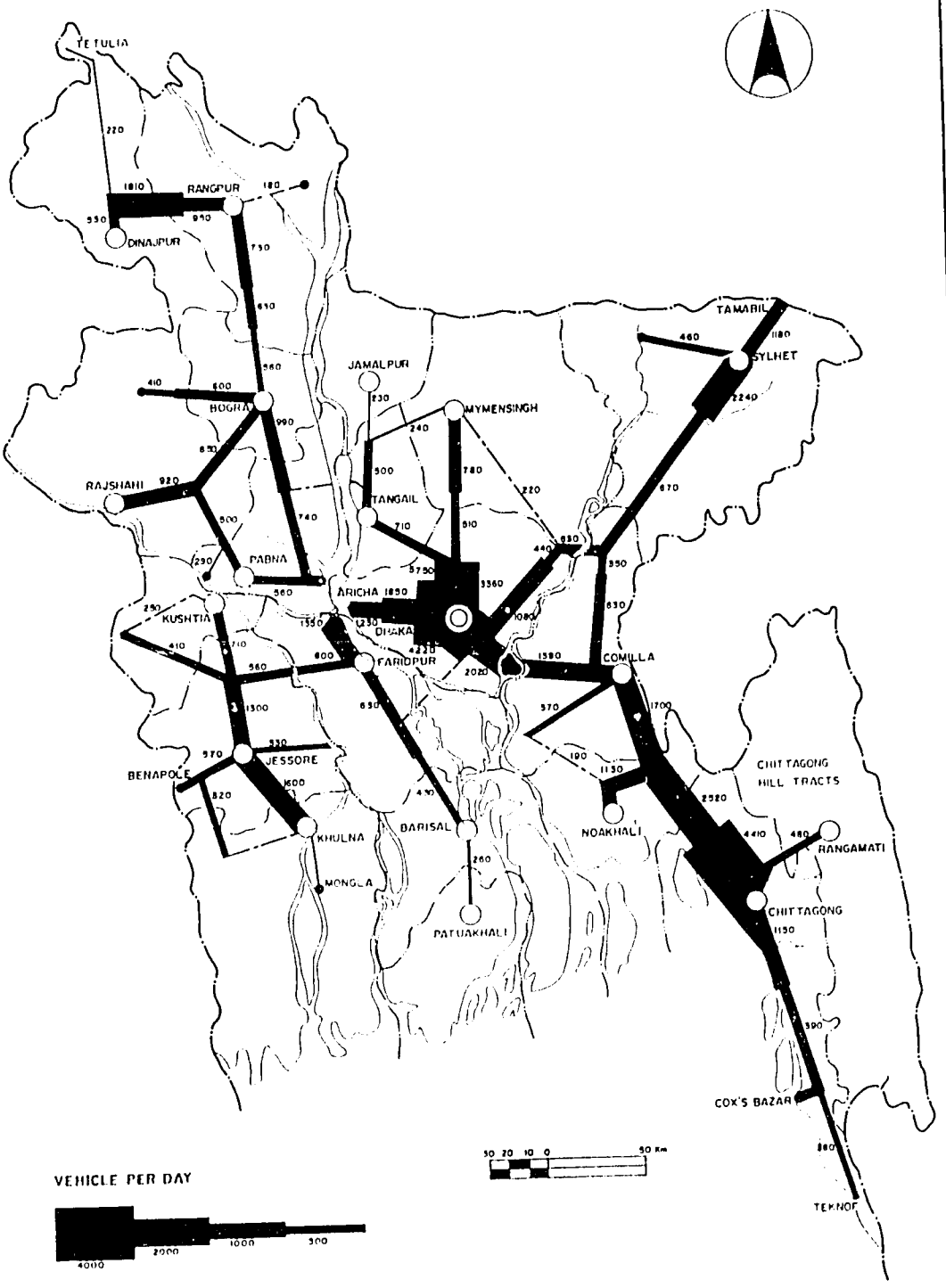


FIG. 9.2.4B ESTIMATED AADT ON THE EXISTING ARTERIAL ROAD NETWORK, 1985

(3) Travel speed surveys

The travel speed surveys were conducted for the BRTC's trucks and buses within their routes in March 1985.

This was judged to be necessary in view of the fact that the conventional speed of 80 km/hr assumed by some consultants was patently inapplicable, as was the utilisation data supplied by the Bus and Truck Owners Association (few distance recorders work) for use in vehicle costing.

Table 9.2.6 and 9.2.7 show the summary of travel speed surveys for trucks and buses. The travel speeds indicated in the tables were calcul calculated considering driver's normal rest time but not including the waiting time for ferry. While running speed were calculated based on the actual driving time. The running speed depends on the road condition. It was observed from this sample survey that the average running speeds of trucks and buses were not much different. They are nearly the same under the existing conditions of the road in Bangladesh.

(4) Ferry traffic

Fig. 9.2.5 shows the relationship between major traffic origin-destination (OD) pairs and ferry crossing. Out of the all interdistrict OD pairs (190 pairs), there are 165 OD pairs for which vehicles have to cross rivers by ferry at least once.

In the major interdistrict movement in Bangladesh today, 8 OD pairs are the only pairs without any ferry crossings out of 24 major OD pairs.

Table 9.2.6 Summary of Travel Speed Survey (Trucks)

Smaple No.	From - To	Running Speed (Km/hr)	Travel Speed (Km/hr)	Remark
Trucks				
1	Dhaka - Dinajpur	24.67	24.67	Delay at Arichagat = 111 hrs. Ferry Journey time = 3 hrs.
2	Dinajpur - Dhaka	29.08	29.08	Delay at Nagarbarighat= 11 hrs. Ferry Journey times = 4 hrs.
3.	Dhaka - Rangpur	32.66	32.66	Delay at Arichaghat = 107 hrs. Ferry journey times = 1 hr.
4.	Rangpur - Dhaka	27.22	27.22	Delay at Nagarbarighat= 33 hrs. Ferry journey times = 4 hrs.
5	Dhaka - Rajshahi	35.0	35.0	Delay Arichaghat = 66-30 hrs Ferry journey times = 4 hrs.
6.	Rajshahi - Faridpur	40.3	23.65	= 9.5hrs
7.	Dhaka - Khulna	33.07	33.07	Delay at Arichaghat = 16 hrs. Ferry journey times = 4 hrs.
8.	Khulna - Dhaka	27.06	27.06	Delay at Dauladiaghat = 35 hrs. Ferry journey times = 1 hr.
9.	Dhaka - Chittagong	24.05	22.04	= 1.0 hrs.
10.	Chittagong - Dhaka	23	22	= 0.3
11.	Dhaka - Chittagong	29.4	25.2	= 1.5
12.	Chittagong - Dhaka	24	21.2	= 1.5
13.	Bogra - Dhaka	31.5	31.5	Delay at Nagarbarighat= 112 hrs. Ferry journey times = 6 hrs.
14.	Dhaka - Bogra	31.5	31.5	Delay at Arichaghat = 45 hrs. Ferry journey times = 5 hrs.
	Trucks Average (15 routes)	29.8 Km/h	28.0 km/h	

Source: BRTC survey in March 1985

Table 9.2.7 Summary of Travel Speed Survey (Buses)

Sample No.	From	To	Running Speed(km/hr	Travel Speed(Km/hr
Buses				
1	Dhaka	Sylhet	33.8	26.1
2	Sylhet	Dhaka	32	25
3	Dhaka	Panchagoar	15.35	11.53
4.	Panchagoar	Dhaka	18.05	14.85
5.	Dhaka	Shatkhira	34	26
6.	Shatkhira	Dhaka	35	26
7.	Dhaka	Dinajpur	37.6	27.4
8.	Dinajpur	Dhaka	47.7	35
9.	Dhaka	Chittagong	31	20.3
	Bus's Average (9 Routes)		31.6 km/h	23.5 km/h

Source: BRTC survey in March 1985

FIG 9.2.5 RELATION BETWEEN MAJOR TRAFFIC O-D PAIRS AND FERRY CROSSING

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CHITTAGONG	1			(0)	(0)		(2)														
C. H. T	2																				
COMILL	3					(1)	(2)														
NOAKHALI	4						(2)														
SYLHET	5						(3)														
DHAKA	6							(1)	(0)	(0)	(0)	(4)	(2)	(2)	(2)		(1)	(1)	(1)	(1)	(1)
FARIDPUR	7													(1)							
JAMALPUR	8																				
MYMENSINGH	9																				
TANGAIL	10																				
BARISAL	11																				
JESSORE	12													(0)	(0)						
KHULNA	13														(0)						
KUSHTIA	14																				
PATUAKHALI	15																				
BOGRA	16																				
RAJSHAHI	17																				
PABNA	18																				
DINAJPUR	19																				
RANGPUR	20																				

LEGEND :

O-D Pair without Ferry Crossing

O-D Pair with Ferry Crossing

(1) O-D Pair of Major Traffic Movement by Road
(Passenger ; More than 2000 Pass/day
Track ; More than 100 Veh/day)
Figure in parenthesis shows number of river gap.

Fig. 9.2.6 shows the annual traffic growth at major crossings in the arterial network which included the Jamuna, Meghna and Daudkandi crossings. The current Jumuna (at Aricha) crossing traffic is about 800 and the others 1,400 vehicles per day.

Recent traffic increases have resulted in creating traffic bottlenecks. Especially at Jamuna crossing at Aricha, the banks of the Jamuna river are yearly eroded by floods and the river course changes frequently, precluding the construction of permanent terminal facilities.

In addition, due to the poor arrangement of queueing areas, the ticket sales system, and the shortage of ferryboats, the waiting time of buses and light vehicles averages between 1.5 to 2 hours. Heavy vehicles have to wait at least 10 hours, sometimes 2 days or more as indicated in Table 9.2.6. It is ovbious that the present ferry capacity is well below current requirement.

BIWTC has been operating ferry services for Jamuna river crossing between the following road gaps.

Aricha Section	Aricha - Nagarbari
	Aricha - Dualatdia
	Aricha - Kazirhat
Dhuapur - Sirajgonj section	Dhuapur - Sirajgonj:

The total of 17 ferries (15 ordinary and 2 roll-on roll-off ferries) are being operated for the above services.

Out of the 17 Nos. of ferries, 13 ferries are deployed at Aricha section and the remaining 4 ferries are operated in Dhuapur - Sirajgonji section. The existing ferry capacity at Aricha is about 190 thousand vehicles per year (Total expected capacity by the end of the SFYP period will be estimated at approximately 290 thousand vehicles per year by the addition of 2 ro-ro-ferries) against the estimated traffic of 290 thousand vehicles in 1984/85.

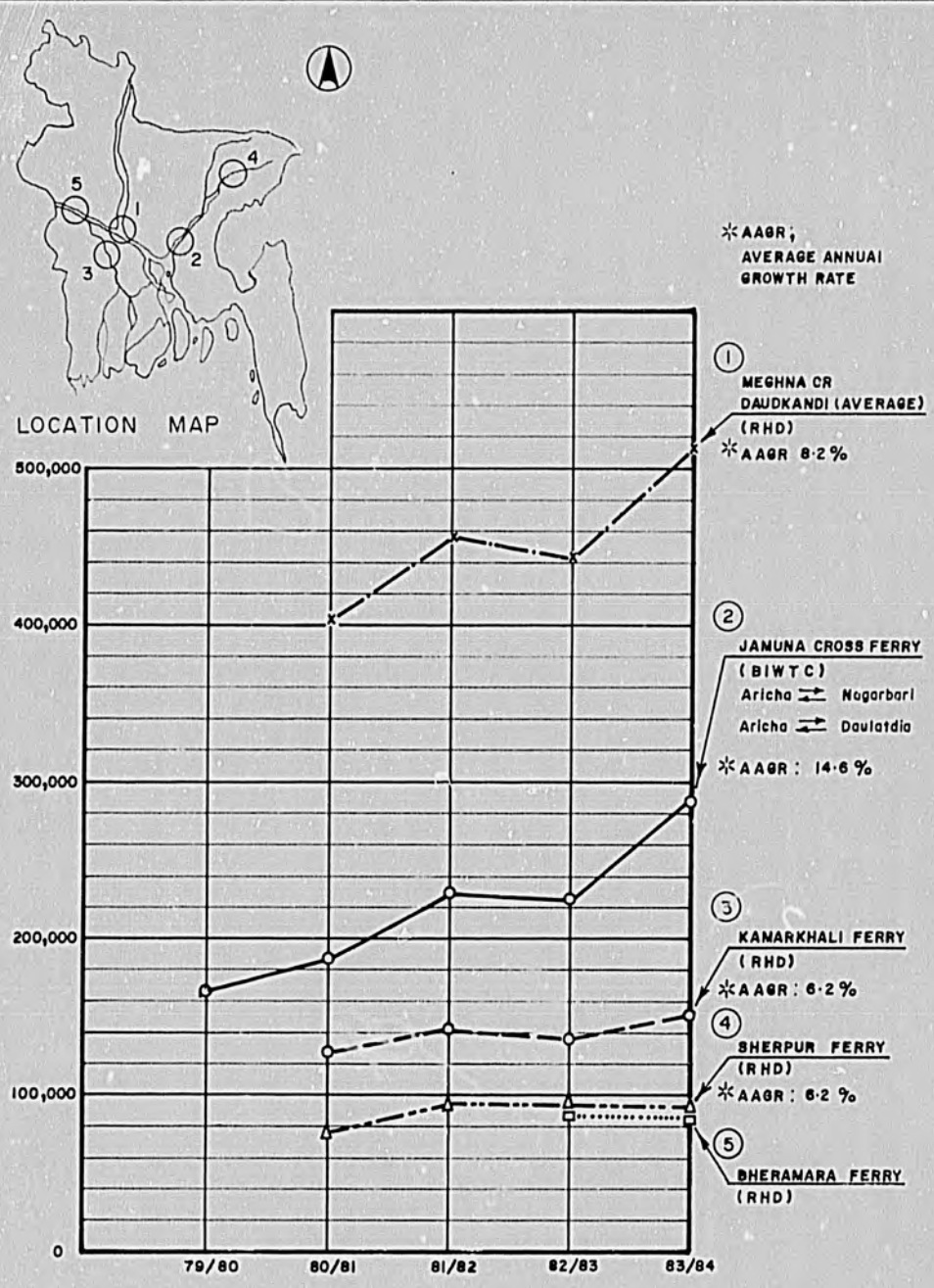


FIG. 9.2.6 ANNUAL GROWTH OF MAJOR FERRY TRAFFIC

(5) Axle loading

For the purpose of estimating goods movements (ton-km) carried by road, the axle load surveys for mainly trucks were conducted in January and February, 1985. Six stations in the east and west Bangladesh were covered and approximately, 1300 trucks were weighed. Accuracy of the RHD's portable weighbridge used in this survey was checked by the Road Research Laboratory during the survey. The survey results are presented in Fig. 9.[illegible] and Table 9.2.8.

Compared with the various survey results which were conducted since BTS in 1973, shown in Table 9.2.9 the following points can be noted;

- BTS estimates which were adopted by the Bangladesh Road Maintenance Improvement and Rehabilitation Project, 1979 (Ref. 6) gives the lowest standard axle values.

- ITS results are a little higher than RHD's values which were obtained in 1982, however the typical patterns of the axle load distribution are very similar as shown in Fig. 9.2.7.

- The value of the suggested number of standard axles for trucks (2.20) by the Road Rehabilitation and Maintenance project in 1984 (Ref. 7) is much higher than the other surveys.

Since the past survey results vary a great deal, the standard axle load to be used for future pavement designs should be carefully decided taking into consideration area.

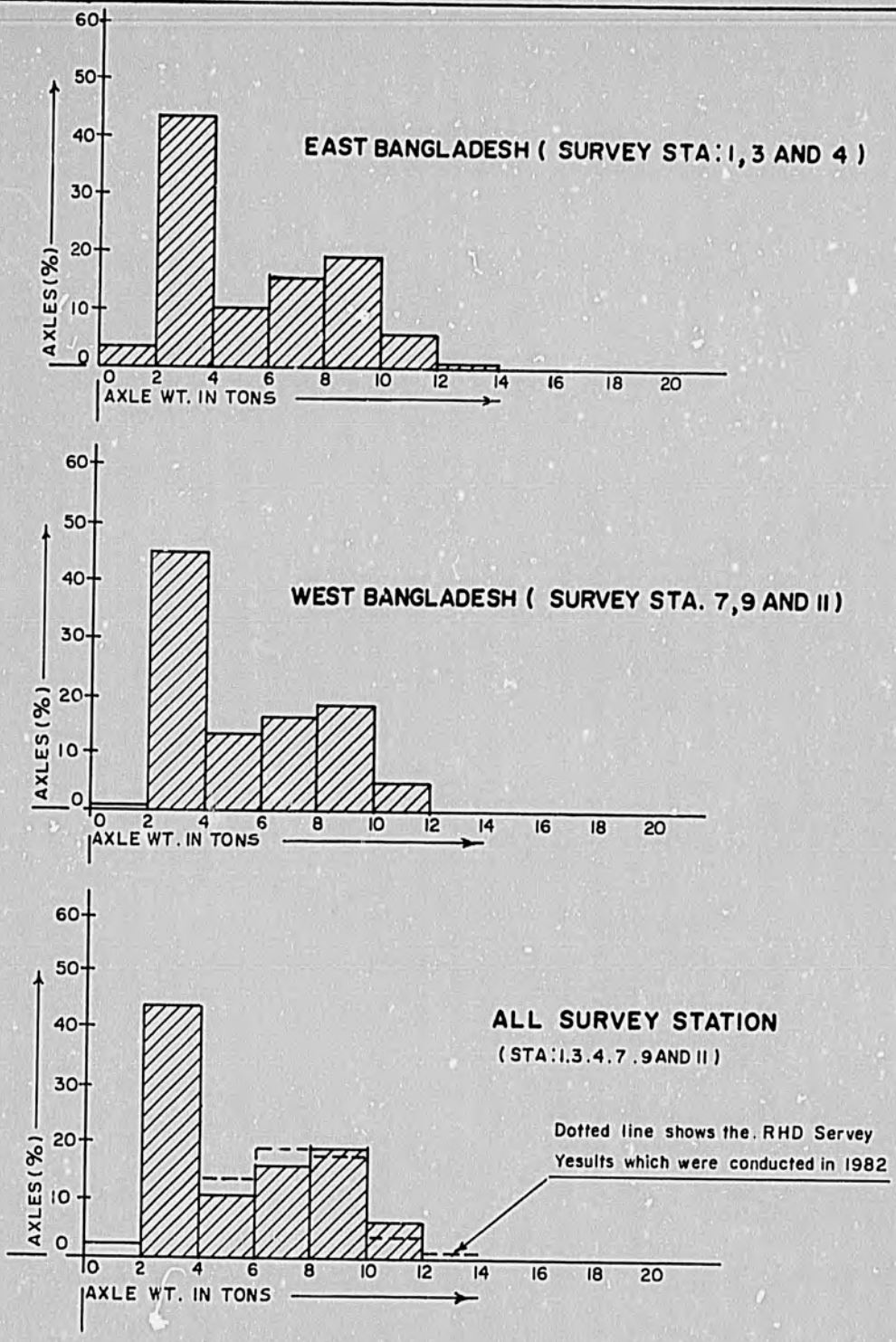


FIG. 9.2.7 AXLE LOAD DISTRIBUTION DIAGRAM (TRUCKS)

Source = ITS Survey in Jan/Feb 1985

Table 9.2.8 Axle Load Distribution of Truck (Summary)

AXLE LOAD RANGE (ton)	STANDARD AXLE EQUIPMENT FACTOR	EAST BANGLADESH (survey station 1,3 &4) NUMBER OF AXLE					STANDARD AXLE	WEST BANGLADESH (survey station 7,9&11) NUMBER OF AXLE					STANDARD AXLE	TOTAL NUMBER OF AXLE (all station		STANDARD AXLE
		Survey station			Sub Total			Survey station			Sub Total					
	(1)	1	3	4	(2)	(3)	(1)x(2)	7	9	11	(2)	(3)	(1)x(3)	(4)	(3)	(1) x (4)
1 - 2	0.0025	5	23	31	59	(3.5)	0.1475	1	3	1	5	(0.5)	0.0125	64	(2.5)	0.16
2 - 3	0.01	63	75	123	261	(15.6)	2.61	16	36	80	132	(14.3)	1.32	393	(15.1)	3.93
3 - 4	0.04	138	87	237	462	(27.7)	18.48	61	91	132	284	(30.7)	11.36	746	(28.8)	29.84
4 - 5	0.08	32	33	72	137	(8.2)	10.96	37	38	28	103	(11.1)	8.24	240	(9.2)	19.20
5 - 6	0.2	7	9	15	31	(1.9)	6.20	5	6	8	19	(2.1)	3.80	50	(1.9)	10.0
6 - 7	0.3	28	12	28	68	(4.1)	20.40	3	12	28	43	(4.6)	12.90	111	(4.3)	33.3
7 - 8	0.7	89	28	84	201	(12.0)	140.70	18	23	71	112	(12.1)	78.40	313	(12.1)	219.1
8 - 9	1.2	44	39	142	225	(13.5)	270.00	31	39	38	108	(11.7)	129.60	333	(12.8)	399.6
9 - 10	1.9	17	25	61	103	(6.2)	195.70	25	28	13	66	(7.1)	125.40	169	(6.5)	321.1
10 - 11	3.0	28	13	38	79	(4.7)	237.00	27	15	5	47	(5.1)	141.00	126	(4.9)	378.0
11 - 12	4.5	11	8	15	34	(2.0)	153.00	3	1	2	6	(0.6)	27.00	40	(1.5)	180.0
12 - 13	6.6	-	4	5	9	(0.5)	59.40	1	-	-	1	(0.1)	6.60	10	(0.4)	66.0
13 - 14	9.5	-	1	-	1	(0.1)	9.50	-	-	-	-		-	1	(-)	9.5
Total		462	357	851	(A) 1.670	(100.0)	(B) 1124.10	228	292	406	926	(100.0)	545.63	2596	(100.0)	1669.73
STANDARD AXLE LOAD		0.65	0.66	0.69	(B) ÷ (A)		0.673	0.90	0.61	0.40			0.589			0.643

Source : ITS Survey in Jan/Feb.,1985.

Table 9.2.9 Summary of Axle Load Survey Results

YEAR	SURVEY STATION	TRUCKS		BUSES	
		NUMBER Of Vehicles	STANDARD Axles/Veh	NUMBER OF of Vehciles	STANDARD Axles/Veh.
1973	BTS		0.22		0.14
1979 (Dry)	Dhaka - Aricha	230	1.47	126	1.32
	Dhaka - Sylhet	88	1.64	191	0.25
1980 (Dry)	Feni - by pass to Chittagong	3,230	0.54		0.46
	to Dhaka		1.30 2.25		0.36 0.66
1981 (monsoon)	Feni by pass to Chittagong	97	0.51	109	0.29
	to Dhaka	169	0.63	151	0.28
1982 (Dry)	RHD Survey				
	Nabinagar	934	0.9	857	0.20
	Katchpur	982	1.0	1,573	0.20
	Mirzapur	447	0.7	351	0.20
	Maynamati	535	1.2	637	0.20
	Kalurghat	335	2.6	510	0.40
			Ave		Ave
		3,233	1.1	3,928	0.20
1985 (Dry)	Intermodel Transport Study (ITS)				
	Chittagong	231	1.30	11	* 0.62
	Katchpur	181	1.32	10	* 0.26
	Joydebpur	429	1.38	-	-
	Khulna	112	1.80	14	* 1.04
	Faridpur	146	1.22	19	* 0.90
	Pabna	204	0.80	12	* 0.38
			Ave		Ave.
		1,303	1.28	66	* 0.70

* Result of small sample survey for big buses only.
Mini buses are not included.

9.2.2 Passenger traffic characteristics

(1) Origin-Destination (OD) matrix

The passenger OD interview surveys were conducted in January and February, 1985 for the analysis of passenger movement. The total of 12 survey stations were selected, approximately 7,000 passengers out of 87,000 passengers in the survey vehicles were interviewed. The sampling rate was about 8% of all travelling passengers in the survey vehicles. The details of the sampling rate of each vehicle type are shown in Table 9.2.10, and the result of the OD interview survey is presented in the form of passenger OD matrix in Fig. 9.2.8. The matrix was developed taking into account the Jamuna crossing as screenline counts. Jamuna screenline traffic estimates are shown in APPENDIX 9.4.

Table 9.2.10 Sampling Rate of Passenger OD Surveys

Type of vehicle	Nos. of passenger interviewed	Nos. of passenger in the vehicle	Sampling rate
Buses	5,099	67,981	7.5%
Mini-buses	1,267	16,791	7.5%
Jeep/Car/Taxi	579	2,013	28.8%
Total :	6,945	86,785	8.0%

(2) Passenger movement

It was estimated from the results of the OD survey that a total of 305,240 passengers were travelling on the main and inter-district road network in a day through the survey stations.

As discribed in Chapter 9.2.1, the scope of traffic survey was limited due to budgetary constraint. Only 12 stations were selected for the OD surveys in the arterial road network to analyze major inter-district movements both of passengers and commodity trucks. The numerous zeros in the OD matrix mean that they are for minor inter-district OD pairs or OD pairs where no survey stations were established in both districts under this study.

The intra-district movement of passengers within populous districts such as Dhaka, Chittagong, etc. account for about 60% of the total.

The proportion of the internal passenger movements within East and West Bangladesh was in the ratio of 7:2, and East-West movement crossing Jamuna river occupying about 10% of the total, as shown in Fig. 9.2.9.

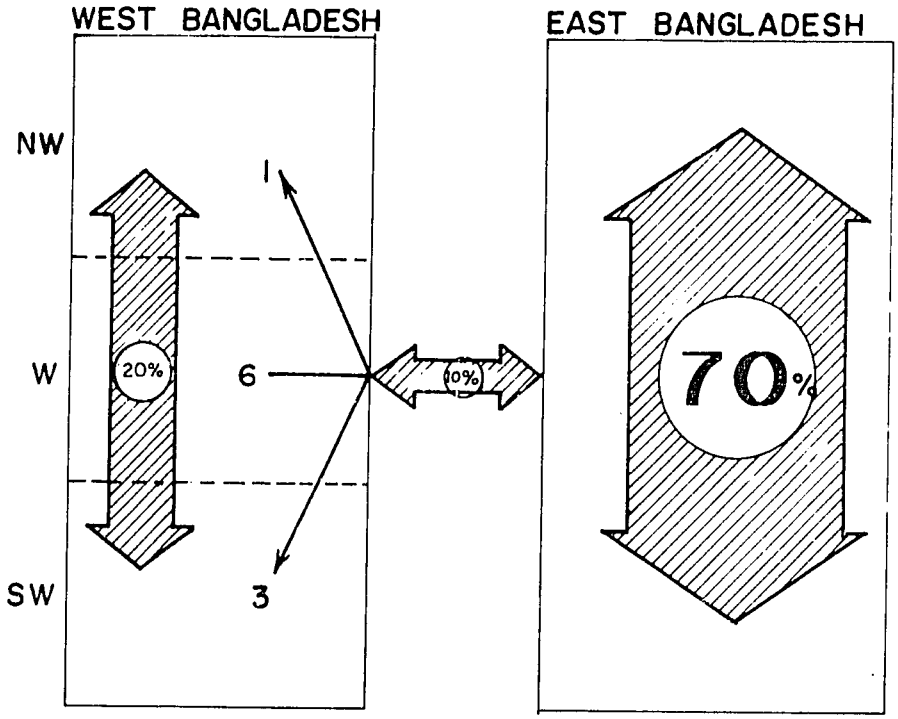
The comparison of passenger movement between BTS and this study is shown in Table 9.2.18.

FIG 9.2.8

O-D MATRIX-PASSENGER SURVEY STA. ALL STATION

		CHITTAGONG	CTG HILL TRACKS	COMILLA	NOAKHALI	SYLHET	DHAKA	FARIDPUR	JAMALPUR	MYMENSINGH	TANGAIL	BARISAL	JESSORE	KHULNA	KUSHTIA	PATUAKHALI	BOGRA	DINAJPUR	PABNA	RAJSHAHI	RANGPUR
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CHITTAGONG	1	17150	0	3960	19320	50	6240	30	60	0	0	0	30	30	0	0	0	0	10	10	0
CTG. HILL TRACTS	2		0	0	0	0	240	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMILLA	3			0	0	1860	7530	250	0	30	100	0	30	30	0	0	0	0	40	10	0
NOAKHALI	4				0	260	9430	0	0	0	0	0	0	40	0	0	0	0	0	0	0
SYLHET	5					22170	4760	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DHAKA	6						36250	3550	1640	15410	9160	1700	2600	2360	3280	290	430	430	1930	1750	1500
FARIDPUR	7							3900	0	0	0	610	1760	780	0	0	0	0	80	30	0
JAMALPUR	8								0	0	0	0	0	0	0	0	0	0	0	0	0
MYMENSINGH	9									8590	0	0	30	0	0	0	0	0	0	0	0
TANGAIL	10										0	0	0	10	0	0	0	0	0	0	0
BARISAL	11											0	380	650	0	560	0	0	0	0	0
JESSORE	12												16360	1420	2440	70	0	0	110	0	0
KHULNA	13													6920	1020	570	80	70	60	50	20
KUSHTIA	14														0	0	0	0	30	0	0
PATUAKHALI	15															0	0	0	0	0	0
BOGRA	16																0	540	1040	170	1910
DINAJPUR	17																	0	20	30	420
PABNA	18																		11100	590	320
RAJSHAHI	19																			0	290
RANGPUR	20																				5450

TOTAL 305,240



Traffic Movement	Passenger / Day	Percentage
Intra- District Traffic	192,890	63.2
East Bangladesh	(144,160)	(47.2)
West Bangladesh	(48,730)	(16.0)
Inter - District Traffic	112,350	36.8
East Bangladesh	(70,050)	(22.9)
West Bangladesh	(16,120)	(5.3)
East-West Traffic	(26,180)	(8.6)
Total	305,240	100.0

FIG. 9.2.9 PROPORTION OF THE PASSENGER MOVEMENT IN BANGLADESH

Source: ITS OD Survey in Jan/Feb, 1985

The major passenger movements are almost all to and from Dhaka having its origin/destination (60% of the total passenger traffic) in connection with "H" shaped trunk road network as shown in Fig. 9.5.2.

Fig. 9.2.10 shows the passenger desire lines at the time of survey and Table 9.2.11 shows the list of major OD pairs for the passenger traffic. Passenger movement between Dhaka and Mymensingh ranks first, occupying 5% of the total passenger movement, 24% of the inter-district movement. This is can be accounted for by the fact that district Mymensingh is one of the most populous areas in Bangladesh following Dhaka and Comilla and road transport became more convenient than before due to the crossing of the Dhaka-Mymensingh road directly. In addition this route has no river.

(3) Bus passengers

The OD interview survey indicated that more than 95% of all road transport passengers in Bangladesh are carried by buses including mini buses.

One bus carries 53 passengers and one mini buses carries 26 passengers per trip on national average. These loading factors were nearly 1.0, the same as the result of PCI survey which was conducted in 1984 under the Meghna, Meghna-Gumti Bridge Construction Project (Ref. 5).

(4) Trip length and load factor

The average trip length of passengers was estimated at as 113 kms for buses, 85.9 kms for mini buses, 91.7 kms for cars/jeep and the overall average of 90 kms. The survey results of trip length and loading factor at each survey station are summarised in Table 9.2.12 and Table 9.2.13.

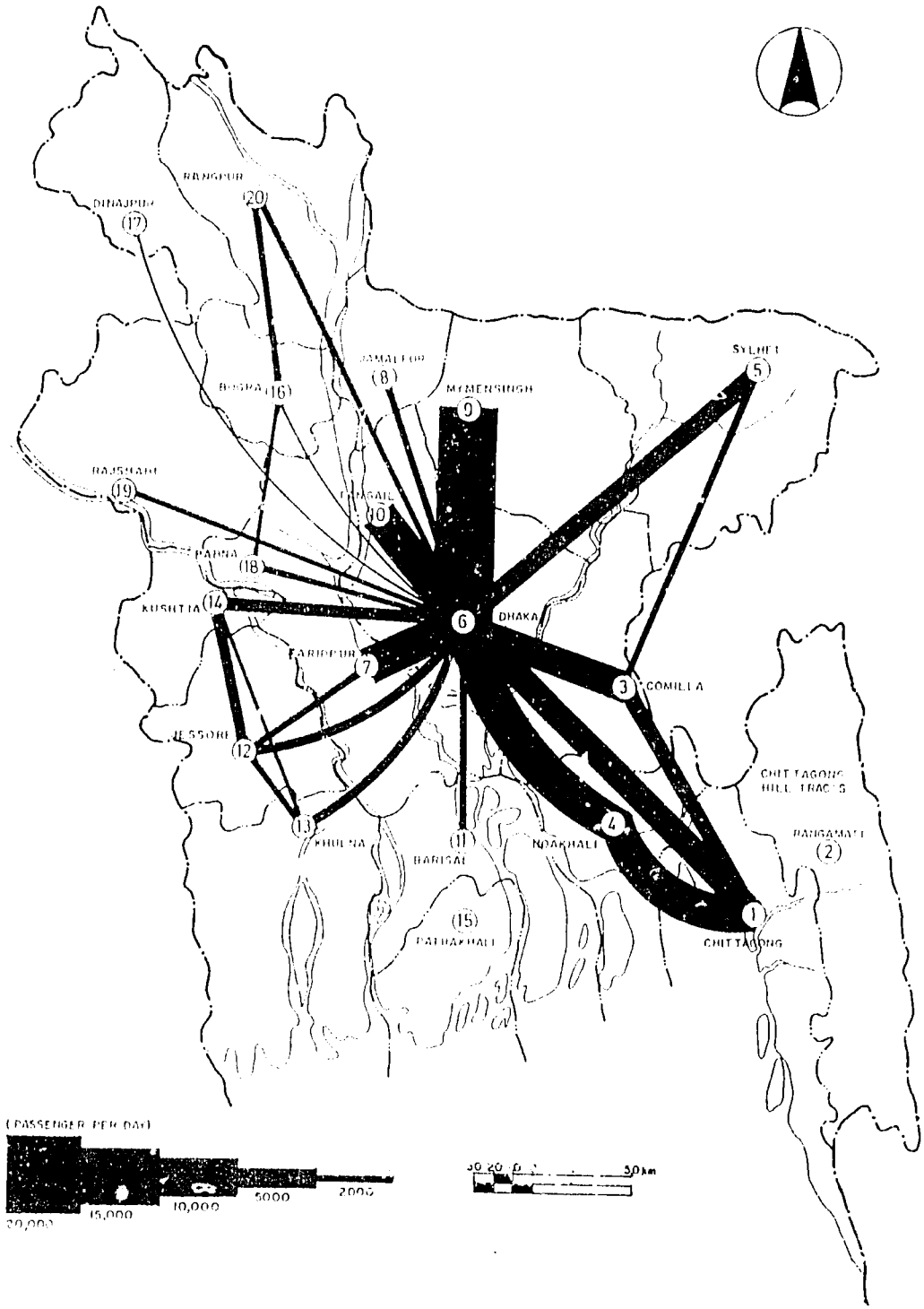


FIG. 9.2.10 MAJOR PASSENGER MOVEMENT BY ROAD

—PASSENGER DISIRE LINE BY O-D SURVEY IN JAN/FEB 1985—

(12 - Stations)

Table 9.2.11 List of Major OD Pair for the Passenger Traffic

Ranking	O-D Pair	Pass/day	District	Location of Road in "H" Shaped Trunk Road Network (Ref.Fig.9.5.2)
1	6-9	15,410	Dhaka - Mymensingh	
2	4-6	9,430	Noakhali - Dhaka	
3	1-4	9,320	Chittagong - Noakhali	
4	6-10	9,160	Dhaka - Tangail	
5	6-7	8,550	Dhaka - Faridpur	
6	3-6	7,530	Comilla - Dhaka	
7	1-6	6,240	Chittagong - Dhaka	
8	5-6	4,760	Sylhet - Dhaka	
9	1-3	3,960	Chittagong - Comilla	
10	6-14	3,360	Dhaka - Kushtia	
11	6-12	2,600	Dhaka - Jessore	
12	6-13	2,460	Dhaka - Khulna	
13	12-14	2,440	Jessore - Kushtia	
14	6-18	1,930	Dhaka - Pabna	
15	16-20	1,910	Bogra - Rangpur	
16	3-5	1,860	Comilla - Sylhet	
17	7-12	1,760	Faridpur - Jessore	
18	6-19	1,750	Dhaka - Rajshahi	
19	6-8	1,640	Dhaka - Jamalpur	
20	6-20	1,500	Dhaka - Rangpur	

Table 9.2.12 Average Number of Passengers and Trip Length

Survey Station	BUSES			MINIBUSES			OTHERS		
	Nos. of Veh.	Ave. Nos. of pass per veh.	Ave. Trip length per sta.	Nos. of Veh.	Ave. Nos. of pass per veh.	Ave. Trip length per sta.	Nos. of Veh.	Ave. Nos. of pass per veh.	Ave. Trip length per sta.
	1	2	3	1	2	3	1	2	3
1	564	62.2	121.7	97	15.0	127.1	615	2.8	91.0
2	379	45.0	83.6	449	20.7	51.9	150	3.5	86.4
3	1204	56.2	109.5	491	31.7	80.5	684	3.1	87.6
4	857	47.4	61.8	662	23.8	61.2	625	2.9	58.4
5	560	48.4	169.0	720	28.6	115.9	126	4.0	159.2
6	193	61.4	52.6	164	21.6	119.8	86	3.7	85.4
Sub-total (Average)		53.0	104.4		25.6	86.0		3.1	85.7
7	329	61.0	120.4	165	23.1	84.5	201	3.8	88.4
8	378	50.1	160.7	62	22.5	115.7	125	3.1	115.7
9	245	55.6	103.9	21	20.8	63.6	112	3.4	54.0
10	198	45.6	105.9	63	28.4	83.1	49	3.8	123.8
11	175	50.3	164.3	93	31.8	78.4	66	4.1	205.6
12	137	66.5	156.6	55	29.9	82.9	71	3.8	139.8
Sub-total (Average)		54.4	134.5		26.2	85.4		3.6	110.4
Total (Average)		53.4	113.0		25.7	85.9		3.2	91.7

Source : ITS Survey in Jan/Feb., 1985

Table 9.2.13 Comparison of Average Load and Capacity of Buses and Minibuses at Different Survey Station

Survey stations	BUSES			MINIBUSES		
	Load (Ave. Nos of passenger)	Capacity (Av. seating capacity)	Ratio	Load	Capacity	Ratio
1	62.2	51.7	1.20	15.0	19.7	0.76
2	45.0	43.7	1.03	20.7	21.2	0.98
3	56.2	51.3	1.10	31.7	28.0	1.13
4	47.4	51.5	0.92	23.8	26.9	0.88
5	48.4	51.3	0.94	28.6	27.7	1.03
6	61.4	52.0	1.18	21.6	23.0	0.94
(East Bangladesh Average)	53.0	50.7	1.05	25.6	25.8	0.99
7	61.0	50.7	1.20	23.1	25.4	0.91
8	50.1	50.0	1.00	22.5	26.9	0.84
9	55.6	50.0	1.11	20.8	23.8	0.87
10	45.6	49.2	0.93	28.4	27.6	1.03
11	50.3	51.4	0.98	31.8	28.0	1.14
12	66.5	51.4	1.29	29.9	28.0	1.07
West Bangladesh Average	54.4	50.3	1.08	26.2	26.7	0.98
National Average	53.4	50.6	1.06	25.7	25.9	0.99

Source : ITS survey in Jan/Feb., 1985.

9.2.3 Commodity traffic characteristics

(1) OD matrix

The truck OD interview surveys were conducted for the analysis of goods movement by road. A total of 12 survey stations, the same as for passenger OD, were selected. Approximately 2700 trucks were interviewed with a sampling rate of 26.5%. The result of the OD matrix is shown in Fig. 9.2.11. The matrix was developed taking into account the Jamuna crossing as screenline counts.

(2) Truck movement

It was estimated by the result of the OD survey that a total of 6,962 trucks moved through the 12 survey stations on the main and inter-district road network in a day, which is 41% of the estimated number of on road trucks in 1985. The inter-district truck movement occupying about 72% of the total. The proportion of the truck movement between East and West Bangladesh is in the ratio of 6:3 and east-west truck movement crossing Jamuna river occupying about 10% of the total as shown in Fig. 9.2.12.

Truck movement is largely devided into two groups : one has origin/destination at Dhaka (44% of the total truck traffic on the main and inter-district), and the other at Chittagong (30%) as shown in the truck OD matrix.

Fig. 9.2.13 shows the truck desire lines indicating a typical pattern of goods movement in Bangladesh, and Table 9.2.14 shows a list of major OD pairs for the goods movement. The average trip length of the truck was estimated as 170 kms from this survey.

Dhaka-Chittagong Highway is used by the goods traffic having origin-destination pairs of Dhaka-Chittagong, Dhaka-Comilla, Comilla-Chittagong and Noakhali-Chittagong. These goods traffic account for 30% of the total goods traffic in Bangladesh.

(3) Commodity types

The share of commodity carried by truck is shown in Fig. 9.2.14 among the commodities observed. Foodgrain was the largest among a goods carried by truck followed by iron and steel in East Bangladesh and by cement in West Bangladesh at the time of survey. The goods traffic between Dhaka-Mymensingh or Dhaka-Rangpur are comparative high because of its high cereal surplus or difficit factors as shown in Section 2.4.7, Volume I.

(4) Loading conditions

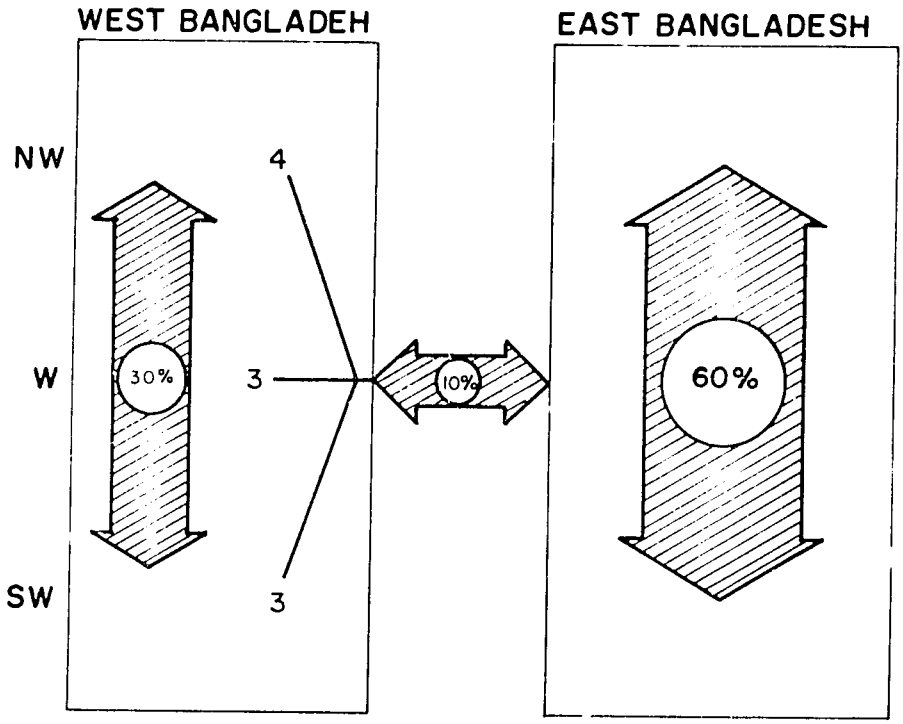
The average weight of loaded and empty trucks was observed as 11.7 tons for loaded, 5.0 tons for empty as shown in Table 9.2.15.

FIG 9.2.11

O- D MATRIX-TRUCK SURVEY STA. ALL STATION

		CHITTAGONG	CTG HILL TRACKS	COMILLA	NOAKHALI	SYLHET	DHAKA	FARIDPUR	JAMALPUR	MYMENSINGH	TANGAIL	BARISAL	JESSORE	KHULNA	KUSHTIA	PATUAKHALI	BOGRA	DINAJPUR	PABNA	RAJSHAHI	RANGPUR
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CHITTAGONG	1	254	0	582	434	43	230	[illegible]	34	16	5	4	4	3	2	0	7	6	[illegible]	[illegible]	[illegible]
CTG HILL TRACKS	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COMILLA	3			0	0	150	172	0	5	3	0	0	0	0	0	0	0	0	1	[illegible]	0
NOAKHALI	4				0	2	164	2	0	0	0	0	0	0	0	0	0	0	0	[illegible]	4
SYLHET	5					231	84	1	0	1	0	0	0	1	0	0	0	0	0	0	2
DHAKA	6						718	28	193	335	282	[illegible]	[illegible]	49	[illegible]	0	35	44	27	[illegible]	94
FARIDPUR	7							213	0	0	0	0	36	104	0	0	0	4	6	0	13
JAMALPUR	8								0	0	0	0	0	0	0	0	0	0	1	0	0
MYMENSINGH	9									80	0	0	1	0	0	0	0	0	1	0	1
TANGAIL	10										0	0	0	1	0	0	0	1	0	0	0
BARISAL	11											0	0	7	0	0	4	0	0	2	2
JESSORE	12												82	389	30	0	14	1	8	2	2
KHULNA	13													63	176	0	19	4	74	71	25
KUSHTIA	14														0	0	0	0	2	0	13
PATUAKHALI	15															0	0	0	0	0	0
BOGRA	16																0	2	16	0	27
DINAJPUR	17																	0	18	2	32
PABNA	18																		209	93	70
RAJSHAHI	19																			0	17
RANGPUR	20																				104

TOTAL [illegible]



Traffic Movement	Trucks/Day	Percentage
Intra-District Traffic	1,954	28.1
East Bangladesh	(1,283)	(18.4)
West Bangladesh	(671)	(9.7)
Inter-District Traffic	5, 008	71.9
East Bangladesh	(3,235)	(46.5)
West Bangladesh	(1,293)	(18.5)
East-West Traffic	(1,480)	(6.9)
Total.	6,962	100.0%

FIG. 9.2.12 PROPORTION OF THE GOODS (TRUCK) MOVEMENT IN BANGLADESH

SOURCE: ITS OD Survey in Jan/Feb, 1985

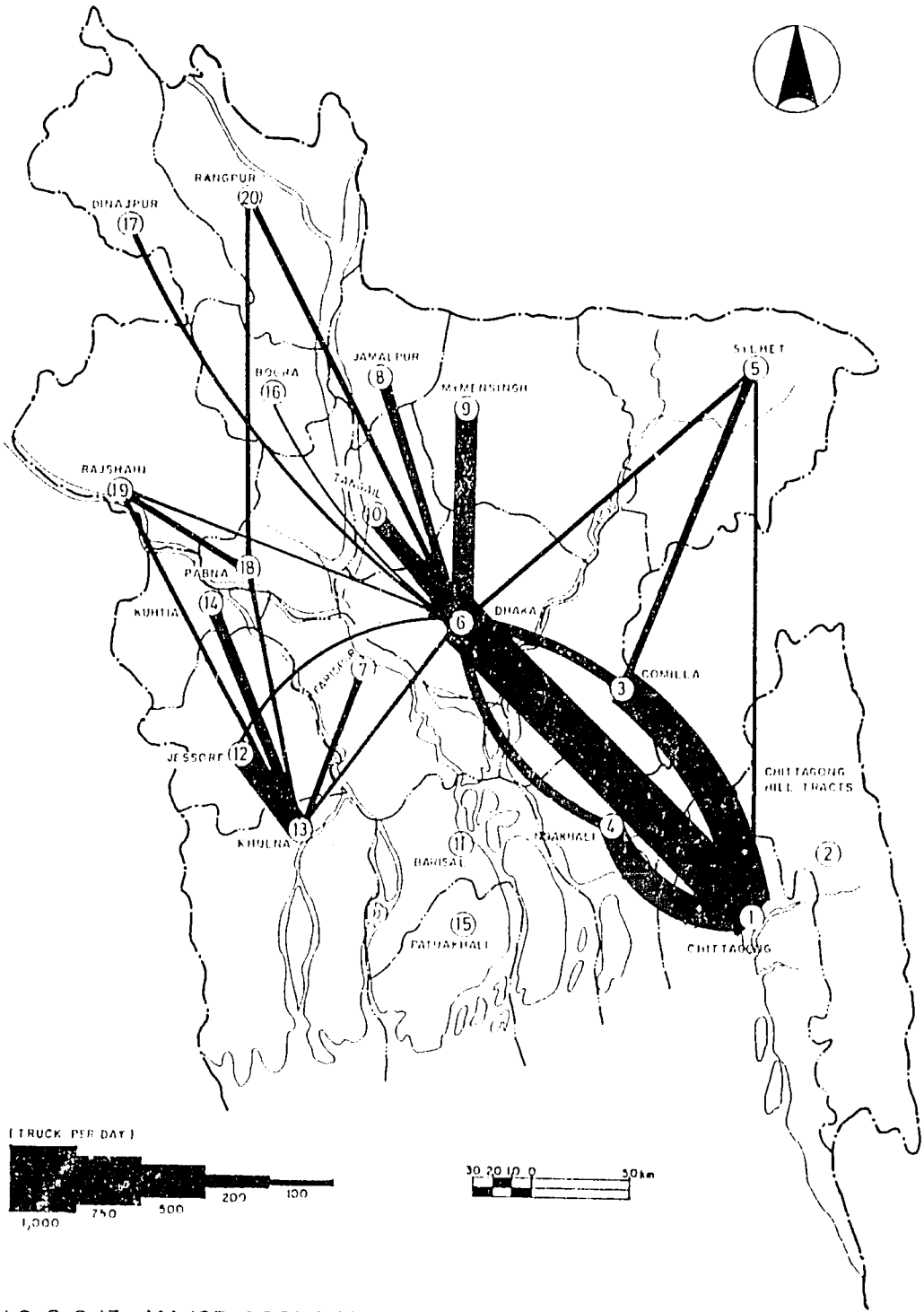


FIG. 9.2.13 MAJOR GOODS MOVEMENT BY ROAD

-TRUCK DISIRE LINE BY O-D SURVEY IN JAN/FEB 1985-
(12-Stations)

Table 9.2.14 List of Major OD Pairs for the Truck (Goods) Movement

Ranking	O-D Pair	Truck/day	District	Location of Road in "H" shaped Trunk Road Network (Ref.Fig.9.5.2)
1	1-6	730	Chittagong - Dhaka	
2	1-3	582	Chittagong - Comilla	
3	1-4	434	Chittagong - Noakhali	
4	12-13	389	Khulna - Jessore	
5	6-9	335	Dhaka - Mymensingh	
6	6-10	282	Dhaka - Tangail	
7	6-8	193	Dhaka - Jamalpur	
8	13-14	176	Khulna - Kushtia	
9	3-6	172	Comilla - Dhaka	
10	4-6	164	Noakhali - Dhaka	
11	3-5	150	Comilla - Sylhet	
12	7-13	104	Faridpur - Khulna	
13	18-19	99	Pabna - Rajshahi	
14	6-20	94	Dhaka - Rangpur	
15	5-6	84	Sylhet - Dhaka	
16	13-18	74	Khulna - Pabna	
17	13-19	71	Khulna - Rajshahi	
18	18-20	70	Pabna - Rangpur	
19	6-12	60	Dhaka - Jessore	
20	6-13	48	Dhaka - Khulna	

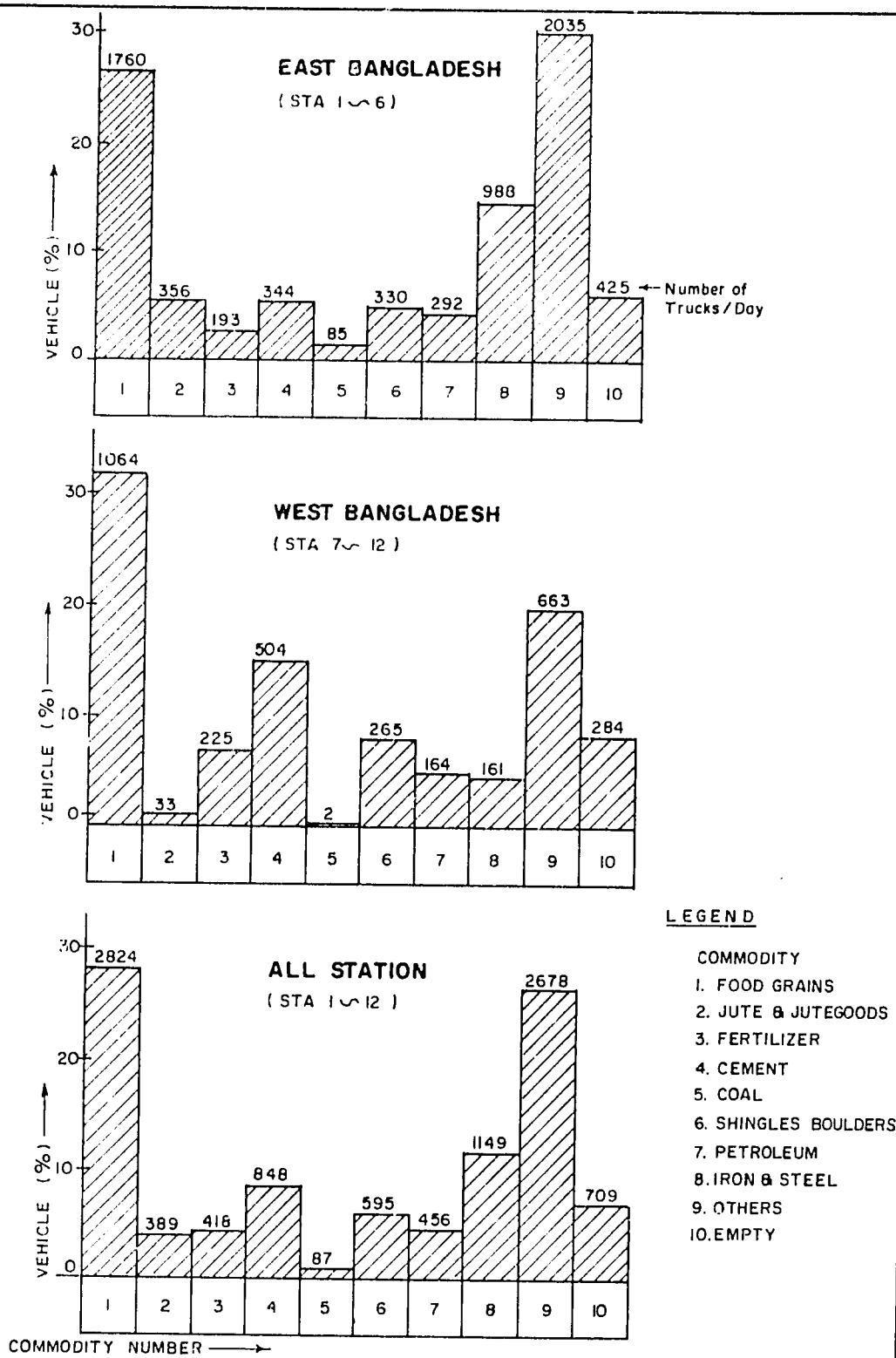


FIG. 9 .2.14 PROPORTION OF COMMODITY CARRIED BY TRUCKS

SOURCE : ITS Survey in Jan/Feb 1985

Table 9.2.15 Truck Weight

AVERAGE VEH. WEIGHT - LOADED (11.7 T tons)

Survey Station	Nos. of Veh. Surveyed	Total Veh. Weight (tons)	Average Veh. Weight (tons)
1	226	2,679	11.9
3	171	1,890	11.1
4	422	4,905	11.6
Sub-total :	819	9,474	11.6
7	112	1,480	13.2
9	135	1,609	11.9
11	178	2,027	11.4
Sub-total :	425	5,116	12.0
Total	1,244	14,590	11.7

AVERAGE VEH. WEIGHT - EMPTY (5.0 tons)

1	5	25.6	5.1
3	10	52.0	5.2
4	7	38.4	5.5
Sub-total :	22	116.0	5.3
9	11	50.2	4.6
11	26	127.0	4.9
Sub-total :	37	177.2	4.8
Total	59	293.2	5.0

Table 9.2.16 Truck Loading Factor (f_1)

Sample No.	Typical O-D Pair	Trucks/day	Total Trip Length (Mile)	Loaded Trip Length (Mile)	Loaded Factor *(f_1)
1	Dhaka-Chittagong	730	324	324	1.00
2	Dhaka-Mymensingh	335	232	116	0.50
3	Chittagong-Comilla	582	324	265	0.82
4	Chittagong-Noakhali	434	192	96	0.50
5	Khulna-Jessore	389	76	38	0.50
6	Khulna-Kushtia	176	192	192	1.00
7	Dhaka-Tangail	282	112	56	0.50
8	Dhaka-Rangpur	259	420	420	1.00
9	Khulna-Faridpur	104	232	116	0.50
10	Pabna-Rangpur	70	306	153	0.50
11	Dhaka-Jamalpur	193	228	114	0.50
12	Dhaka-Comilla	172	118	59	0.50
13	Dhaka-Sylhet	84	650	384	0.59
14	Dhaka-Jessore	165	374	336	0.90
15	Dhaka-Noakhali	164	384	288	0.75

Average Loaded Factor (f_1) : 0.71

Empty Factor ($1-f_1$) : 0.29 (Say 0.30)

Source: ITS Survey

Remarks: *Loaded factor means as follows;

$f_1 = 1.00$; Return Loaded

$f_1 = 0.50$; Return Empty

$0.50 < f_1 < 1.00$; Loaded in other place

Empty trucks were observed among truck fleets, 7.0% of the total truck traffic were empty at the time of survey. However, since this empty percentage seems to be small for the actual empty factor, the Consultants conducted the additional interview survey at the truck terminal in Dhaka to find a realistic truck loading factor. It was found from this survey that truck travel to a nearest town where return loads can be obtained after unloaded at an original destination. Taking into account of this traffic characteristic, the loaded factors (f_1) shown in Table 9.2.16 were calculated using loaded trip and empty trip length between origin, original destination and return loaded places.

s Table 9.2.16 shows the estimated truck loading as the result of survey. The empty factor was estimated at about 30% of the total truck traffic on road.

9.2.4 Development since 1973

The various historical growth rates which are linked to road transport are shown in Fig. 9.2.15. GDP growth rate indicated 3.5 - 4.0% during 1973-1983. The vehicle fleet on road grew at an average of 9.2% per annum during 1975-1981 and the road traffic grew at an average 8.3% per annum which are almost two times of the GDP growth. However the arterial road net work length increased only 0.4% per annum during 1975 to 1981. It should be noted that the mechanized road transport grew faster than the other transport mode such as railway inspite of the poorly developed highway network. The road sector is becoming increasingly important in Bangladesh.

Table 9.2.17 shows comparison of AADT on the arterial road network between 1980 and 1985. Approximately 500 kms length of the arterial road graded up to AADT level more than 500.

Table 9.2.17 Comparison of Road Length by Level of AADT between 1980 and 1985.

	*1980		** 1985			
AADT Range	Length	(%)	Length	(%)	Increase	(%)
0 - 150	809	(24.7)	533	(15.2)	-	9.5
250-500	1025	(31.3)	792	(22.6)	-	8.7
500-1,000	1030	(31.5)	1380	(39.3)	+	7.8
1,000-3,000	393	(12.0)	670	(19.1)	+	7.1
3,000 and above	14	(0.5)	133	(3.8)	+	3.3
Total :	3271	(100.0)	3508	(100)		

Source : Consultants Estimates

* Refer to Fig. 9.2.4A
** Refer to Fig. 9.2.4B

Compared with the passenger movement between BTS(1973) and ITS (1985) survey, it is noted that number of passenger moved on the main and inter-district road in 1985 grew at an average four times of the year 1973. It is also noted that the passenger movement linked to Dhaka having its origin/destination indicates biggest growth rate among others following the population growth in urban areas (the growth rate of Dhaka during 1981-85 indicated at average 4.3% per annum which is the highest growth rate among urban areas as shown in Table 2.2.5, Volume I, Chapter 2) as shown in Table 9.2.18.

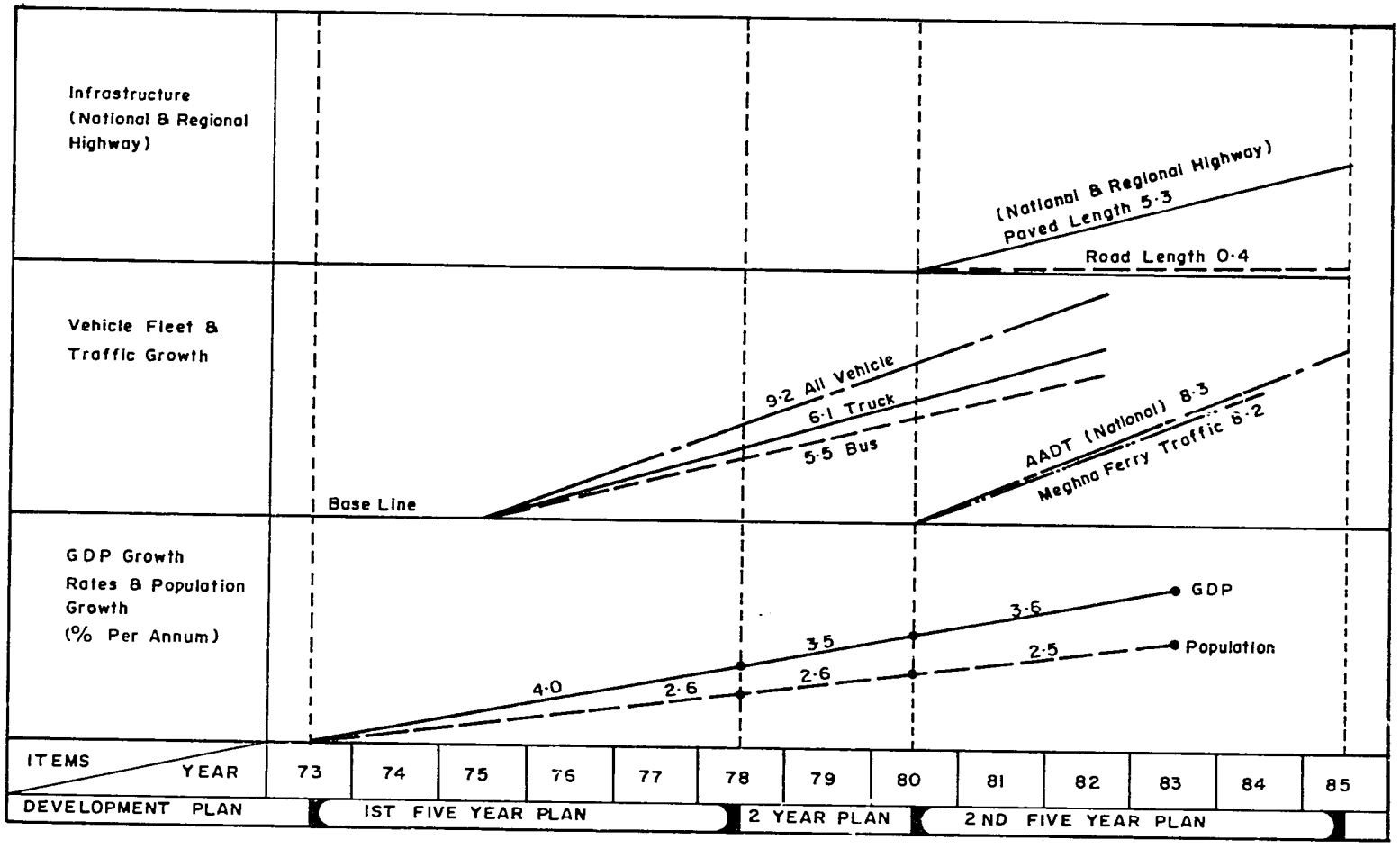


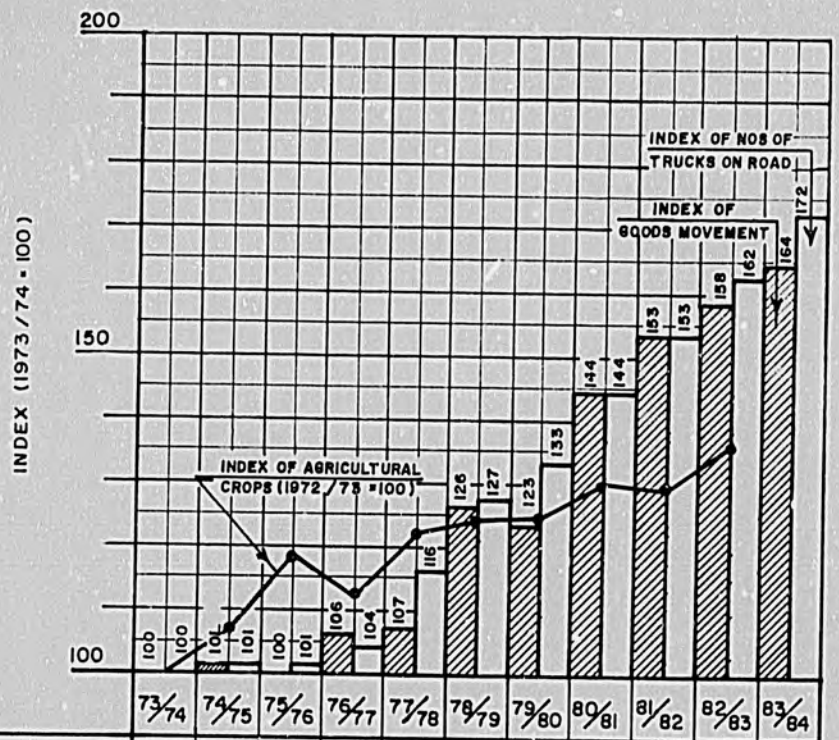
FIGURE 9.2.15 HISTORICAL VARIOUS GROWTH RATES RELATED TO ROAD TRANSPORT

Table 9.2.18 Comparison of Passenger Movement between 1973 and 1985

BTS 1973				ITS SURVEY, 1985	
Ranking	O-D Pair	District	Pass/day (one direction)	Pass/day	Ratio
1	1-4	Chittagong-Noakhali	1,658	4,660	2.8
2	1-2	Chittagong-C.H.T.	1,480	n.a.	n.a.
3	12-13	Jessore-Khulna	928	710	0.8
4	6-10	Dhaka-Tangail	737	4,580	6.2
5	12-14	Jessore-Kushtia	585	1,220	2.1
6	9-10	Mymensingh-Tangail	529	n.a.	n.a.
7	16-20	Bogra-Rangpur	459	955	2.1
8	3-6	Comilla-Dhaka	301	3,765	12.5
9	16-18	Bogra-Pabna	291	520	1.8
10	18-19	Pabna-Rajshahi	190	295	1.6
11	7-11	Faridpur-Barisal	154	305	2.0
12	1-6	Chittagong-Dhaka	144	3,120	21.7
13	3-5	Comilla-Sylhet	125	930	7.4
14	17-20	Dinajpur-Rangpur	119	210	1.8
15	1-3	Chittagong-Comilla	109	1,980	18.2

Source : BTS/ITS

While, the goods carried by trucks have been growing steadily since 1973. According to BBS report, the goods movement grew in proportion to the growth of number of trucks on road as shown in Fig. 9.2.16. BBS figures seem to have been calculated based on an unit rate such as tons per truck. However, judging from the growth of agricultural crops which are linked to goods carried by truck, this growth pattern of the good movement must be reasonable. Since the growth rate of goods movement has been twice of the agricultural crop's growth rate it can be noted that the goods movement by trucks increased faster than other modes and by taking goods away from the other modes.



	73/74	74/75	75/76	76/77	77/78	78/79	79/80	80/81	81/82	82/83	83/84
Movement of Goods by Road (Thousand tons per year)	10.445	10.579	10.470	11.086	11.156	13.143	12.887	15.017	15.955	16.517	17.098
Number of Trucks on Road (Veh/day)	9.380	9.457	9.469	9.757	10.871	11.894	12.522	13.496	(14.319)	(15.192)	(16.119)

Source : BBS 1983-84

Remark : Figure in parenthesis are the Consultant's estimate

FIG. 9.2.16 RELATION BTWEEN GROWTH OF GOODS MOVEMENT AND TRUCKS

9.3 Road Transport Performance

9.3.1 Physical achievements of the road transport operating agencies

The SFYP allocated Taka 6,900 million which was utilized for the RHD normal schemes, Upazila road schemes and road schemes in CHT region.

In the middle of the SFYP the government decentralized the administration to bring it close to people and accordingly upgraded the old thanas (police stations) into Upazilas. To make this local administration effective a programme to link the Upazila centres with the nearest metalled roads was taken up from 1982/83.

The major development in the road sector over the SFYP was the construction of Khulna-Mongla Road and upgrading the Dhaka-Chittagong and Dhaka-Aricha Road. The other roads and bridges completed during the SFYP riod were Bogra-Natore Road, Chiringa-Alikadam Road, Dhaka-Sylhet Road (Narshingdi-Sarail-Sylhet Section), Panchagar bridge, Surma bridge and Lamakazi bridge, etc. Besides, feasibility studies for Buriganga bridge (Postogala point), Meghna bridge and Meghna-Gumti bridge and Gorai bridge on Jessore-Faridpur Road have been completed. Out of 19 war damaged bridges at the beginning of the SFYP 11 were rehabilitated leaving another 8 to be taken up during the Third Five Year Plan.

Physical targets and achievements in detail of RHD during the first four years of SFYP and physical targets for the final year of the plan period are shown in Table 9.3.1. The expected performance of RHD in achievement of physical targets during the whole plan period can also be seen from the same table.

While the physical achievement made by BRTC in the SFYP period is shown in Table 9.3.2. The plan allocated Taka 350 million which was mainly utilized for construction of Integrated Central Workshop for BRTC bus and truck division and acquisition of buses.

The BRTC's data shows that BRTC carried 6.5 million passengers and 19 thousand tons of goods in 1984 which is almost twice of the same in 1979. However, these performance indicate only 3.8% of the total passengers and less than 1% of the total goods carried by mechanized road vehicles which is negligible.

Table 9.3.1 Physical Targets and Achievements of RHD during SFYP 1980-85 (RHD)

Items of works RHD normal schemes	First 4 years of SFYP (1980-81 to 1983-84)		Targets for final year of SFYP (1984-85)	Expected performance during SFYP	
	Targets	Achievements		Targets	Achievements
I New construction of roads (miles)					
(a) Paved	317.24	342.84	73.99	391.23	416.83
(b) Brick paved	281.69	268.01	63.02	344.71	331.03
(c) Earthwork	384.00	312.18	48.30	432.30	36[illegible].48
II Upgrading of existing roads (miles)					
(a) Paved	286.77	298.81	16.48	303.25	315.29
(b) Brick paved	5.50	6.54	-	5.50	6.54
III Bridges and culverts (Rft)					
(a) RCC/PC types	16053	12703	3001	19054	15704
(b) Portable steel bridges (baily)	14918	9550	2790	17708	12340
(c) Bridges and culverts under reconstruction programme	3115	1260	1210	4325	2470
IV Others :					
(a) Land acquisition (miles)	172.57	130.08	43.60	216.17	173.68
(b) Ferry services(No.)					
- Steel ferry	19	11	3	22	14
- Marboat	46	48	1	47	49
(c) Equipment (No. procured by types)					
- Bull Dozer	2	-	1	3	1
- Grader	4	-	-	4	-
- 3-wheeled Road roller	53	45	12	65	57
- 2-wheeled Road roller	13	8	-	13	8
- Pneumatic roller	7	-	-	7	-
- Portable steel bridges(rft)	12810	12810	-	12810	12810
- R.T. Roller	10	8	-	10	8
- Water Tanker	10	10	3	13	13

Source: RHD, Report of the working group for Road and Road Transport subsector on road development under RHD during TFYP, February, 1985.

Table 9.3.2 Target and Achievement of Development Projects during SFYP, (BRTC)

Tk. in million

SL NO.	Name of the project	Target		Achievement		Remarks
		Physical	Financial	Physical	Financial	
1	2	3	4	5	6	7
1.	Scheme for construction of Integrated Central Workshop for BTRC Bus and Truck Division.	(i) Procurement and installation of workshop machinery, equipment and tools. (ii) Construction of workshop building, store house, canteen painting & tyre retreading shops. (iii) Construction of office building and residential building.	198.40	(i) Machinery & equipment. (ii) Completed construction and workshop building, store house, canteen painting & tyre retreading shops. (iii) Completed construction of office and residential building.	193.95	This is a completed project Tk. 44.50 lakh has not been released.
2.	Setting up of Training Institute for Mechanics and Drivers of BRTC.	(i) Completion of construction of floor space of office building Training Workshop, domitory boundary wall etc. (ii) Procurement of training equipment.	45.30	(i) Completed of construction of floor space of office building, Training workshop, Domitory and boundary wall. (ii) Training equipment have been procured and installed.	34.90	This is a completed project.
3.	Revised scheme for acquisition of 200 buses including rehabilitation of 30 buses.	Procurement of 200 buses and rehabilitation of 30 buses.	142.87	(i) 146 buses including 7 mini buses have been procured. Procurement of 24 buses (Tata) is in process. (ii) Rehabilitation of 20 single decker buses have been, done.	111.34	This project has been spilled over to the TFYP.
4.	Improvement of existing Depots and Sub-Depots of BRTC.	Civil construction work for improvement of existing physical facilities.	1.00	Improvement work worth Taka 10.00 lakh has been completed.	1.00	This is a completed project. Taka 5.00 lakh was not made available to BRTC. Having alternative BRTC has paid Tk. 5.00 lakh from its own resource.
5.	Construction and improvement of Central Bus Terminal at Fulbaria.	Construction of pavement & boundary etc.	9.00	Completed construction of pavement & boundary wall, arrangement made for water supply, sanitary to electric supply.	4.30	This is a completed project. After wards the CBT has been handed over to Dhaka Municipal Corporation as per Govt. decision.
6.	Acquisition of 100 trucks.	(i) Payment of liabilities against procurement of 100 trucks from M/S Progati before SFYP.	5.20	Payment has been made.	5.20	-
7.	Construction of 100 passenger shelters in Dhaka and Ctg. cities.	Construction of 100 passenger shelters.	4.50	77 passenger shelters have been completed.	1.00	-
8.	Scheme for procurement of 48 mini buses for the Dhaka Municipal Corporation.	Procurement of 48 mini buses and payment of Bank liabilities on account of procurement of 48 mini buses by DMC.	4.20	Procured 48 mini buses from DMC.		Bank liabilities of Taka 42.00 is expected to be paid in 1985-86.
	TOTAL :		410.47		351.69	

Source: BRTC

9.3.2 Existing level of performance

(1) Method of estimation

Due to the lack of data all previous studies have estimated the performance of the road mode in terms of total ton-km and total passenger-km by means of the multiplication of vehicle fleet size, average loading, and assumed annual kilometrage utilized. Resulting nation-wide performance figures vary depending upon particularly the assumed level of annual utilization.

Although the results of the Consultants' O&D surveys provided a good basis for establishing characteristics of road transport in Bangladesh, the Surveys did not cover all areas of the country. However, the Consultants' effort to put together all available traffic counts resulted in the nation-wide traffic volume estimates as shown in Section 9.2.1. The total ton-km and the total passenger-km estimates were obtained in the following manner based on 1985 traffic volumes.

All road links were classified into 12 groups with different traffic compositions depending on their geographical location and their relationship with major movements. Percentage distribution figures for each vehicle type for each of the 12 groups were taken from the Consultants' survey results after checking against RHD's actual counts at various locations. Combining the traffic conditions per vehicle (4.7 tons per truck, 53 persons per bus, 26 persons per minibus, 3.6 persons per car/taxi/jeep, and 1.5 persons per rickshaw), ton-km and passenger-km for each link were calculated. Summation was made over the entire network to yield nation-wide total ton-km and passenger-km.

It should be noted that, while the Consultants previous total ton-km and passenger-km figures presented in the Draft Final Report were under-estimated due to their being based on survey results, estimates presented in this report may be in the side of over-estimation. Some of the traffic counts could have been taken at locations not entirely outside the influence of urban traffic and may not be representative of the entire length of the subject road link. The extent of such distortion can not be determined by the available data. It would probably be less than 10%.

(2) Total passenger-km

A total of 15,460 million passenger-km per year was obtain d by the above procedures for 1985. Breakdown by vehicle type is shown below:

Vehicle Type	Passenger-km per year (billion)
Bus	12.45
Minibus	2.38
Jeep/car/taxi	0.48
Rickshow	0.16
Total	15.46

Study	Year	Pass.km (million)
1. Intermodal Study	1985	15,460
2. World Bank Sector Memorandum	1979	14,362
3. BTS Review and update	1979	18,720
4. Bangladesh Energy Planning Project	1981	10,267
	1982	11,130

Sources 2 and 3 took only buses into account. All except ITS derived estimates from vehicle fleet including buses operating inside cities, whereas the Consultants' estimate is for traffic outside of cities. Source 4's estimate was based on the average bus occupancy of 41 persons, which is 23% lower than the Consultants' survey result.

When the average occupancy is 53 persons per bus and the annual utilization is 72,000 km as claimed by private operators, the total bus passenger-km of 12,450 million implies that a total of 3,300 buses are being operated for inter-city services, leaving 5,600 buses to city services, leaving 5,600 buses to city services, primarily in Dhaka and Chittagong. Hourly capacity of 5,600 buses with average occupancy of 80 persons per bus and the average trip of 20 minutes can accommodate 1.3 million passengers during a rush hour.

The above estimate for the total passenger-km on inter-city routes therefore, appears reasonable.

(3) Total ton-km

A total of 2,460 million ton-km was obtained by the procedure described above. A comparison with previous estimates is shown below:

Study	Year	Ton-km (million)
1. Intermodal Transport Study	1985	2,460
2. World Bank Sector Memorandum	1979	768
3. Bangladesh Energy Planning Project	1982	1,479

Source 3 estimate was based on the average load of 3.4 tons per truck, which is 28% lower than the Consultants' finding by the traffic survey. Considering the subsequent growth, two estimates are comparable.

9.3.3 Historical changes in road mode performance

The method utilized in this report estimate the existing ton-km and passenger-km was directly based on existing traffic volumes rather than the indirect method of estimating from fleet size as in previous studies. Estimates given in previous studies, therefore, are not directly comparable to estimates of road mode performance developed in

9.4 Service Quality, Fares, Rates and Costs

9.4.1 Service quality

(1) Passenger services

A survey of road transport passenger users was conducted to ascertain why they had preferred road to other Modes of transport, assuming an alternative existed. Travellers on some 22 routes were questioned, and the results are given in Table 9.4.1 for bus and microbus separately. None cited the cost as the reason for selecting this Mode. Convenience seems to dominate passengers decision on choosing this Mode as shown in Table 9.4.2 and Table 9.4.3.

(2) Freight services

A survey of freight shippers was conducted, covering major shippers of Petroleum products, jute products, fertilizer, cereals, iron and cement. The reason for the choice of road as opposed to alternative modes was requested. The results for shippers who used road for certain routes in preference to other Modes are given in Table 9.4.4.

The predominant reason for choosing road (63%) was the saving of time. However, a significant number noted that the absence of a competing Mode (24%) was the reason for choosing road.

9.4.2 Fares and rates and loading-unloading charges

A survey of passenger fares, freight rates and charges for loading and unloading were carried out. Actual amounts paid as opposed to official rates were asked and answers recorded.

Table 9.4.5 summarizes road passenger fares by route, and they are illustrated in Fig. 9.1.1. For distances over 100 km fares per km are fairly constant. But there is a clear distinction between routes including the Jamuna crossing and other routes.

Table 9.4.6 summarizes the results of freight rates survey by route. They are plotted in Fig. 9.4.2 for their per ton-km rate and hauling distance. Considerable variations exist depending on routes. These differences are probably reflection of the route conditions and the degree of availability of backhaul cargo. Except for a few extreme cases, however, the general relationship between the per ton-km rate and the hauling distance follow the relationship between the cost and the distance.

Table 9.4.7 shows the results of the survey on loading and unloading charges. Apparently actual charges vary a great deal even for the same commodity, indicating the matter is not a simple one including the effect of the availability of labor at a particular time and place.

this study. Past performance estimates were obtained by calculating backwards from the existing situation by means of estimated growth rates.

For freight traffic by trucks, the growth rate in the period 1976-1980 was estimated at 8.0% per annum based primarily on the truck traffic growth. For the period 1980-1985 it was assumed to be 6.1% per annum, the rate of truck fleet growth, with the implication that per vehicle performance has remained constant during the period.

For passenger traffic the growth rate of total passenger-km was determined by taking growth rates of each of vehicle fleets of buses, minibuses, and cars/taxis/jeeps, weighted by their respective shares in the total passenger-km on inter-city routes. Table 9.3.3 summarized the procedures.

Table 9.3.4 shows estimated changes in the total ton-km of freight transport and the total passenger-km by road mode.

Table 9.3.3 Passenger Traffic Growth Rates

Vehicle Type	Fleet Growth Rate	Year (1975-1980)	Composition 1985	1980	1975
Bus	5.5% p.a.		81.4	87.0	91.7
Minibus	14.4		15.5	10.1	8.5
Car/taxi/jeep	11.3		3.1	2.4	1.8
	Average growth rate % p.a.		7.0	6.5	6.2
	Period average growth rate % p.a.		6.8	6.4	

Table 9.3.4 Ton-km and Passenger-km Growth

Year	Ton-kilometer (million)	Passenger-kilometer (million)
1975/76	N.A.	8380
1976/77	1370	8953
1977/78	1489	9566
1978/79	1618	10220
1979/80	1759	10918
1980/81	1912	11665
1981/82	2037	12516
1982/83	2169	13429
1983/84	2310	14409
1984/85	2460	15460

Source: Consultants

Table 9.4.1 Road Passenger User Survey

No.	Origin	Destination	Distance km	Time hours	Speed k.p.h	Comfort	Advantage	Other
1.	Dhaka	Chittagong	240	7.3	33	B[1] Mod[3]	Comfort[5]	(8 resp.)[4]
	Dhaka	Chittagong	240	7.3	33	B. Mod	Near house	
3.	Dhaka	Comilla	90	2.3	39	B Good	Comfort[5]	(2 resp.)
	Dhaka	Comilla	90	2.3	39	B. Good	Near house	
	Dhaka	Comilla	90	2.3	39	B. Good	Save time	(2 resp.)
	Dhaka	Comilla	90	2.3	39	B. Mod	Comfort[5]	(2 resp.)
	Dhaka	Comilla	90	2.3	39	B. Mod	Save time	(2 resp.)
4.	Dhaka	Bhariub	88	2.0	44	B. Good	Save time	(3 resp.)
7.	Dhaka	Kishorganj	186	4.0	47	B. Mod	Easier	
9.	Dhaka	Mymensingh	124	2.0	62	M[2] Good	Easier	(3 resp)
	Dhaka	Mymensigh	124	2.0	62	M. Good	Save time	
	Dhaka	Mymensingh	124	2.0	62	M.Mod	Easier	
	Dhaka	Mymensingh	124	2.5	50	B. Good	Near house	(2 resp.)
	Dhaka	Mymensingh	124	2.5	50	B. Good	Save time	(2 resp.)
12.	Dhaka	Sylhet	264	7.0	38	M.Good	Comfort[5]	(3 resp.)
	Dhaka	Sylhet	264	7.0	38	M. Good	Save time	
	Dhaka	Sylhet	264	7.0	38	M.Good	Comfort[5]	
	Dhaka	Sylhet	264	7.0	38	M. Mod	Save time	(4 resp)
	Dhaka	Sylhet	264	7.5	35	B. Good	Near house	
	Dhaka	Sylhet	264	7.5	35	B. Mod	Save time	(3 resp.)
	Dhaka	Sylhet	264	7.5	35	B. Mod	Easier	
	Dhaka	Sylhet	264	7.5	35	B. Mod	Near house	
15.	Dhaka	Khulna	278	7.5	37	B. Good	Save time	
	Dhaka	Khulna	278	7.5	37	B. Mod	Safer	(2 resp.)
	Dhaka	Khulna	278	7.0	40	B. Bad	Near house	
	Dhaka	Khulna	278	7.0	40	B. Mod	Save time	(2 resp.)
18.	Dhaka	Jessore	218	6.5	34	B. Mod	Save time	
22.	Dhaka	Dinajpur	385	12.0	32	B. Good	Easier	
	Dhaka	Dinajpur	385	12.0	32	B. Mod	Save time	
	Dhaka	Dinajpur	385	12.0	32	B. Mod	Safer	(2 resp.)
	Dhaka	Dinajpur	385	12.0	32	B. Mod	Near house	
23.	Dhaka	Rangpur	304	10.5	29	B. Good	Easier	

Table 9.4.1 Continued

No.	Origin	Distination	Distance km.	Time hours	Speed k.p.h	Comfort	Adventage	Other
23.	Dhaka	Rangpur	304	10.5	29	B. Good	Save time	
	Dhaka	Rangpur	304	10.5	29	B. Mod	Save time	(4 resp.)
	Dhaka	Rangpur	304	10.5	29	B. Mod	Easier	
27.	Dhaka	Chandpur	156	4.0	39	M. Mod	Comfort[5]	(2 resp.)
	Dhaka	Chandpur	156	4.0	39	M. Mod.	Safer	(6 resp.)
	Dhaka	Chandpur	156	4.0	39	M. Bad	Comfort[5]	
28.	Dhaka	Vayuka	84	1.5	56	M. Good	Easier	
	Dhaka	Vayuka	84	1.5	56	B. Good	Near house	
29.	Dhaka	Sherpur	194	6.5	30	B. Mod	No other mode	(3 resp.)
	Dhaka	Jamalpur	173	5.5	31	B. Mod	No other mode	(2 resp.)
	Dhaka	Jamalpur	173	5.5	31	B. Mod	Save time	
	Dhaka	Jamalpur	173	5.5	31	B. Mod	Near house	
31.	Dhaka	Tangail	93	2.5	37	B. Good	Near house	
	Dhaka	Tangail	93	2.5	37	B. Good	No other mode	
	Dhaka	Tangail	93	2.5	37	B. Good	Save time	
32.	Dhaka	Trisal	102	1.5	68	B. Good	Near house	
33.	Dhaka	Modupur	128	4.5	28	B. Good	Near house	
34.	Dhaka	Barisal	229	8.0	29	B. Good	Save time	(2 resp.)
	Dhaka	Barisal	229	8.0	29	B. Mod	Save time	(4 resp.)
	Dhaka	Barisal	229	8.0	29	B. Mod	Near home	
35.	Dhaka	Faridpur	105	3.5	30	B. Good	Save time	
	Dhaka	Faridpur	105	3.5	30	B. Mod	Save time	(5 resp.)
	Dhaka	Faridpur	105	3.5	30	B. Mod	Easier	
	Dhaka	Faridpur	105	3.5	30	B. Mod	Near house	
	Dhaka	Faridpur	105	3.5	30	B. Mod	Safer	
	dhaka	Faridpur	105	3.5	30	B. Bad	Near house.	
36.	Dhaka	Goalanda	78	2.5	31	B. Good	Save time	
37.	Dhaka	Benapole	256	7.0	37	B. Mod	Safer	
	Dhaka	Benapole	256	7.0	37	B. Mod	Save time	

Source : Consultant

Note B = ; [2]M = Microbus. [3]Mod= Moderate, [4] resp= responses. [5]Comfort= Other modes too crowded.

Table 9.4.2 Analysis of Road Passenger Users Survey

Advantage over other Modes	Bus comfort				Microbus comfort				Total	
	Good	Moderate	Bad	Total	Good	Moderate	Bad	Total		
Less crowded	2	10	0	12	3	3	1	7	19	18
Save time	14	22	2	38	2	4	0	6	44	41
Near House	7	8	1	16	0	0	0	0	16	15
Easier	2	4	0	6	4	1	0	5	11	10
Safer	0	6	0	6	0	6	0	6	12	11
No other Mode	1	5	0	6	0	0	0	0	6	5
Total :	26	55	3	84	9	14	1	24	108	100
% :	31%	65%	4%	100%	38%	58%	4%	100%		

Source : Consultants

Table 9.4.3 Percentage Distribution of Road Passenger Users Survey

Advantage over other Modes	Bus comfort				Microbus comfort			
	Good	Moderate	Bad	Total	Good	Moderate	Bad	Total
Less crowded	8%	18%	0%	14%	33%	21%	100%	29%
Save time	54%	40%	67%	46%	22%	29%	0%	25%
Near House	27%	15%	33%	19%	0%	0%	0%	0%
Easier	8%	7%	0%	7%	45%	7%	0%	21%
Safer	0%	11%	0%	7%	0%	43%	0%	25%
No other mode	3%	9%	0%	7%	0%	0%	0%	0%
Total :	100%	100%	100%	100%	100%	100%	100%	100%

Source : Consultants.

Table 9.4.4 Road Users Freight Survey

preference for use of road	Survey results	
	No.	%
Save time	26	63
Save cost	4	10
Not available on others	10	24
Safer	0	0
Convenient	0	0
No rail wagons	1	3
Total :	41	100

Source : Consultants

Table 9.4.5 Road Passenger Fares Survey

Route No.	Origin	Destination	Bus B Microbus M	Distance km.	Fare Taka/	Fare Taka/ P. km.
1	Dhaka	Chittagong	B	240	43	0.18
3	Dhaka	Comilla	B	90	18	0.20
4	Dhaka	Bhairab	B	88	20	0.23
7	Dhaka	Kishorganj	B	186	32	0.17
9	Dhaka	Mymensingh	B	124	20	0.16
9	Dhaka	Mymensingh	M	124	23	0.19
12	Dhaka	Sylhet	B	264	65	0.25
12	Dhaka	Sylhet	M	264	70	0.27
15	Dhaka	Khulna	B	278	60	0.22
18	Dhaka	Jessore	B	218	55	0.25
22	Dhaka	Dinajpur	B	385	88	0.23
23	Dhaka	Rangpur	B	304	75	0.25
27	Dhaka	Chandpur	M	156	35	0.22
28	Dhaka	Valuka	B	84	13	0.15
28	Dhaka	Valuka	M	84	16	0.19
29	Dhaka	Sherpur	B	194	35	0.18
30	Dhaka	Jamalpur	B	173	30	0.17
31	Dhaka	Tangail	B	93	15	0.16
32	Dhaka	Trisal	B	102	17	0.17
33	Dhaka	Modhupur	B	128	23	0.18
34	Dhaka	Barisal	B	229	50	0.22
35	Dhaka	Faridpur	B	105	30	0.29
36	Dhaka	Goalonda	B	78	25	.32
37	Dhaka	Benapole	B	256	55	0.21

Source : Consultants Survey.

Table 9.4.6 Road Freight Rates Survey

Route No.	Origin	Destination	Commodity	Distance km.	Rate Taka/ Tonne	Rate Taka/ T. km.
1	Dhaka	Chittagong	Petroleum	240	338	1.41
1	Dhaka	Chittagong	Jute	240	352	1.47
1	Dhaka	Chittagong	Cement	240	290	1.21
1	Dhaka	Chittagong	Wheat	240	708	2.95
1	Dhaka	Chittagong	Rice	240	708	2.95
1	Dhaka	Chittagong	Iron	240	424	1.79
9	Dhaka	Mymensingh	Jute	124	321	2.59
9	Dhaka	Mymensingh	Rice	124	340	2.74
15	Dhaka	Khulna	Jute	278	351	1.26
22	Dhaka	Dinajpur	Jute	385	827	2.15
23	Dhaka	Rangpur	Jute	304	788	2.59
31	Dhaka	Tangail	Wheat	93	215	2.31
31	Dhaka	Tangail	Rice	93	220	2.37
35	Dhaka	Faridpur	Rice	105	220	2.10
38	Dhaka	Pabna	Jute	161	589	3.56
39	Dhaka	Bogra	Jute	198	616	3.11
40	Dhaka	Ashuganj	Jute	88	300	3.41
41	Dhaka	Shiddirganj	Jute	13	291	22.38
42	Dhaka	Ghorasal	Jute	32	354	11.06
45	Chittagong	Sylhet	Wheat	426	675	1.58
45	Chittagong	Sylhet	Rice	426	675	1.58
47	Chittagong	Feni	Fertilizer	82	198	2.41
48	Chittagong	Cox's Bazar	Fertilizer	159	249	1.57
49	Chittagong	Comilla	Fertilizer	150	258	1.72
50	Chittagong	Mymensingh	Wheat	364	798	2.19
50	Chittagong	Mymensingh	Rice	364	798	2.19
51	Chittagong	Tejgaon	Rice	230	775	3.37
57	Khulna	Jessore	Fertilizer	60	105	1.75
57	Khulna	Jessore	Rice	60	180	3.00
58	Khulna	Kushtia	Fertilizer	146	180	1.23
59	Khulna	Faridpur	Wheat	200	400	2.00
59	Khulna	Faridpur	Rice	200	400	2.00
61	Narayanganj	Mymensingh	Rice	135	345	2.56
62	Narayanganj	Tejgaon	Rice	20	70	3.50
63	Narayanganj	Ghorasal	Fertilizer	50	33	0.66
66	Ashuganj	Brahmanbaria	Fertilizer	23	88	3.83

Source ; Consultants Survey.

Table 9.4.7 Road Freight Loading and Unloading Costs Survey

Commodity	Loading cost Taka/Tonne	Unloading cost Taka/Tonne	Comments
JUTE	6 - 20	6 - 14	Higher figure towards Dhaka lower from Dhaka.
FERTILIZER	8 - 10	10 - 12	
WHEAT	12 - 25	10 - 20	
RICE	12 - 30	11 - 30	
IRON	23	23	
CEMENT	20	20	

Source : Consultants survey.

FIG.9.4.1 ROAD PASSENGER RATES
(1985 Prices)

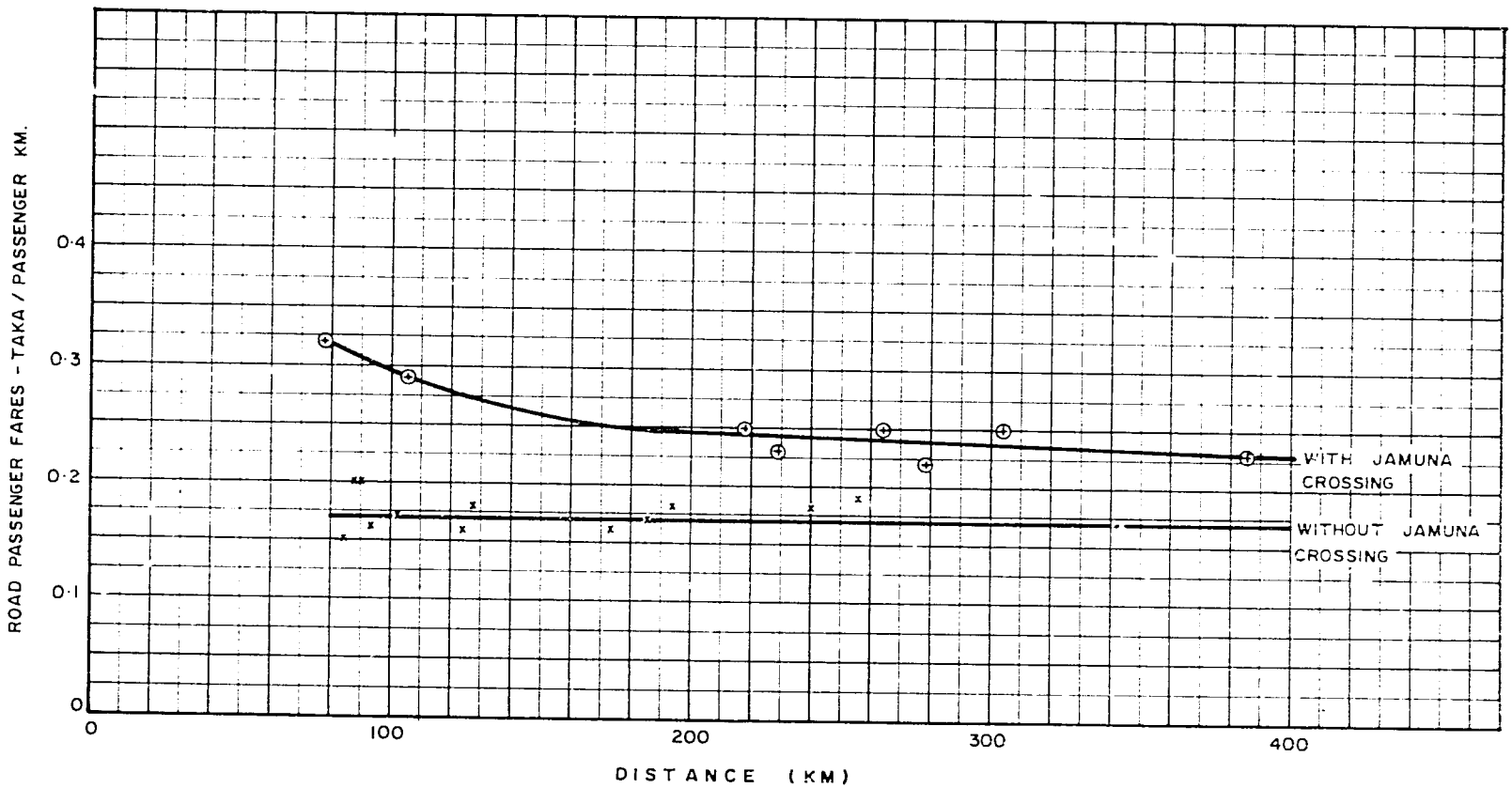
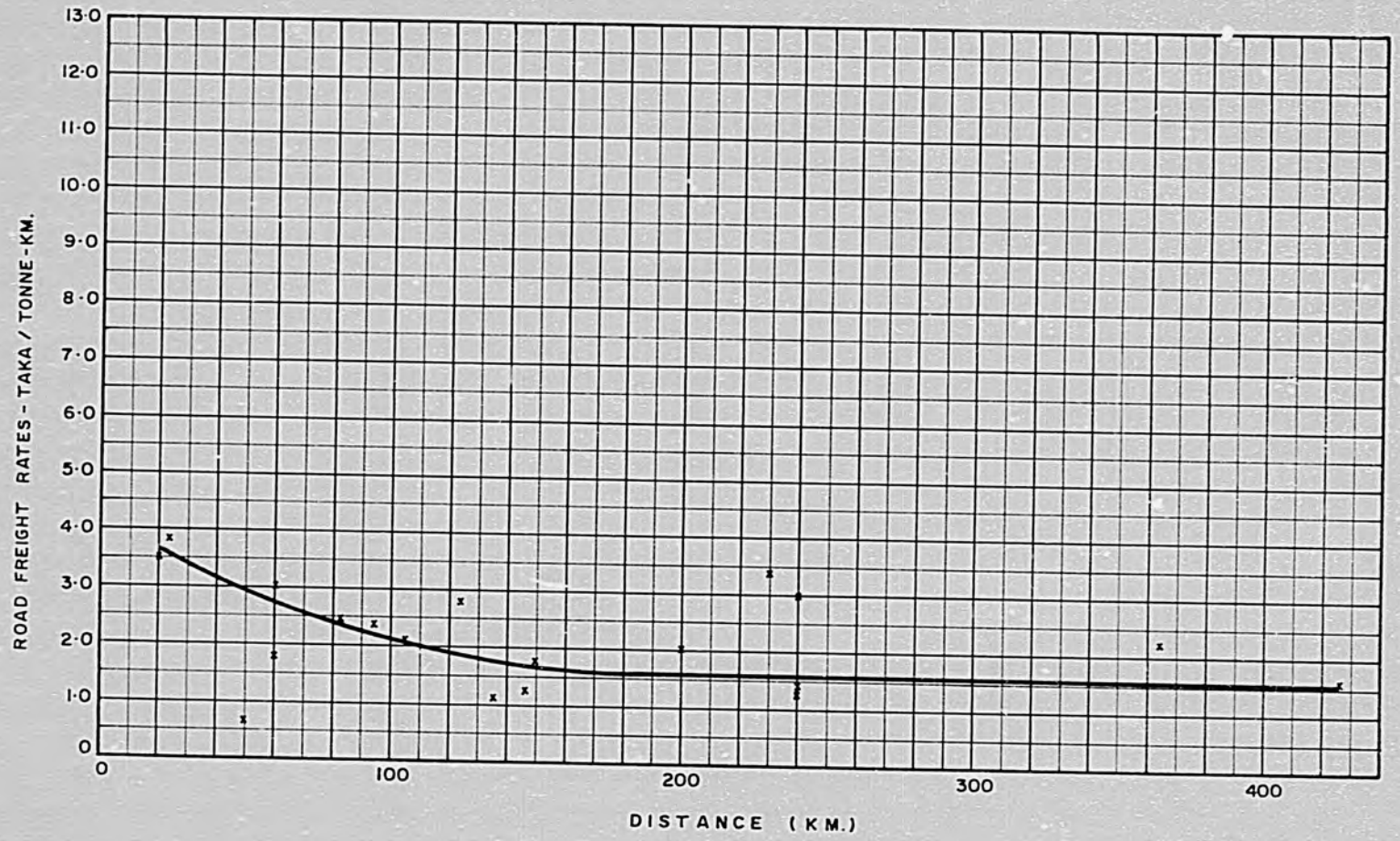


FIG. 9.4.2 ROAD FREIGHT RATES
(1985 Prices)



9.4.3 Road transport costs

Operating Characteristics of trucks and buses in Bangladesh have been determined by means of the results of the Consultant's traffic surveys and the analysis of existing data as shown in the preceeding sections. Detailed data on recent cost performance of trucks and buses were obtained from BRTC, Bangladesh Bus Truck Owners Association, and Inter-District Bus Owners Association.

Considerable differences exist between data supplied by BRTC and private sector associations. Costs provided by the private sector associations tended to be higher than those by BRTC in general. It is of course understandable that the private sector tries to claim high costs in every opportunity. For example, private bus owners listed every conceivable routine and periodic maintenance and repair items and claimed the maintenance and repair cost three times as high as that by BRTC. Overall non-capital cost per vehicle-km in 1983-84 reported by BRTC was Tk. 7.8, whereas by the private sector Tk. 11.9 for trucks. For inter-district buses comparable figures were Tk. 9.7. for BRTC and Tk. 10.9 for the private sector. The above two cost data were compared with each other as well as with data presented in previous studies and the most appropriate cost figures were determined item by item. The results are shown in Tables 9.4.8 and 9.4.9 for trucks and buses respectively.

Amortization costs for the life of 10 years at an interest rate of 15% with 15% scrap value at the end of life were taken for the capital cost for both trucks and buses in the calculations.

Conversion factors for economic costs from financial costs as shown in the ADB Road Rehabilitation and Maintenance Project Report were adopted considering tax components, real cost of foreign exchange, and labour shadow price.

Table 9.4.10 and 9.4.11 show ton-km costs and passenger-km costs at different hauling and travel distances for trucks and buses respectively together with performance characteristics of them used in arriving at these costs.

Comparison was made with the vehicle operating cost data shown in the Road Rehabilitation and Maintenance Project Report prepared with the assistance of ADB in June 1984. Becauses of higher unit cost data supplied by BRTC and the private sector and generally lower performance characteristics determined by the results of traffic surveys, unit costs developed by this study are somewhat higher than those in the previous studies as shown in Table 9.4.12.

For other types of vehicles, namely pickups, minibuses, jeeps and cars, actual performance and cost data comparable to trucks and buses were not available. Because of the relative insignificance of these types of vehicle, (the combined share of these four vehicle types in the traffic was found to be 26%), vehicle operating costs of them were derived by means of factoring the unit costs developed in the ADB Road Rehabilitation and Maintenance Project as shown in Table 9.4.12.

The relationship between the unit road transport cost and the distance are illustrated in Fig. 9.4.3 and Fig. 9.4.4. for passengers and for freight respectively.

Table 9.4.8 Truck Operating Cost

	Financial	Economic
Fixed Costs per year (Taka)		
Crew wages and allowances 1/	63,000	50,400
Overhead	27,900	20,350
Insurance	3,500	2,380
Fees and taxes	7,000	-
Amortization 2/	93,150	58,680
Total :	194,550	138,810
Variable Costs Per Km (Taka)		
Fuel and Lubricant	2.42	3.02
Tyres and Tubes	1.12	0.67
Maintenance and repair	2.30	1.38
Tolls and fees	0.41	-
Total :	6.25	4.31

Note : 1/ Crew allowances are in actual practice virtually a fixed cost item.

2/ Initial cost Tk.5,50,000 residential value 15%, life 10 years, interest rate 15% capital recovery factor 0.19925, the initial set of tyres and tubes is included in the initial cost for simplicity.

Table 9.4.9 Inter-District Bus Operating Cost

	Financial	Economic
Fixed Costs per year (Taka)		
Crew wages and allowances	73,125	58,500
Overhead	42,863	31,260
Insurance	9,500	6,950
Fees and taxes	3,125	-
Amortization 1/	109,240	68,810
Total :	237,853	165,520
Variable Costs Per km (Taka)		
Fuel and lubricant	2.29	2.86
Tyres and Tubes	0.89	0.53
Maintenance and repair 2/	4.17	2.50
Tolls	0.45	-
Other	0.45	0.36
Total :	8.25	6.25

Note : 1/ Initial cost Tk.6,45,000 residual value 15%, life 10 years, interest rate 15% capital recovery factor 0.19925.

2/ BRTC figure was modified considering the very high private sector maintenance costs.

Table 9.4.10 Truck Ton-km Costs by Distance

Conditions.

Average trips length	170 km
Overall average load (both ways)	4.7 tons
Average travel speed	28.0 km/hr.
No. of working days	300 days
Working hours per day	12 hours
Annual utilization (from BTS Review)	44,800 km
Average non-running hours per trip (12 X 300-44,800/28)/263	7.60 hours

	Financial	Economic
Fixest cost per working hour (Tk.)	54.0	38.6
Variable cost per km	6.25	4.31

Per Vehicle and Per Ton-km Costs

Distance	Running	Hours	Financial Cost (Tk.)				(Economic Cost (Tk.)			
km	Hours	/Trip	Variable	Fixed	Total	Ton-km	Variable	Fixed	Total	Ton-km
25	0.89	8,50	156	459	615	5.23	108	328	436	3.71
50	1.79	9.39	313	507	820	3.49	216	362	578	2.46
100	3.57	11.2	625	605	1270	2.62	431	432	863	1.84
150	5.36	13.0	938	702	1640	2.33	647	502	1149	1.63
200	7.14	14.7	1250	794	2044	2.17	862	567	1429	1.52
250	8.93	16.5	1563	891	2454	2.09	1078	637	1715	1.46
300	10. 7	18.3	1875	988	2863	2.03	1293	706	1999	1.42
350	12. 5	20.1	2188	1085	3273	1.99	1509	776	2285	1.39
400	14. 3	21.9	2500	1683	3683	1.96	1724	845	2565	1.36

Source : The Consultants, Table 9.4.8.

Table 9.4.11 Bus Pass.-Km Costs by Distance

Conditions

Average bus trip length	148	km
Average number of passengers	53.4	persons
Average travel speed	23.5	km/hr
No. of working days	300	days
Working hours per day	24	hours/day
Annual utilization (from BTS review)	72,000	km/year
Average trips per year	486	trips/year
Average non-running hours per trip (24 x 300 - 72000/23.5) 486	8.51	hours/trip

	Financial	Economic
Fixed cost per working hour	33.0	23.0
Variable cost per km	6.25	6.25

Per Vehicle and Per Passenger - km Costs

Distance	Running	Hours	Financial Cost (Tk.)				Economic Cost (Tk.)			
km	hours	/Trip	Variable	Fixed	Total	Pass-km	Variable	Fixed	Total	Pass-km
25	1.06	9.6	206	316	522	0.391	156	221	377	0.282
50	2.13	10.6	412	350	762	0.285	313	244	557	0.208
100	4.26	12.8	825	422	1247	0.234	625	294	919	0.172
150	6.30	14.9	1238	491	1729	0.216	938	343	1281	0.160
200	8.51	17.0	1650	561	2211	0.207	1250	391	1641	0.154
250	10.6	19.1	2063	630	2693	0.202	1563	439	2002	0.150
300	12.8	21.3	2475	703	3178	0.198	1875	490	2365	0.148
350	14.9	23.4	2888	772	3660	0.196	2188	538	2726	0.146
400	17.0	25.5	3300	841	4141	0.194	2500	587	3087	0.144

Source : Table 9.4.9. The Consultant.

Table 9.4.12 Average Economic - Vehicle Operating Costs

	ADB RRM Study	ITS	Traffic Composition
Vehicle Running Costs	(Tk./km)	(Tk./km)	(%)
Trucks	4.34	4.31	49
Buses	4.38	6.25	25
Pickups	2.62	(2.60)	1
Minibus	2.64	(3.77)	12
Jeeps	2.39	(2.37)	4
Cars	3.55	(3.53)	9
Average	-	4.62	100
Vehicle Time Costs	(Tk./year)	(Tk./year)	
Trucks	116580	138810	49
Buses	149200	165520	25
Pickups	89100	(106090)	1
Minibuses	113160	(125540)	12
Jeeps	50280	(59870)	4
Cars	57660	(60970)	9
Average	-	133400	100

Average Per Hour Tk. 18.5/hr.
For 7200 hours per year.

Source : The Consultnats.

FIG. 9.4.3 ROAD TRANSPORT PASSENGER FINANCIAL AND ECONOMIC COSTS
(1985 Prices)

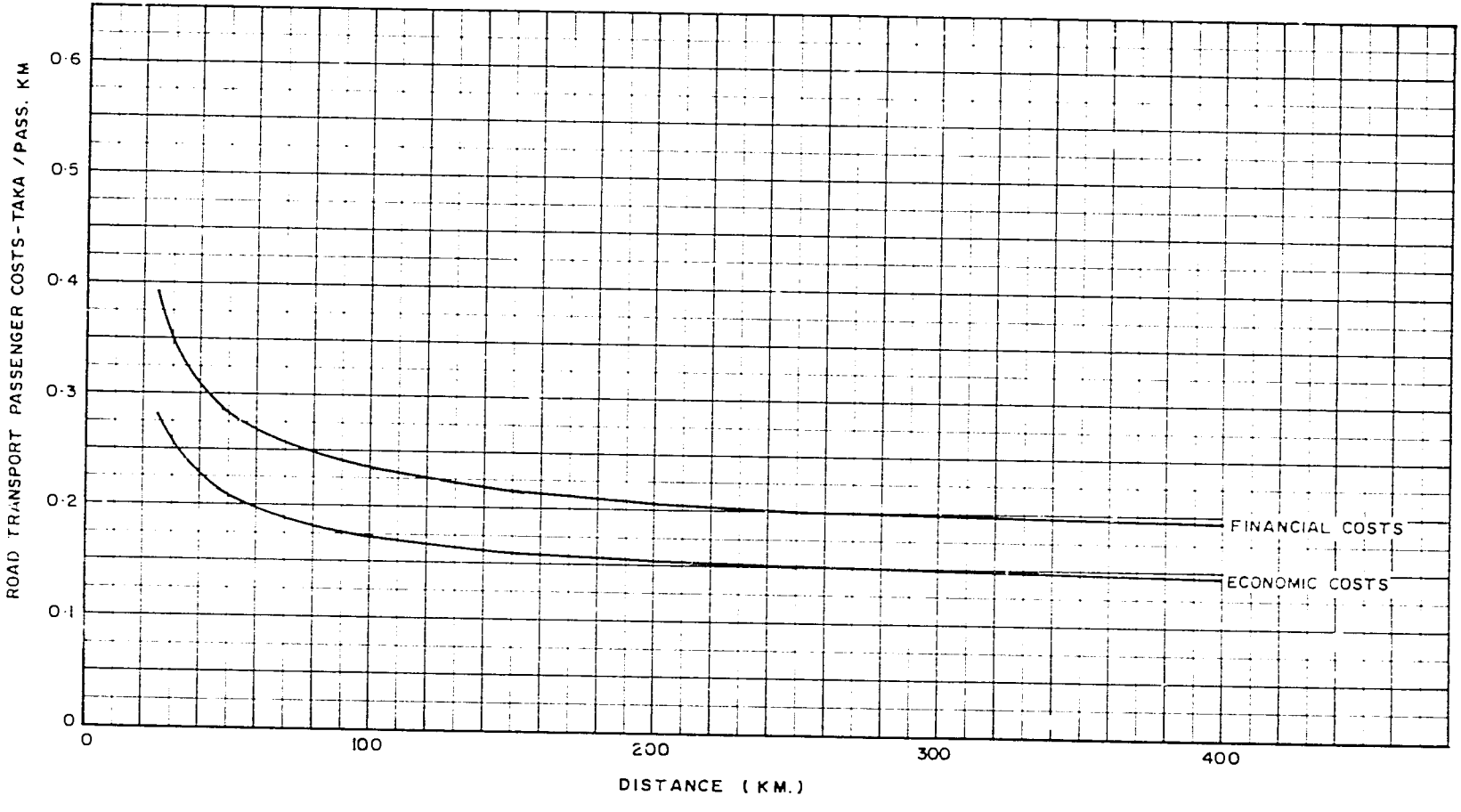
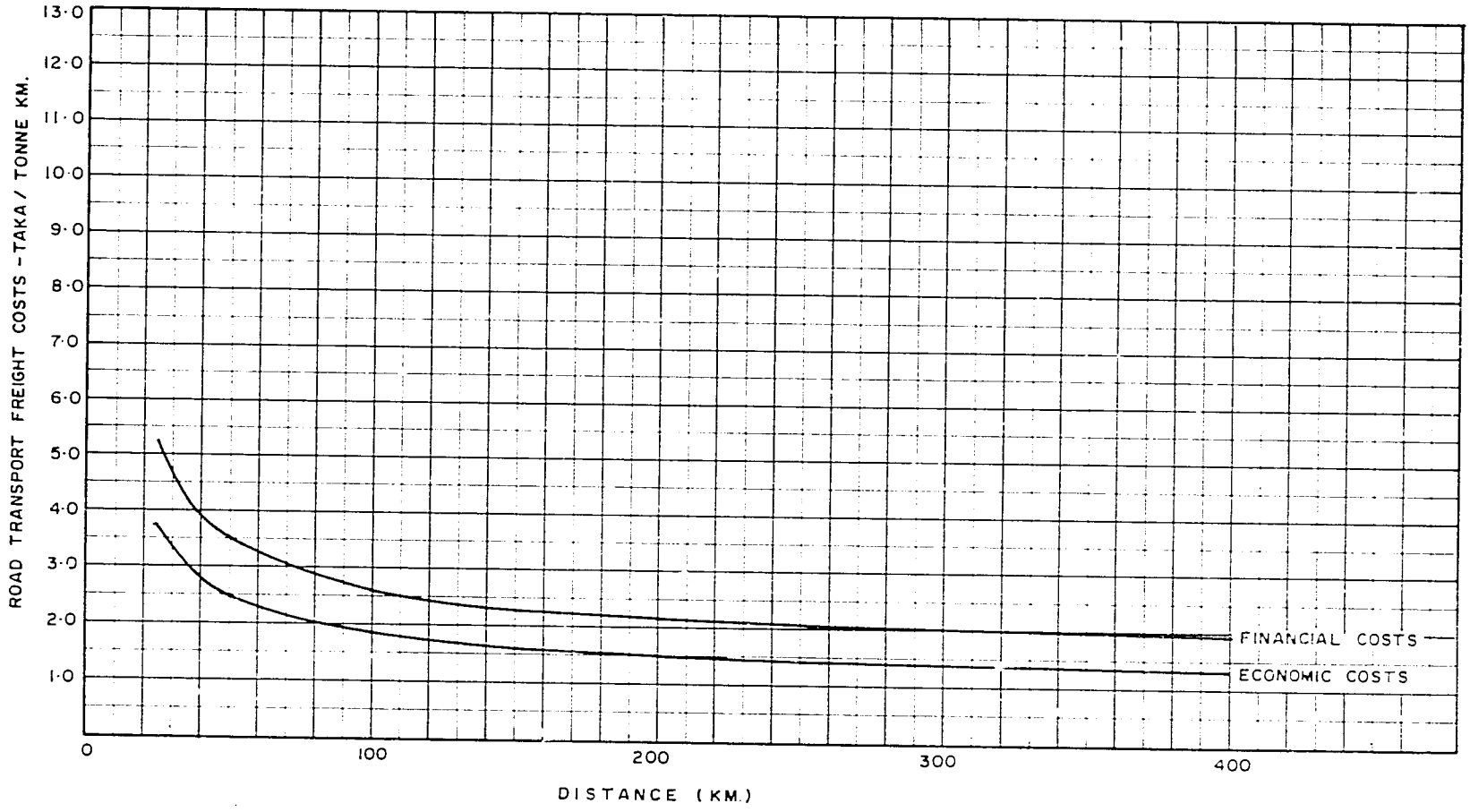


FIG.9.4.4 ROAD TRANSPORT FREIGHT FINANCIAL AND ECONOMIC COSTS
(1985 Prices)



9.4.4 Comparison of rates and costs

Actual passenger fares and freight rates are compared with the estimated unit costs graphically in Fig. 9.4.5 for passengers and in Fig. 9.4.6 for freight. In both cases actual fares and rates are lower than the financial cost at any distance. This means that road transport operators in Bangladesh are not earning sufficient revenue to replace their vehicle every 10 years as assumed in deriving the cost estimates. Operators are no doubt forced to cope with this problem of low rates by stretching the vehicle life.

FIG. 9.4.5 COMPARISON OF ROAD PASSENGER COSTS AND FARES
(1985 Prices)

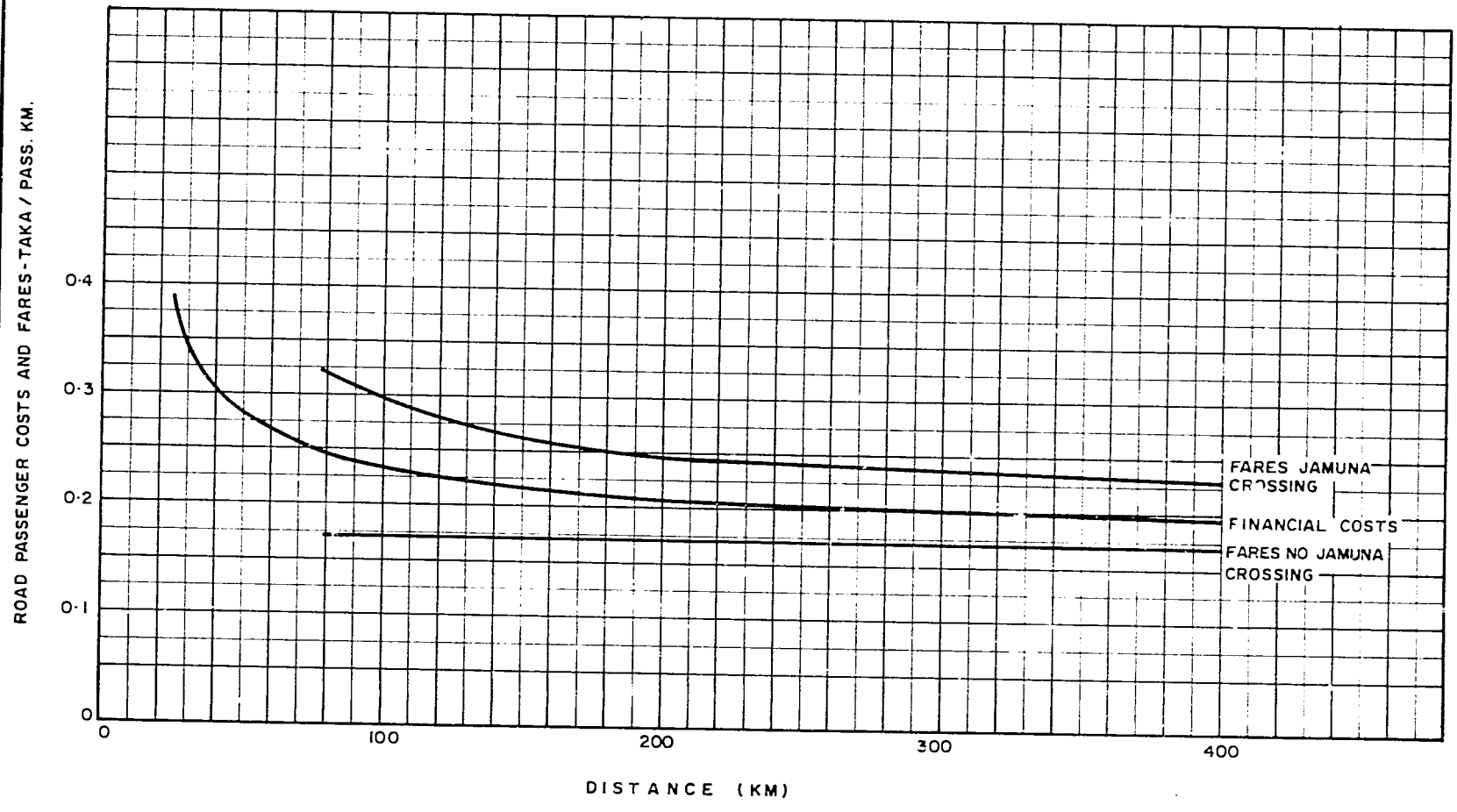
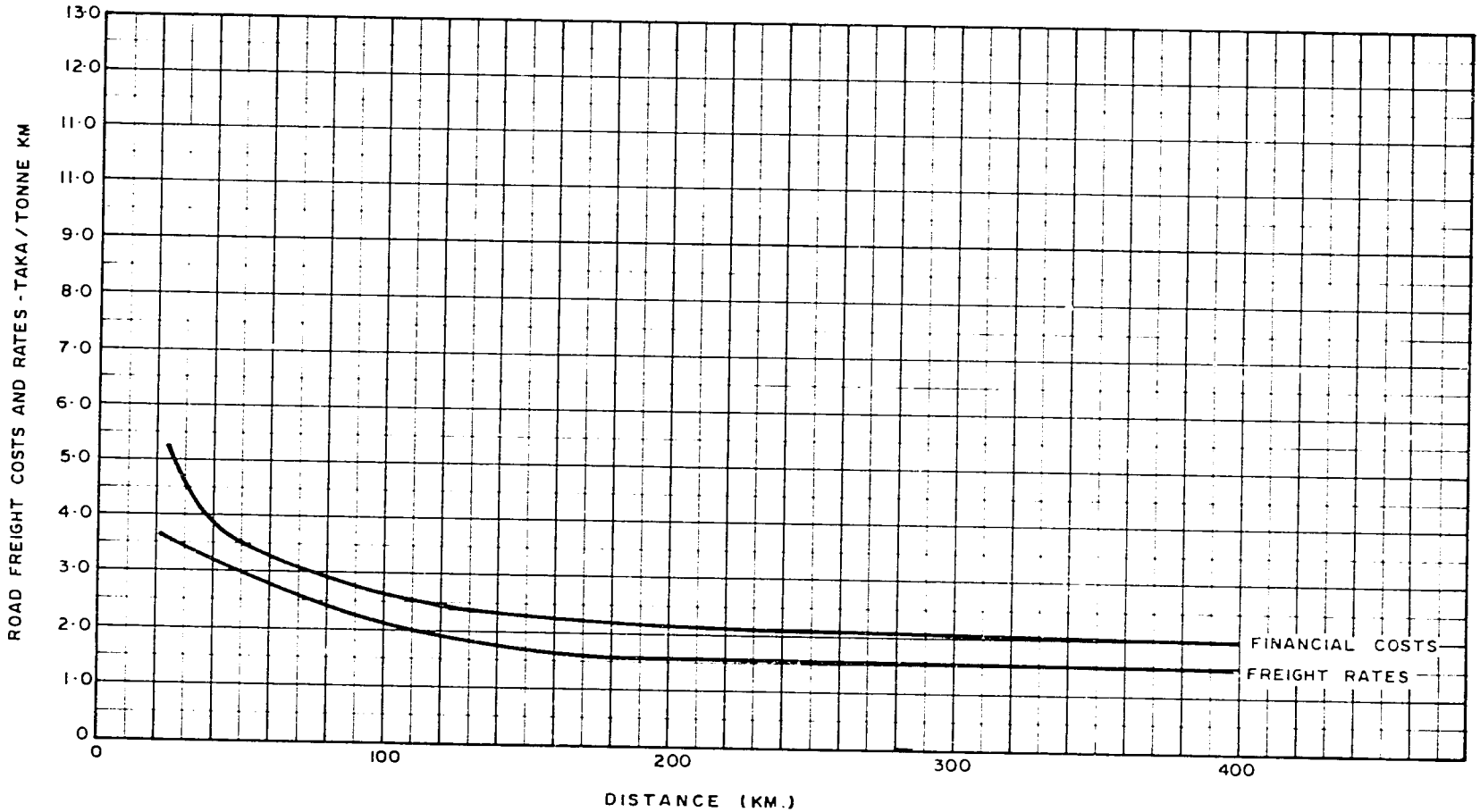


FIG.9.4.6 COMPARISON OF ROAD FREIGHT COSTS AND RATES
(1985 Prices)



9.4.5 Expenditures on road sector

The annual expenditure on main and inter-district road during past four years from 80/81 to 83/84 in shown in Table 9.4.14.

The average annual expenditure is approximately Tk. 1,460 million at 1984/85 prices. The annual expenditure in last four years has not increased. The percentage allocation is as follows;

New construction works	= 25.7%
Upgrading and Widening Works	= 29.0%
Maintenance works	= 26.4%
Bridge & Construction works	= 6.7%
Miscellaneous works	= 12.2%
Total	= 100%

According to RHD records in January 1985, the percentage of foreign aid t[illegible]ure on new construction work was 29% and on upgrading w[illegible] as illustrated in Table 9.4.13.

Table 9.4.13 Share of Foreign Aid on National Road Construction and Improvement (Million Taka 1984/85 Price)

Financial Year	New construction		Up-grading/widening	
	Local	Foreign	Local	Foreign
1981/81	126.9	28.1	442.4	78.2
1982/82	179.3	67.1	232.0	3.4
1982/83	189.4	68.6	304.6	81.5
1983/84	237.6	141.3	236.9	25.8
Total :	733.2	305.1	1215.9	188.9
	(71%)	(29%)	(87%)	(13%)

Source : RHD

9.4.6 Construction costs and maintenance costs

The construction and maintenance costs for the main and interdistrict roads such as national and regional highway are calculated based on the typical RHD ongoing schemes as follows:

(1) New road construction cost (National highway category-A)

a. Khulna-Mongla Road

Total road length : 36.1 km (12.2 m crest width)

Pavement : 7.3 m width, 45 cm thick

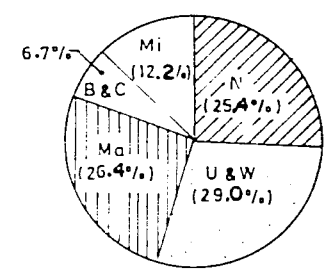
TABLE 9.4.14 ANNUAL EXPENDITURE ON MAIN AND INTER-DISTRICT ROAD

(MILLION TAKA)

FINANCIAL YEAR	ROAD LENGTH (km)			EXPENDITURE (84/85 PRICE)						AVERAGE EXPENDITURE PER km
	NATIONAL HIGHWAY	REGIONAL HIGHWAY	TOTAL	(1) N	(2) U & W	(3) Ma	(4) B & C	(5) Mi	TOTAL	
80/81	2,758	1,205	3,963	319	582	437	100	82	1520	0·38
81/82	2,761	1,215	3,976	354	287	367	65	108	1,181	0·30
82/83	2,771	1,221	3,992	380	470	350	112	304	1,616	0·40
83/84	2,774	1,221	3,995	443	349	381	110	219	1,502	0·38
AVERAGE			3,982	374	422	384	97	178	1,455	0·37

REMARKS (1) N : FOR NEW CONSTRUCTION
(2) U & W : FOR MAJOR UP-GRADING & WIDENING
(3) Ma : MAINTENANCE
(4) B & C : BRIDGE & CULVERT
(5) Mi : MISCELLANEOUS (INFRA-STRUCTURE PROJECT, ROAD RESEARCH , TESTING FERRY ETC)

SOURCE : RHD



PERCENTAGE BY WORKS
(AVERAGE PAST 4 YEARS)

Total construction cost	:	*Tk. 569.3 million
Cost per km	:	Tk. 15.8 million (1984 price)
*Land acquisition cost	:	1.9% of total cost

b. Comilla-Chandina Bypass

Total road length	:	23.7 km (11 m crest width)
Pavement	:	6.7 m width, 58 cm thick
Total construction cost	:	*Tk. 416.1 million
Cost per km	:	Tk. 17.6 million (1984 price)
*Land acquisition cost	:	1.4% of total cost

c. Polder Road (8 km) : Tk. 18.7 million/km

(2) Upgrading cost

Typical upgrading cost of national highway in the RHD ongoing schemes are as follows:

(million Taka)

Road Section		Length	Estimated Cost (1984/85 price)		Cost per km
Daudkandi	- Chittagong	216	845.3		3.9
Demra	- Narshingdi	39	123.3	3.2	3.2
Tongi	- Joydevpur	13	50.0	3.8	3.8
Joydevpur	- Modhupur	113	280.0	2.5	2.5
Nayarhat	- Aricha	50	121.2	2.4	2.4
Nagarbari	- Gobindaganj	148	474.3	3.2	3.2
Gobindaganj	- Beldanga	138	448.8	3.3	3.3
Nagarbari	- Pabna	45	210.7	4.7	4.7
Pabna	- Iswardi	29	78.2	2.7	2.7
Rajshahi	- Natore	90	285.9	4.3	4.3
Goalanda	- Jhenaidah	105	367.6	3.5	3.5
Jhenaidah	- Jessore	45	150.1	3.3	3.3
Jhenaidah	- Bheramara	72	383.0	5.3	5.3
(Summary)					(max. 5.3 - min. 2.4)

(3) Maintenance Cost

The RHD spent average 384 million Taka per annum during 80/81 - 83/84 for the 3,982 km length of the national and regional highways. The average maintenance cost is some 96 thousand Taka per km at 84/85 price.

9.5 Infrastructure

9.5.1 Road network, bridges and ferries

(1) Road network

It has been a difficult task to develop the road network in Bangladesh due to various inherent geographical, technical and other constraints. The road transport is a comparatively new transport mode for the nation. Although railways and waterways have always been important for inter-district transport, the development of paved roads started only in 1950 and was limited to inter-city routes and to those surrounding major population centres. However, the late sixties, most of the existing network was completed.

For the systematic development of the road network, the roads and highways of Bangladesh have been classified into 4 categories, namely national highways, regional highways, feeder roads and upazilla roads. National highways connect Dhaka to divisional headquarters and important regional centres, and regional highway connect to district headquarters to industrial and commercial centres. Thus the main and inter-district roads are represented by national and regional highways.

All of the key centres such as divisional and district headquarters are now connected by national and regional highways, but most of arterial roads are substandard, having narrow and weak pavements, and narrow bridges or inefficient ferry services.

Table 9.5.1 shows the position of road length as on 30 June, 1985 under the administration of the RHD, and Fig. 9.5.1 shows the existing main and inter-district road network (arterial road) which totals some 4,000 kms.

Table 9.5.1 Length of Roads Under RHD by Categories and Type of Construction (as on 30 June 1984)

Category of Roads	Total road length (km)	Length as per present pavement condition				
		Paved road	HBB or partly paved road	Gravel road	Earthern road	Tracks only
National Highways	2,780	2,654	31	-	95	-
Regional Highways	1,216	990	172	11	43	-
Feeder Roads	2,833	1,128	550	231	891	33
Upazila Roads	3,621	883	951	33	1,491	263
Total	10,450	5,655	1,704	275	2,520	296

Source : Inventory of Roads under RHD as on 30 June 1984 (RHD)

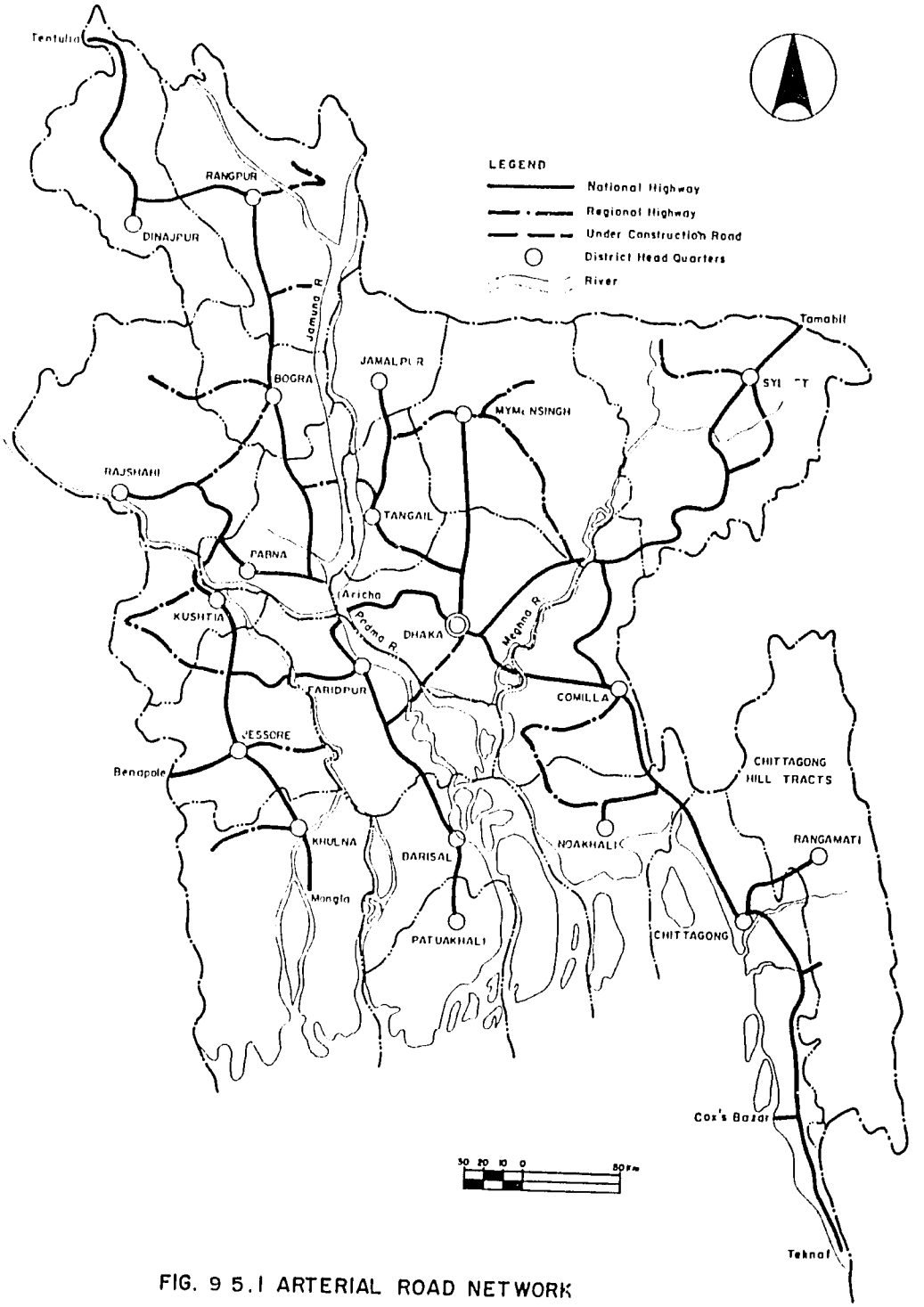


FIG. 9 5.1 ARTERIAL ROAD NETWORK

As can be seen in Fig. 9.5.2 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. And the route for East-West traffic is cut by the two big rivers being the Jamuna and Meghna. Both are unbridged gaps requiring ferry services. This "H" shape route forms a part of the Asian Highway and is the major frame of road transport network Bangladesh.

Descriptions of major route are summerised and tablated in Table 9.5.2.

(2) Bridges and ferries

(a) Bridges

Approximately 2000 bridges exist in the country. However, no standard inventory is kept at RHD headquarters and no accurate up-to-date inventory of bridge conditions is available. Moreover little maintenance work has been done thereon.

Existing bridges are divided into the following two groups for the maintenance or inspection purposes.

"Group A"	Good - - - - -	-No maintenance required.
	Fair - - - - -	-Routine maintenance required.
	Poor - - - - -	-Requires repair within 6 months.
"Group B"	Dangerous- - -	-Requires immediate repair within traffic signing and restriction.
	Close- - - - -	-Bridge must be closed.

From visual inspection it was estimated that one third of the existing bridges belong to "Group B" giving rise to a serious problem.

Updating the road system inventory in full detail and the introduction of a maintenance management method of evaluation is urgently required. A data bank should be established.

Table 9.5.3 shows the position of bridges and culverts since 1972, while Table 9.5.4 shows the bridge classification according to the bridge inventory of the updated BTS in 1978-79.

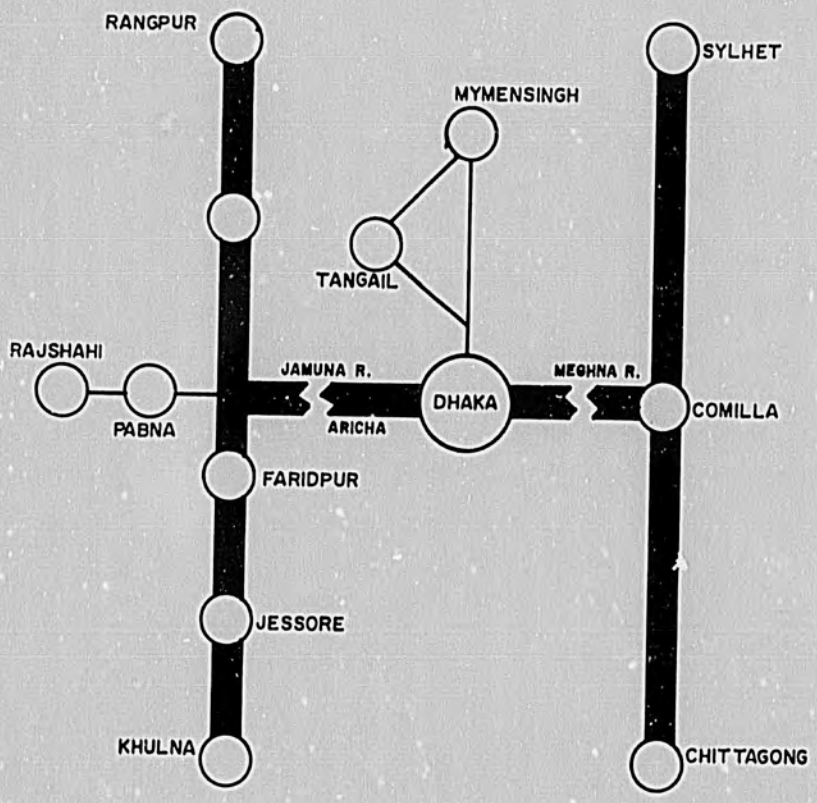


FIG. 9.5.2 "H" SHAPE TRUNK ROAD NETWORK

Table 9.5.2 Major Route Description

Location	Name of Route	Length (Km)	Pavement Width: Less than 5.5m (one lane)	Pavement Width: more than 5.5m (two lanes)	Ave. Traffic volume in route 1985 (Veh/day)	Route Description
	Dhaka (Jatrabari) ∫ Chittagong	260	0	100	2,580	One of the heaviest trafficked highways in Bangladesh. There are two river gaps. Chandina-Comilla and Feni by pass projects are now under construction.
	Dhaka (Demra) ∫ Sylhet	265	52.7	47.2	1,190	There are 3 river gaps. For two of them, bridge projects are going on. The section between Garail and Sylhet is very narrow extensively damaged.
	Dhaka (Mirpur) ∫ Aricha	75	0	100	2,110	This is a representative route for East-West traffic. The road condition of this route is fairly good.
	Daulatdia ∫ Khulna	220	48.8	51.2	1,120	Part of Dhaka-Khulna road. The section between Jessore and Jhenida is of one lane (old standard) A widening/upgrading project is now going on.
	Nagarbari ∫ Dinajpur	290	53.6	46.4	860	Important road for North-West traffic. This road is in a very poor condition. A maintenance and rehabilitation project is now being planned by IDA.

Table 9.5.3 Bridge and Culvert Position

Year			72/73	78/79	S.F.Y.P. (79/80-84/85)		
Bridge	Number		1,006	1,868			
	Length	(Rft)	95,865	152,071	Target	61,042	Rft
					Achievement (Expected)	45,204	Rft
Culvert	Number		2,182	3,850			
	Length	(Rft)	24,132	40,895		(Approx)	
Total	Length	(Rft)	119,997	192,966		283,170	

Source : Updated BTS, R.H.D 1984 - 85 ADP

Table 9.5.4 Bridge Classification

Total number of bridges	:	1,868	
% of bridge by category	:	Multi-span bridges	41.6%
		Single span bridges	58.4%
% of bridges by type	:	Concrete bridges	66.9%
	:	Steel bridges (concrete deck)	8.8%
	:	Steel bridges (timber deck)	3.1%
	:	Timber bridges	8.5%
	:	Brick and other types	12.7%
% of bridges by width	:	More than 5.5m	51.9%
	:	Less than 5.5m	48.1%

Source : Updated BTS

(b) Ferries

Total of 65 RHD ferry crossings in the country 32 were currently operative in the arterial road network. Table 9.5.5 shows the number of ferry crossing in different category of road, and Fig. 9.5.3 shows the location of major ferries.

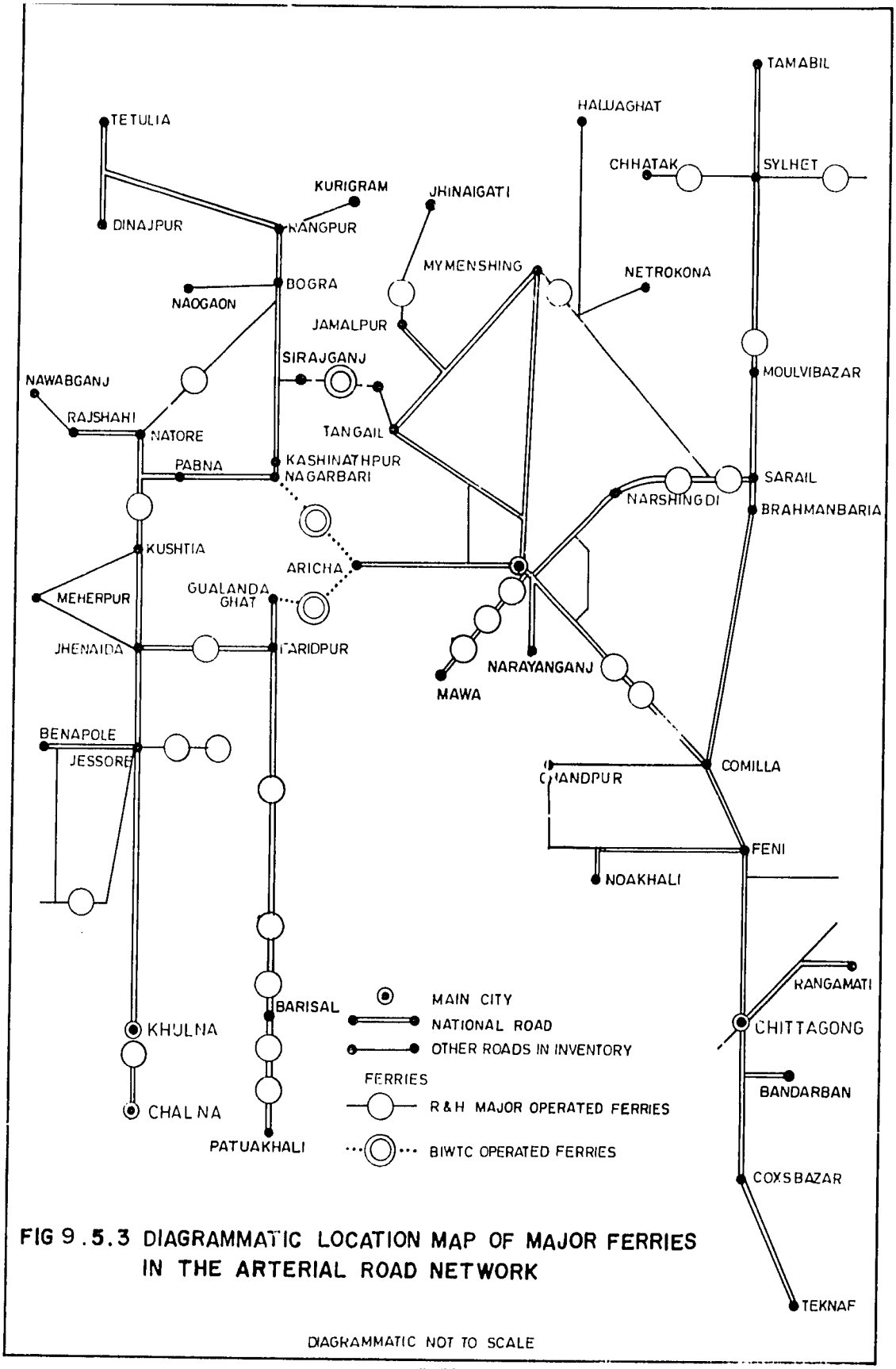


FIG 9.5.3 DIAGRAMMATIC LOCATION MAP OF MAJOR FERRIES IN THE ARTERIAL ROAD NETWORK

DIAGRAMMATIC NOT TO SCALE

Table 9.5.5 Number of Ferry Crossings

Category	1980	1981	1982	1983
National Highways	16	16	18	20
Regional Highways	10	11	13	12
District & feeder roads	33	35	32	33
Total	59	62	63	65

Source : R.H.D.

A complete inventory of ferry boats is not available, but it is estimated that about 100 boats are in-service; 55% being made of steel, each with twin engines having a capacity of 8 to 18 cars or 3 to 9 trucks; 45% are wooden, with single engines having a capacity 6 passenger cars or less, and many of existing ferries were are more than 10 years old.

There are two authorities operating ferry services in this country. The R.H.D. is operating ferry services at short road gaps, and the BIWTC is operating and maintaining ferry services on longer gaps and across the mighty rivers of Padma - Jamuna at Aricha, Nagarbari, Daulatdia, Bhuanpur and Siranjgonj. Aricha is the most important road crossing point of East - East traffic in Bangladesh.

Fig. 9.2.6 shows the annual ferry traffic growth at major river crossings in the arterial network which included the Jamuna, Meghna and Daudkandi crossings. The current Jamuna (at Aricha) crossing traffic is about 800 and the others 1,400 vehicles per day.

9.5.2 Road standards

As the road transport network in Bangladesh is a comparatively new medium viz-a-viz other modes such as railways or inland waterways, the road standards have not been fully established. The RHD has recently revised its design standards for road. Table 9.5.6 and 9.5.7 shows the present RHD standard the design new road is expected to follow those standards.

Table 9.5.6 Standard Cross Sectional Widths by Type of Roads

Type of Road	Category	Traffic Volume (in PCE)	Crest Width (m)	Pavement Width (m)	Shoulder Width (each side·m)
National Highway	A	More than 500	12.20	6.70	2.75
	B	200 - 500	12.20	5.50	3.35
Regional Highway	A	200 - 500	11.00	5.50	2.75
	B	200 - 500	11.00	3.65	3.65
Feeder, Upazila Roads		Less than 50	7.35	3.65	1.85
Rural Roads/Union Roads			5.50	3.65	0.93
Village Roads			3.56	-	-

Source : RHD

Remarks: * PCE Factors in Bangladesh suggested by ESCAP are

Heavy Trucks, Busses, Commercial Vehicles, Animal Drawn or Push Carts 3.0

Cars, Jeeps, Pick-ups, Station Wagons, Microbuses, Auto Rickshaws 1.0

Motorcycles, Rickshaws 0.5

Bicycles 0.5

The RHD has standardised design for new construction and rehabilitation and this varies with each of the following classification.

Case 1. Upgrading/widening section when the cement concrete (CC) is in good condition and no crack has developed in CT.

Case 2. Upgrading/widening section where the CC is damaged condition.

Case 3. Upgrading/widening section where the pavement is flexible and has no underlying CC pavement.

Case 4. New construction.

With new construction, the following pavement structures are specified.

Subgrade: C.B.R. 8
(Compacted sand layer must be used for improved sub-grande)

Sub-base: 100mm water bound macadam with specified brick chips (CBR 80) and 100mm water bound macadam with specified brick chips (CBR 25)
Total, 200mm water bound macadam.

Table 9.5.7 Geometric Design Standards by Road Classification

Road Classification			National Highway	Regional Highway	Upazila Road	Rural Road
Design speed (km/hr.)	Plain Terrain	Ruling design speed	80	65	50	30
		Minimum design speed	65	50	40	25
	Rolling Terrain	Ruling design speed	65	50	40	25
		Minimum design speed	50	40	35	20
Minimum Horizontal Curve Radii (mm)	Plain Terrain	Ruling Minimum	230	155	90	40
		Absulute Minimum	155	90	60	30
	Rolling Terrain	Ruling minimum	155	90	60	30
		Absolute minimum	90	60	45	25
Vertical Curves	Minm. grade change (%) not. requiring a vertical curve		0.6	0.8	1.0	2.0
	Minimum length of vertical curve (m)		50	40	30	10
Superelevation Rate. Minm. (%)			6	6	6	4
Cross Fall of carriageway (%)			2.0	2.5	3.0	4.0
Passing sight Distance, Minm. (m)			470	340	235	120
Stopping sight Distance, Min. (m)			120	90	60	30

Source : Roads & Highways Department

Base : 75mm semi-grout with stone chips & bitumen (CBR 80)

Surfacing 50mm asphaltic concrete with specified stone chips bitumen and sand.

The RHD pavement standards are noted that Road Note 31 has been followed with some modifications to suit local conditions.

In practice the above pavement design standards are not widely practiced and the pavement have often been designed by the particular engineer in charge on the basis of his experience and intuition.

As a result of the Consultants surveys it was possible to classify existing roads into the following groups.

Group I :- New standard as represented by the Feni by-pass and the Khulna-Mongla Roads. These do not exactly follow the same RHD standards National Highway, category A, but based on the revised standards. This has a recommended cross section with minimum standards which can be accepted for two-way two-lane highways.

Group II :- Old standard one lane roads from Pakistan days represented by roads between Benapole and Jessore or Jhenida and Faridpur in Western Bangladesh. This type of road seems to be easy to up-grade due to the adequate crest width and low embankment hight in the area of low flooding probability.

Group III :- Non-standard roads represented by a part of Dhaka-Chittagong road in Eastern Bangladesh. Widening and up-grading of this type of road is difficult and costly because of material needs for high embankment and its compaction.

It was found that more than 40% of the existing National Highway are substandard roads having narrow carriageway of less than 5.5m (one land road) as shown in table 9.5.2. These roads will have to be upgraded to the latest standard National Highway, Category A to accommodate the traffic demand.

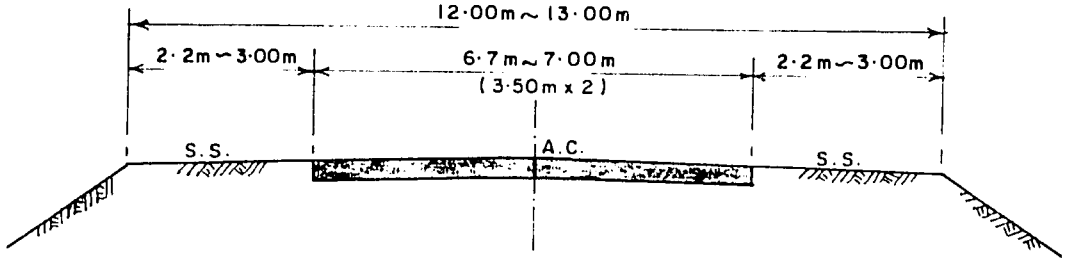
9.5.3 Development over the past decade

Fig. 9.5.5 shows a diagram of development of road infrastructure from the beginning of First Five Year Plan (FFYP) to the end of Second Five Year Plan (SFYP).

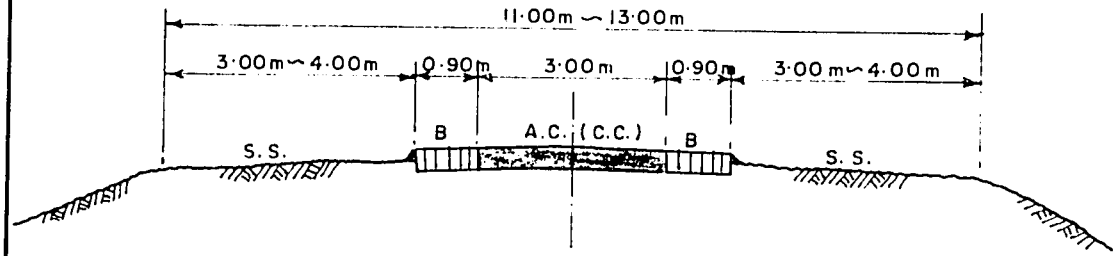
It should be noted that the road lengths shown in Fi.g 9.5.5 were derived from Project Control Division's memo (RHD) date January 16, 1985 and are slighly different from the figures shown in Table 9.5.1 which were also derived from RHD's road inventory date.

The FFYP launched in 1973 mainly aimed at rehabilitation and restoration of roads, bridges and ferry systems which were heavily damaged during the liberation war.

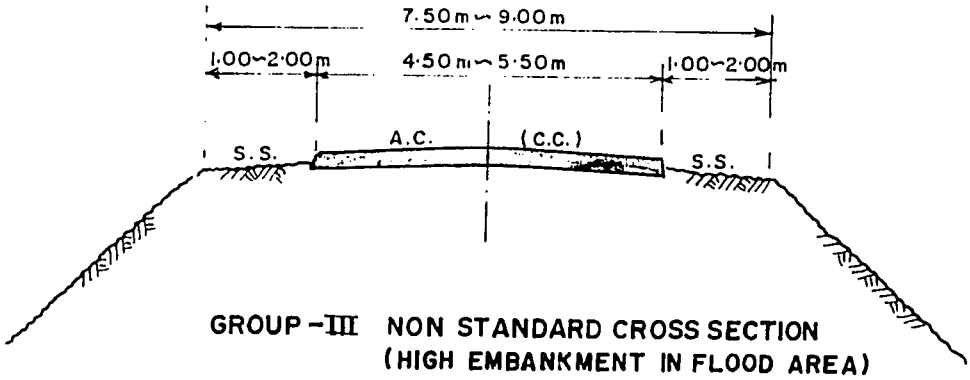
The arterial road network did not increase its total length substantially and the rehabilitation and restoration programme did not complete



GROUP – I NEW STANDARD CROSS SECTION



GROUP-II OLD STANDARD CROSS SECTION
(LOW EMBANKMENT IN LOW FLOODING PROBABILITY AREA)



GROUP – III NON STANDARD CROSS SECTION
(HIGH EMBANKMENT IN FLOOD AREA)

LEGEND

S.S: Soft Shoulder

A.C: Asphalt Concrete Surface

C.C: Cement Concrete Surface

B: Brick

FIG. 9. 5.4 TYPICAL CROSS SECTIONS OF EXISTING ROADS

during the FFYP. Following FFYP, an interim Two Year Plan was introduced during 1978-79 and SFYP launched in 1980 with the following major objectives for transport sector;

(a) Provision of transport facilities commensurate with increasing productive activities in the economy, and

(b) Development of a network of rural transport system through implementation of a feeder road programme connecting growth centres of the country including thanas, hats and bazars and introduction of new technology in rural transport mode.

As shown in Fig. 9.5.5 the total length of feeder and upazila roads greatly increased following the objective above. The paved national and regional highways grew at an average rate of 5.4% p.a. but the arterial road network itself did not grow in length during SFYP.

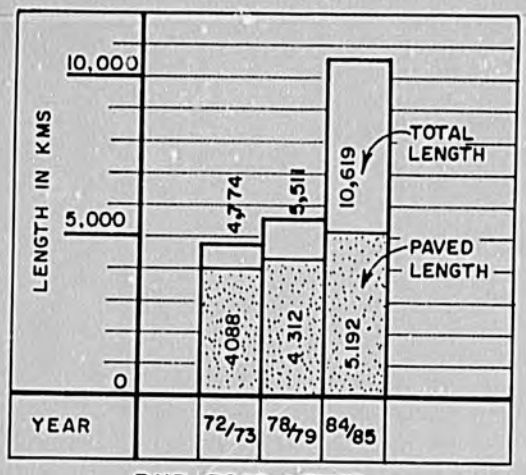
The river gaps using ferry services in Dhaka-Aricha road and Dhaka-Comilla roads which are the most important trunk road in Bangladesh, have been reduced and greatly improved traffic flow by the construction of three major bridges, namely Mirpur, Mayerhat and Taraghat bridge in Dhaka-Comilla road and two major bridges, namely Fuldi and Katchpur bridge during the past decade.

However, the present condition of the road network is less than satisfactory due to various constraints such as the inadequate allocation of fund, construction materials and equipment, limited workable days, etc. The poor condition of the road network is reflected mainly in three ways namely narrow pavement width, deteriorating surface conditions and unstable shoulders. Table 9.5.8 shows the length of paved roads of national and regional highway as per their carriageway width as in June 1984. It is observed that more than half of the arterial roads have not enough carriageway width for two lane road even in 1984.

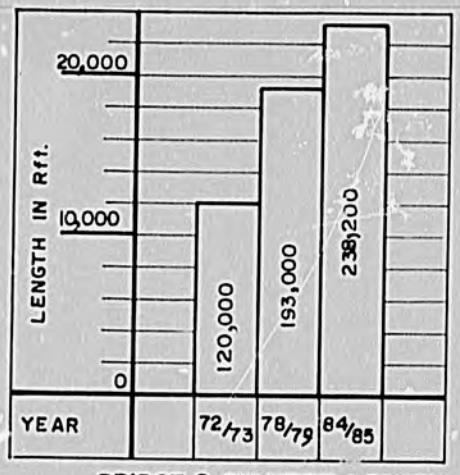
Table 9.5.8 Carriageway Width of Arterial Roads

Category of Roads	Length of paved roads as per carriageway width						
	below 3,65	3,65	4-5.2	5.5	6.7	over 6.7	Total
National Highway	589	496	55	916	566	35	2,657
Regional Highway	172	245	66	492	16	-	991
Total :	761	741	121	1,408	582	35	3,648

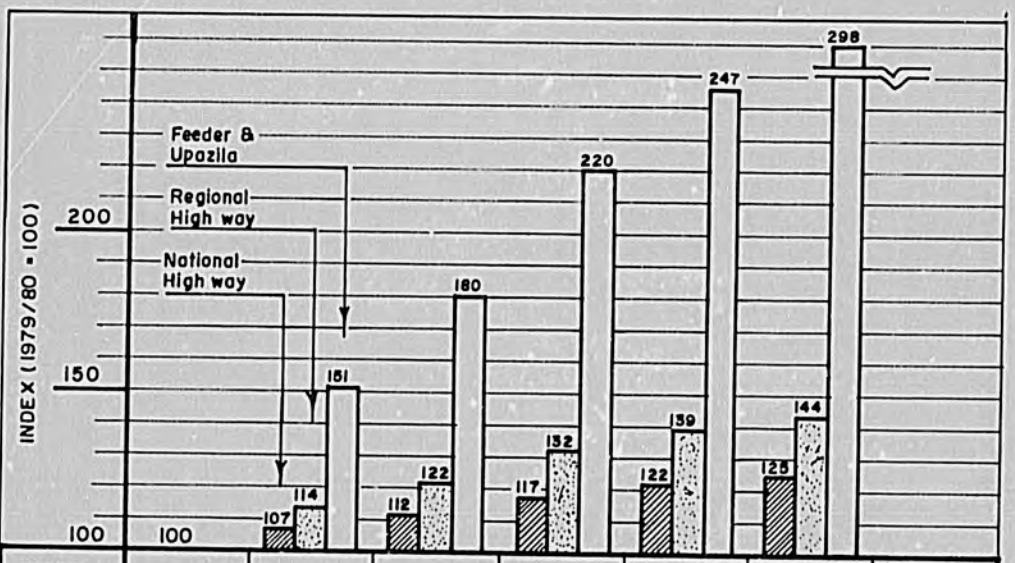
Source : Inventory of Road under RHD as on 30 June 1984. (RHD)



RHD ROAD LENGTH



BRIDGE & CULVERT LENGTH



YEAR	79/80	80/81	81/82	82/83	83/84	84/85	* A AGR
National Highway	2,731 (2,198)	2,758 (2,357)	2,761 (2,455)	2,771 (2,568)	2,774 (2,684)	2,774 (2,751)	D. 3 % (4.6)
Regional High way	1,188 (721)	1,205 (819)	1,215 (877)	1,221 (954)	1,221 (1·004)	1,221 (1.036)	D. 5 % (7.5)
Feeder & Upazila	2,112 (471)	2,375 (713)	2,579 (846)	6,335 (1,036)	6,474 (1,162)	6,624 (1,405)	25.1% (24A)

VARIATION OF PAVED ROADS OF DIFFERENT CATEGORIES UNDER RHD DURING S.F.Y.P (1980-85)

FIG. 9.5.5 DEVELOPMENT OF ROAD INFRASTRUCTURE

9.6 Vehicle Fleet

9.6.1 Fleet by type

There are two series of official statistics concerning the vehicle fleet produced by the Ministry of Communications.

i) The statistics for registered vehicles are based on the initial registration of the vehicles before they are used.

ii) The statistics for "on-road" vehicles are based on road taxes paid by the vehicle owner.

The statistics for registered vehicle are however, does not show the number of vehicles in use due to the existing registration practice by the relevant authorities allowing the vehicle owner's laxity in not recording abandonment or scrapping of old vehicles for deregistration.

Table 9.6.1 shows the relation between number of registered vehicles and "on-road" vehicles. The number of dis-used or scrapped vehicles is unrecorded.

Table 9.6.1 Differences between Registered and "On-Road" Vehicles in 1981

Vehicle Type	Registered vehicles	On-Road vehicles	Differences	(%)
Trucks	23 846	13 496	10 350	43,4
Buses	9 819	7 183	2 636	26,8
Cars/Jeeps/Station Wagons	49 324	34 379	14 945	30,1
Taxis	1 896	1 112	784	41,3

Source : BBS 1983-84.

Since the statistics of the "on-road" vehicles are more reliable than the figures for registered vehicles, the growth factor to be used for this study is based on the statistics of the "on-road" vehicles and checked by the other traffic records.

Table 9.6.2 The Number of "On-Road" Vehicles by Types 1975/81

Year	Trucks	Buses	*Minibuses	Cars/Jeeps	Total	Annual Growth rate %
1975	9 457	5,223	1,583	16,809	33,072	
1976	9,469	5,264	1,586	17,816	34,135	3.2
1977	9,757	5,494	2,015	21,533	38,799	13.7
1978	10,871	5,773	2,385	23,927	42,956	10.7
1979	11,894	6,044	2,855	26,567	47,360	10.3
1980	12,522	6,457	3,557	29,970	52,506	10.9
1981	13,496	7,183	3,549	31,939	56,167	7.0
Average Annual Growth Rate (%)	6.1	5.5	14.4	11.3	9.2	9.2

Source = BBS 1983/84

Remarks : * Includes figures for station wagons. Seating capacity is less than 15 seats.

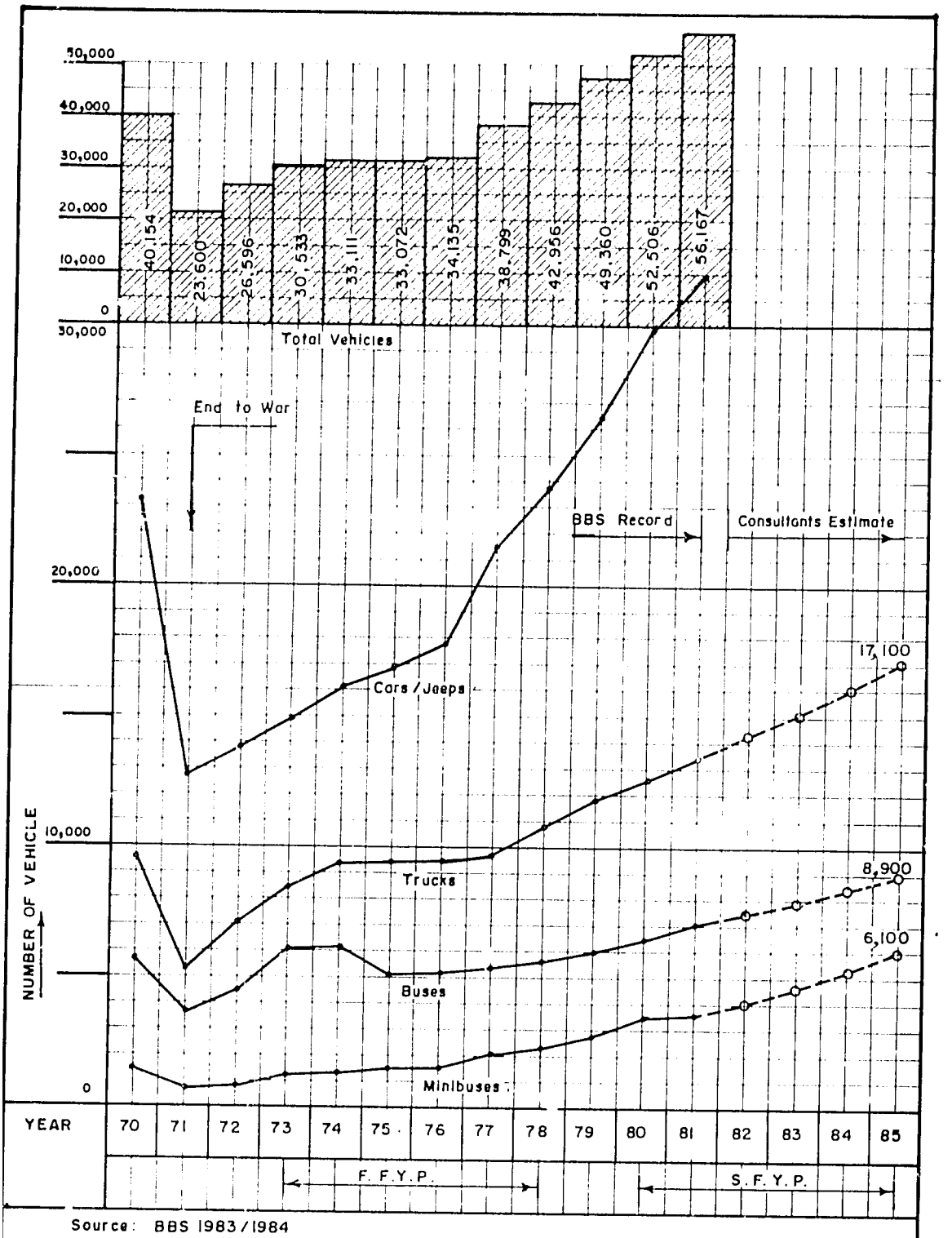
Table 9.6.2 shows the number of on-road vehicles in Bangladesh after the war from 1975 to 1981. In 1981 there were approximately 32,000 car/jeeps 13,500 trucks, 7,200 big buses and 3,500 minibuses including station wagons.

9.6.2 Changes in the past decade

Fig. 9.6.1 shows the growth of the number of on-road vehicles during the period 1970-81, and the estimated figure for 1985.

As shown in Fig. 4.6.1 from 1970 to 1971, there was a sudden decrease in the number of all types of vehicles due to the war. Afterwards the number of trucks and buses increased and reached pre-war level in 1974 but the number of cars and jeeps could reach the pre-war level in 1978. From the middle of First Five Years Plan (F.F.Y.P) to the beginning of Second Five Years Plan (S.F.Y.P), there was a steady growth in the number of each vehicle type. In this period between 1975 to 1981, the annual growth rates for each vehicle were as follows: 6.1% for trucks, 5.5% for big buses, 14.4% for minibuses and 11.3% for cars and jeeps.

The growth rates of cars and minibuses indicates high growth in the fleet following the growth of urban areas such as Dhaka or Chittagong. The growth rates for trucks and buses appear to be logical figures from the other traffic records such as ferry traffic as shown in Fig. 9.2.6 (1980-84, Meghna: 8.2%, Kamarkhali and Sherpur: 6.2%) and fuel consumption records as shown in Table 9.6.3.



Source: BBS 1983/1984

FIG. 9·6.1 GROWTH OF THE NUMER OF ON-ROAD VEHICLES

Table 9.6.3 Fuel Consumption (Road)

(Thousand tonnes)

Year	Freight	Passenger	Total
1975/76	66.5	80.1	146.6
1976/77	66.7	83.6	150.3
1977/78	69.7	91.6	161.3
1978/79	80.8	99.2	180.0
1979/80	90.9	104.1	195.0
1980/81	97.8	101.6	199.5
Average Annual	8.0%	4.9%	6.4%
Growth rate	8.0%	4.9%	6.4%

Source : Bangladesh Energy Planning Project (ref. 16).

Table 9.6.4 shows the estimated number of on road vehicles in 1985, using the same average growth rates in the period 1975-81.

Table 4.6.4 Estimated Number of On-Road Vehicle in 1985

Year	Trucks	Buses	Minibuses	Car/Jeeps	Total
1981	13496	7183	3549	31939	56167
* (%)	(24.0)	(12.8)	(6.3)	(56.9)	(100.0)
1985	17100	8900	6100	49000	81100
* (%)	(21.1)	(11.0)	(7.5)	(60.4)	(100.0)

* Proportion of total in each vehicle types.

Source : 1981 (BBS 1983-84)

Remarks: 1985 (comsultant's Estimate)

The estimated number of trucks and buses on-road classified by district in 1985 is as shown in Table 9.6.5.

Table 9.6.5 Estimated Number of Buses and Trucks On-Road in 1985

Sl. No.	Name of District	* 1981 Busese	* 1981 Trucks	** 1985 Buses	** 1985 Trucks
1.	Chittagong	2 155	4 068	2 670	5 155
2.	Chittagong H.T.	63	681	78	863
3.	Comilla	167	238	207	302
4.	Noakhali	345	473	427	599
5.	Sylhet	362	160	448	203
6.	Dhaka	1 879	3 856	2 328	4 887
7.	Faridpur	127	167	157	212
8.	Jamalpur	2	9	3	11
9.	Mymensingh	107	224	133	284
10.	Tangail	87	188	108	238
11.	Barisal	152	97	188	123
12.	Jessore	677	830	839	1 052
13.	Khulna	465	846	576	1 072
14.	Khushtia	91	173	113	219
15.	Patuakhali	11	-	14	-
16.	Bogra	154	371	191	470
17.	Dinajpur	79	346	98	438
18.	Pabna	50	106	62	134
19.	Rajshahi	144	385	178	488
20.	Rangpur	66	278	82	352
	Total	7 183	13 496	8 900	17 102

Source : * BBS 1983-84

** Consultant's Estimate.

Remarks : Assumed annual growth rate of 5,5% for Buses 6,1% for Trucks

9.7 Road Infrastructure Operational Issues

9.7.1 Construction practice

(1) Manual construction method

Road embankment are built, compacted by hand in Bangladesh. Therefore, roads vary in quality. The material for base is locally-burnt crushed brick, or stone from riverbeds in Sylhet and northern districts, picked up in baskets, and transported to site by boat, rail and road, (average haul is often more than 200 km) and crashed by hand on site. This manual construction method may help the employment of labour, but it does not result in properly graded aggregate. This manual construction method is slow, and uneconomic in terms of its gestation period and there is no effective quality control.

(2) Problem area

There are many problems in implementation of road schemes during SFYP. The RHD report noted that the problems encountered are of regular nature and continue to impede rapid progress of works under the department. Some of the outstanding problems are listed as follows:

(a) Inadequate allocation of funds for a large number of schemes,

(b) Limited working season for road and bridge construction (6-7 months from November to May),

(c) Scarcity of construction materials and equipment of building roads and bridges,

(d) Limited number of financially sound contracting firms in the road subsector,

(e) Lack of required incentives to officers and staff in service for efficient management and discharge of responsibilities.

In addition to the above, latest TRRL report on the contracting system in Bangladesh (Ref. 4) and Staff Consultant Report (Ref. 7) underlines several important problem areas as follows:

(a) RHD's divisional offices are responsible for both the construction and maintenance of roads and it is in fact often difficult to determine which operations are classed as maintenance and which as construction.

(b) The general lack of site supervision in Bangladesh is probably the single most important factor against good quality construction;

(c) A lack of heavy equipment at the disposal of individual construction firm is a hindrance. Construction equipment are hired from RHD, moved to site, and operated by RHD personnel. Absence of adequate maintenance, and dependence on RHD for

both operation and maintenance hinder smooth use of the equipment, and equipment management.

(d) There are no trucks in the Department less than about 9 of cars less than 5 years old. Equipment has been provided from many sources mainly under aid agreements. Spare parts are therefore a major problem.

(e) Quality control of site works on road contracts in Bangladesh is virtually non-existent.

(f) The contracting industry in Bangladesh lacks finance and an uncertain work load. The grade A - General Contractors would normally be the only contractors eligible for tendering for foreign aid schemes.

(g) In the social climate of Bangladesh it is obviously highly desirable to maximise labour utilisation. Thus, although equipment is essential for certain operations such as compaction, a careful assessment as to which items are most suitable for Bangladesh conditions is required.

In order to improve the present situation and to maximise benefits generated by the road, these problems are considered in depth.

(3) Material for road embankment

A large quantity of material for road embankment is required for highway improvement programs. In order to make effective use of total resources available in Bangladesh, the construction of highway would be economic by using material dredged from the riverbeds. The report on Maghna bridge Construction project (Ref. 5) indicates that average CBR value of the material from the riverbed is 9 from the six numbers of test results. It is expected that sand material from the riverbed or sand bar is good for embankment.

9.7.2 Road maintenance

(1) The present situation

Road maintenance work to be performed by RHD includes;

- Paved roads : Drain clearing, grass cutting, shoulder levelling pothole patching, patching overlays, widening and the repair of damaged sections.

- Unpaved roads : Drain clearing, grass cutting, hole filling and regravelling.

According to the RHD records, the RHD's average maintenance expenditure for the arterial roads during past 4 years was Tk. 384 million (1984/85 price) which occupies approximately 26% of total annual expenditure as seen from Table 9.4.14 in Section 9.4.4. However the maintenance works above are, rarely seen in Bangladesh. Many part

of the existing road remains with deteriorating surface condition and unstable shoulders. It seems that inadequate maintenance is due to lack of finance, management, technical skills and equipment.

Judging from visual inspection, it was observed that half of existing roads have to be ungraded and a quarter to be resurfaced. The average present Serviceability Index (PSI) of this country may be as low as about 1.5 to 2.0, lower limits of PSI 2.5 for overlay and 1.5 for resurfacing applied in AASHO standard.

It is clear that the raising of PSI by rehabilitation works and proper maintenance is closely related to the reduction of vehicle operation cost, lack of maintenance means loss of benefit.

The RHD has equipment problems for the maintenance works. This is not only the number of necessary construction equipment but also the procurement of spare parts problems.

Spare parts/stock control is extremely complicated and difficult because of the very large variety of manufacturing countries, years of manufacture and equipment obsolescence. For example from the 1979 RHD inventory, it appears that road rollers then in use were manufactured between 1942 and 1979 in the U.S.S.R., UK, USA, Poland, Germany, Japan, Denmark, whilst one manufacturer was unknown.

(2) Administration of maintenance

Highway maintenance is defined as the preserving and keeping of each roadway, structure, and facility as nearly as possible in its original condition as constructed or as subsequently improved and such additional work as is necessary to keep traffic moving safety.

The most critical responsibilities in performing maintenance procedures lies in the maintenance and repair of pavement and structure. The road transport agency must maintain and repair a highway so that it is tree of danger for all who use it in a way normally expected them.

Repair, whether to the travelway, structures, appurtenances, or other highway components may be classified into two general categorise; i) Urgently needed repairs or ii) programmed repairs, i.e., those to be performed sometime later.

From visual iaspection it was estimated that one third of the existing roads and bridges belong to "category i) giving rise to a serious problem. Therefore, the establishment of maintenance procedure is urgent necessity in addition to road rehabilitation programmes.

(a) Maintenance management

i) Inventry: RHD need information to formulate and evaluate policies; to plan and design highways; and to administer the construction, maintenance, and operation of the highway facilities under their control. The roadway inventry should be a part of the broad information system and should be prepared so that those physical elements of a highway which require maintenance are located and quantified.

ii) Selecting components:

The history of expenditures by the maintenance agency should be studied and those axtivities representing a major investment should be identified. The physical elements of the highway system which are maintained by these activities can then be identified.

iii) Units of measure:

The units of measure used for the field data collection should be based on ease of measurement by personnel conducting the inventry. Field measurement can be converted to more suitable unit using data processing procedures at some later time.

iv) Updating inventry:

When an initial inventry has been established for a RHD, it is imperative that formal procedures be devised to ensure that the inventory is kept up to date. A highway is a dynamic system and changes will occur continually. Routes will be relocated, pavements will be rebuilt, signing and service facilities will be altered, added to and deleted for various purposes. It will be necessary to update the inventory data to reflect these changes.

v) Performance standards:

Performance standards establish the basic criteria for indivisual maintenance activities. A performance standard includes a description of the work methods to be used in performing the activity, the optimum crew configuration interms of the numbers and classifications of labor, the types and numbers of equipment units and the types and amounts of material required per unit of work accomplished.

Table 9.7.1 lists typical activities for which performance standards are established and the units commonly used.

vi) Inspection:

Maintenance can not be undertaken from an office, and the district maintenance engineer can be expected to inspect all his roads monthly. Moreover all potholes should be repaired between these monthly inspections. One important aspect of maintenance is the record-keeping, particularly that of the rate of a road's deterioration.

In Bangladesh where the RHD is short of vehicles, it would be difficult for the maintenance engineer to make his monthly inspection by car. However, it is suggested tnat one vehicle be allocated to each such engineer so that good records for maintenance can be ensured.

(b) Budgeting

A basic consideration in the management of a highway maintenance program is the development of a budget that accurately reflects the proposed maintenance program.

Maintenance and repairing works for pavement and bridges are critical to the performance of the maintenance program. Expenditures on pavement maintenance may represent 30% or more the total maintenance and repair budget. The budget allocation for highway maintenance is proposed as shown in Fig. 9.7.1.

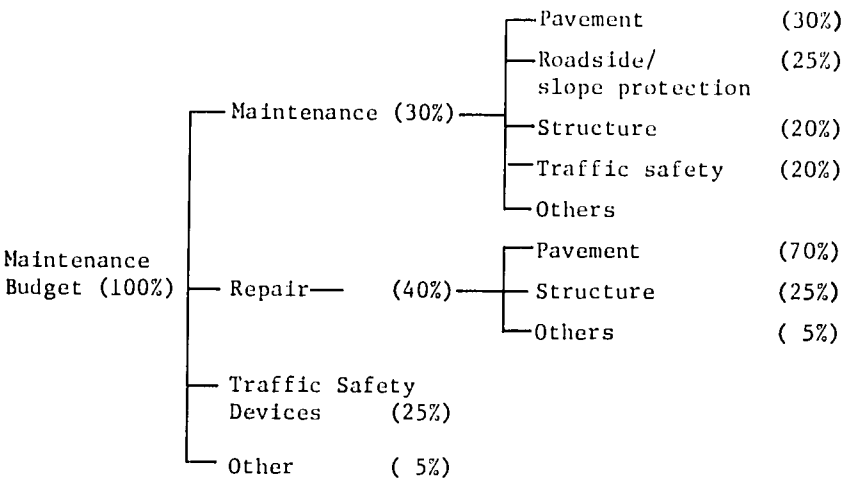


Fig. 9.7.1 Budget Allocation for Highway Maintenance

As discribed in Subsection 9.4.5, the RHD spent average 384 million Taka per annum during 80/81 - 83/84 for the 3,982 Km length of the national and regional highways. The average maintenance cost is some 96 thousand Taka per Km at 84/85 price. This is too small to keep the normal maintenance operation for the highway.

Generally, for all type of asphalt roads, the maintenance costs over the first 25 years of their lines can be expected to equal about half the initical of building the pavement. And the average highway mentenance cost is estimated 2 - 3% of initial cost of construction of the highway. In case of Bangladesh highway, it is suggested that the minimum of 0.36 million Taka per Km should be allocated for the highway maintenance which is

about four times of past expenditure. The estimation is based on the following:

(1)	Standard highway construction cost per Km	: Tk 17 million
(2)	Average pavement cost per Km	: TK 7 million
(3)	Percentage of pavement maintenance cost as against the total initial cost of building the pavement	: 2 %
(4)	Percentage of pavement maintenance cost as against the total maintenance and repair cost	: 37 % (Ref. Fig 9.7.1)
(5)	Percentage of maintenance cost as against the initial construction cost	: 2 %

(1) x (5) = 17 x 0.02 = 0.34
(2) x (3) ÷ (4) = 7 x 0.02 ÷ 0.37 = 0.38

Ave = 0.36 million Taka

Remarks;

Standard highway construction cost and average pavement cost were estimated with reference to Khulna - Mongla Road and Comilla - Chandina Bypass.

Table 9.7.1 Typical Maintenance Activities

Activity	Accomplishment Units
FLEXIBLE PAVEMENT PROGRAM	
Base and Surface Repair	Cu m
Surface Patching-Premix (Hand)	Cu m
Surface Patching-Premix (Machine)	Cu m
Surface Patching-Spot Seal	Sq m
Seal Coat-Sand	Sq m
Seal Coat-Flush	Sq m
Crack Filling	# Filler Material
Heater Planning	Sq m
RIGID PAVEMENT PROGRAM (P.C.C.)	
Patch Spalled Areas	Cu m
Partial and Full Depth Patches	Cu m
Paved Shoulder Mt'c. (Premix)	Cu m
Paved Shoulder Seal-Sand	Sq m
Joint Sealing	# Filler Material
Expansion Joint Repair	Lin. m
REPAIRING MISCELLANEOUS CONCRETE APPURTENANCES (Except Bridge Structures), Sidewalks, Concrete Dikes, Riprap, Retaining Walls, Slope Pavement, Curbs, Gutters, and Drop Inlets	Cu m
ROADSIDE MAINTENANCE PROGRAM	
Cleaning Culverts	Each
Cleaning Culvert Openings and Drop Inlets	Each
Dressing and Shaping Ditches	Lin. m
Cleaning Ditches	Cu m
Remove Sand drifts	Cu m
Roadway Section Restoration: Slides, Slip-outs, Washouts, Banksluff	Cu m
Shoulder Slope Maintenance (Blading)	Shoulder km
Vegetation Control (Mowing, Flailing, Burnings, Etc.)	Shoulder km
Vegetation Control (Chemical Weed Spray)	
ROADSIDE CLEANUP	
Remove Debris, Litter, Trash	Shoulder km
Empty Litter Barrels	Each
Sweeping: Traveled Way, Shoulders and Gutters	Traveled km
MAINTENANCE OF ROADSIDE APPURTENANCES	
Right-of-Way Fences and Gates	Lin. m
Cattle Guards and Wings	Each
Removal of Encroachments (Advertising Sings, etc.)	Each

Activity	Accomplishment Units
TRAFFIC SERVICE PROGRAMS	
Maintenance of Directional, Route and Warning Sings, Guide Posts, R/W Markers, and Kirometere post Markers	Each
Guardrail-Repair and Replacement	Lin. m
Guardrail-Painting	Lin. m
Guardrail-Cleaning	Lin. m
Pavement Striping, Center Line, Lane Intermittent or Dashed Line	Km
Pavements Striping, Center Line, Lane and Barrier Stripes, Solid Line	Km
Pilot Lining (Spotting for Traffic Line Painting)	Sq. m
Pavement Markings, Includes Arrows, Stop Bars, Gore Markings, Pedestrian Crossing, Painted Cattle Guards	Each
Roadway Lighting Operations: Highway Lighting, Bridge and Approach Lighting (Incl. Electrical Energy Costs)	Traveled Km
Patrolling for Protection of Public Traffic on Weekends and During Severe Weather Conditions	
MAINTENANCE AND REPAIR OF STRUCTURES	
Structural Members, Bridges, Under and Over Crossings (Includes Repair and Painting), Bridge Deck and Railing Maintenance (Painting, Linseed Oil or Other Surface Treatment), Repair and Maintenance of Pumping Plants in Structure, Incl. Cost of Electrical Energy.	Each
Inspection of Structures (Bridges and Culverts)	Each
Roadway and Drainage Grading	Cu. m
Flood Control	Man-hours
HEAVYSEAL AND CHIPS	Sq. m
BITUMINOUS SURFACE	Cu. m
TRAFFIC SERVICES	
Erection of Route, Safety and Direction Markers	Each
Construct Cattle Guards	Each
Construction of Guardrail	Lin. m
MATERIALS PRODUCTION ACTIVITIES	
Aggregate Production	Cu m
Premix Production	Cu m
Mixing Salt and Sand	Cu m

9.8 Road Transport Operational Issues

9.8.1 Road worthiness and maintenance

The Directorate of Road Transport Maintenance is responsible for the implemeatation of motor vehicles rules and regulations and for the inspection of motor vehicles in both Government and private sector. The Directorate is an attached Directorate of Roads and Road Transport Division under the Ministry of Communications. There are, at present, 19 zonal offices of the Directorate of Road Transport Maintenance and each zonal office is headed by an Inspector of Motor Vehicles. The primary function of this Directorate is the inspection of motor vehicles to certify their continued road worthiness.

The organisation lacks facilities for adequate checking of vehicles at present. Due to lack of permanent accommodation and proper facilities for the testing of motor vehicles, roads are being used as testing fields. The present system of inspection is based on the visual and physical performance of an Inspector. As a result, a large number of buses, trucks and other motor vehicles are found travelling without lights, proper brakes, window pane, window screen, and many other engine and mechanical defects. Such errors and mistakes which may leave serious defect unnoticed and may result in dangerous road accidents can be remedied by the establishment of Mechanical Vehicles Inspection Stations in different zones which will be more scientific and accurate using scientific equipment.

The Directorate of Road Transport Maintenance has submitted a pilot project for inclusion in TFYP by the name "Scheme for the establishment of mechanical vehicles inspection station with associated facilities". The proposal further considers establishment of two stations in the first phase to be followed by another two stations in the second phase. In recent years the BRTC was equipped with excellent workshops through International (Japan) funding. They are presently under-utilized, raising costs of the BRTC operations. Even if the four proposed mechanical vehicle inspection stations are established still those will fall short of total requirement in the country. Under such a situation the well equipped BRTC garages may be used for checking vehicle road-worthiness. If the above proposals are implemented there will be substantial reduction in the accidents, raise the standard by enabling more defect-free vehicles on road and at the same time it would reduce the losses of BRTC. There should also be a system of periodic checking of all vehicles in the country. Traffic police section should also have the authority to send suspect vehicles for checking.

Road vehicle maintenance is an important aspect of road traffic operation. Both in private sector as well as in public sector poor standard of maintenance and shortage of spare parts cause many of the vehicles inoperative for many useful hours in a year. BRTC has created so far 12 depots, 4 sub-depots, 2 workshops, one training institute and other ancillary facilities. Moreover, there are innumerable privately owned workshops spread all over the country. An integrated central workshop of BRTC at Joydevpur has been constructed under Japanese grant and was commissioned for service in 1982. This is in fact the biggest and most sophisticated modern automobile workshop in Bangladesh. BRTC's standard of maintenance has improved as before but due to shortage of spare parts and materials, inspite of having enough manpower, the target of workshop could not be achieved and monthly output/production varies from 22-40 percent.

Overall BRTC is suffering from poor standard of maintenance of the fleet of buses and trucks and there is absence of adequate workshop facilities. In addition, there is a lack of system in procurement of spares resulting in over-procurement as well as under-procurement. Moreover, there is an absence of preventive system for ensuring servicing of vehicles. There is no periodical inspection for all BRTC vehicles which should be done at least twice in a year. It is reported that due to establishment of Integrated Central Workshop at Joydevpur the percentage of on road BRTC vehicles has registered an increase from 41% in 1979 to 77% in 1984. With the existing physical facilities BRTC is fully capable of maintaining and operating a fleet of 1,000 buses and 500 trucks which demand expansion of BRTC services. The existing Depots and sub-depots which were created long ago are not in very good condition and need renovation and major repairs. Some of them even will require improvement to bear any addition to existing vehicle fleet.

In order to ensure better performance, ancillary facilities needed to be provided to the essential personnel of the operating units. Training facilities to transport workers, drivers and personnel of private and public sector will have to be provided in order to improve their skill and reduce damage to vehicles.

9.8.2 Trucking operation

Trucking operation in Bangladesh is carried out on commercial and on non-commercial basis. Commercial or for hire trucks are operated by private sector and also by public sector through BRTC. The non-commercial trucks are owned by government (different Ministries including Ministry of Defence) and semi-Government (nationalized or other statutory agencies) organizations.

The growth of truck fleet on road during 1975 to 1981 as shown in Table 9.6.2 indicates that the annual growth rate was 6.1% from a total number of 9457 in 1975 to 13496 trucks in 1981. This declining rate points to a fact that truck fleet growth is turning towards a more stable growth rate situation in Bangladesh.

A truck fleet forecast upto 1985 was made assuming a 6.1% annual growth rate and is shown in Table 9.6.4 as no official figure upto 1985 was published.

In the commercial trucking operation in Bangladesh private sector plays a very significant role with its predominant share over public sector transport in the no. of vehicle fleet and tonnage handled. Before independence the share of public sector truck ownership was very much limited.

In 1971 a truck division was created under BRTC to provide truck service in the public sector. At the end of 1984 the total active truck fleet of BRTC was 168 of which 155 nos. were reported to be road worthy. BRTC has been playing the role of a controlling agency in the trucking operations of Bangladesh by keeping the freight rates of private operators at a competitive level refraining them from charging exorbitant rates.

BRTC truck fleet mainly carries food grain, fertilizer, jute and jute goods etc. of government, autonomous and nationalized organisations on a route-wise tariff. The operation and maintenance of BRTC truck fleet is

carried out from 4 depots each in Chittagong, Dhaka, Khulna and Bogra with a total present operating capacity of 500 trucks. But considering the nominal share of public sector trucks in the total truck fleet of the country it is doubtful how much influence BRTC truck fleet can really exert on the privately owned truck haulage rates. The present share of BRTC truck to total truck fleet is about 1.04% which is negligible.

Table 9.8.1 BRTC Bus and Truck Fleet

	December, 1979		December, 1984	
	Bus	Truck	Bus	Truck
1. Total fleet (active)	675	110	465	168
2. Under major repair	302	13	134	13
3. Road worthy	373	97	331	155
4. Average on road	34.22%	81.82%	71.18%	92.26%

Source : BRTC

There is a small number of own use truck fleet owned by public and private organisations mainly used in the delivery of POL, Soft drinks, tea, jute, sugar, etc. But the common practice in the commercial freight movement is private sector contract carriage. Movement of goods by truck are generally contracted directly between the vehicle operator or vehicle owner groups office and the goods consignor. For the movement of government and public sector goods movement a fixed contract hire agreement.

Majority of the truck owners have one or two vehicles. The number of individual owners having more than 5 trucks are rather small. There are a number of owners cooperative in the country.

Ownership groups are also gaining popularity in the face of increasing competition within the trucking industry. Already in most of the big commercial areas like Chittagong, Dhaka, Khulna, Jessore there are several owners groups in trucking business. The group's office accepts order for haulage and use the group's vehicle. There are also truck owner's association in each district with the objective to protect the owners' interest in negotiations and deliberations with Government agencies and road transport employee unions. Entry to the membership is rather liberal with a nominal fee renewable annually.

During the First Five Year Plan the Government policy was to increase the public ownership and limit the private sector operations. But at the end of the plan period and during the following Two Year Plan the policy was changed considering the very large private sector and its operating efficiency vis-a-vis public transport under BRTC.

9.8.3 Bus operation

With the growing number of passenger operation and government's decentralization policy bus operation has assumed greater importance in providing door to door service with higher accessibility than other passenger transport modes.

The growth of bus fleet on road in the country during 1975 to 1981 was 5.5% per annum, while the minibus and Station Wagon fleet increased by about 14.4% annually during 1975 to 1981 (See Table - 9.6.2). Assuming an annual growth rate of 5.5% for buses the total number of bus fleet on road stands at 8900 in 1985 and with 14.4% annual growth rate during 1981 to 1985 the mini-bus fleet rises to 6100 in 1985 (See Table 9.6.4). The fact of high growth of mini-bus fleet is due to tee fact that within Dhaka city and in the inter-city travel for relatively shorter distance mini-bus service has offered more comfortable and speedy service in passenger transport. Therefore, an increasing preference for mini-bus service accompanied by liberal government policy to import reconditioned or second hand mini-bus at a cheaper rate led to a high growth rate. The introduction of mini-bus service in the passenger transport of Bangladesh has improved the quality of service in road transport. Moreover, it created competition with bus service on the one hand and with rail and inland water transport passenger service on the other.

The commercial passenger transport of Bangladesh is characterised by public sector participation through BRTC and private sector having a much higher share. By December 1984 the total number of active BRTC bus fleet was 465 compared to total bus fleet of 8315 in the country. Therefore, with a share of only 6% public sector participation in the road transport passenger operation and 94% share by the private sector the latter assumes greater role in the bus operation of the country.

Bangladesh Road Transport Corporation was established in March 1961 with the object to provide an efficient, adequate, economical and properly coordinated system of road transport service operating on commercial lines in which services the private firms did not provided. BRTC has carried about 6.5 million passengers in 1984 from a level of 3.0 million in 1979. BRTC operated bus services in the cities of Dhaka and Chittagong and 16 inter-district routes covering almost all district headquarters by the late seventies. BRTC also operates a small fleet of mini-buses mainly inter-district.

Bus operation of BRTC is an uneconomic venture till today. The low rates of fares falling far below the cost of operation, loss of revenue through inadequate collection and leakage of collected revenue, poor standard of maintenance, shortage of spare parts, redundant personnel per vehicle compared to road worthy vehicles are some of the causes those lead to uneconomic bus operation of BRTC. Although there has been improvement in the utilization of capacity in recent years but still BRTC could not prove its commercial viability.

As a public sector transport organization BRTC has to run its operation with a lot of limitations. Government rules and regulations, fare structure and other constraints and braving all these it tries to offer infrastructure facility to the people who are by and large men of small means. This is not the case with private operators. Apart from running commercially it has to render welfare cum public utility services.

(a) Beggars, disabled, blind, and destitutes travel free by BRTC buses.

(b) Armed forces personnel, BDR, Ansar, students travel at concessional fare.

(c) Low fare rate fixed by Govt. compared to operating cost, considering the public interest.

(d) Damage of Transport vehicles during civil strike and political disturbances, thus effecting the revenue income.

(e) No subsidy is given by the Govt. for any damage/less incured in case of BRTC's operation. On the otherhand it may be noted that bearing all the above constraints and overcoming the problems and barries BRTC is making net surplus in its truck operation. In most of the months, operation it earns operational surplus in its bus operation. It is due to application of improved and efficient administrative principles and management systems that it has reduced the expenses and wastage and earned more revenue compared the number of vehicles. Moreover, credit should go to BRTC since it renders an ideal and effective service to the people with very limited resources.

In the transport of passengers by road with 94% share in total fleet of buses private sector plays a dominant role in the overall performance of passenger service. Individual owners of buses having only one or few vehicles each form operational grouping by forming bus owners' association. Such associations are prevalent in all the districts and are generally formed according to routes. On inter-district routes often more than one association exists. Bus associations are quite organized and more sound organizationally. Bus associations frame their own service scheduling and fare structures. Individual buses are required to operate on an agreed time table and any breach is subject to be fined. Like truck owners' association bus owners' association also provides a protective negotiating front against government agencies and road transport employees' unions.

9.8.4 Regulations

In order to ensure a national and efficient road transport system in Bangladesh it is necessary to establish proper ground roles. In the road transport system of Bangladesh a measure of order and discipline is required to promote the existing transport system to fulfill the transport need of to-day and of to-morrow.

Road transport regulations in Bangladesh originates mainly from the Motor Vehicle Act 1939 followed by the Bengal Motor Vehicle Rules 1940 and several other amendments in 1961 and 1967.

The regulations are quite comprehensive but outdated. The enforcement of regulations are very weak. The axle load regulations are outdated and rather unenforceable regulations in force. It is every difficult to check on compliance with these and no applicable fine could be enforced for infringement. The existing regulation in practice should be modified and should be more clearly.

Customs regulations affecting road vehicles are complex. They should be replaced by two main rates, one for imported and one for locally

assembled vehicles and with a simple progressive tax rate based solely on C.I.F. value. Similarly the tax rate on spare parts should be rationalised.

In case of road accident on rural roads the police station of the area investigates the case and records the accident. But there is no regular system of collecting road accidents data in the country and R.H.D. is not reported for the identification of accident blackspots for a remedy. Many of the road accidents, if no fatal, are not reported at all due to trouble of police and court.

A regular system of rural highway patrol by traffic police to control vehicle speed and traffic behaviour on highways and at small towns be established. Proper rural driving behaviour should be enforced.

Many disassociated authorities are involved in road sector and many regulations have remained unchanged for many decades which are outdated. Moreover, when statistics are published they are often in-applicable and become historic records. As a result of this no official seems to be able to take the initiative for enforcement and it appears that most vehicles on the road fail to comply with road-worthiness regulations or to comply with traffic regulations. Each organisations should be clearly assigned duties and a coordinated body should oversee the activity of each individual organisation.

Ordinary vehicle registration and licensing is carried out by district authorities which are notified to the Commissioner of Traffic Police in due course. After 2-3 years records of vehicle registered are published. Often list submitted by the local authorities do not agree with the totals published. To be of any value informations should be monitored to a Central Vehicle Registry Office at the end of each month and recorded on a computer, so that vehicles can be located for legal purposes, and checked for payment of licences the following month when needed.

Until one controlling authority has been appointed and regulations rationalised the maximum utilisation of the road network cannot be achieved, and minimum road transport cost will remain illusory.

CHAPTER 10 INLAND WATER TRANSPORT

10.1 Inland Waterway Institutional Organisations

10.1.1 Introduction

All aspects of water transport and port facilities are under the Ministry of Ports, Shipping and Inland Water Transport. The organizations under the guidance of the Ministry are shown in Fig. 10.1.1 and are as follows:

Sea Port : Chittagong Port Authority and Chalna Port Authority

Shipping : Bangladesh Shipping Corporation
Department of Shipping
Mercantile Marine Department
Marine Academy.

Inland Water Transport : Bangladesh Inland Water Transport Authority
Bangladesh Inland Water Transport Corporation

(1) Sea Ports

The Sea Port Authorities of Chittagong and Chalna are semi autonomous organizations providing facilities for international waterborne commerce and the transfer facilities for the movement of these goods inland by water, rail and road.

Chittagong Port Authority came under the Ministry of Ports, Shipping and Inland Water Transport in 1977. The Port of Chalna Authority was established under the Ministry in 1976.

(2) Bangladesh Shipping Corporation

The Shipping Corporation was established in 1972 to provide shipping services on international routes. BSC acquired its first ocean going vessel the " BANGLAR DOOT " in 1972, and commenced liner service on the U.K/Continent route. BSC received four coasters from BIWTC in July 1972 and another coaster in April 1973. With the use of chartered vessels, the Corporation joined the UK/Continent Conference in March 1973.

Today the corporation owns a fleet of approximately 25 vessels. These vessels operate on major world liner routes transporting general cargo, crude oil and food grains. It is estimated that this fleet now carries 20 percent of the nation's imports and exports.

(3) The Mercantile Marine Department

It provides for rules and regulation regarding safety of life at sea and inland waters. Marine surveyors under this department are responsible for verification of proper ship repairs, safety equipment, hull condition, load capacity and vessel registration.

MINISTRY OF PORTS, SHIPPING AND INLAND WATER TRANSPORT

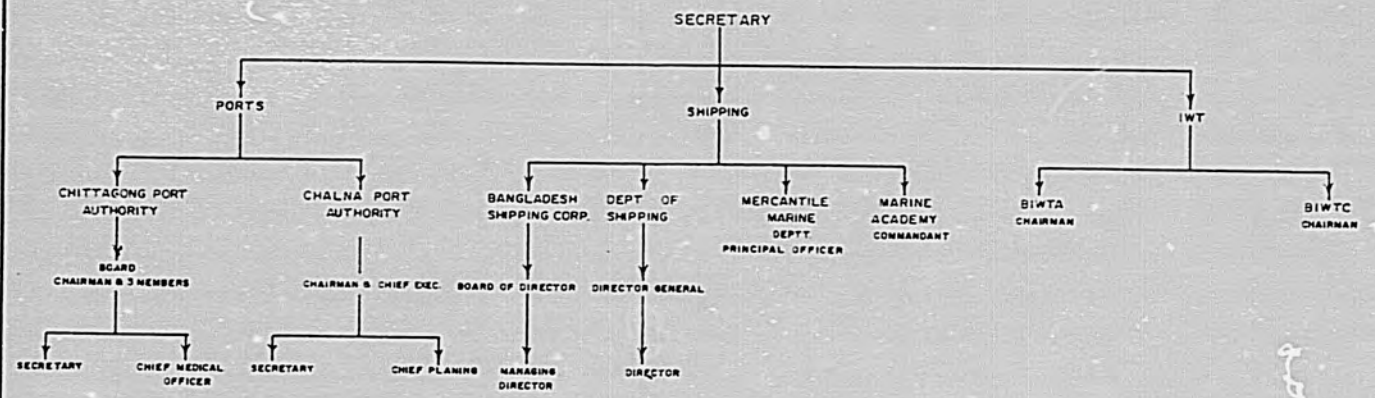


FIG. 10.1.1 ORGANISATION STRUCTURE. MPSIWT

In addition the department provides for the manning and up-keep of lighthouses.

(4) The Marine Academy

Responsible for the professional training of ships officers, with an annual intake of 48 cadets, equally divided into Nautical and Engineering branches.

(5) Bangladesh Inland Water Transport Corporation

BIWTA is a semi-autonomous organization responsible for river conservancy, the regulation of inland water transport operators, the construction and operation of terminal facilities on the waterways, hydrological and hydrographic studies, dredging, salvage of sunken ships, pilotage, navigation charts, and navigation aids.

(6) Bangladesh Inland Water Transport Corporation

BIWTC is an autonomous organization operating inland waterway transport services under the Ministry.

10.1.2 Bangladesh Inland Water Transport Authority

The Inland Water Transport Authority (IWTA) was established in 1958 as a semi-autonomous organization to take over the river conservancy functions carried out privately until that time and to regulate inland water transport operators. It also was to construct and operate various terminal facilities along the waterways.

The authority was re-organized in 1981. The organizational structure of BIWTA is shown in Fig. 10.1.2.

BIWTA is a government authority responsible for:

1. Construction and operation of inland river port facilities.
2. Development of passenger facilities.
3. Fixing of maximum and minimum fares and freight rates.
4. Approval of timetables and fare tables for passenger vessels.
5. Dissemination of navigational and metereological information.
6. Provision of pilotage.
7. Hydrographic surveys and dredging.
8. Provisions of navigational aids.
9. Allocation of routes and grant of route permits.
10. Removal of wrecks and obstructions in channel.
11. Determination of port requirements such as passenger, cargo, jetties, ghats and godowns.
12. Auction of annual contracts for labour stevedore for cargo handling by stevedore labour.

As shown in Fig. 10.1.2 BIWTA consists of several departments : Ports & Traffic, Engineering, Mechanical & Marine Engineering (Yard & Workshop) Finance, Accounts, Conservancy & Pilotage, Hydrography, Deck Personnel Qraining Centre, Secretarial, Planning, Purchase and Stores.

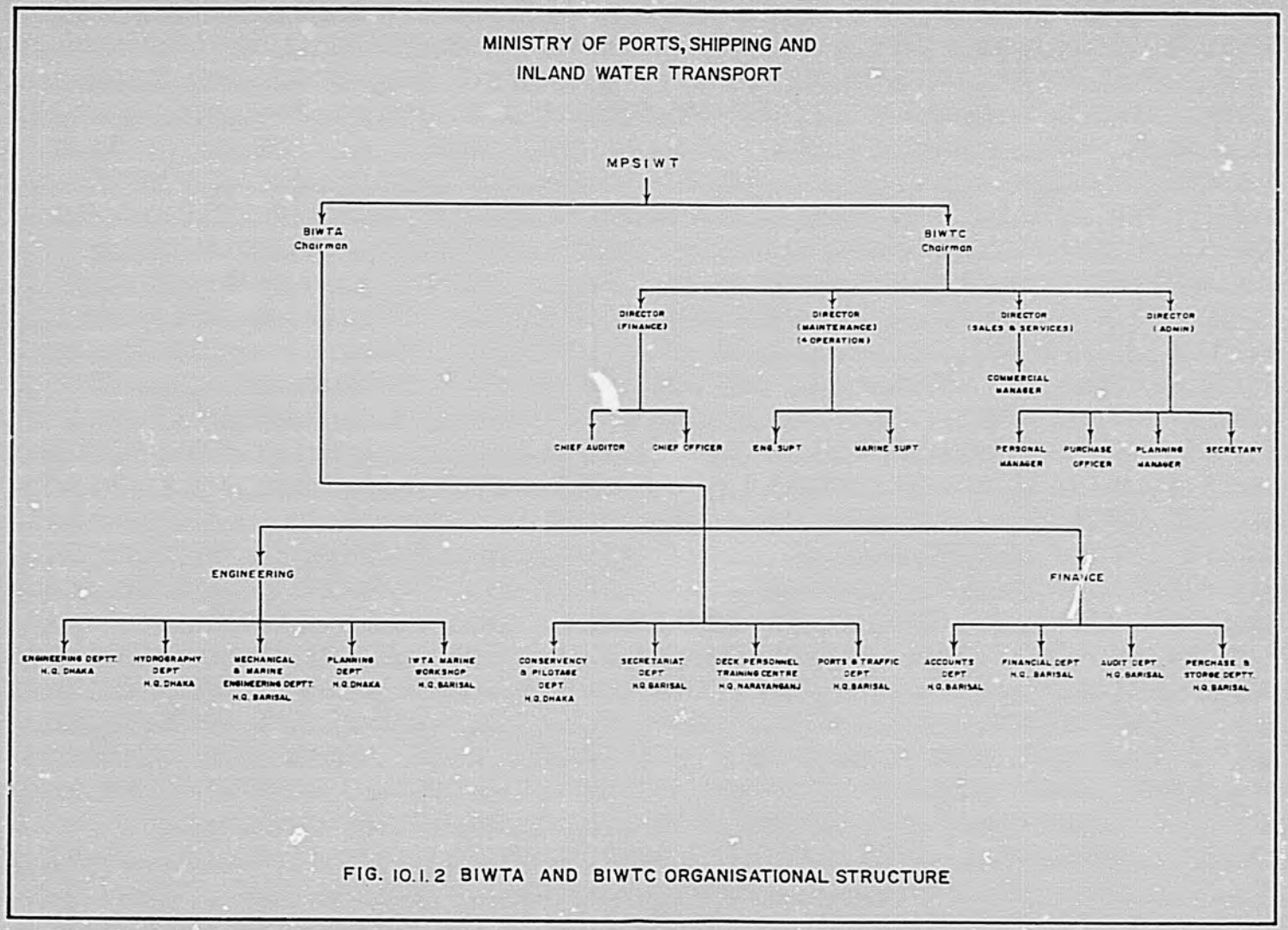


FIG. 10.1.2 BIWTA AND BIWTC ORGANISATIONAL STRUCTURE

BIWTA does not control the cargo handling, which essentially determines a port's freight throughput.

Since its inception, BIWTA has carried out many surveys and has developed seven major inland ports : Dhaka, Narayanganj, Chandpur, Barisal, Khulna, Bagabari and Bhairab Bazar and 90 launch landing stages on the rivers of Bangladesh.

The description of BIWTA's activities are contained in Section 10.5 infrastructure.

10.1.3 Bangladesh Inland Water Transportation Corporation

BIWTC was established in 1972. Its formation was based on taking over two public companies and eight small vessel operators whose assets were abandoned at the time of Independence. The Corporation is an independent entity not subject to the usual government budgetary and personnel regulation.

The Commission is headed by a chairman who reports to the Minister of Ports Shipping and Inland Water Transport.

There are four divisions, each headed by a director, Finance, Maintenance and Operations, Sales and services, and Administration.

Essentially associated with commercial operations the BIWTC operates "Social Service Operations" to remote areas, particularly the outer chars in the Bay of Bengal. BIWTC possesses repair facilities and a sizeable fleet of cargo and tanker vessels.

As a government owned operation there is a rigidity in operations that is inhibiting to entrepreneur operational styles, as is the need to maintain the BIWTC published rates.

10.1.4 Private organizations

There are four trade associations representing the inland water private sector vessel operators. They are:

(a) Coastal Vessel Owners
(b) Passenger Launch Owners
(c) Barge Owners
(f) Tug Boat Owners

They act as a focus for the private owners and are consulted by government on matters affecting their obvious interests.

10.2 INLAND WATERWAY TRAFFIC

10.2.1 Freight traffic

The IWT fleet is operated by private companies and the Government owned BIWTC, with the latter shewing a rapid decline in importance to only 23% of the freight carried in 1982/83. There is some difficulty in ascertaining the total volume of freight carried by IWT vessels as it is believed there is under-reporting by the private sector, partly because of inaccurate or incomplete records and partly because of desire to reduce tax or other payment liabilities. Also, the actual number of vessels that are operational is not certain, as sometimes vessels laid up or scrapped are not taken off the register.

Estimates have been made of the total tonnage and tonne kilometres for the period 1976/77 to 1984/85. The tonnage handled by the private sector in 1976/77 is given as 2.707 million tonnes in the Review and Update of BTS. On the basis of a static DWT for the fleet of 201,441 tonnes (see Section 10.6), an annual tonnage of 13.44 tonnes per DWT were carried.

Without any other data, it has been assumed that this has remained at the same level for the private sector throughout the period. The resulting estimates for the private sector tonnage handled for the period 1977/78 to 1984/85 are given in Table 10.2.1. The average annual growth rate for the period 1976/77 to 1980/81 is 5.18% p.a and for 1980/81 to 1984/85 is 9.03% p.a., reflecting the encouragement of the private sector through more liberal policies during the SFYP.

As the tonnages for BIWTC as well as the static DWT are given by BIWTA the resulting value of tonnes per DWT has been calculated over the period 1976/77 to 1982/83, and the results given in Table 10.2.1.

It can be seen that although there was some improvement in BIWTC performance in 1977/78 to 1979/80, there was a sudden decline to the 1976/77 level thereafter. In order to estimate the tonnage handled by BIWTC in 1983/84 and 1984/85, the tonnes per DWT in 1982/83 have been assumed to apply.

It is clear that the public sector is less efficient than the private sector, partly because of the ageing fleet and partly because of operational inefficiencies leading to long turn-round times.

Annual records of IWT freight flows are not provided. Provisional figures issued by BIWTA for 1982/83 are just available, whilst the previous data were for 1978/79. Although it is generally accepted that the recorded tonnages are under stated, the data for 1982/83, has been analysed in order to present an indication of the relative importance of different commodity groups and different routes.

The total tonnage and tonne-kilometres have been calculated and are given in Table 10.2.1. It has been assumed that the average lead of 241 km, quoted in the Review and Update of BTS, for 1976/77, has remained the same upto 1984/85. Although it has been necessary to make a number of assumptions, based on very little data, the total tonnage for 1982/83, although higher than the recorded volume by BIWTA, is only 4% higher than BIWTA's estimate. For comparison purposes, the provisional recorded total tonnage by IWT in 1982/83 is 3.81 million

Table 10.2.1 IWT Freight and Tonne-kilometres 1976-1984

Year	Private			Public (BIWTC)			Total Tonnes/ (Millions)	Total Tonnes.km. (Millions)
	DWT Tonnes	Tonnes DWT/year	Tonnes/ year Million	DWT Tonnes	Tonnes DWT/year	Tonnes/ Year Million		
1976/77	201441	13.44[E]	2.707[D]	179643	8.62	1.549[D]	4.256	1026
1977/78	192543	"	2.588[C]	169234	13.22	2.237[D]	4.825	1163
1978/79	204940	"	2.754[C]	168744	12.63	2.132[D]	4.886	1178
1979/80	218440	"	2.936[C]	168358	12.15	2.046[D]	4.982	1202
1980/81	246484	"	3.313[C]	164220	9.65	1.584[D]	4.897	1180
1981/82	299777	"	4.029[C]	148626	8.94	1.328[D]	5.357	1291
1982/83	315853	"	4.245[C]	137472	8.92	1.226[D]	5.471	1319
1983/84	330921	"	4.448[C]	127155	8.92[E]	1.134[E]	5.582	1345
1984/85	348388	"	4.682[C]	117612	8.92[E]	1.049[E]	5.731	1381
Growth Rate 1976 - 1980			+5.18%p.a			+0.56%p.a	+3.57%p.a	+3.57%p.a
Growth Rate 1980 - 1984			+9.03%p.a			-9.79%p.a	+4.01%p.a	+4.01%p.a

Notes C = Calculated
D = Data
E = Estimated
I = The average lead given in Updata and Review of BYS is 241 km.

Source: BIWTA, BBS 1982 year book, Consultants calculations.

tonnes, whereas the BIWTA estimate in the report for the TYFP is 5.25 million tons.

Because BIWTC has shown a significant decline in tonnage handled, particularly in the period 1980/81 to 1984/85, (some 9.8% p.a), the overall increase in IWT freight has been around 4% p.a., despite the rapid growth of the private sector.

The inter district flows and intra-district movements for eight commodity groups are given in Appendix 10, the district total IWT freight flows are in Table 10.2.2 and a summary is given in Table 10.2.3 for the whole of Bangladesh.

There is quite a large volume of intra-district flows (26% of the total) but 86% of this is in Khulna district, and is predominantly Chalna Port traffic moving by river to and from Khulna.

The seven main commodity groups account for about 90% of the total tonnage, with food (23%) and petroleum products (27%) being the main commodities carried. The distribution of the major commodity movements are shown in Appendix 10 and total in Figure 10.2.1.

Table 10.2.2 IWT Freight Flows - Total All Commodities 1982/83

District	No.	TOTAL ALL COMMODITIES		
		Inter-District		Intra-District
		Out Tonnes	Out Tonnes	Tonnes
Chittagong	1	1844583	57580	40151
CHT	2	12573	58510	-
Comilla	3	50804	121639	7989
Noakhali	4	2173	3628	-
Sylhet	5	179141	14780	11174
Dhaka	6	446617	1464876	64497
Faridpur	7	26493	33540	196
Jamalpur	8	-	-	-
Mymensingh	9	3001	37200	-
Tangail	10	-	-	-
Barisal	11	28883	193110	13267
Jessore	12	-	2229	-
Khulna	13	226446	680325	839477
Kushtia	14	-	2887	-
Patuakhali	15	9599	51093	720
Bogra	16	-	-	-
Dinajpur	17	-	-	-
Pabna	18	4269	114288	200
Rajshahi	19	-	-	-
Rangpur	20	903	-	-
Bangladesh		2835485	2835485	977671

Source: BIWTA

Table 10.2.3 Summary IWT Freight Flows 1982/83

COMMODITY	Inter-District		Intra-District		Total	
	Ton	% Total	Ton	% Total	Ton	%
Food	477290	55	396921	45	874211	100
Fertilizer	215294	64	1185-3	36	333877	100
Jute etc.	234767	52	218316	48	453083	100
Cement	397999	82	84947	18	482946	100
Stone etc.	172348	100	-	0	172348	100
Iron/steel	51042	98	1024	2	52066	100
P.O.L.	1033664	99	12881	1	1046545	100
Sundries	253081	64	144999	36	398080	100
TOTAL	2835485	74	977671	26	3813156	100

Source: BIWTA and Consultants calculations.

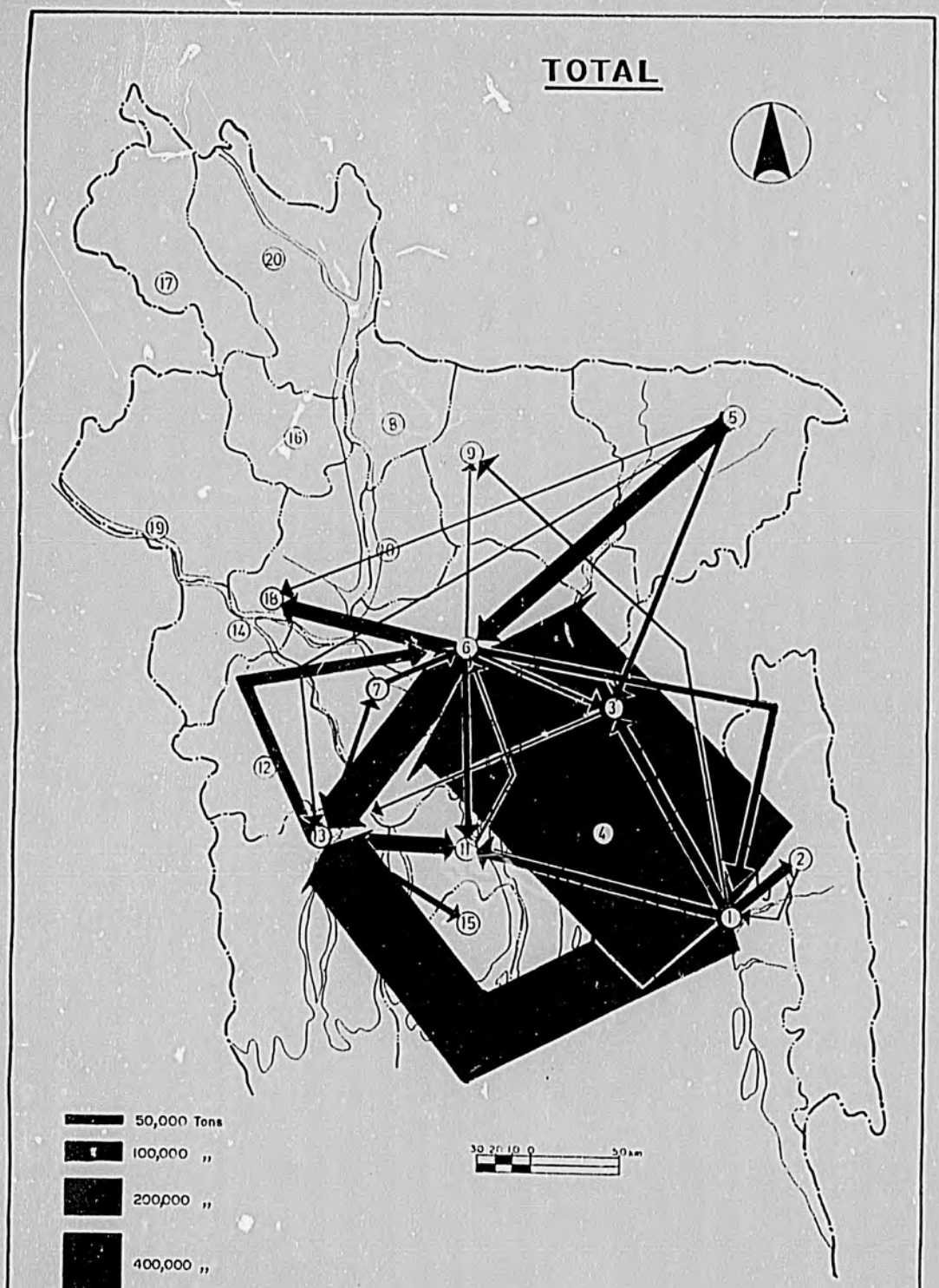


FIG. 10.2.1 IWT MAJOR INTERDISTRICT MOVEMENTS OF ALL COMMODITIES 1982/83

10.2.2 Passenger traffic

(1) General

The IWT passenger carrying fleet is mainly under private control, mostly in small independent companies. The Governments involvement is restricted to a few launches operated by BIWTC, including the well known Dhaka to Khulna "Rocket." Although BIWTA is responsible for licensing the private operators, it is difficult to be certain as to the number of passengers they carry. It is generally believed that the private operators do not keep accurate records and that overloading is extensive. As there are no reliable records, estimates have been made by various studies of the operating characteristics of the fleet. BIWTA have made their own estimates, based on the average load per vessel, the number of vessels and the number of trips per year. Unfortunately, it appears that a mistake has been made in the computation, as the number of trips used was based on 2 way trips, rather than on one way trips and hence the estimated number of passengers would need to be doubled.

(2) Surveys

Because of the confusion surrounding the statistics, surveys were carried out on passenger load factors and data was collected on the number of launches and steamers operating with an estimate of the number of trips being made daily. The route of each vessel enabled the distance travelled to be calculated.

Random sample passenger counts were made from the passenger ghat at Dhaka, Barisal, Narayanganj, and Khulna. The counts were then compared with the rated capacity to get a measure of the load factor. In the BTS report, 1974, the results of a survey of load factors based on the average taken at several points taken along the route were given. This showed that the average load factor at that time was a very high 1.98. From the results of the survey conducted by this study it would seem that there has been little improvement as the average load factor was found to be 1.90, although this is only based on arrival or departure load factors.

The distribution of passenger launches and steamers by district for 1984/85 are given in Table 10.2.4. Of the total 1494 passenger vessels, records were available for 1203, from the districts indicated in Table 9.2.4. From these, detailed analysis of the operating characteristics was made and an estimate of the annual number of passenger-kilometres made for each vessel, by assuming 320 operational days per year, with 90% operational effectiveness, the actual distance travelled per one way trip and the estimated load at a load factor of 1.9 of theoretical capacity. This gave an estimated 4995 million passenger-kilometres. Assuming that the vessels for which records were not obtained exhibit the same capacity and operating characteristics, these 291 vessels would give a further 1208 million passenger-kilometres. From the calculations, the average number of passenger-kilometres per vessel per year is 4.15 million. Using this figure, and the number of IWT passenger vessels registered in the years 1978/79-1982/83, an estimate is made of the past passenger kilometres. In Table 10.2.5 the number of vessels and passenger kilometres are shown. The update of the BTS report, the average load

of passengers was found to be about 44 kilometres. Without more recent data, the average passenger lead used was 44 kilometres obtained from the BTS report update to estimate the total number of passenger on IWT, which is shown in Table 10.2.5.

Table 10.2.4 IWT Passenger Vessels 1984/85

District	Number of IWT vessels	Comments
Chittagong	77	Records kept
Chittagong Hill Tracts	93	-
Comilla	93	-
Noakhali	5	-
Sylhet	53	-
Dhaka	745	Records kept
Faridpur	41	Records kept
Mymensingh	15	-
Tangail	17	-
Barisal	140	Records kept
Jessore	6	-
Khulna	175	Records kept
Patuakhali	25	Records kept
Pabna	9	-
Total, records	1203	
Total, no records	291	
Grand Total	1494	

Source BIWTA.

Table 10.2.5 IWT Passenger Traffic 1978/79 to 1984/85

Year	IWT Passenger Vessels, Number	Passenger-Km. (Million)	Passenger (Million)
1978/79	1003	4164	94.6
1979/80	1039	4314	98.0
1980/81	1091	4530	102.9
1981/82	1280	5314	120.8
1982/83	1350	5605	127.4
1984/85	1494	6203	141.0
Growth Rate 1978-1984	6.87% p.a	6.87% p.a	6.87% p.a

Note: The average annual growth rate is the same for vessels, passenger-kilometres and passengers, as a constant performance has had to be assumed.

Source: BIWTA and Consultants estimates.

(3) BIWTC

A study of BIWTC's Rocket service was carried out by having an observer travel on the vessel, one trip, Dhaka to Barisal on April 5th and two way trips, Dhaka to Khulna on May 8/10th. The result were compared with vessel log books for a number of trips by several vessels. From the survey, it appeared that the rated capacity was exceeded throughout the trip, however, the average load factor from the log books seemed to be 0.26. There would seem to be some discrepancy here that might merit further attention, particularly as the private sector is clearly operating consistently at loads exceeding capacity. However, BIWTC only handles a small but a steady declining proportion of IWT passenger traffic as can be seen in Table 10.2.6.

Table 10.2.6 BIWTC and IWT Passenger Traffic 1978/79 to 1982/83

Year	Total IWT Passenger (Millions)	BIWTC Passenger (Millions)
1978/79	94.6	2.6
1979/80	98.0	2.7
1980/81	102.9	2.8
1981/82	120.8	3.0
1982/83	127.4	2.8

Source: BIWTA

10.3 Inland Waterway Performance

10.3.1 BIWTC

(1) Size of Fleet

BIWTC is the owner-operator of the public sector waterborne fleet of vessels. This fleet, numbering 382 vessels in 1983, is divided into three classifications, bay crossing cargo, inland water cargo and passenger vessels.

Over the past 11 years there has been a continuing decline in the fleet size and its carrying capacity, the fleet reducing from 564 vessels in 1973 with a static capacity of 165 thousand tons to 382 vessels in 1983 with a static capacity of 147 thousand tons. (See Table 10.3.1) This decline is due both to a disinvestment policy of the Government, initiated in 1976, and to the steady rise of private sector vessels.

Table 10.3.1 Carrying Capacity of Mechanized National Fleet (Static)

	BIWTC		Private		Total		BIWTC %	
	1973	1983	1973	1983	1973	1983	1973	1983
Fleet Size	564	382	547	1,412	1,111	1,794	50.7	21.3
Static Capacity (Kilo-tons)	165	147	133	328	298	475	50.3	30.9

(2) Vessel performance

Tables 10.3.2 and 10.3.3 were prepared from BIWTC annual records. In order to analyse actual vessel performance and delay factors, log books from four vessels were selected at random. Three months from each vessel were reviewed with dates and times recorded. The vessels were M.V. Korangi a 22 year old tanker operating from Narayanganj to Chittagong. The M.V. Hizala an 18 years old coaster operating from Dhaka to Chittagong, the Bay Crossing tug boat BT 6 - 237 operating from Chittagong to Dhaka and vessel 1046 a 10 year old bulk grain coaster operating from Chittagong to Narayanganj.

Table 10.3.2 BIWTC Coaster Performance

Average sailing distance: 294 km
Average speed : 7 knots
Delay factor = 0.8 : 5.6 knots
= 10.4 km/hr

Based on BIWTC records for 20 vessels
trips per year: 28.8
tons per trip : 896 tonnes
1983/84 19 vessels 446,000 tonnes
Average load: 446,000/28.8 x 19 = 815 tonnes
Average steaming days per annum
2 x (294/10.4) x 28.8/24 = 68 days
Non-steaming days = 297
Non-steaming days per round trip = 10.3

Source: BIWTC
Consultants Calculations

Table 10.3.3 BIWTC Tanker Performance

Average sailing distance : 313 km
Average speed (Table 10.3.3) : 10.4 km/hr
Using same load factor as 10.3.3:

$$\frac{\text{Av load}}{\text{DWT}} = \frac{818}{899} = 0.91$$

1983/84 12 vessels 261,000 tonnes

Average round trips per year
261,000/(1,019 x 0.91) x 12 = 23.5 trips
Average steaming days per annum
2 x (313/10.4) x 23.5/24 = 59 days
Non steaming days = 306 days
Non steaming days per trip = 13.0 days
Average load = 927 tonnes

Source: BIWTC
Consultants Calculations

a) Delays

Vessel delays for the 3 month survey periods were:

(Day - Hours)

	Waiting for berth	Waiting for orders	Stand By	Pilot Delays	Engine Repairs	Navigation Delays
M.V. Korangi	0 - 19	34 - 17	17 - 40	0 - 29	23 - 30	0 - 9
M.V. Hizala	0 - 22	12 - 0	N.R.	0 - 29	11 - 12	N.R.
Tug B T 6-237	9 - 30	13 - 13	5 - 8	1 - 3	7 - 5	0 - 3
M.V. 1046	5 - 45	5 - 0	N.R.	N.R.	12 - 0	N.R.

Note: N.R. = Not recorded in log.

b) Lost time

On a monthly basis the total lost time for the first three vessels was approximately as follows:

M.V. Korangi	Jan 83 - 31 days	Sept 83 - 25 days	July 83 - 22 days
M.V. Hizala	Nov 83 - 10 days	June 84 - 16 days	Dec 84 - 20 days
Tug B T 6-237	April 84-17 days	Aug 82 - 22 days	Aug 84 - 6 days

Available days for the first three vessels over the three month survey periods is 270. Delay days are 169 representing approximately 62 percent of the vessels time.

M.V. 1046 had a better performance record due to its comparatively newer condition with low repair down time and its use in the grain trade negating lengthy waiting for orders experienced by general cargo vessels. Delays for this vessel accounted for 32 percent of the vessels time. Waiting for orders, stand-by and engine repairs account for the major delay factors.

About 70 percent of the BIWTC vessels have recently been supplied with radio communication. This improvement should lead to an improvement in vessel scheduling. However, this single improvement is not the whole solution to the delay problem.

Because random log book samples indicated a superior performance by M.V. 1046 over others in the samples, a more detailed analysis was made. This cargo vessel provided a three year record.

However, the records are incomplete. Some entire months are missing, certain required data was not recorded and much of the logged voyage information can not be read. Vessel log

books are considered official records and are expected to contain detailed and accurate records of the vessel's movements. The contents of BIWTC log book leave much to be desired in this regard. There was, however sufficient information to verify delays and estimate vessel utilization.

The vessel was employed primarily on the movement of bulk grain from Chittagong to Narayanganj and returning empty to Chittagong. Average metric tonnes handled per round trip was 850. Due to the bulk being handled from silo or direct from silo to silo there were not the usual cargo handling delays associated with general cargo port operations.

A total of 79 voyage days were taken from the logs (Jan 14 to 31 1984 - Nov and Dec. 1983) with the following results.

	Waiting for berth	Waiting for orders	Weather delays	Waiting for tide (dredging)	Vessel repairs
Hours	139	118	34	32	278
Days	5.8	4.9	1.4	1.3	11.6

Total lost days 25 out of 79 or 32 per cent.

(3) Voyage round trips

The log book for MV 1046 was examined to determine complete round trip Chittagong - Narayanganj - Chittagong performance. The results showed the round trip required 178 hours or 7.4 days.

The initial findings on voyage times were considered low and did not compare with other vessel utilization. Analysis of BIWTC statement of Earnings and Expenditure 1983 - 1984 showed this vessel to have low maintenance and repair costs record of 89 thousand taka as compared to its sister vessels C 1063 of 132 thousand taka, a 67 percent increase.

This could indicate that less repair requirements reduced voyage times.

Assuming there were no future lengthy delays due to repairs and awaiting spare parts, this vessel should make approximately 45 round trips per year.

Annual Cap 45 trips x 850 tonnes = 38,150 tonnes.

However, further review of the Log Book on a random 6 month basis indicated 1983 - 1984 vessel round trips were approximately 38.

Number of Round Trips

1983	1984
Aug-3	Oct-3
Feb-3	April 3.5
Nov-3	
Dec-3.5	

Total 6 months = 19. annual trips = 38

The difference amounts to 7 trips or 52 delay days.

It is readily seen that this comparatively better performing vessel's trips could be increased.

(4) Operating delays

A further examination for BIWTC total fleet delays was made for the month of June 1984 and set out in Table 10.3.4.

This revealed a senious proportion of lost time, and the questions of delays involving waiting-for-orders and stand-by were explored with BIWTC operating and scheduling personnel. There are a number of inter-related scheduling and communication problems causing waiting-for-order and stand-by delays. In brief they are:

(a) Lack of available berths

(b) Coasters are ordered for in-bound sea vessels. When these ships arrive late, the coaster remains on standby.

(c) Coastal vessels are often used by shippers for storage purposes as the cost is less than that for godowns and extra handling.

(d) Chittagong must notify the Dhaka control office on barge tug and coastal vessel availability. The Dhaka control office checks the various users, such as Government food, cement and fuel agencies for their requirements. They then set priorities and assign vessels. This information is passed back to the Chittagong office. The Chittagong office then tries to locate an available berth or determine the inbound ships arrival data and time for discharge at anchorage. When this information is in hand, they try to locate the coastal vessel, tug or barges. This may involve sending a message by radio or boat to the ship captain. Quite often when the message arrives, the captain or the crew are ashore and can not be readily located. Barge crews must report to the office for orders.

(e) Assigned Coasters, tugs and barges are often delayed after receiving orders, due to emergency repairs.

(f) Further delays are experienced when the coaster or barges must wait for high tides.

(g) Coastal vessels are placed in special catagories to avoid contamination i.e. cement, jute, foodgrain, fertilizer. This results in vessels being available but not acceptable.

(h) At any given time 30 to 60 percent of the BIWTC total fleet may be out of service. In this regard the BIWTC Chittagong vessel voyage repair shop alone had 8 vessels under repair and 6 waiting for spare parts.

(i) Much of the time spent waiting reflect a lack of demand for service.

(j) There is little or no incentive for BIWTC employees to increase efficiency. Due to the many delays in communications, scheduling, and repairs, the services are lost to private operators.

Table 10.3.4. BIWTC Fleet Performance-June 1984

Number of vessels	Type	Waiting loading days	Voyage days	Waiting to discharge days	Discharge days	Repair and survey days	Total days	Total round trips	Remarks
12	Tanker	73	85	26	35	88	360	23 (Av 1.9)	Out of 360 days, waiting, survey and Repair were 187 or 52%
19	Coastal	41	109	36	80	166	570	40 (Av 2.1)	Out of 570 available days 243 or 43% were for waiting survey and Repair. Waiting for loading per round trip were 2.7 days unloading 2 days
8	Self propelled barges	5	45	53	42	32	219	7 (Av 0.9)	Out of 219 available day 90 were waiting for repair or 41%
258	Dumb barges and flats	1.583	Waiting tow 1178	811	562	2,530	7,740	76 (Av 0.29)	Out of 7,740 available days 6102 were for waiting and repair or 79%. Each round trip took 102 days.
4	Bay crossing tugs	13	-	-	-	57	-	120 (Av 30)	Out of 120 available day 70 were for waiting or repair or 47%
19	Main line Tugs	Waiting orders 162	71	Waiting sailing days 19	-	224	570	-	Out of 570 available days 224 were for waiting or repair or 39%. Note: Dumb barges awaiting tow 1,178 and
20	Inland tugs	Waiting orders 44	84	Waiting sailing days 28	Harbor Duty 356	70	600	-	Out of 600 available days 142 were waiting and repair or 23% Harbor duty days were 356 while under way days were only 84 indicating over 4 days waiting for each day under way.

(5) Working cargo

A typical general cargo vessel would have the following increased productivity if cargo handling were improved.

a) Existing case

Typical Vessel	:	Coastal General Cargo 900 Tonne Cap.
Route	:	Chittagong to Khulna
Sailing time	:	3.75 days
Voyage delays	:	1.12 days
Load/Unload	:	12.00 days
Turnround time		16.87 days

Annual number of trips		:	22
Average Vessel Load		:	850 tonnes
Loading/Unloading		:	2 hatches working by head load
Handling rate		:	8.7 tonnes/hours/hatch 17.4 tonnes/hr
Eight hour day		:	139 tonne/day
139÷850	loading	:	6.0 days
	unloading	:	6.0 days
	Total		12 days

b) Increased productivity

Loading/Unloading 2 hatches working with conveyor and hand trucks.

Handling Rate		: 18 tonnes/hour/hatch	= 36 tons/hr
Eight hour day		:	= 288 tons/day
288÷850	loading	: 3 days	
	unloading	: 3 days	
	Total	6 days	

Sailing time	:	3.75
Voyage delays	:	1.12
Load/unload	:	6.00
Turnround time		10.87

Annual Voyages/Year: 33.5

Annual Extra Voyages: 11.5

Additional annual cargo capacity 11.5 x 850 = 9,775 tonnes

10.3.2 Private operators

(1) Introduction

Meetings with the private operators were held in the presence of the heads of the operators associations. Initial meetings were viewed by the association members with certain caution and suspicion and evasive responses were given. As a result the information on costing, vessel operations, tonnage and passengers carried, member of annual trips, etc. was not readily forth coming. However, repeated visits to the coastal vessel operators and passenger launch owners associations offices produced much of the information sought on vessel costing.

As has been noted in previous report, data supplied by the private sector vessel operator should normally be regarded with some scepticism. The cost data supplied in this instance appear to be accurate, and is discussed in section 9.4.

(2) Fleet size

The private sector is characterized by many small and determined operators without adequate policing of their operations. With few exceptions it is characterized by the smallness of the firms. have to operate under price controls, inflationary conditions, and high interest rates.

The private sector fleet of mechanized coastal freight vessels, tankers, barges tugs, and passenger launches has shown continuous growth since 1973. Cargo carrying fleet size increased from 647 vessels in 1973 to approximately 1,300 vessels in 1983. Passenger launches during this period increased from approximately 600 to over 1,400 in 1984. This is shown in table 9.3.1. This steady growth in competition with the BIWTC fleet under regulated freight rates indicates a more efficient operation.

The private sector total fleet increased in 10 years by over 100 percent, rising from 1255 vessels in 1974 to approximately 2740 vessels in 1984. This fleet now carries over 90 percent of passenger traffic and 74% water borne cargo. The private sector plays a vital role in water transport. This role should be recognized, encouraged and, where possible, assisted.

(3) Fleet growth

The growth in the private sector is attributed to the following:

a) The small size of individual fleets in providing more direct management and response to offered freight.

b) Administrative costs are low.

c) Repair and maintenance costs and time consuming delays are minimized by more direct access to private repair facilities.

d) Apparent gross overloading of both passengers and freight for increased revenue per voyage.

e) A plying of the more lucrative trades routes.

f) Lack of bureaucratic delays in scheduling and responding to offered or available freight.

g) A more direct interest in the operation and financial aspects of their vessels than that of individuals in the public sector.

h) Greater vessel utilization.

i) Operational initiative.

(4) Problems encountered by coastal vessel operators

The private coastal vessel operators cited the following problems in providing cargo service on the inland waters.

a) Dredging: River ghats must be properly dredged as they are deteriorating instead of improving. The main channel from Dhaka/Narayanganj/Chandpur/Barisal/Khulna/Chittagong must be kept dredged to official depths and provided with navigational aids for night and day navigation. The channel to Rajshahi/-Shylet should be dredged so that vessels with at least 9 feet of depth can operate year around.

b) River ghats: Must be maintained, dredged, and provided with mechanical cargo handling equipment with a minimum discharge rate of 200 tons per hatch per hook per day for food grain, fertilizer and cement.

c) Chittagong port: must facilitate berthing areas for vessels carrying jute and provide prompt delivery to the consignee.

d) Freight rate: must be established that will allow vessel owners sufficient income to repay bank loan.

e) The mercantile marine department: must be reorganized with personnel having knowledge of repairs and modern equipment.

10.3.3 Port cargo handling operations

(1) Introduction

Cargo handling by head load is still dominant in port operations in Bangladesh. It is hard work, inefficient and constitutes the primary cause of low port freight throughput and vessel delay. The availability of manpower and its low daily wages make the use of machinery uneconomic when it is, as at present, assessed in isolation. The hire of one fork truck at 150 taka an hour is equal to the cost of employing 40 men for one hour at the going wage rate of 30 taka per day. As a result, the use and charges for equipment cannot be

economically justified by the operating stevedore. The real costs of low productivity are the hidden capital costs of the port infrastructure and vessels occasioned by delays, or the cost of unproductive time on capital investment.

(2) Port productivity

Random studies of freight handling productivity were made in each port. Further investigations were made at private sector factories handling freight at their own facilities

a) BIWTA ports

Examples taken at the BIWTA ports were then compared to past reports and usually found to be either in agreement, or showed a slight decline, indicating that little improvement in productivity has taken place since 1974.

Due to variations in port location, cargo jetty design, embankment and godown to jetty distances, the handling rates or productivity vary from one port to another, but in every case freight handling at BIWTA ports is below acceptable world norms. Homogenous bagged cargo, for example, was handled in one port at the rate of 8.75 tons an hour but with mechanized equipment, fork trucks and pallets, or conveyors the expected rate of productivity would have been 20 - 25 tons an hour. The use of machinery would thus result in a doubling of a ports utilization, halving of its time costs, better vessel utilization, but with a reduction in employment opportunities.

As designed, the present BIWTA ports should on average, have throughput capacities for bagged cargo, with two hatches and an eight hour day, as follows:

a) Reinforced concrete construction with mobile crane: Loading/unloading 280 - 300 tons per day.

b) Pontoon with two way easy passage gang plank: Loading/unloading: 150 - 200 tons per day.

As at present utilized the facilities have an average throughout as follows:

i) Reinforced concrete construction with mobile crane: Loading/unloading: approx 140 tons per day

ii) Pontoon with two way easy passage gang plank (headloads): Loading/unloading: approx 90 tons per day.

b) Private facilities

In every observed instance the private sector port facilities either using cranes, conveyors, tracked dollies, and wooden slides achieved handling rates ranging from 20 to 25 tons an

hour for homogeneous cargo. A Bangladesh Government urea fertilizer factory, designed by the Japanese and built in the seventies, uses a conveyor system and slides for loading coasters and barges at a rate of 48 tons an hour. (2 hatches at 24 tons per hatch).

c) Observations

Tonnage throughput figures vary by size and mass of the bagged cargo so all throughput estimates vary. The mass of various types of bagged cargo can range between 50 and 100 kgs. Throughput also vary with the type of vessel and with the vessels's cargo handling equipment. Moreover, seasonal weather conditions also affect handling rates.

(3) Cargo handling equipment use policy

a) Introduction

The introduction of basic mechanical equipment for improved cargo handling productivity can be expected to meet the usual reluctance to change from traditional methods. Inspection of a little of the equipment that is available for cargo handling shows that for the most part it is inoperative. In most cases it has been out of service a long period of time due to the lack of spare parts, maintenance and cost of hire.

b) Hiring arrangements

Under the present contractural arrangements with stevedoring companies, the stevedore controls the vital cargo handling function while the port controls the equipment. Discussions with stevedores regarding the use of available equipment revealed a reluctance to use it. They cited the following objections.

a) Lengthy formalities involved in hiring equipment

b) Equipment not being available when needed, and

c) The use of equipment was more costly than the hiring of labour.

c) Observations

Discussions revealed a disinterest on their part as to the role they played in the larger aspect of overall efficiency. The contractor works directly for a shipping agency and is paid by the vessel owner. In turn he must contract and pay the port for the use of the facility, and labour for work it performs and thus does not see any direct advantage in utilizing mechanical equipment for a quicker discharge when, at present labour rates, the use of the equipment would reduce his profit.

While it may not pay the stevedore to hire equipment, its

use would give better port and vessel utilization, lowering thereby investment needs and overall costs. It is not the fault of the stevedore but of the annual contractural conditions, which must be altered. There is a need for a government policy decision on the question of maintaining the present labour intensive handling methods which is an indirect labour subsidy or providing handling equipment that will increase the productivity of vessels and port facilities and reduce or eliminate the present investment losses of these operations and to a large degree the expansion of the total vessel fleet.

(4) Increasing cargo handling productivity

a) Introduction

In countries where labour pay rates are high, the immediate approach for increasing general cargo handling productivity is the use of pallets and fork lift trucks from cargo hold to godown storage or delivery. In Bangladesh, with few vessels and jetties having cargo handling cranes, labour rates being low, and facilities being located on sloping river banks, such systems are not possible nor economically viable. Simpler means of increasing productivity from vessel to truck, rail wagon, godown or storage area should be utilized. Intensive hand labour can take place in areas away from the jetty, but means must be found for increasing vessel turnround and present port throughput.

b) Use of cargo handling equipment

Some 90% of all cargo handled is in the form of homogeneous bags and bales. The least expensive method of handling this type of freight is with motor driven conveyors, tracked wheeled and pushed dolleys and stevedore heavy duty two wheeled hand truck. A stevedore hand truck would enable two to three bags to be moved at a time. This would double or triple the present one bag head load per man. Further, it would take the mass of the load from head and body to the wheels of the hand truck.

Improved simple slides (as used by some stevedores) for loading from jetty to barge or coastal vessel hold, would improve loading, if not unloading rates. Stacking conveyors in the godowns would permit increased use of cubic space. Reversable motor driven portable height adjustable conveyors from jetties to godowns, rail cars, trucks, or up embankments in conjunction with hand trucks would appear to be the solution to increasing throughput. Current costs for heavy duty, covered, portable, reversible, motor driven conveyors is $10,000 per 30 metres.

c) Selection of equipment

As no two ports have the same physical characteristics the

choice of improved handling equipment for increased productivity has to be made on a port to port basis. Productivity gains with simple new handling equipment would have to be carefully measured against present head-load handling.

d) Productivity: Its effect on vessel and port costs

Any increase in cargo throughput at the vessel berths will reduce vessel voyage turn around time and provide increased utilization of vessels, reducing capital costs pro rata. Not only can capital investment in new vessels be reduced, but also investment in pontoons and jetties.

10.3.4 Quality of service

(1) Freight

A survey of freight shippers was conducted, covering major shippers of petroleum products, jute products, fertilizer, cerals, iron and cement. The reason for the choice of IWT as opposed to alternative modes was requested. The results for shippers who used IWT for certain routes in preference to other modes are given in Table 10.3.5. Although the sample is small, it can be seen that the predominant reason for choosing IWT for freight is a saving of costs over other modes.

Table 10.3.5 IWT Users Freight Survey

Preference for use of IWT	Survey Results	
	No.	%
Save time	0	0
Save Cost	14	77
Not available on others	1	6
Safer	0	0
Convenient	1	6
No rail wagons	2	11
Total	18	100

Source: Consultants

(2) Passenger

A survey of IWT passenger users was conducted to ascertain why they had prefered IWT to other modes of transport, assuming an alternative existed. The survey was limited by the available resources to only 4 routes, and thus is only a small sample and as such should be used with caution. Nevertheless, certain characteristics stand out. The survey results are given in Table 10.3.6 and an analysis of the reasons for the travellers, preference for IWT are given in Table 10.3.7. Though the sample is small first class passengers predominantly found the journey comfortable and third class only moderately so. Whilst there are several reasons why first class passengers prefered

Table 10.3.6 IWT Passenger User Survey

No.	Origin	Destination	Distance km	Time Mars	Speed kph	Comfort	Advantage	Other
15	Dhaka	Khulna	363	26.0	14	I[1] Mod.[2] III Mod. III Bad	Convenient[3] Save Cost Save Cost	(4 resp.)[4] (3 resp.)
27	Dhaka	Chandpur	66	4.5	15	I Good I Good I Good I Good II Good III Mod. III Mod.	Convenient Save time Save Cost Comfort Comfort Near house Save cost	(2 resp.) (2 resp.) (2 resp.) (2 resp.) (3 resp.)
34	Dhaka	Barisal	169	11.5	15	I Good III Good III Good III Mod. III Mod.	Comfort Save cost Comfort Near house Save cost	(4 resp.)
35	Dhaka	Faridpur	134	10.5	13	I Good III Good III Mod. III Mod.	Road bad Save cost Comfort Save cost	(2 resp.)

Source: Consultant

Note 1. I: First class, II: Second class, III: Third class
2. Mod.: Moderate
3. Convenient: For travel with goods.
4. resp: responses

Table 10.3.7 Analysis of IWT Passenger Users Survey

Advantage over other modes	Comfort Good			Comfort Moderate			Comfort Bad			Total
	I	II	III	I	II	III	I	II	III	
Save cost	2	0	2	0	0	8	0	0	1	13
Save time	1	0	0	0	0	3	0	0	0	4
Near house	0	0	0	0	0	0	0	0	0	0
Comfort	5	2	1	0	0	1	00	0	0	9
Convenient	2	0	0	4	0	0	0	0	0	6
Road bad	2	0	0	0	0	0	0	0	0	2
Total	12	2	3	4	0	12	0	0	1	34

Source: Consultants

IWT, third class clearly regarded the low fares as the main reason for their choice.

10.3.5 Comparison of public and private vessel utilization

(1) Introduction

Based on the December 1984 records the private sector should have made 37.8 round trips per year. BIWTC vessels should have made 28.8 round trips. However, due to delay factors the average number of voyage per vessel in 1984 were 28.8 for the private sector and 22 for public sector.

This is in reverse of the findings in the Second Inland Water Transport Study of 1980. This report on vessel utilization listed the average annual coastal vessel round trips as 24 for BIWTC and 22 for the private sector.

(2) Shipping

Based on an examination of their records information on vessels costs was obtained. A one month record of tons of grain handled per vessel between Chittagong and Narayanganj was studied. This movement was compared to that of BIWTC on the same route and during the same month.

In the month of December 1984, private coastal vessels made 44 round trips using 14 vessels, carrying 42 thousand tons of grain from Chittagong to the grain terminal in Narayanganj. On average each vessel carried 955 tons, an indication of overloading, assuming the legal carring capacity per vessel was 900 tons. During this month each vessel made 3.14 trips or a trip every 9.87 days.

In the same month and in the same service BIWTC employed 20 vessels making 48 round trips handling 43 thousand tons. On average each vessel made only 2.4 round trips per month or one trip every 12.5 day with an average load factor of 896 tons per trips.

This equal comparison of private and public fleet utilization is a clear indication of better vessel operations by the private sector. It was also noted that the private sector coastal fleet is now the dominant operator between the major ports i.e. Chittagong, Dhaka, Khulna, Chalna, Barisal, Chandpur and Narayanganj. This leaves the less profitable, low cargo density routes to be served by the BIWTC. However, the rapid growth of the private sector vessel operators numbering 188 in 1978 and 260 in 1984 has increased competition and reduced their earnings. As a result, private operators are now being increasingly forced to operate on the secondary water routes.

(3) Barging

In 1982 the recorded number of barges (dumb craft) in the private sector was 567 an increase of 184 over 10 years. The estimated static carrying capacity in 1982 was 153 thousand tonnes. Private Barge

owners have formed an Association for the protection of their interests in dealing with the Government agencies controlling the ports, waterways and cargoes. At present the Association has about 180 members.

The owners claim they are more efficient than the BIWTC, and can operate at lower costs. This claim is directly related to their achieving greater vessel utilization.

At this time there is a controversy between the private and public sector barge operators over rates and allocation of Government owned cargoes. The Governments controls 80% of the barge cargo and allocates these shipments. The private sector barge owners do not feel they are receiving a fair share, with the major portion going to the BIWTC fleet.

The private barge owners are not allowed to directly submit tenders for carriage. They are required to use shipping and clearing agents. As a result the share of any Government cargo allocated to them must be negotiated through a middle man. The middle man charges the Government the established rate of 95 taka per tonne and hires the barge at the competitive prevailing rate of 55 taka per tonne, Khulna to Mongla. Private barge operators would like to see the function of the shipping and clearance agent separated from the hire of barges and the Government rate paid for barge hire. Agents in other fields work on a commission basis, not as middlemen. This matter is now under review by the office of the Director General of the Department of Shipping, Ministry of Ports and Shipping, IWT.

(4) Tugs

A review of the ratio of tug boats to barges in the public and private sector reveals they are about equal.

Table 10.3.8 Availability of Tugs and Barges

	Private	BIWTC
No. of Tugs	117	52
No. of Barges	567	229
Ratio	4.8	4.4

These ratios are considered acceptable. Private operators claim that it is no problem to get a tug boat which is in sharp contrast to the high loss of time to public sector barges claimed by BIWTC as due to the unavailability of tugs.

Although BIWTC tugs are available for hire to the private sector, it does not use them due to the hire rates charged. On the question of barge charges it was cited that BIWTC charges the prevailing Government rate of 95 taka per tonne between Khulna and Mongla whilst the private sector rate is 55 taka per tonne.

(5) Advantages of Private Sector

In addition to the facts outlined in the previous sub-sections the examination and discussions revealed that there were advantages that the private operators could use to obtain cargo. These include:

(a) Rates can be adjusted downward to meet market supply and demand situation.

(b) Scheduling and communications are handled directly without formality and the need for others approval.

(c) Wages paid for officers and crew are higher than those for Government service, resulting in greater discipline and incentive.

(d) Bonuses can be paid to the captain and Engineer for vessel dispatch and extra voyages.

(e) Ready access to ship repair yards as opposed to BIWTC vessels being required to be repaired in BIWTC ship repair facilities.

(f) Berthing space is made available without the restriction imposed on Government vessels. Extra unofficial payments result in their vessels getting priority over BIWTC.

(g) Spare parts are more readily obtainable as much bureaucratic paper work is eliminated and there are less constraints on budget expenditure.

(h) Private owners are more willing to employ cleaning crew when changing from one type of cargo to another.

Under these conditions, and the considerable financial losses in running commercial operations, the question of privatisation of BIWTC must be considered. The matter is discussed under Section 10.7. Operational issues.

10.4 Costs, Rates and Fares

10.4.1 Freight cost

The private operators offered quite detailed costs, but without performance data, there is limited use for the information.

The vessels examined were operating between Chittagong and Narayanganj, a jetty to jetty distance of 380 km. These are given in Table 10.4.1.

BIWTC keeps separate accounts for coaster operation and tanker operation. Table 10.4.2 and 10.4.3 show summary of these two kinds of operations for the fiscal year 1983/84.

As in the BTS, 29 of repair and maintenance cost was assumed to be variable and the rest fixed. Crew wages and allowances were assumed to be constant irrespective of vessel usage. Instead of book values of depreciation and interest, capital costs were calculated as the amortisation of vessels at the replacement value. It should be noted that the price of new vessels in recent years has not increased. Economic costs were calculated from financial costs by means of conversion factors shown in Table 10.4.3. Resulting annual costs for coaster and a tanker are shown in Table 10.4.5 and 10.4.6.

The BIWTC fleet performance data, average vessel performance indicators estimated for coasters and tankers and shown in Tables 10.3.2 and 10.3.3. Current vessel utilization is low, as analyzed in section 10.3. For the current performance level coaster and tanker costs per ton-km were calculated for various hauling distances and the results are shown in Tables 10.4.7 and 10.4.8. Basic assumptions for the above calculations are : 1) Vessels return empty, and therefore the entire round trip cost should be borne by the subject cargo. 2) The average number of non-steaming days, whether under repair or in port, per round trip applied to each round trip regardless trip distance.

Table 10.4.1 Vessel Operator Cost (Private Sector)

Item		Caravan	Redrose	Nila
1)	Fuel Cost per trip TK.	25,000	25,000	33,500
2)	Cost of vessel new TK.	6,000,000	6,000,000	7,500,000
3)	Annual cost repair/ Maint TK.	200,000	200,000	250,000
4)	Monthly crew pay roll TK.	20,000	20,000	24,000
5)	Direct Expenses office management TK.	30,000	30,000	30,000
6)	Indirect Expense TK.	10,000	10,000	10,000
7)	Insurance annualy TK.	125,000	125,000	150,000
8)	Interest on loan TK.	18%	18%	18%
9)	Replacement Value TK.	4,000,000	4,000,000	4,000,000
10)	Age of vessel	17	17	18
11)	Cargo cap tonnes	850	750	1,122
	No of trips per year	28	28	30
	Kilometres per month	1,900	1,900	2,660

Table 10.4.2 Coaster Operation Summary 1983/84

Fleet Summary

Total No. of vessels in operation	19
Average Age of vessels	19
Financial performance	899 tons
Tons carried	446 thousand tons.
Total ton-km	131 million
Fuel cost	22.8 million
Repairs and Maintenance	4.1 million Tk.
Pay and Allowance	5.1 million Tk.
Depreciation	5.4 million Tk.
Other Direct Expenses	0.7 million Tk.
Interest	1.4 million Tk.
Indirect Expenses	10.2 million Tk.

Source : BIWTC.

Table 10.4.3 BIWTC Tanker Operation Summary 1983-84

Fleet Summary

No. of Vessels in operation	12	
Average Age	16.5	years
Average SWT	1019	tons
Tons carried	261	thousand tons
Total ton - km	81.8	million

Financial Performance

Earnings	33.9	million Tk.
Fuel	17.0	million Tk.
Repair & Maintenance	2.1	million Tk.
Pay and Allowance	3.3	million Tk.
Depreciation	1.6	million Tk.
Other Direct Expenses	0.6	million Tk.
Interest	1.0	million Tk.
Indirect Expenses	6.6	million Tk.

Source : BIWTC

Table 10.4.4 Financial-Economic Cost Conversion Factors

Crew Wages and Allowances	0.80
Maintenance	1.00
Indirect cost	0.66
Direct cost	0.75
Vessel amortization	1.20
Fuel	1.20

1. Personnel costs are a mixture of skilled and unskilled labour costs. A factor of 0.80 was adopted.
2. Maintenance costs include spare parts cost with a high foreign currency component and labour. A factor of 1.0 was adopted, assuming that the effects of both components would cancel out each other.
3. Indirect costs contain toll fees and other transfer payments in the order of 12%, which should be excluded from the economic costs. The remaining is largely labour.

Table 10.4.5 Estimated Coaster Costs 1985

Fixed Cost Per Year (Taka 000)	Financial	Economic
Crew Wages and Allowances	295	235
Standing Maintenance	169	169
Indirect costs	591	389
Amortization (at 15% for 25 years, 0.1545)	3576	4611
Total fixed cost per year	4631	5404
Variable Cost Per Year (Taka 000)		
Fuel	1200	1440
Running Maintenance	69	69
Other Direct Costs	41	31
Total variable costs per year	1310	1540
Total cost, per year, per vessel	5941	6944

Source : The Consultants.

Note: 1. 1983/84 recorded costs were increased by 10% except for amortization and fuel.

2. Variable maintenance cost was taken at 29 of the total maintenance/repair cost.

3. Financial replacement cost 30,000 Tk./DWT X 899 tons.

Table 10.4.6 Estimated Tanker Costs 1985

Fixed Cost Per Year (Taka 000)	Financial	Economic
Crew Wages and Allowances	303	242
Standing Maintenance	137	137
Indirect Costs	605	399
Amortization (at 15% 20 years, 0.1543)	6282	7538
Total fixed cost per year	7327	8316
Variable Cost Per Year (Taka 000)		
Fuel	1417	1700
Running Maintenance	56	56
Other direct Costs	55	41
Total variable cost per year	1528	1797
Total cost per year per vessel	8855	10113

Note : 1. Financial replacement cost 38,700 Taka/DWT X 1019 tons.

Table 10.4.7 Coaster Tonne-km Cost 1985

		Financial	Economic
Fixed cost per day	(Tk.000)	12.7	14.8
Variable cost per km.	(Tk.)	77.6	91.6

Distance (km)	Variable cost (Tk 000)	Round trip Steaming days (days)	Turn Round days (days)	Fixed Cost (Tk 000)	Total Cost/Vessel (Tk 000)	Ton - km. cost (Tk)
Financial Cost :						
25	3.9	0.20	10.5	133.4	137.2	6.71
50	7.8	0.40	10.7	135.9	143.7	3.51
100	15.5	0.80	11.1	141.0	156.5	1.91
150	23.3	1.20	11.5	146.1	169.4	1.38
200	31.0	1.60	11.9	151.1	182.1	1.11
250	38.8	2.00	12.3	156.2	195.0	0.95
300	46.6	2.40	12.7	161.3	207.9	0.85
350	54.3	2.80	13.1	166.4	220.7	0.77
400	62.1	3.20	13.5	171.5	233.6	0.71
Economic Cost :						
25	4.6	0.20	10.5	141.8	146.3	7.16
50	9.2	0.40	10.7	158.4	167.6	4.10
100	18.3	0.80	11.1	164.3	182.6	2.23
150	27.5	1.20	11.5	170.2	197.7	1.61
200	36.6	1.60	11.9	176.1	212.7	1.30
250	45.8	2.00	12.3	182.0	227.8	1.11
300	55.0	2.40	12.7	188.0	243.0	0.99
350	64.1	2.80	13.1	193.9	258.0	0.90
400	73.3	3.20	13.5	199.7	273.1	0.83

Source : The Consultant.

Table 10.4.8 Tanker Tonne-km Cost 1985

			Financial	Economic
Fixed	cost per day	(Tk.000)	20.07	22.78
Variable	cost per km.	(Tk.)	103.87	122.15

Distance (km)	Variable cost (Tk 000)	Round trip Steaming days (days)	Turn Round days (days)	Fixed Cost (Tk 000)	Total Cost/Vessel (Tk 000)	Ton - km. cost (Tk)
Financial Cost :						
25	5.2	0.20	13.2	265	270	11.66
50	10.4	0.40	13.4	269	279	6.03
100	20.8	0.80	13.8	277	298	3.21
150	31.2	1.20	14.2	285	316	2.27
200	41.6	1.60	14.6	293	335	1.80
250	52.0	2.00	15.0	302	354	1.52
300	62.3	2.40	15.4	310	372	1.34
350	72.7	2.80	15.8	318	391	1.20
400	83.1	3.20	16.2	326	409	1.10
Economic Cost :						
25	6.1	0.20	13.2	301	307	13.24
50	12.2	0.40	13.4	306	318	6.85
100	24.4	0.80	13.8	315	339	3.65
150	36.6	1.20	14.2	324	361	2.59
200	48.8	1.60	14.6	333	382	2.06
250	61.1	2.00	15.0	342	403	1.74
300	73.3	2.40	15.4	351	424	1.53
350	85.5	2.80	15.8	360	446	1.37
400	97.7	3.20	16.2	369	467	1.26

In sub-section 10.3.1 the lost time for four vessels over a three month period was given. The first two vessels represent general cargo traffic. The third is a tug and the fourth is a gain carrier loading and discharging from silos.

The total time over 90 days for the first two vessels amounts to:

	Waiting for Berth	Waiting for Orders	Stand Delays	Pilot Repairs	Engine Delays	Navigation	NR
Total Time	1-17	42-17	NR	2-10	34-42		NR
%	1.4%	46.9%	-	2.4%	38.5%		-

The significant delay is in "Waiting for orders". Engine repairs are considered to be a constant factor and so in considering improved performance are ignored.

The condition considered capable of improvement is in the administration of the ships and a 33% improvement in performance is possible. This would give an improvement of 15% in non-steaming days.

Tonne-km costs for the case with the non-sailing time per trip reduced by 15% were calculated for coasters and tankers and are shown in Table 10.4.9 and 10.4.10.

The above results are illustrated in Figures 10.4.1 through 10.4.4.

Table 10.4.9 Improved IWT Coaster Transport Costs (1985 Prices)

Distance (km)	Variable cost (TK. '000)	Turnround Days	Fixed Cost (TK. '000)	Total Cost (TK. '000)	Ton-km cost (TK)
(1) Financial Costs					
25	3.88	8.9	113.35	117.23	5.73
50	7.76	9.1	115.51	123.27	3.01
100	15.52	9.4	119.82	135.34	1.65
150	23.28	9.8	124.14	147.42	1.20
200	31.04	10.1	128.46	159.50	0.97
250	38.80	10.5	132.78	171.58	0.84
300	46.56	10.8	137.10	183.66	0.75
350	54.32	11.1	141.41	195.73	0.68
400	62.08	11.5	145.73	207.81	0.64
(2) Economic Costs					
25	4.58	8.9	132.09	136.67	6.68
50	9.16	9.1	134.61	143.77	3.52
100	18.32	9.4	139.64	157.96	1.93
150	27.48	9.8	144.67	172.15	1.40
200	36.64	10.1	149.70	186.34	1.14
250	45.80	10.5	154.73	200.53	0.98
300	54.96	10.8	159.77	214.73	0.88
350	64.12	11.1	164.80	228.92	0.80
400	73.28	11.5	169.83	243.11	0.74

Source: Consultants

Table 10.4.10 Improved IWT Tanker Transport Costs (1985 Prices)

Distance (km)	Variable cost (TK. '000)	Turnround Days	Fixed Cost (TK. '000)	Total Cost (TK. '000)	Ton-km cost (TK)
(1) Financial Costs					
25	5.19	11.2	225	230	9.94
50	10.39	11.4	229	239	5.16
100	20.77	11.7	235	256	2.76
150	31.16	12.1	242	273	1.97
200	41.55	12.4	249	291	1.57
250	51.94	12.8	256	308	1.33
300	62.32	13.1	263	325	1.17
350	72.71	13.4	270	342	1.05
400	83.10	13.8	276	359	0.97
(2) Economic Costs					
25	6.10	11.2	256	262	11.29
50	12.22	11.4	259	272	5.86
100	24.43	11.7	267	292	3.15
150	36.65	12.1	275	312	2.24
200	48.86	12.4	283	332	1.79
250	61.08	12.8	290	352	1.52
300	73.29	13.1	298	371	1.34
350	85.51	13.4	306	391	1.21
400	97.72	13.8	314	411	1.11

Source: Consultants.

FIG. 10.4.1 EXISTING IWT COASTER TRANSPORT FINANCIAL AND ECONOMIC COSTS (1985 Prices)

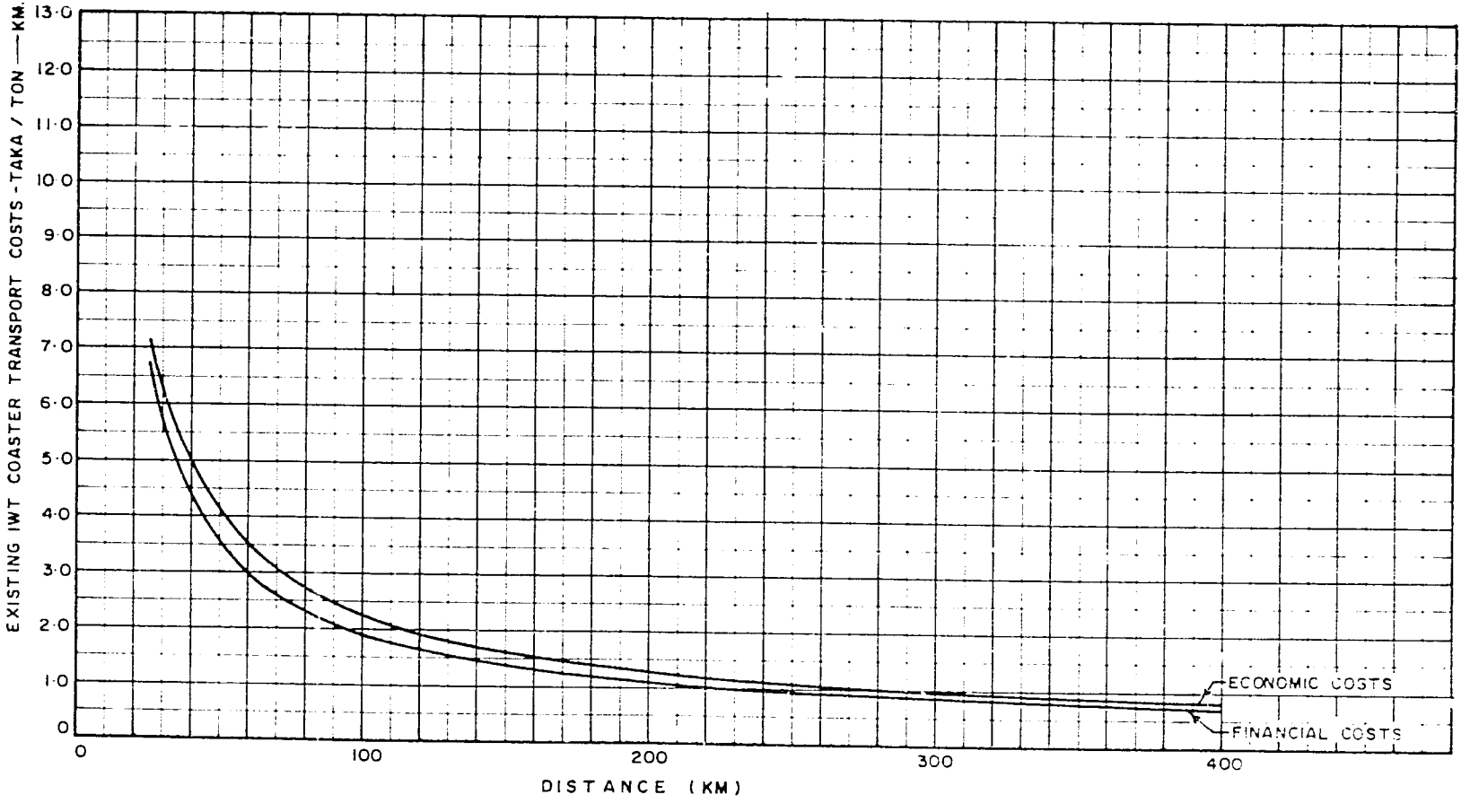


FIG. 10.4.2 EXISTING IWT TANKER TRANSPORT FINANCIAL AND ECONOMIC COSTS (1885 Prices)

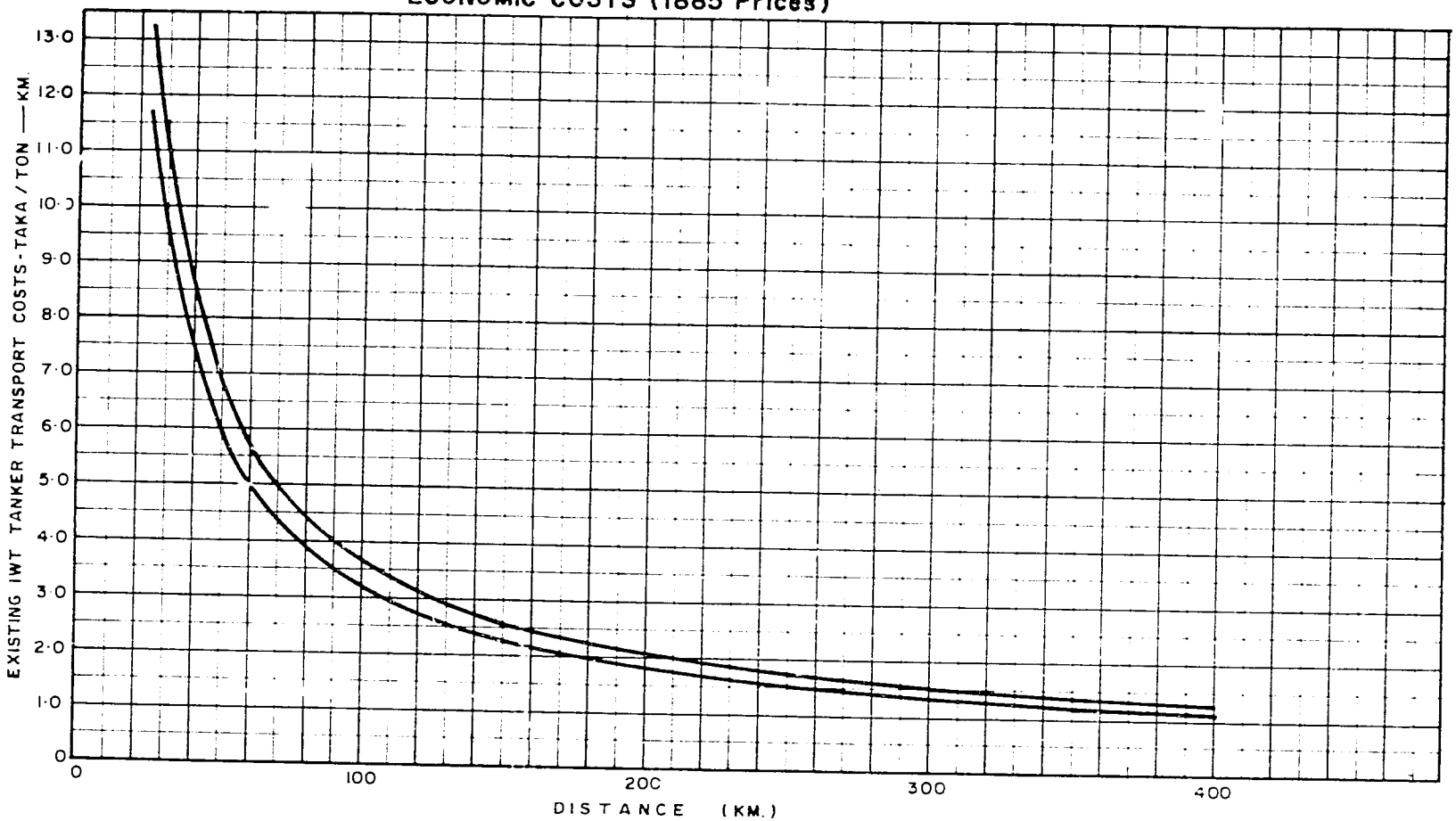


FIG. 10.4.3 IMPROVED IWT COASTER TRANSPORT FINANCIAL AND ECONOMIC COSTS (1985 Prices)

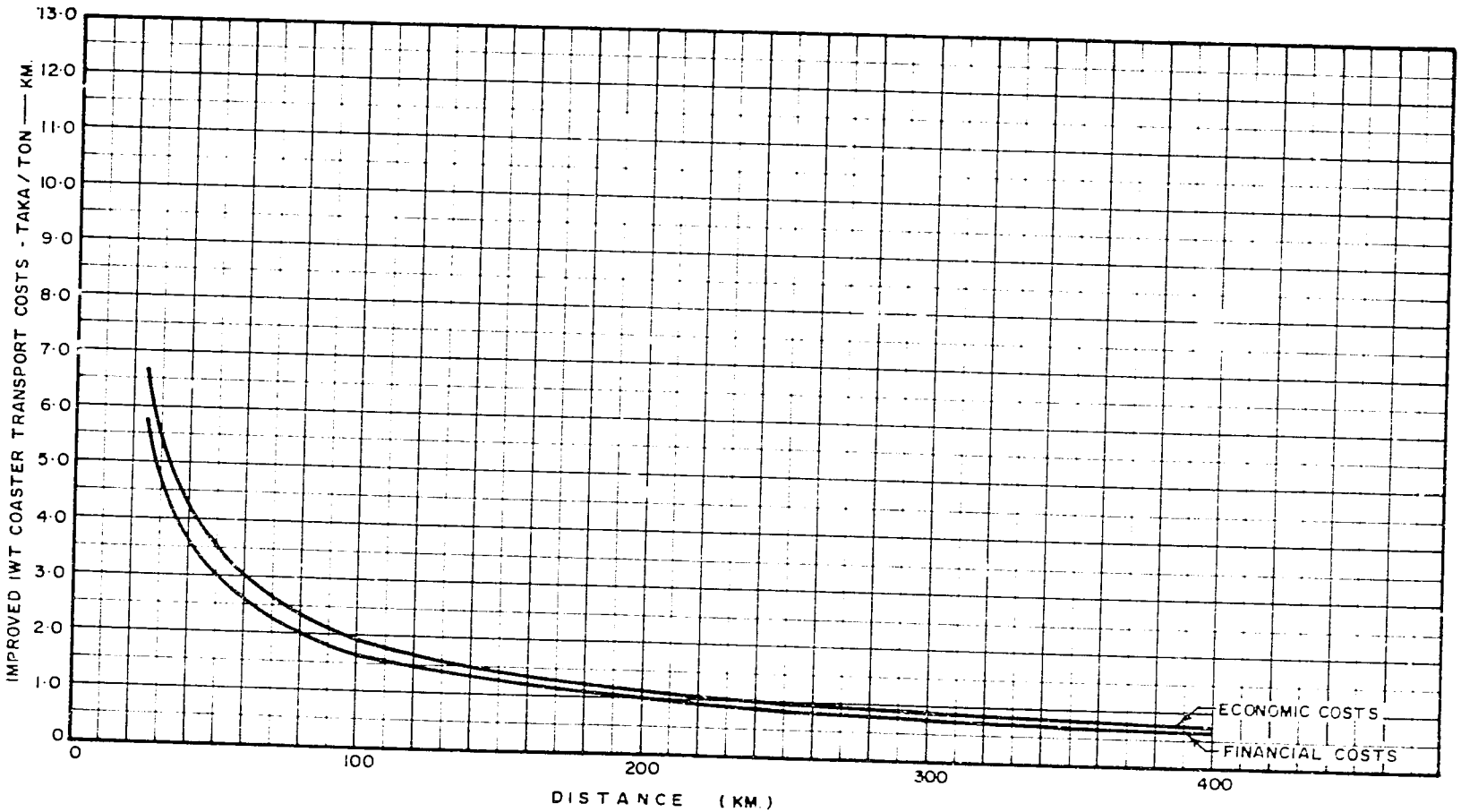
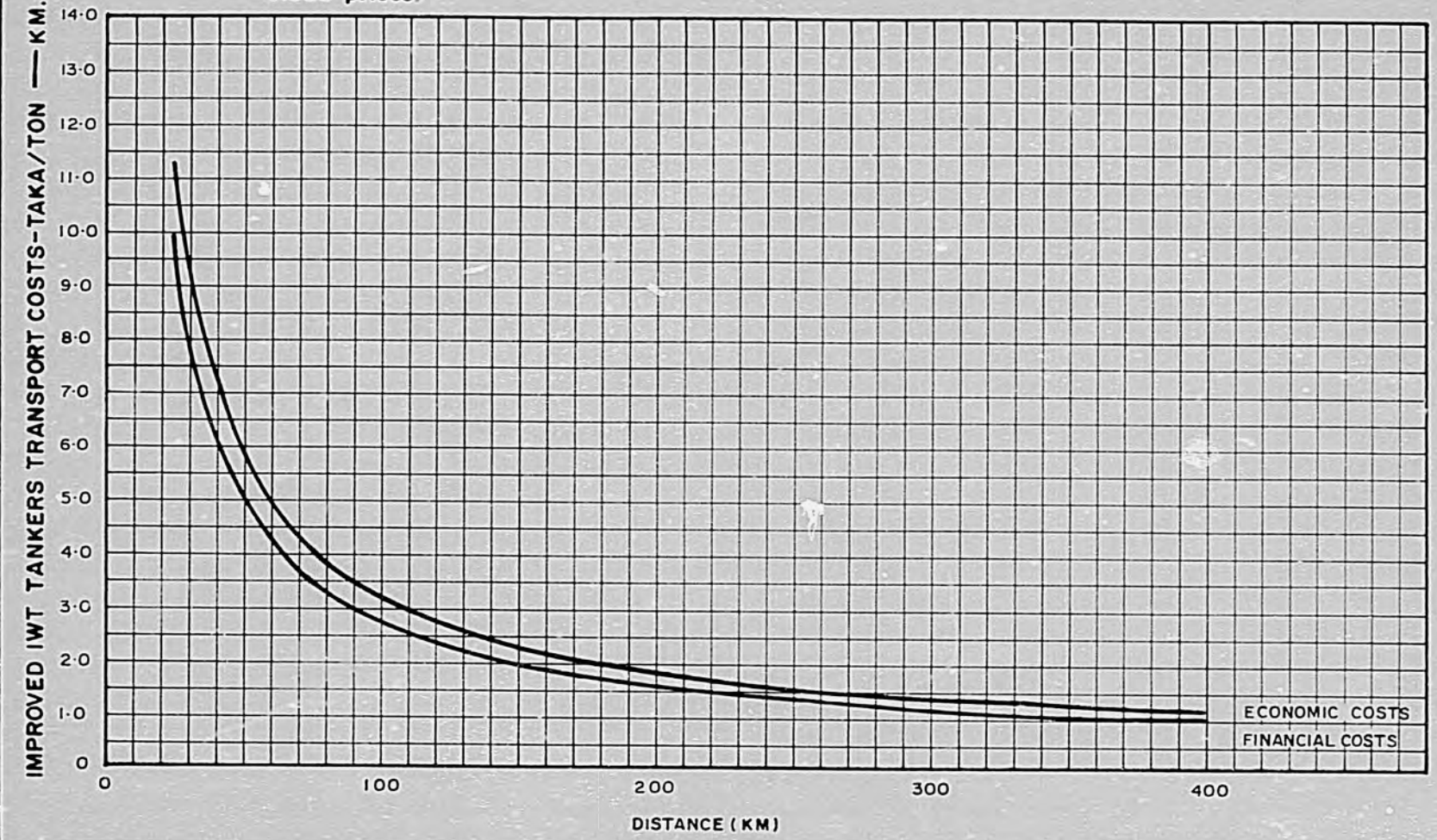


FIG. 10.4.4 IMPROVED IWT TANKER TRANSPORT FINANCIAL AND ECONOMIC COSTS

(1985 prices)



10.4.2 Passenger cost

No fleet wide information comparable to coasters and tankers were available. Information on certain passenger launches, however were made available. Table 10.4.11 and 10.4.12 show actual performance data for a typical BIWTC passenger launch operation during 1983-84. Private launch operators supplied the information in Table 10.4.13. BIWTC's record shows the average load factor of 26%. However the Consultants survey indicated load factor of in the order of 190% which agreed with the result of BTS surveys. A load factor of 190% was adopted. Table 10.4.14 shows financial and economic costs of passenger launch service by this particular vessels based on the figures shown in table 10.4.15. Because of higher local currency content of launch vessels the economic cost of amortization was assumed to be 1.14 times the financial cost.

Costs per passenger-km at various distance are shown in Table 10.4.15.

It was assumed that the number of hours spent in landing stations per trip is a function of sailing time, taking a minimum of 30 minutes up to the sailing period of 6 hours and a maximum of 6 hours for the sailing period beyond 1 day. It was also assumed that all vessel departures are done within the day-light period of 6 am. to 6 pm. hours between the arrival after dark and 6 am. next morning are divided by the number of trips per day and are attributed to each trip.

The passenger km costs shown in Table 10.4.15 were derived for the load factor of 190% as stated before. If 100% load factor is taken, the figures should be increased by 90%.

Relationship between the travel distance and limit cost is illustrated in Figures 10.4.5 and 10.4.6. Because of the discreteness of the number of voyages to fit departure times within daylight hours, the cost curve shows some bumps.

Table 10.4.11 BIWTC Passenger Launch Performance

Capacity	180 pass
Daily round trip	128 km
Travel speed	11.4 km/hr.
Passenger - km/gr(normal) at 26% load factor	1.80 million
Full daily service at 26% load factor total pass-km/gr	2.19 million
Estimated non-operating days	17.8%
Operating days say:	300
Non-steaming hours/steaming hours	0.217
Actual load factor	1.9
Actual passengers/vessels	342

Source: BIWTC

Table 10.4.12 BIWTC Passenger Launch Costs 1983-84
(80 ft Prototype Vessel)

Fuel cost	469 Thousand Tk.
Repair and Maintenance	12 Thousand Tk.
Pay and Allowance	75 Thousand Tk.
Direct expenses	0.5 Thousand Tk.
Indirect expenses	143 Thousand Tk.

Source: BIWTC

Table 10.4.13 Vessels Costs (Private Sector)

	Vessel	Hena Express	M.V. Mita	M.V. Sheema	Shakil Ahmed
1.	Fuel consumed/trip oneway	24 Gal	84 Gal	84 Gal	-*
2.	Cost of vessel new in Taka	800,000 wooden hull	850,000 wooden hull	800,000 wooden hull	3,500,000 steel hull
3.	Annual cost for Repair/maintenance Taka	80,000	90,000	90,000	75,000
4.	Pay roll monthly Taka	15,000	15,000	15,000	22,500
5.	Direct cost of management	7,000	9,000	9,000	15,000
6.	Indirect cost i.e. Rent, Elect. Gas	10,000 Tk	25,000	25,000	40,000
7.	Insurance annual Taka	0	0	0	0
8.	Interest on loan	0	18%	18%	16%
9.	Amount of loan	0	300,000	300,000	240,000
10.	Vessel Replacement cost Taka	Not given	-	-	-
11.	Age of vessel	30 years	20 years	22 years	5 years
12.	Number of passengers monthly	6,000	15,360	13,500	12,000
13.	Distance travelled per month kilometres	1965	7020	7020	7380
14.	Number of trips per month	30	30	30	-

Source: Owners
The owners estimated 45 days of down time per year due to surveys repairs and waiting for spare parts not available in local markets.

* This data is suspect and has been ignored in this table.

Table 10.4.14 BIWTC Passenger Launch Cost 1985 (80 ft Prototype)

	Financial	Economic
Fixed Cost Per Year (Tk 000).		
Crew Wages & Allowances	82.4	65.9
Standing Maintenance	9.2	9.2
Indirect Cost	157.3	103.8
Amortization (at 15% for 25 yrs)	386.3	440.4
Total fixed cost per year	635.2	619.3
Variable Cost Per Year (Tk. 000)		
Fuel	468.0	562.0
Running Maintenance	3.9	3.9
Other Direct Cost	0.6	0.5
Total variable cost per year	472.5	566.4
Total cost per year	1107.7	1185.7

Note : 1) 1983/84 recorded costs were inflated by 10% except for fuel and amortization.

2) Variable maintenance cost was taken at 29% of total maintenance cost.

3) Financial replacement cost.

Source : The Consultants

Table 10.4.15 Launch Passenger - km Cost

	Financial	Economic
Fixed Cost Per Day (Tk.000)	1.74	1.70
Variable cost per km (Tk)	12.30	14.75

Distance	Variable Cost	Steaming Time	Total Time	Total Fixed cost	Total cost	Pass-km cost	Pass-km cost
(km)	(km)	(Days)	(Days) (min.1.0)	(TK)	(TK)	(TK) (at overload)	(TK) (at capacity)
Financial Cost							
25	308	0.09	304	529	837	0.098	0.186
50	615	0.18	406	706	1,321	0.077	0.146
100	1,230	0.37	609	1,060	2,290	0.067	0.127
150	1,845	0.55	1,217	2,118	3,963	0.077	0.146
200	2,460	0.37	1,217	2,118	4,578	0.067	0.127
250	3,075	0.91	1,912	3,327	6,402	0.075	0.143
300	3,690	1.10	1,957	3,405	7,095	0.069	0.131
350	4,305	1.28	2,150	3,741	8,046	0.067	0.127
400	4,920	1.46	2,262	3,935	8,855	0.065	0.124
Economic Cost							
25	369	0.09	304	517	886	0.604	0.198
50	338	0.18	406	690	1,428	0.084	0.160
100	1,475	0.37	609	1,035	2,510	0.273	0.139
150	2,213	0.55	1,217	2,069	4,282	0.083	0.158
200	2,750	0.73	1.217	2,069	5,012	0.073	0.139
250	3,688	0.91	1,912	3,250	6,938	0.081	0.154
300	4,425	1.10	1,957	3,327	7,752	0.076	0.144
350	5,163	1.28	2,150	3,655	8,818	0.074	0.641
400	5,700	1.45	2,262	3,845	9,745	0.071	0.135

Source: The Consultant

Table 10.4.16 IWT Freight Users Rates Survey

Route No.	Origin	Destination	Commodity	Distance	Rate Tk/Tonne	Rate Tk/T.km.
1	Dhaka	Chittagong	Petroleum	352	594	1.69
1	Dhaka	Chittagong	Jute	352	561	1.59
1	Dhaka	Chittagong	Cement	352	206	0.59
1	Dhaka	Chittagong	Wheat	352	240	0.68
1	Dhaka	Chittagong	Rice	352	240	0.68
12	Dhaka	Sylhet	Cement	420	120	0.29
15	Dhaka	Khulna	Jute	303	563(?)	1.55
39	Dhaka	Bogra	Jute	291	563	1.93
54	Chittagong	Dalutpur	Petroleum	418	171	0.41
55	Chittagong	Comilla	Fertilizer	425	203	0.48
56	Chittagong	Narayanganj	Wheat	342	230	0.67
56	Chittagong	Narayanganj	Rice	342	230	0.67
59	Khulna	Faridpur	Wheat	172	218	1.27
59	Khulna	Faridpur	Rice	172	218	1.27
60	Khulna	Barisal	Wheat	185	169	0.91
60	Khulna	Barisal	Rice	185	169	0.91
69	Gherasal	Barisal	Fertilizer	193	85	0.44

Source : Consultants Survey.

FIG. 10.4.5 EXISTING IWT PASSENGER FINANCIAL COSTS.
(1985 prices)

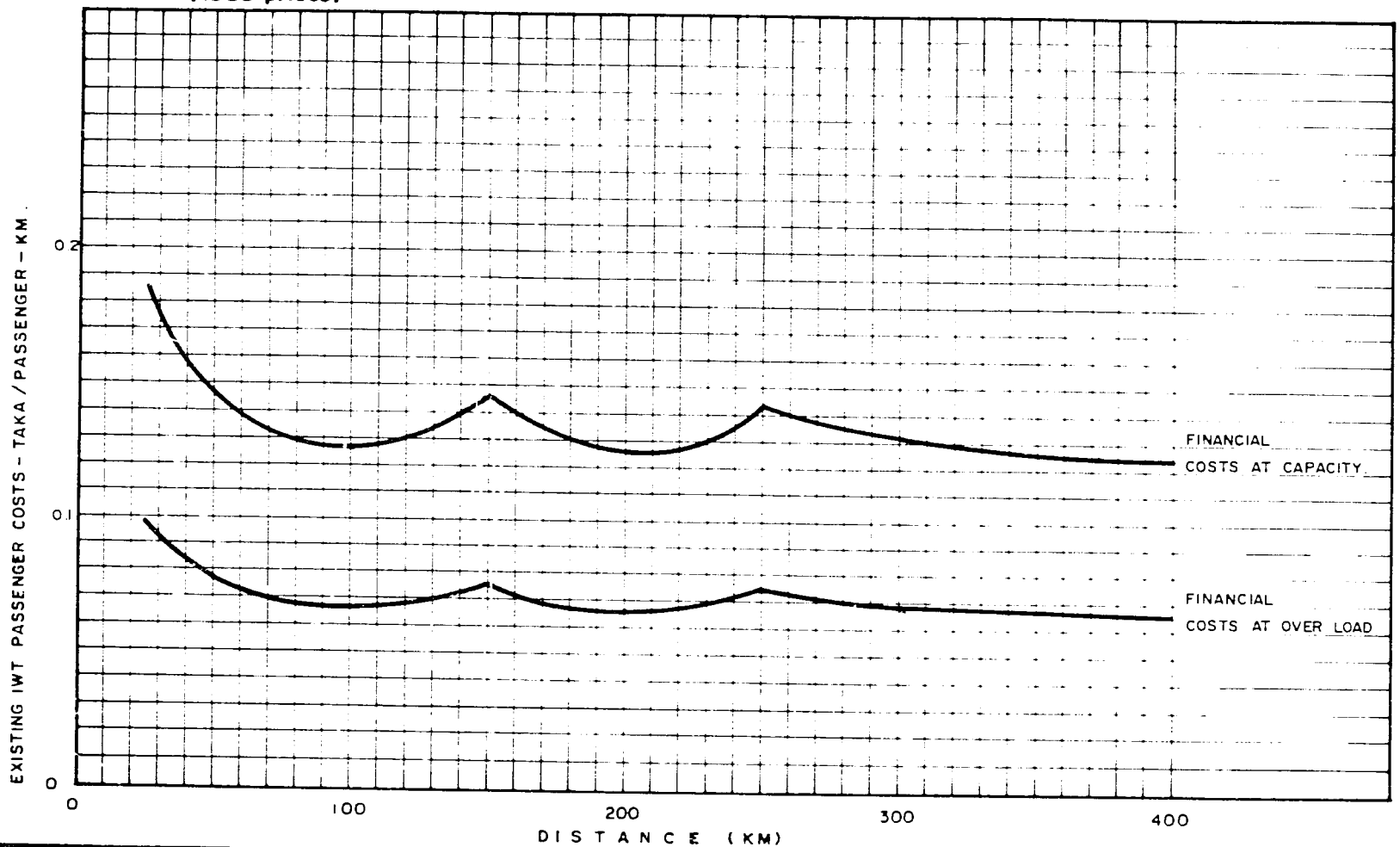
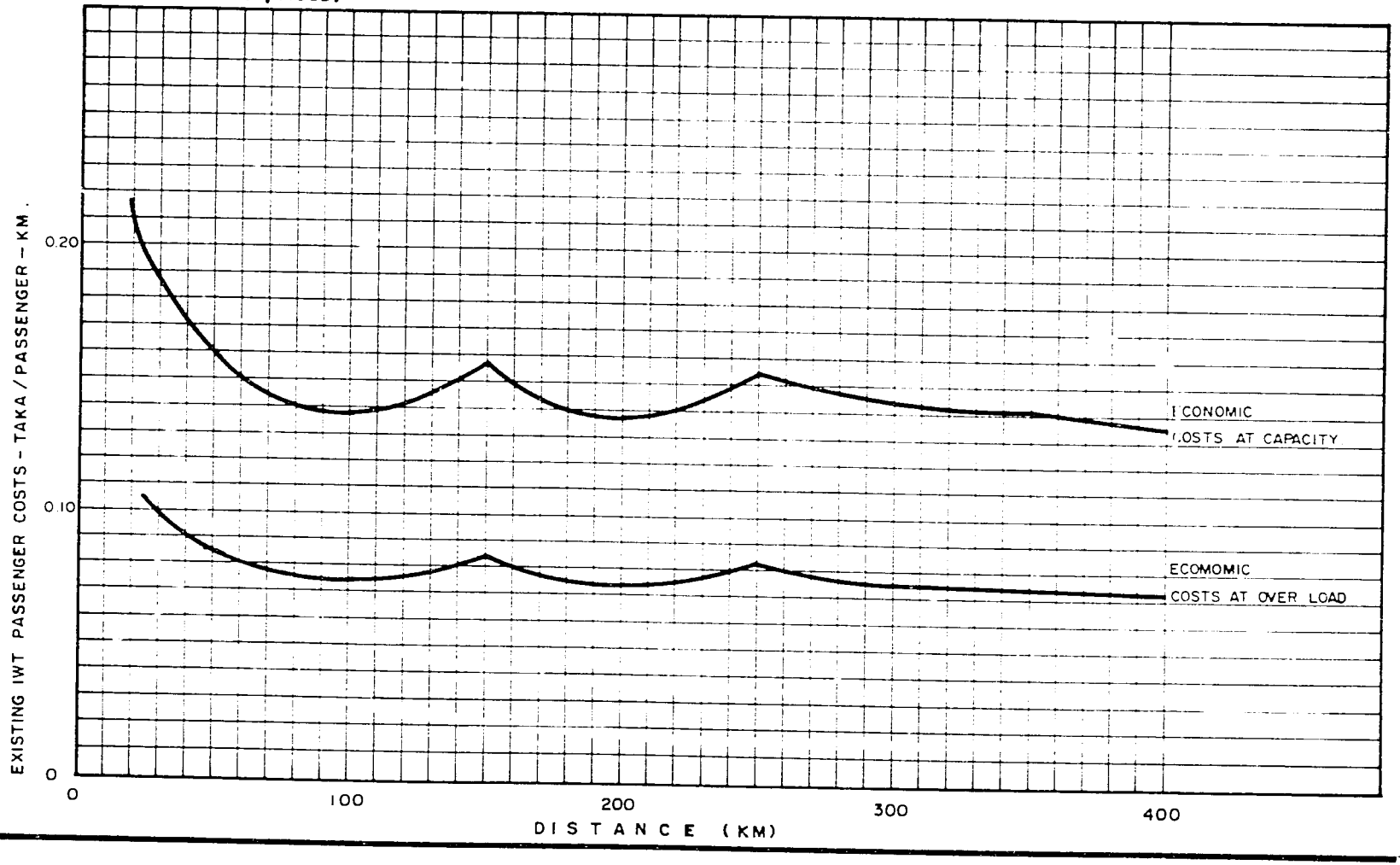


FIG. 10.4.6 EXISTING IWT PASSENGER ECONOMIC COSTS.
(1985 prices)



10.4.3 Fares and rates

Actual freight rates paid by shippers were surveyed by the Consultants. The results are summarized in Table 10.4.16 and illustrated in Figure 10.4.7.

Similarly actual fares paid by passengers were surveyed. The results are summarized in Table 10.4.17 and illustrated in Figure 10.4.8.

10.4.4 Loading and unloading

Loading and unloading costs were obtained during the survey, although the number of samples was quite limited. Table 10.4.18 summarizes the results.

10.4.5 Comparison of costs and fares and rates

Figure 10.4.9 compares the freight cost as developed in sub-section 10.9.1 and the actual freight rates. Apparently coaster operations cannot charge enough to replace their mostly old, already depreciated vessels.

Whilst the costs used are based on BIWTC, the private operators have to be at least 50% more efficient than BIWTC at published rates to break even. As their rates are less than BIWTC, in order to obtain traffic this efficiency margin has to be even higher.

On the other hand passenger launch operator have a small profit margin.

Table 10.4.17 IWT Passenger Fares Surveys

Route No.	Origin	Destination	Class	Distance km.	Fare Tk/Pass	Fare Tk/Pass.km.
15	Dhaka	Khulna	I	363	200	0.55
15	Dhaka	Khulna	III	363	65	0.18
27	Dhaka	Chandpur	I	66	25	0.39
27	Dhaka	Chandpur	II	66	15	0.23
27	Dhaka	Chandpur	III	66	15	0.23
34	Dhaka	Barisal	I	169	152	0.90
34	Dhaka	Barisal	III	169	25	0.15
35	Dhaka	Faridpur	I	134	25	0.19
35	Dhaka	Faridpur	III	134	18	0.13

Source : Consultants Survey.

Table 10.4.18 IWT Fright Loading and Unloading Costs Survey

Commodity	Loading Cost Tk/Tonne	Unloading Cost Tk/Tonne	Comments
Jute	6-20	6-14	Higher figure towards Dhaka lower, from Dhaka
Fertilizer	8	9-10	
Wheat	8-10	8-9	
Rice	8-10	8-9	
Cement	40-48	12	

Source : Consultants Survey.

FIG. 10.4.7 IWT FREIGHT TARIFFS-1985 RATES
(1985 Prices)

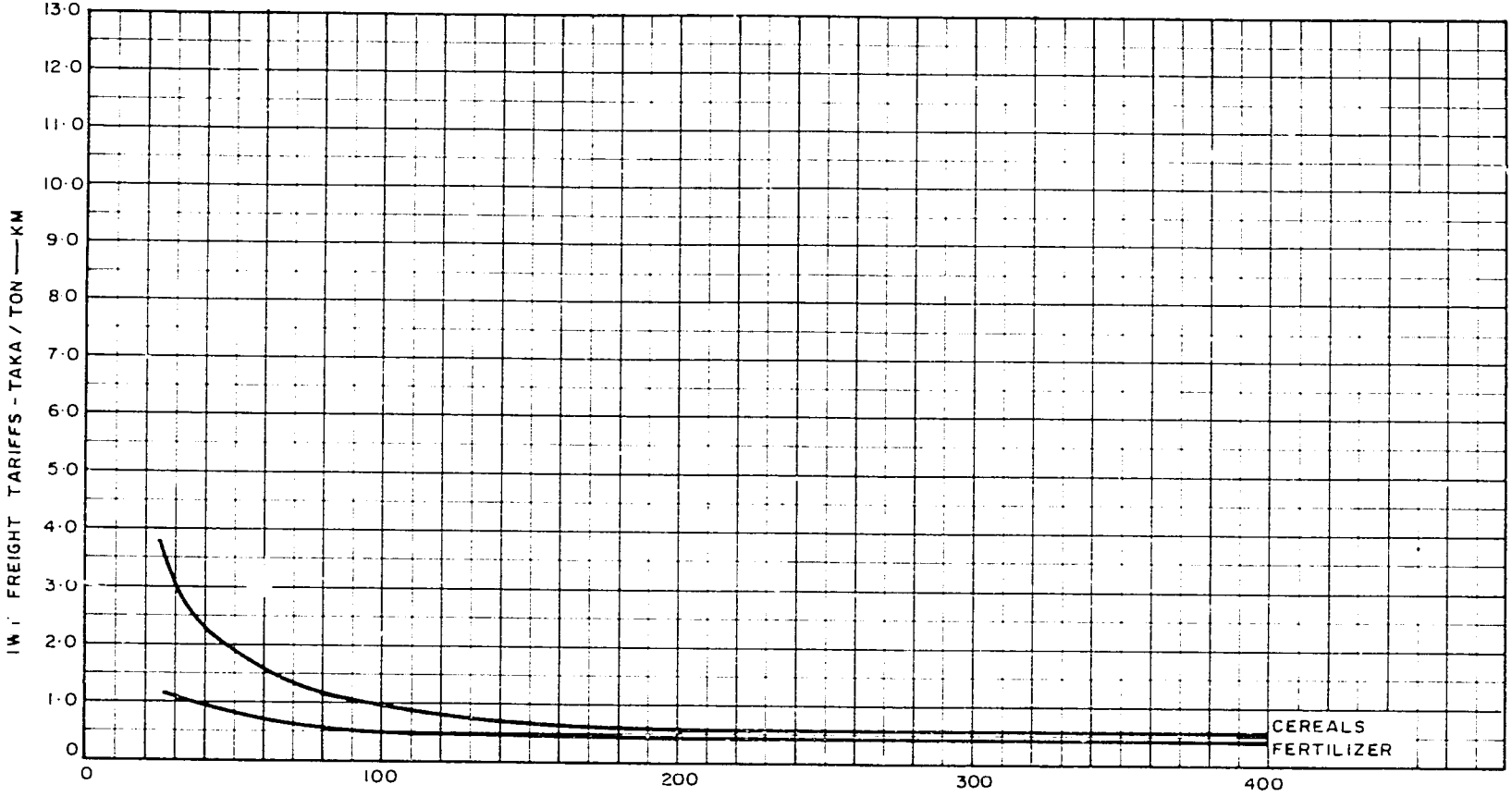


FIG. 10.4.8 IWT PASSENGER TARIFFS-1985 RATES
(1985 Prices)

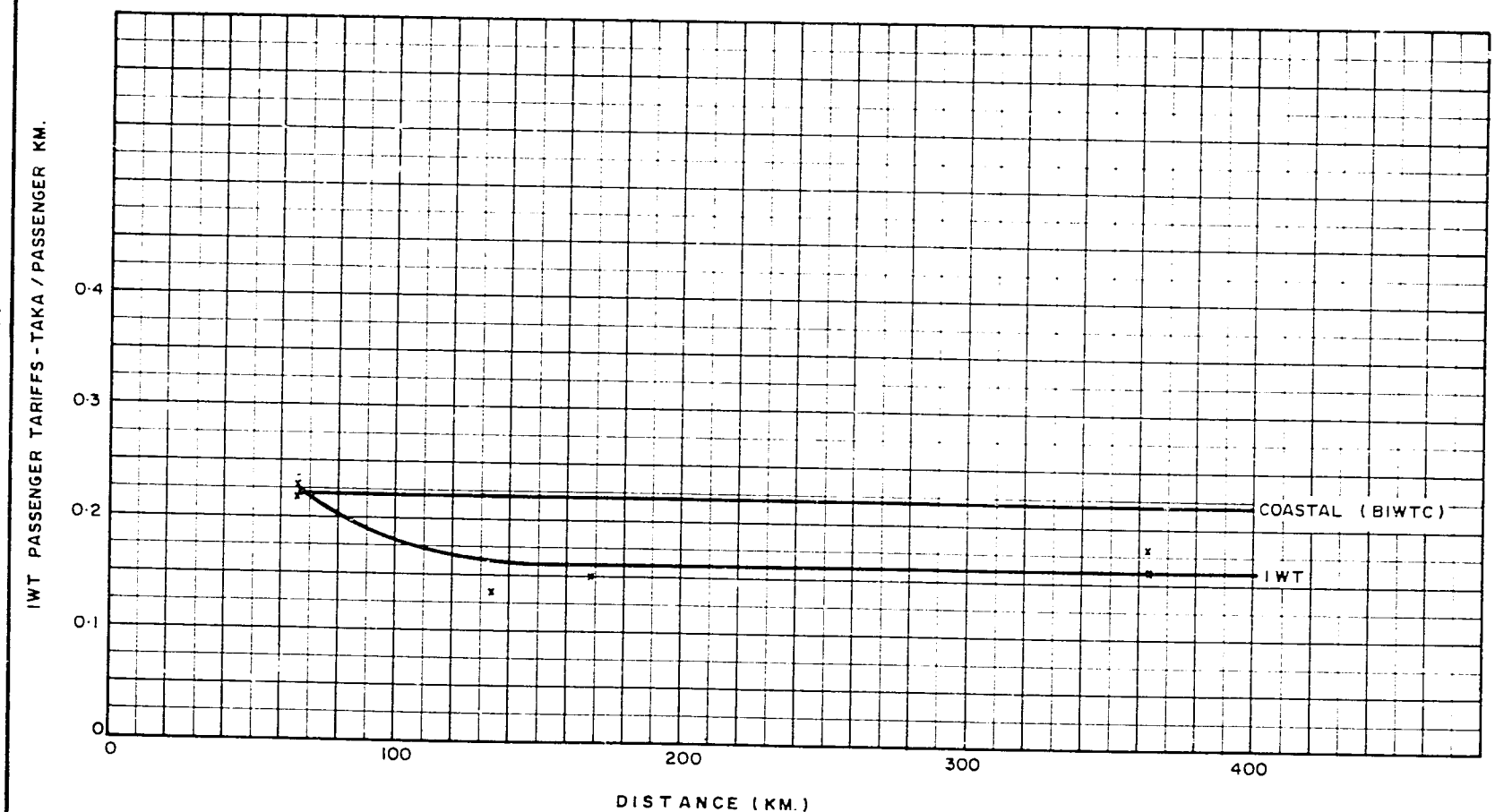


FIG. 10.4.9 COMPARAISON OF IWT FREIGHT COSTS AND RATES
(1985 Prices)

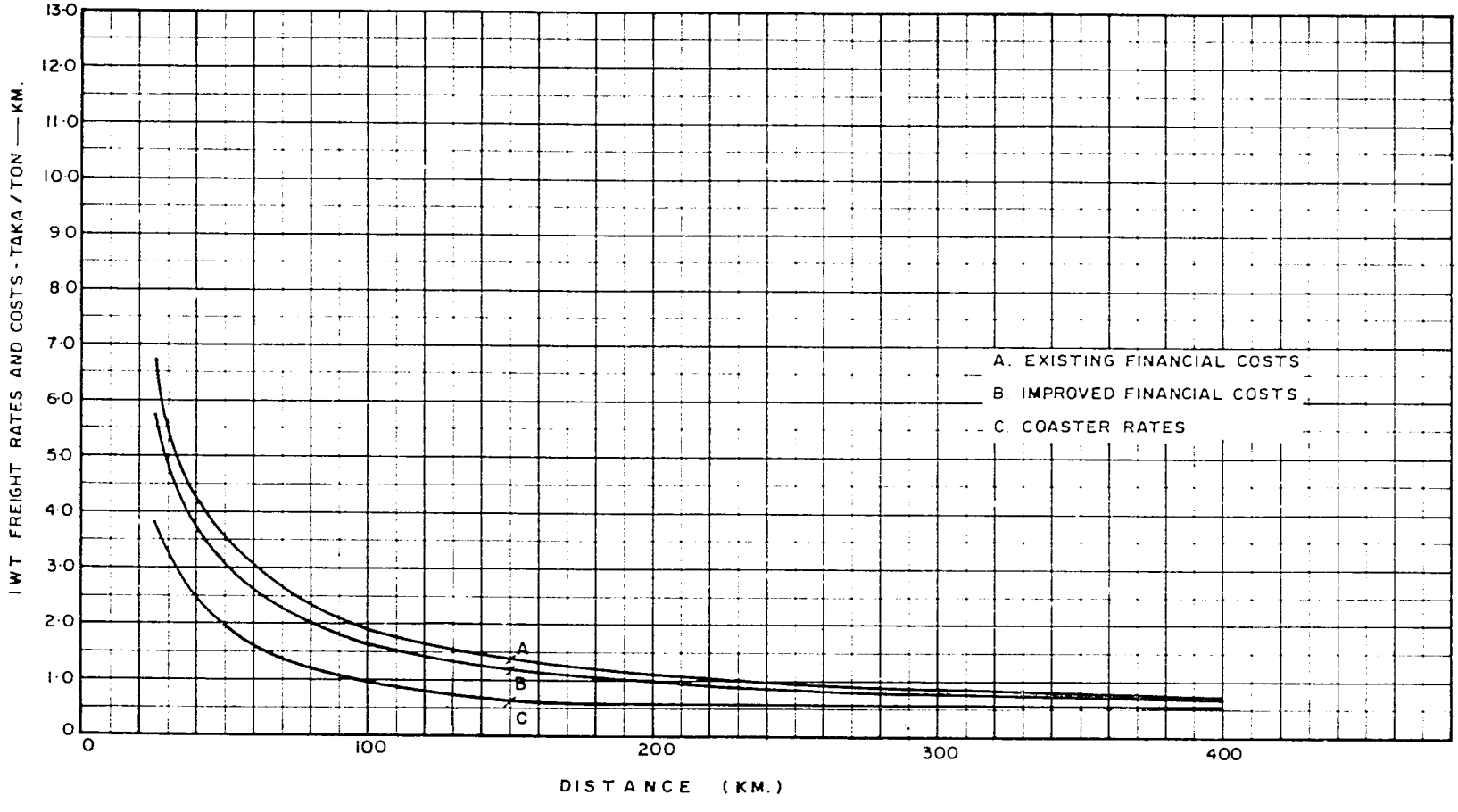
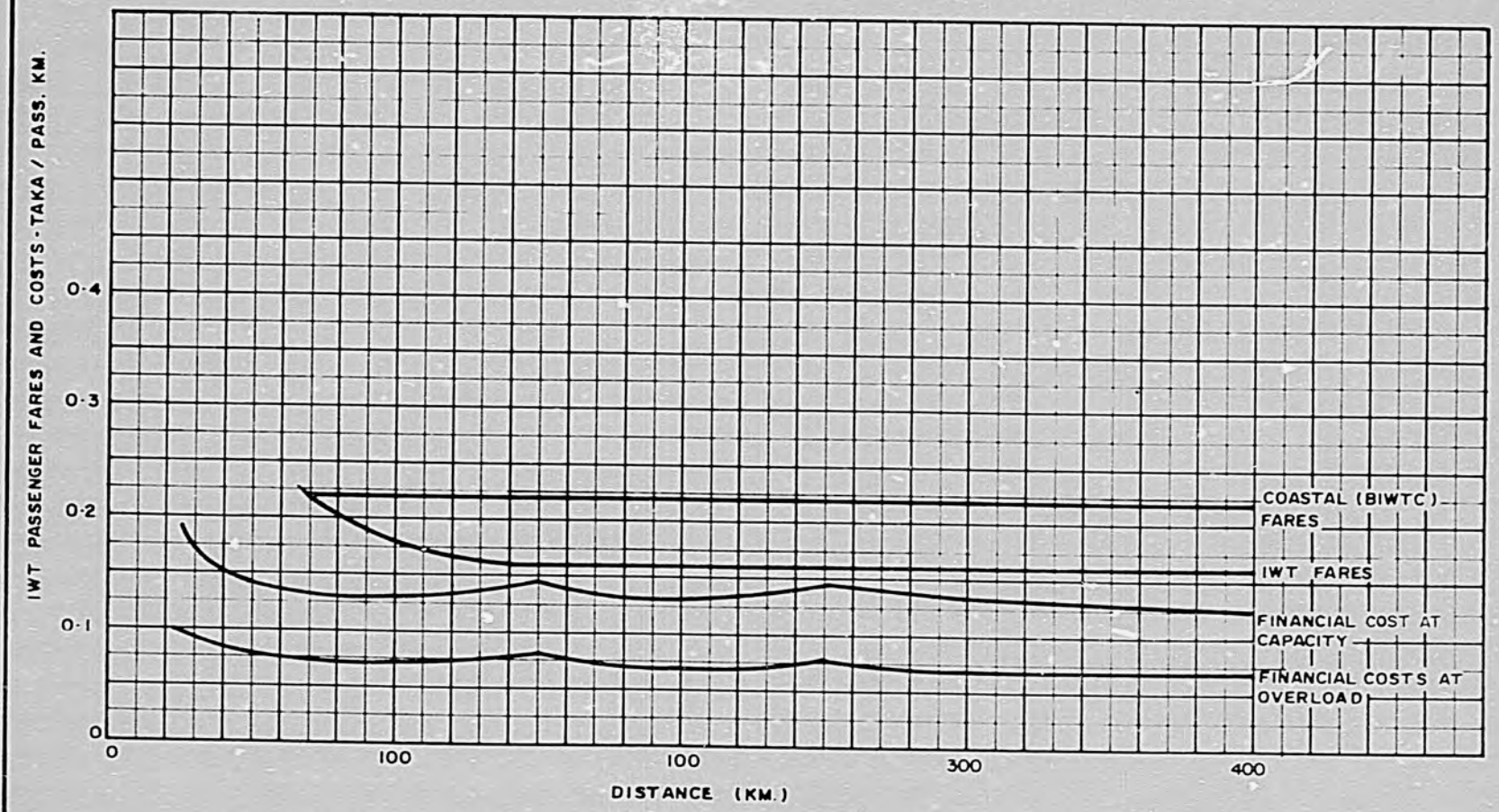


FIG. 10.4.10 COMPARISON OF IWT PASSENGER COSTS AND FARES
(1985 Prices)



10.5 Infrastructure

The infrastructure is the responsibility of the BIWTA operations and this section reports on this aspect.

10.5.1 Inland ports

(1) Administration

While each of the BIWTA major inland ports has a local administration, the head of each department is directly responsible to the main office in Dhaka. The departments are: Ports and Traffic, Engineering, Conservancy & Pilotage and Accounts. The department concerned with cargo handling is the Port & Traffic Department.

One Port and Traffic officer is in charge of each port and directly responsible to the Director of Ports. The responsibilities of the Port and Traffic Officer include administration and management of the personnel employed in the Port and Traffic Department, port traffic, lease of shops and places for vendors within port area, leases of jetties and launch ghats to private operators, revenue earnings, maintenance and development.

(2) Port descriptions

The inland river ports, Dhaka, Narayanganj, Chandpur, Khulna, Barisal, Bagabari and Bhairab bazar, have been visited and project proposals reviewed.

(a) Dhaka port

The port of Dhaka is located along both banks of the Buriganga river. It is an old port serving Dhaka city with its population of between 3 to 4 million. The port has many limitations due to congestion, insufficient road capacity, particularly in old Dhaka, and constantly increasing demands from the rapid increase in population.

Broken steps leading from the river to the street with loading congestion on the street hampering freight handling operations is a particular cause of congestion.

The most important cargos handled in Dhaka port are: jute, cotton textiles, garments, leatherware, news print, rubber, soap, chemicals, furniture, iron and steel products, edible oil, flour, rice, food grains and cement. Country boats supply the cities daily needs of fresh fruit, vegetables, fish and meat as well as many industrial goods.

All passenger launch traffic is handled at the BIWTA passenger ghat. Within the port there are number of private jetties belonging to jute mills, lumber companies, oil companies and other industries.

(b) Narayanganj port

The port is situated at the Lakhya river about 10 miles south-east of Dhaka. As the capacity of Dhaka port is limited, Narayanganj port is serving as the main import and export for the greater Dhaka area. Narayanganj is also a principal centre of the jute trade in Bangladesh.

The port has good railway and road connections, and considerable quantities of goods are transhipped at Narayanganj. The main export commodities are: jute, oil seeds, sugar cane and tobacco. Import commodities are foodgrains, fertilizer, building material, and general cargo.

The West bank of the river contains most of the cargo jetties, a passenger terminal and many private jetties. The East bank is used for ship repair a
private jute handling jetties. Within the port limits there is a bulk grain handling silo complex for food grain mostly jetties areas on the West bank are served by rail. The port is under study as a possible site for an inland container terminal.

There are no rated infrastructural deficiences at this port.

(c) Chandpur port

The port of Chandpur is located below the confluence of the rivers Meghna and Padma in the centre of the Bangladesh river delta. There are road and railway connections to Dhaka, Narayanganj, Chittagong and to the north, northeastern, and southern districts. Chandpur is often utilized as a transhipment port for inland traffic.

The jetties for steamers, passenger vessels, coasters and cargo vessels are, in the main, located on the northern river bank with the exception of some jute handling jetties. Railway and road connections are also on the northern river bank.

Industries consist of jute mills, jute bailing companies, rice mills, Panama Industries, a small boatyard, a match factory, a saw mill, a fishmarket (iced fish being distributed to other areas from here), ice factories and some small enterprises. Three oil companies-Meghna Petroleum Co., Jamuna Petroleum Co., Burmah Oil - have storage tanks some provisional unloading facilities.

There is a lack of pontoons and proper facilities for efficient handling of a major volume of fish. Boats are tied up 4 or 5 abreast with loading and unloading being by head load, gangs walking on wooden planks across other vessels.

(d) Barisal port

Barisal district is a major area for the production of rice, sugar cane, tobacco, vegetables, coconut, mustard seed, meat

and dairy products. It is also major fish handling and distribution centre for markets in Dhaka and Khulna.

A lack of pontoons necessitates midstream loading and unloading. One concrete jetty damaged by erosion has not been repaired and there is poor road access.

(e) Khulna port

The Port is located approximately 48 kilometres north of the seaport of Chalna. It is a major inland distribution port. There are connections by inlands waterways coastal routes, roads and railway. The road and railway connections serve other inland districts of Bangladesh not served by water routes particularly to the northern and north western regions. The port is important for the region as it is a main transhipment centre, where imported goods are distributed, and products from other districts are collected for export, or consumed as raw materials by the industries at Khulna. Most of the production is exported and of great value for the economy of the country. The area is also surplus in food production so food is shipped to other districts. Thus Khulna is an important market for a variety of agricultural commodities such as rice, pulse, mustard seeds, sugar cane, coconuts, leaves, vegetables and honey, bamboo, bonemeal, frozen froglegs and dried fish.

The partial destruction of Roosvelt Jetty by river bank erosion has placed a severe strain on other unloading areas, resulting in excessive vessel waiting times.

(f) Bagabari port

The port of Bagabari is a new, well planned port, destined to play a major future role in water transport for agricultural distribution. It has one infrastructional drawback, the distance from the loading/unloading jetties to the truck loading area is approximately 90 metres and to the godown 120 metres. Freight handling "Head load" operations must be carried out with an excessively large number of men over a long distance.

(g) Bhairab Bazar port

This is an old port located on the Meghna River serving as a distribution point for water and coal to the districts of Sylhet and Mymensingh. In recent years the port has grown to become one of major importance as these districts have grown. Unfortunately the city has grown, around the port and now restricts, due to congestion and lack of access roads, the flow of cargo from the port.

Broken steps lead from the river bank to narrow congested streets and old inadequate godowns that are located in alleys and have no adjacent truck loading area.

(3) Observations

Visits to all of the major inland ports revealed many similarities in inland infrastructural design, operation, equipment and management, but no two are indentical. For example, the old port of Dhaka and the new port of Bagabari both have essentially the same type of pontoons and jetties, and their freight handling methods are similar. However they are not fully comparable in that Dhaka is hemmed in by the city while Bagabari is located in a large, remote and open space with ease of movement for access and cargo handling.

In every case the ports are limited by one or more elements, either location, design, equipment, manning, management, and in most instances congestion caused by the encroachment of the cities. A number of these deficiencies have been noted by BIWTA and project schemes proposals in TFYP are aimed at rectifying these deficiencies.

There appeared to be an imbalance at certain ports between the number of vessels jetties or loading unloading areas and the godown capacities. In some ports there are sufficient jetties and a lack of storage capacity; in other ports the situation appears to be the opposite. Future studies on the inland ports should review this situation carefully.

10.5.2 Waterways

(1) Introduction

The river systems of Bangladesh originates in the Himalaya mountains flowing south to form on of the largest deltas in the world, before entering the Sea of Bengal. The principal rivers are the Ganges, Meghna and Brahmaputra.

The rivers flow through largely level countryside with little natural restrictions on their flow. As a result the rivers under annual flooding condition tend to change course and often destroy or erode embankments, either natural or man made This unchanneled flow over alluvial lands along with the heavy suspended sediment from the mountains create a siltation problem reported to be as high as 2,400 million tons annually. Efforts to control the siltation problem and retain river channels by man made embankment and river training works are helpful but have not proven to be answers to the siltation and shifting channels problem. The only practical method, to date, to maintain river navigation at required depths is by dredging channels and limited channel protective works.

(2) Dredging

a) Government agencies

In order to provide vital river navigation and irrigation to farming areas, four Government agencies are responsible for dredging. They are the Bangladesh Water Development Board (BWDB) responsible for irrigation projects and the Bangladesh

Inland Water Transportation Authority (BIWTA), responsible for the development and maintenance of navigational channels. The Port of Chalna Authority and Chittagong Port Authority have responsibility for the dredging and navigational aids in their districts and at their facilities. Chalna Port contracts this service to BIWTA while Chittagong Port uses its own equipment and personnel.

b) Draft restrictions

While maintenance dredging requirements of certain relatively stable rivers can be consistant from year to year, other rivers such as the Jamuna require constant surveys and develop unpredicatable siltation.

c) Dredging improvements

The Surma-Baulai river in Sylhet, the Hurasagar river in Pabna and the Ichhamati river in Dhaka district totalling over 320 kms have been dredged to provide a minimum of 6 ft draft.

However the 3,640 kms of waterways with a draft of over 6 ft in 1973 has deteriorated to 2,847 kms according to BIWTA records.

d) Siltation

While passenger launches draw a maximum draft of only 1.35 metres, the Passenger Launch Owners Association members readily provided a list of operating areas that required dredging. The areas described are generally in the vicinity of the vessel berthing pontoons and many are small in area.

As the interview was held in Khulna, complaints were generally confined to the rivers in that area: i.e. Meghna, Padma. Modhumati and Pussar River. The following are locations cited as requiring dredging:

Table 10.5.1 Lengths of Channels Needing Dredging

Item	Location	Required dredging length
1.	Sindiaghat	15 metres
2.	Jalirpur	13 metres
3.	Saraspur	15 metres
4.	Jagania	19 metres
5.	Tala	9 metres
6.	Jaynapos	45 metres
7.	Sukaali	15 metres
8.	Khulna to Assasuni - Shapara, near Bardia	N/A
9.	Khulna to Dhaka - Barfa to Monuikdah	3.1 km
10.	Bagerhat - Mouth of Tushkaal Channel	0.6 km
11.	Khulna Bhatiapara - Dicreerchas and Mather	1.6 km

Source: Launch Owners Association

The ready citing of waterways and locations is another indication of the serious need for increased maintenance dredging capacity. Additional areas are given in the Project Proposals for improvement to navigation channels for the passenger launches and other traffic.

e) Dredging capacity

The estimated annual dredging capacity of BIWTA is 4 million cubic metres if working 2 shifts and 6 million cubic metres working 3 shifts. That of BWDB is 6.5 million cubic metres, or an average total of approximately 10.5 million cubic metres.

A review of BIWTA dredging for both maintenance and development over the past 4 years shows the fleet operating at 1.3 million cubic metres below their operational capacity. This reduction in operating capacity is attributed to budgetry restraints. Reports from both the pilots and private sector vessel operators indicate that present river siltation problems are a most serious concern. This budget restriction on the dredging fleet capacity appears to be ill-timed in view of the reported heavy siltation problems in both major and minor waterways.

Past and Present Dredged Volumes

Year	Volume cubic metres (000)
1979-80	2,669
1984-85	2,676

The TFYP for dredging calls for a large effort to be made on dredging secondary waterways. While this is important, it is imperative that the major river commercial channels and the port berthing areas be maintained at official depths. These channels serve the ports of Dhaka, Narayanganj, Chandpur, Barisal, Khulna and Chittagong. Budget restrictions should not be applied to either of these two important tasks. If emphasis in the TFYP is placed on dredging secondary water ways and the budgeted expenditure has not been increased it is logical to expect continued high rates of siltation in the major channels.

Table 10.5.2 Dredging Budget 1980 to 1985

In lacs Taka

Yea.	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
Expenditure						
Dredging Income	405.5	431	731	599	675	725
Hydrography	43.3	50	53	64	67	125
Maintenance Dredging Budget	95.7	70	150	150	150	150

Note: The budget over the past 4 years for maintenance dredging has remained the same.

The budget for hydrography in 1984-85 is double that of 1983-84. This large increase for planning and study should be reflected in an expansion in dredging projects and budget appropriations in 1985-86. It is not clear how dredging charges and income are derived. However, the budget income as given would appear to amply justify increases in budget expenditure. In view of inflationary factors over the past 4 years, the budget allocation for maintenance dredging has actually provided for less annual dredging capability.

(3) Survey and data collection

a) Government agencies

One of the most important functions of maintaining the waterways is the survey and collection of data for the purpose of measuring depths and changes in the land, waterways and navigation channels. This information is vital to dredging, the publication of maps and navigation charts. There are six Government agencies involved in collecting geophysical, hydrological and topographic data. They are:

(1)	Hydrographic Dept. of BIWTA	Hydrographic Survey Bangladesh Inland and Coastal Waters.
(2)	Chittagong Port Authority	Hydrographic Survey, within Port Limit
(3)	Port of Chalna Authority	Hydrographic Survey, within Port Limit
(4)	Land Reclamation, BWDB	Hydrographic, Hydrological and Hydrometereological data of inland areas.
(5)	Bangladesh Navy	Oceanographic Survey of the sea.
(6)	Survey of Bangladesh	Preparation of Topographical Maps.

Examination of these functions shows that they all employ much of the same instrumentation. The qualifications for personal all have similar and interelated training requirements.

Review of these various agency functions and their interrelationships indicate that none are self-sufficient and therefore must depend on inputs from the other agencies. The net result is a duplication of work, personnel, map and charting, printings, equipment and their related expenses.

b) Decca navigation system

Due to the annual changes in hydrology, annual maintenance dredging requirements can not be forecast on a long term

basis. As a result extensive surveys must be carried out prior to dredging. When required dredging areas are determined, dredges and their attendant auxiliary fleet must be scheduled and located in the areas. The survey and positioning of the dredger fleet is a most difficult undertaking. The mapping, marking and location of areas to be dredged requires an accurate system of measurement for location positioning of the dredgers. This is now performed with the same 20 years old Navigation System.

A project proposal for the TFYP calls for a renewal of this antiquated and now difficult to maintain system of radio directional finders. Over the past 20 years the original Decca Navigation System has undergone many improvements. Newer systems have been developed to provide more accurate positioning for surveys. The use of accurate dredger fleet positioning equipment will provide more efficient use of the dredgers. A complete review of newer survey equipment systems should be made prior to the renewal of the present outmoded system.

c) Standard high and low water datum

The survey of base data for Standard Low Water and Standard High Water was last performed in 1963. SLW-SHW data serves as the bench mark from which all calculations of water depths are made. The SHW and SLW bench marks are subject to change annually. Unless this datum is kept current all navigation and water-way measurements and their publications are subject to error. Standard procedure requires this data be updated every 5 years. It is now 22 years since this required bench mark was established in Bangladesh. This vital data base should be re-established as soon as possible.

There are four separate but related functions that could be merged into one or two organizations. They are:

1) Water Resources Survey.

2) Land Survey.

3) Support services i.e. cartagraphy, computer services, printing, instrumentation, stores and distribution of information.

4) Dredge fleet operations and maintenance.

The merger of existing agencies to conduct surveys and dredging could result in overall responsibility under one Government Agency or Authority. If for policy reasons such a merger cannot be implemented, project proposals in the TFYP for auxilary dredging fleet replacement requirements should be placed under further review.

10.5.3 Navigational aids

a) Marked channels

The BIWTA state that in the ten years 1973 to 1983 the length of marked channels increased from 2,590 km to 4,740 km.

b) Night navigation

The night lighted navigation aids decreased from an average of 1 lit buoy in 13 km in 1973 to one in 19 km in 1983.

c) Comments

The inportance of river navigation to the Bangladesh economy is large and good delay-free navigation is essential to maintain an even flow of shipping. Many of the rivers are tidal and grounding is a serious matter. Good channel marking is necessary, with good well set out aids. The increase in activity with night sailings on well lit waters will be a big increase in performance for the BIWTC and private owners. The cost curves for passenger traffic in particular show the cost increases due to sailing only in daylight hours.

10.6 Fleet, Shipyards and Ferries

10.6.1 Fleet

(1) Commercial vessels

In Table 10.6.1 the number of vessels for the private sector and BIWTC are given, with the static carrying capacity and the average per vessel. The data is taken from the BEPP Transport analysis and updated using the BIWTA and BIWTC figures. For 1984/85, the number of BIWTC vessels is given as 297. Assuming the average static capacity per vessel has continued to decline at the same rate as the period 1976-1979, an estimate for 1984/85 of 396 tonnes is calculated. This then gives the estimate for the BIWTC fleet static capacity. From BIWTA report on Third FYP, the total IWT fleet is given as 1735 vessels with a static carrying capacity of 466,000 tonnes. Thus, using the BIWTC figures, the estimate for the private sector has been obtained for 1984/85. The figures for 1982/83 and 1984/84 have been obtained by interpolation.

It can be seen from the table that whilst there has been considerable increase in the size of the private sector, particularly in the period 1980/81 to 1984/85, there has been a significant decrease in the size of the public fleet. Two factors have combined to cause these effects. Firstly, the encouragement of the private sector and secondly the aging and non-replacement of the public sector fleet have ment that freight has been attracted to the private fleet.

(2) Dredgers

a) Vessels

A review of the characteristics of both the BIWTA and the BWDB dredging fleets shows that a wide range of dredgers are employed. However, a large portion of both fleets have similar characteristics. BIWTA has 8 large dredgers of recent design; two were built in 1972, five in 1975 and one in 1962. These dredgers are similar in design and capacity with eleven of the dredgers of BWDB aquired between 1977 and 1982. The remaining twenty-one BWDB dredgers are smaller units required for irrigation works or could be used for limited areas such as at jetty berths. In addition to dredgers, each agency employs a large fleet of auxiliary craft, such as, survey boats, inspection launches, cranes, tug boats and in the case of BIWTA salvage boats, and bouy tenders. Table 10.6.2 contains a review of the present fleet capacity, size, and conditions. Analysis of these tables indicates a large duplication of dredges and auxiliary equipment.

From an operational and economic view point it would appear that the management, organization and fleet could be integrated to ensure a more efficient operation and an optimal, coordinated annual dredging programmes. This would provide for master planning of maintenance, development of channels

Table 10.6.1 IWT Freight Private and Public Vessels 1975 to 1984

Year	Private Sector			BIWTC (Public sector)		
	No. vessels	Static capacity (Tonnes)	Average per vessel (Tonnes)	No. vessels	Static capacity (Tonnes)	Average per vessels (Tonnes)
1975/76	826[B]	204147[B]	247			
1976/77	857[B]	201441[B]	235	405[B]	179643[B]	444
1977/78	864[B]	192543[B]	223	394[B]	169234[B]	430
1978/79	904[B]	204940[B]	227	393[B]	168744[B]	429
1979/80	943[B]	218440[B]	232	395[B]	168358[B]	426
1980/81	1019[B]	246484[B]	242	391[E]	164220	420[E]
1981/82	1136[B]	299777[B]	264	359[E]	148626[E]	414[E]
1982/83	1229[E]	315853[E]	257[E]	337[E]	137472[E]	408[E]
1983/84	1329[E]	330921[E]	249[E]	313[E]	127155[E]	406[E]
1984/85	1438[C]	348388[C]	242[C]	297[D]	117612[E]	396[E]
Growth rate 1975-1980	4.29%	3.84%		-0.9%p.a	-2.22%p.a	
Growth rate 1980-1984	8.99%p.a	9.04%p.a		-6.64%p.a	-8.00%p.a	

Notes: B = Taken from BEPP Transport analysis

E = Estimated

C = Calculated from BIWTC data and BIWTA data

D = Data from BIWTC

I = Over 4 years, 1976-1980

Source: BEPP Transport analysis

BIWTA

Consultants.

Table 10.6.2 Characteristics of BWDB Dredging Fleet December 1983

Sl. No.	Name of dredgers	Year of built	Draft loaded (metre)	Dredging depth (metre)	Pump H.P.	Expected out turn/-hour (cubic metre)
1.	S.D. Abudhabi	1977	1.8	13.5	1,125	240
2.	" Halda	1978	1.8	13.5	1,125	240
3.	" Manu	1979	1.8	13.5	1,125	240
4.	" Buriganga	1979	1.8	13.5	1,125	240
5.	" Tista	1979	1.8	13.5	1,125	240
6.	" Dudkumar	1979	1.8	13.5	1,125	240
7.	" Kasalong	1981	1.8	13.5	1,125	240
8.	" Sangu	1981	1.8	13.5	1,125	240
9.	" Dhaleswari	1982	1.8	13.5	1,125	240
10.	" Titas	1982	1.8	13.5	1,125	240
11.	" Kumar	1982	1.8	13.5	1,125	240
12.	" Jamuna	1966	1.3	13.5	600	86

Sl. No.	Name of dredgers	Year of built	Type of engine	Pump H.P.
	Hoffman Type Dredger			
13.	S.D. Surma	1962	Gray Marine	450
14.	" Dharla	1952	-do-	450
15.	" Meghna	1954	M.W.M.	310
16.	" Chandana	1953	S. Pricardo	240
17.	" Karnafully	1953	-do-	240
	Atrai Type Repowered & Modified Dredgers			
18.	S.D. Arial Khan	1953	Cummins	300
19.	" Atrai	1953	Gray Marine	300
20.	" Baleswar	1953	-do-	300
21.	" Bangshi	1953	Cummins	300
22.	" Bhairab	1953	Gray Marine	300
23.	" Feni	1953	-do-	300
24.	" Gorai	1953	-do-	300
25.	" Gumti	1953	Cummins	300
26.	" Haringhata	1953	-do-	300
27.	" Karatoya	1953	-do-	300
28.	" Kushiara	1953	Gray Marine	300
29.	" Kirtinasha	1953	-do-	300
30.	" Madhumati	1953	Cummins	300
31.	" Muhuri	1953	Gray Marine	300
32.	" Passur	1953	-do-	300
33.	" Rupsa	1953	Cummins	300

Source: B.W.D.B.

and irrigation of Bangladesh waterways and land-surveys. Not only would the fleets to be more efficiently utilized there would be the advantage of having the present under utilized BWDB computer centre for service to navigation and waterway development. Additional advantages would be in the ability to cross-utilize the existing and limited trained dredging personnel.

Under an integrated management, the Chittagong and Chalna Ports proposal for hopper dredges would come under the new management organization with assurances to the ports of maintaining their vital waterways.

It is recommended that the organization and joint usage of fleets under one management be immediately studied for what appears to be a large area of annual cost savings and improved utilization of present assets. If the study is undertaken immediately further expenditure for dredges and accompaning work boats, survey vessels and launches etc. by the concerned agencies should await the recommendation of the study.

b) Condition

Although a limited number of BIWTA dredges and auxilary vessels were inspected it was not possible to survey this extended fleet during this study period. Those vessels examined appeared to be well maintained and in good condition. Project proposals for renewal of some 30 auxilary vessels and 3 3 suction dredges was initially viewed with skepticism. Inland fresh water operating vessels, if properly maintained, should have a minimum life expectancy of 30 years. The dredges that are to be replaced are only between 10 and 16 year old. The 30 auxilary vessels are 22 years old.

A review of a study, country Boats of Bangladesh, by Institute to Social Studies Advisory Service of Feb. 1984, states that of BIWTA's total fleet of 70 vessels only 20 are fully operational. It is recommended that hull and machinery surveys on the fleet be conducted by an international organization prior to approval for renewal, such organizations could be loyds of London, American Bureau of Shipping or the Norwegi Classification Society. Private international reputable surveyors could also be employed.

c) Dredger requirements

There is no one type of dredger that can perform all required types of dredging. As a result different types of dredgers are required. For example, a small grab dredger is required in limited working areas, such as along side jetties. Trailer suction dredgers are used in shallow areas. Cutter section dredgers are employed for major works in hard soils. Each type of dredger has a different operation and machine plant. Hence each type must employ trained personnel in these different requirements. This reduces the ability to transfer trained personal from one type of dredge to another.

As a result the number of trained personal for each type unit in each government agency is in short supply.

10.6.2 Shipyards

(1) Overview

Six ship yards were examined, two in Narayanganj, one in Chittagong under BIWTC, one in Barisal under BIWTA, one private building yard and the Chittagong Dry Dock under Bangladesh Steel and Engineering Corporation.

The yards visited appeared to be staffed, if not overstaffed, with trained personnel but are hampered by the continued use of antiquated machinery, methods employed and tools. Materials handling equipment is inadequate and should be increased. The use of hand labour instead of machinery is costly in terms of delays. For example, electric motor coils are hand wound instead of machine-wound, the baking of motor insulation is performed in time consuming makeshift uncontrolled ovens. Steel plate cutting is often performed by manual labour, using hammer and chisel, as opposed to cutting by buring or shears.

Further delays are experienced in waiting for spare parts or in fabrication of parts in antiquated forgoing and blacksmith shops. These inadequacities are time consuming and a major cause of extended vessel repair delays. In addition to the delays associated with vessels under repair there are the additional delays to other vessels waiting for available yard facilities.

(2) Narayanganj BIWTC ship yards

There are four separate BIWTC ship repair yard facilities in Narayanganj.

They perform the following:

Yard	I	Repair of tanker and passenger vessels.
	II	Repair of coastal vessels,
	III	Repair of flats and barges
	IV	Repair of tug boats and barges

In addition to the repair yards there is one floating dry dock and 3 slip ways.

a) Facilities

These repair facilities were built at the turn of the century and are equipped to handle steam engine repairs and basic wooden hull repairs. Although additional machines and equipment have been added to the yards over the years they retain much of their early design and equipment. In those days all vessel propulsion and auxillary equipment was by steam reciprocating engines and associated boilers. The engines,

pumps, etc. were not the precision machines of today. For the most part today they are diesel engines, electric generators and motors. In fact, there is not one steam propelled vessel in the BIWTC fleet today. However, the yards have not been equiped properly to handle the precision close tolerance repair and maintenance of diesel engines, electric motors, centrifugal pumps, hydraulic fluid systems and electric circuits. As a result many repairs can not be made to the original tolerance and design of the machinery. This inability, due to inadequate shop facilities, to meet close design specifications leads to large reductions in engine power out-put contributes to high fuel rate of consumption, and the high rate of repeated vessel break down.

b) Material handling

The repair facilities are not equipped to handle large vessel components. For example, there are no yard cranes. There is no proper dock for vessels under repair which are docked side by side with access from land to ship and ship to ship by make-shift wooden gang planks (a serious safety factor when handling equipment and parts). Night lighting, fixed welding machines, cranes, etc., are non existent.

c) Floating dry dock

A TFYP proposal calls for a new floating dry dock. The present dock was built in 1945. It was damaged during the fighting for Independence and subsequently repaired. Inspection of this dry dock indicates it is structurally sound and should provide service for another 20 years. However, the original pumping system and associated equipment are worn out and should be renewed. In addition, it is recommended that the design be reviewed for the purpose of adding handling cranes to the dock. If the present structure is adequate or can be strengthened, 2 cranes of approximately 2 ton lift capacity each are recommended. Generators should be added and a night lighting system installed. Rehabilitation of present facilities should take precedence over additional facilities.

d) Consolidation of ship repair facilities

The present organizational structure of four separate repair facilities represents a duplication of many of each yard's facilities and trained personnel. It would appear that after consolidation and modernization of the public sector facilities, redundent yards should be offered for sale to the private sector.

(3) BIWTA vessel and navigational aids fabrication and repair yard, Barisal

This repair and construction yard has shown a continuing expansion with increased production of vessel repairs and of new construction. This production could be further increased with the introduction

of new equipment and its further expansion. Typical equipment requirements include take ovens for electric coils and up-to-date electric measuring and testing equipment. Vessel repair and would be improved with the addition of steel plate bending and rolling equipment, steel shears for cold plate cutting, burning torches and additional welding machines. Materials handling would be vastly improved by the use of over-head mobile cranes and fork trucks. The addition of a wet basin for floating vessels under repair should also be considered. Production in the BIWTA Marine Workshop has steadily increased since 1979-80 as is illustrated by the large increase in tonnes of steel consumed shown in Table 10.6.3.

Table 10.6.3 BIWTA Marine Workshop Output

Year	Number of vessels repaired	Number of dredgers repaired	Number of pontoons repaired or constructed	Steel consumed tonnes
1979-80	52	3	10 rep	82
1980-81	28	1	5 const. 2 rep.	83
1981-82	17	2	14 const. 10 rep.	249
1982-83	10	4	6 const. 12 rep.	153
1983-84	15	1	11 const.	612

In addition to vessel repairs the yard constructs and repairs navigational equipment i.e., buoys and beacons, winches, capstans and anchors.

(4) BIWTC Ship voyage repair yard, Chittagong

This small voyage repair facility contains the basic elements and facilities for voyage running repairs and should prove adequate for near future requirements. At the time of inspection (March 1985) there were 8 vessels in the yard under engine or hull repair. Six of these vessel were tied up awaiting importor spare parts or the fabrication of spares in the work shops. One vessel the M.V. Abdul Matin, a passenger vessel, was being repaired with a used and worn out cylinder liner as a new spare was not available. This emergency repair was being made in order to have the vessel meet its scheduled sailing. The vessel will be operating at reduced power. It can be expected that the vessel will, in a brief period, return to the yard for a similar emergency repair.

(5) Chittagong dry dock limited

This is the largest ship repair facility in Bangladesh. Inspection of the yards facility indicates it could, with certain additions and equipment, become a world class repair facility.

A noted problem is in the lack of readily available stores of steel plate, pipe, tubes and fitting in the wide range of types and quality required for modern ships. It is understood the UNDP has a programme, awaiting approval, for 12 foreign experts to upgrade each separate department of this yard.

Review of BIWTC Drydock Repairs

A review of one years repairs performed on the floating drydock is an indication of repetitive repairs to the same vessels (July 1983 June 1984).

This is shown in Table 10.6.4. Out of 54 dockings in one year, 14 vessels accounted for 33 dockings or 260 days of drydock availability. This is an indication of improper initial repairs being performed, that then require additional dockings. The reasons for this are judged to be caused by lack of proper equipment, or spare parts and inadequate yard facilities to effect repairs.

Table 10.6.4 Vessels Drydocked More Than Once (1983-1984)

Item	Name of vessel	Times on Drydock	Total Number of days on Drydock
1	Kajal	2	11
2	Kutubdia	6	15
3	T 1057	2	33
4	Agragani	2	10
5	Rangabali	4	38
6	T 1059	3	45
7	Kakali	2	11
8	I - T 8-392	2	12
9	Aila	2	15
10	Seraiya	2	29
11	I T 8-396	2	19
12	Kutubdia	2	7
13	F Amanat Shah	2	15
	Totals	33	260

In most countries a vessel is drydocked once a year. At that time surveys are made, repairs or replacements of tail shafts, rudders etc. scraping and painting are performed to the exterior, while engines and other repairs are being carried out at the same time.

Average time on the Drydock for survey, scraping painting and tail shaft inspection does not exceed 5 to 6 days.

(6) Private ship building yard, Narayanganj

A brief visit was paid to a private shipyard engaged in the construction of two tankers 600 tons each. The yard consists of an open field, brick keel blocks, one or two burning torches, and welding machines, a number of ship fitters with hammers and chisels. There are no cranes or other handling machines or observed work shops. The surprising aspect is the vessels are taking shape and no doubt will be launched and operated in the future. This yard is a tribute to the ingenuity of the Bangladesh ship builder.

Unfortunately, the Consultants were not aware, until late in the study, of the activities of the Highspeed Group of Companies in ship building and repair in Bangladesh. This joint venture group is led by Mitsui Engineering and Shipbuilding Co. Ltd., of Japan with participation of the International Finance Corp., Highspeed Group of Companies and Bangladesh Shilpa Bank.

They have developed a complex in Dhaka for building river and coastal vessels upto 1,200 DWT. There facilities are being equiped with modern machinery. In addition to ship building, steel fabrications and machinery could be handled for industrial and civil engineering works.

(7) Conclusions

The present public and private ship repair facilities are suffering from a long term lack of investment to modernize. In their present condition of antiquated facilities, they are performing at a level higher then would normally be expected. However, due to the low state of physical facilities and the lack of adequate and proper spare parts, much of the work performed is of a temporary nature. This results in repetitive short term emergency repairs that, had the facilities and equipment been available should have been avoided. The frequency of vessels entering repair yards and the slow process of making the repairs, results in delays to other vessels awaiting repairs. This is another prime reason for the under-utilization of vessels. The private and public sector yards should be studied for the purpose of upgrading and possible consolidation. The above stated problems may contribute to the considerably high level of maritime casualities.

(8) Previous study of ship repair yards

In 1978 a study was done by the Norwegian Agency for International Development (NORAD) and carried out by Shipping Research Services. The aim of that study was the modernization of the BIWTC ship repair facilities. Recommendations of that study, for whatever reasons, have not been implemented. A cursory review of its findings and recommendations, suggests it would provide the necessary background for an updating study.

10.6.3 Spare parts

(1) Introduction

The difficulties in acquiring spare parts are caused by the lengthy requirements in meeting present regulations for using foreign exchange, the disapproval for import if a similar material is manufactured in Bangladesh and the customs clearance. In order to control imports the Government has adopted "Buy Bangladesh Policy". As a result requests for imports of equipment, materials, and spare parts are reviewed against available local manufactured goods. Should similar equipment be available through local manufacture the import request is denied. While this is a laudable policy, it should be tempered by consideration as to the highly technical aspects of quality and performance, for example foreign made machinery must be of high quality in order to complete in world markets. This leads to extensive testing of materials and rigid specifications. One engine or machine may have as many as 3 to 5 separate filter systems for items such as lubrication, cooling, fuel etc. Each separate filter may carry a different microm filter specification for protection of the various components of the engine or machine. These requirements can not always be met with a locally manufactured all purpose filter. In brief the supplier of filters must manufacture a wide range of types and sizes.

(2) Substitution

A Bangladesh filter supplied to the Narayanganj BIWTC shipyard as a substitute for an import request was compared to the used imported filter. The Bangladesh filter was largely hand made. Hand punched holes in the outer cover for liquid passage were not uniform and in some cases not punched through. The entire filter material was dissimilar to the original filter requested. Its use as a replacement would lead to further engine failures in a short period of time.

Similar problems of substitution contribute to the high recorded incidence of repeated engine wear and failure and frequent repair requirements. The substitution of local metals for replacing bearing, liners, or materials for fabrication is another cause of engine down time. The speed of the engine and size of the bearings along with the type of lubrication required vary from one engine to another; manufacturers take these matters into consideration and specify type and materials for repair or replacement. These requirements can not always be met with substitute local manufactured materials and products.

(3) Procedures

The process of completing the necessary paper work involved can take up to 6 months. The process is not only lengthy and bureaucratic but represents no small loss of income when a vessel is inactive due to unavailable spare parts. In brief, the process, as understood, involves the following procedures:

(a) Papers must be pr red requesting the needed part for the Ministry of Indus 's approval and possible local substitution.

(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 part.

(d) The papers are then returned to the Controller of Import and Export for issuance or denial of an Import Licence.

(4) Conclusions

It is recognized that a serious problem may exist in a shortage of foreign exchange and that this requires strict control. However, lengthy vessel downtime solely due to processing the required import licence is very costly.

(a) It is questionable that BIWTA is in a position to evaluate vessel operators needs. It would appear that their role in the process could be eliminated.

(b) The Government should review this process carefully with the aim of speeding the process for obtaining import licences. One small section of the Office of the Controller of Import and Export should be able to handle the process and grant or reject a licence within six days. The implications are not only in cost improper substitution leads nor only to additional damage and repair but also to wasted capital investment in ships due to reduced annual voyages. This factor should be the overiding consideration.

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

(d) A technical office be established within the Ministry of Industry, comprised of engineers, to evaluate requests for import spare parts and materials. Foreign specification must be equaly compared to local manufactures and in certain cases tested, before substitutions of local manufacture are directed to be made for vital spares and equipment. In time this office should publish lists of approved imports for spares and materials. Such a guideline list would expedite the process for acquiring spare parts.

While the objectives of the present policy are understandable, required adherence to this present policy may well be uneconomical in the long term.

10.6.4 Ferries

The road aspect of the ferries in Bangladesh were discussed in Chapter 9. Where ferry services by RHD and BIWTC were investigated.

(1) Ferry vessels

a) Fleet

Seventeen ferry vessels are listed by BIWTC of which thirteen operate on the Aricha to Nagarbari Daulatdia, and Kazirhat services, four serving between Sirajgonj and Bhuapur. These are listed in Table 10.6.5

b) Ferry capacity

It is noted, in Chapter 9, that the dry season traffic flow is some 12% higher than the average. However during the dry season, when river current is less, more than 3 round trips per day can be made by the larger ferries, so seasonal traffic variations reduces the pressure on ferry capacity.

In order to estimate present annual ferry vehicle capacity certain allowance must be made for vessel annual downtime for maintenance, repair, annual inspection, surveys and reduced round trips due to flood conditions during certain periods of the year. For estimating purposes it is assumed that each vessel annually operates the equivalent of 290 days at full capacity and that flood season utilization applies.

The demand for transport is such that trucks, buses, cars and passengers are kept waiting for available ferry space; trucks having the lowest priority wait up to three days. To alleviate this condition BIWTC has abandoned all schedules, operating the ferries as frequently as possible on most routes. This has provided on average one additional round trip per ferry per day, and traffic levels have risen accordingly.

In preparing Table 10.6.6 these factors have been taken into consideration, and an economic capacity of 47,000 vehicles a year per RoRo vessel has been derived based on the formula.

Annual capacity = No. vehicles x round trips x 2 x 290 days

c) Future requirements

The daily ferry boat vehicle capacity is 1,212 vpd. Service capacity to and from Aricha exceeds 800 vehicles per day (of which 85% are heavy vehicles) and to and from Sirajgonj and Bhuapur, 350 daily.

The 1984-85 estimated Aricha Ferry capacity requirements are 398 thousand pa (1,090 vpd) and is considered attainable by increased trips over the full year. For capacity planning a maximum growth rate of 8% applies; allowing this annual growth in vehicle carrying requirements the approximate number of vehicles requiring transport will rise to 585 thousand by 1989/90.

Table 10.6.5 Details of Ferries

Item	Name of ferry	Type	Year of building	Year of acceptance in service	Design capacity		No. of single trips that can be made normally in day	Design total carrying capacity per day	
					Vehicles	Pass		Vehicle	Pass
1	Amamat Shah	Ro-Ro	1980	1980-81	27	335	4	108	1,340
2	Shah Jalal	"	1980	1980-81	27	335	4	108	1,340
3	Kopoti	Large	1975	1975-76	13	100	4	52	400
4	Kishori	"	1974	1974-75	13	100	4	52	400
5	Karabi	"	1972	1972-73	13	100	4	52	400
6	Kamini	"	1974	1974-75	13	100	4	52	400
7	Kumari	"	1973	1972-73	13	100	4	52	400
8	Kasturi	"	1972	1972-73	13	100	4	52	400
9	Kakali	"	1974	1974-75	13	100	4	52	400
10	Ketoki	"	1973	-	13	100	4	52	400
11	Flat Tan	-	1935	-	14	30	3	42	00
12	Gumti	Small	1963	-	3	30	3	9	90
13	Gorai	"	1963	-	3	30	3	9	90
14	Comilla	"	1963	-	6	100	4	24	400
15	Dhaka	"	1963	-	6	100	4	24	400
16	Faridpur	"	1964	-	6	100	4	24	400
17	Jessore	"	1963	-	6	100	4	24	400
	Total daily design capacity for the fleet ...							788	8,470

Source: BIWTC

Table 10.6.6 Present Ferry Boat Capacity

Ferry vessels	Ferry capacity (Trucks) and type	Ferry round trips/day	Total daily capacity 2 ways	Annual capacity at 290 days (thousand)
2	27 Ro-Ro	3	324	94
8	13 Side loading	3	624	181
1	14 towed	3	84	24
2	3 Side loading	3	36	10
4	6 Side loading	3	144	42
17			1,212	351

Source: BIWTC
Consultants Calculations

In addition to requirements for increasing traffic, seven of the present side loading ferries are over twenty years old, whilst one is fifty-this year and requires a tug boat for propulsion. These small uneconomic ferries require replacement. These could be handed over to the RHD for use on low capacity crossings for an economic analysis of operating cost with delay cost included would show them not to be viable. On the present route. Their present capacity is only 76 thousand vehicles per year.

1989/90 required capacity	585,000
Less existing capacity	351,000
Add replacement capacity	76,000
Additional capacity required	310,000

Number of roll-on-roll off ferries with 27 vehicle capacity
310,000/47,000 = 4.68

This is a minimum requirement keeping in service the older side loading vessels. To make the whole fleet RoRo for a capacity of 585,000 vehicles, a total of 11 vessels need to be purchased, thus permitting the retirement of the 20 year old vessels, and their relegation to lesser ferry crossings.

Requirements beyond 1989/90 will need to be re-assessed in the light of traffic growth and the Jamuna bridge project.

d) Terminal facilities

The present facilities are in need of immediate basic improvements. The loading ramps are in poor condition and result in delays, whilst access roads are inadequate, and parking areas should be paved and toilets provided and maintained. It is not clear whether this is the responsibility of BIWTA or the RHD. The leasing of tea and coffee shops would add to the amenities- the leesee might be required to maintain the roilets.

There is a need to establish a system of orderly queueing, at present the arrangement leads to much disorderlyness.

10.7 Operational Issues

10.7.1 Privatization of BIWTC

(1) Background

The primary reason for nationalization of river transport under BIWTC in 1972 was to assure river transport under the then emergency condition. It is clear that this once vital function is increasingly being filled by the private sector. The Government should consider a gradual reduction of public sector in the coastal vessels tug, barge and passenger fleet. They are unprofitable, underutilized and in most cases in poor condition.

(2) Social services

The Government should recognize that public service is in the national interest and that direct subsidy to BIWTC fleet operations must be paid.

The BIWTC must provide services to those communities where the private sector cannot economically complete. Many of these communities lie on secondary waterways and on the off-shore chars. Similarly there may be cargoes requiring specialized equipment beyond the capacity of the private sector to fund.

However the Government cannot compete with the private sector for cargoes where the private sector has the commercial advantage. These operations should be phased out.

(3) Future activities

Currently the BIWTC activities are divided into three areas, commercial, shipyard and ferries.

a) Commercial

The fleet is generally old and in poor condition, and is in need of renewal and major refits. The commercial activities should be run down in relation to vessel condition on existing activities. The new subsidized and special activities require vessels designed for the specific services retained by BIWTC. These new vessels will be more economic to operate being new and technically improved.

b) Shipyards

The BIWTC ships must use BIWTC shipyards which are shunned by the private sector because of high costs. This is an uneconomic process. The BIWTC should be able to compete on an open market for shipyard repair services. Shipyard repair facilities are not commercially viable under the existing circumstances. This makes a suitable project for private venture capital to purchase the facilities and to modernize to provide economic and reliable services to shipping.

c) Ferries

The RHD ferry fleet is larger than the BIWTC, and operate in a vastly larger number of locations. In this sense the BIWTC ferry operations across rivers is an anacroism and the RHD should be the responsible authority. In this context there would be no interface problems between different authorities. An interdepartmental transfer would be a procedural move to integrate facilities and initiate the run-down of activities. Privatization is an attractive alternative.

(4) Asset disposal

a) Tugs and barges should be offered first to the railways, the port sector and other government agencies. There is a big need to increase the railway ferry link and this should be given first priority on equipment.

b) Commercial vessels. The should be disposed of as going concerns in as-is condition. The more modern and commercially viable vessels retained for the new traffic requirements.

c) Shipyards. These may be difficult to dispose by total sale, however there are opportunities to lease or to have a minority shareholding with private venture capital. Modernization is necessary and a minority share may assist the process of disposal under these conditions.

(5) Future requirements

The disposal of the assets and the identification of future traffic are not easily undertaken by staff under the pressure of daily shipping management activities. It is recommended that a suitable study be initiated to :

a) Advise on assets for disposal

b) Suitable procedures for disposal

c) Identify social service needs

d) Identify special traffic needs outside private sector capabilities

e) Propose new administrative procedures for the new services

f) Make recommendations on the appropriate management structure

10.7.2 Survey coordination

It is recommended that a study be made of those organizations responsible for the data collection, mapping of land and charting of waterways for the purpose of eliminating duplication and the present shortage of

trained personnel and equipment. This could lead to consolidation and a separate organization for this purpose.

10.7.3 Financial assistance to private vessel owners

The third serious complaint of the private operators is the difficulty in obtaining bank financial backing for vessels replacement. They would like to replace older wooden hull vessels with new steel hull types. The financial problems of foreign exchange associated with acquiring vessel replacement loans should be studied with the aim of developing a method by which international agencies could assist or guarantee loads to the private sector.

Should such financial assistance be made available it would be well for the agency to deal directly with the Owners Association for the purpose of standardizing the fleet. This would ease the present problem of having to acquire spare parts from many countries and companies. Further, through the Association, multi-replacement orders could be arranged with cost saving to the individual members of the Association.

10.7.4 Future projects

(1) Administration

a) Computers introduced into waterway administration and training in use and application.

b) Introduce fraud waste and abuse programme to protect government interests.

c) Marine surveys, inspections, safety regulation programmes undertaken with suitable training programmes started.

d) Statistical data procedural reform initiated to make it computer based and more reliable.

e) River pilotage standards improved through training programmes and in formation systems.

(2) Waterways

a) Massive dredging and waterway improvement programmes undertaken.

b) New techniques for river training and bank protection studied and works undertaken.

c) Studies undertaken for consolidation of dredging activities and benefits to be obtained.

(3) Infrastructure

a) Inland ports to be studied for upgrading of facilities and possible relocation.

b) Introduction of mechanical equipment on limited scale - conveyors and hand trucks.

c) Modernization of shipyards promoted and worker training programmes initiated.

d) Maintenance repair shops and equipment preventative maintenance programmes initiated.

(4) Shipping

a) Prototype standard designs prepared for major classes of vessels with maximum commonality of mechanical equipment.

b) Spare parts availability increased by allowing stocks to be aquired and necessary funding to be investigated.

CHAPTER 11 SEAPORTS

11.1 Seaports Institutional Organisation

11.1.1 Chittagong port authority

(1) Introduction

Chittagong is an old established seaport with historical origins. Its present prominence started in 1888 when the Port Commissioner's Act was introduced and the Commissioners started to function. Four jetties were built between 1899 and 1910 by the Assam and Bengal Railway, and the Port jointly administered by the Railway & the Port Commissioners.

Partition in 1947 made Chittagong the only deep water port in East Pakistan. During the fifties, nine jetties, including seven new and a number of pontoon berths and moorings were constructed.

In July 1960 the original administration required re-organisation and the Chittagong Port Trust was formed. This also failed to cope with the pace of development and in 1976 the Chittagong Port Authority was formed.

The Port of Chittagong is the major sea port of Bangladesh. It is situated on the right bank of the River Karnafuli about 5.6 km inland from the Bay of Bengal.

(2) Organisation

The Ordinance propagating the Port Authority to provide for the establishment of an Authority for the management maintenance and development of the Port.

Chittagong Port Authority is a service organisation under the Ministry of Communications, Ports, Shipping & IWT Division. The Board of the Authority in discharging its functions is guided on questions of policy by such direction as may be given to it, from time to time, by the Government.

The Board of the Authority consists of a Chairman and not more than three other Members appointed by the Government who are full time officers of the Authority and hold office on such terms and conditions as may be determined by the Government. The Chairman reports to the Secretary of the Ports, Shipping and IWT Division.

The Chairman is the Chief Executive of the Authority and other members perform such duties as are assigned to them under the Ordinance. The Authority has an Advisory Committee consisting of persons representing Port users including Importers and Exporters. Local Government Agencies and allied Public Agencies viz. Navy, Customs, Railways, inland Water Transport etc., for the purpose of advising the Authority.

The object is to give more authority to management for better administration and development of the Port.

11.1.2 Chalna port authority

(1) Introduction

Chalna is a new port and anchorage. The division of the country by the Jamuna river tended to divert sea going traffic on the East of the river to Chittagong and the West to Calcutta. Partition in 1947 closed the easy access route to Calcutta, and great strain placed on the port at Chittagong to handle all the deep water traffic.

An anchorage and port was needed to serve the West and in 1950 an anchorage and lighterage facility at Joymenginal on the Pussur River commenced. This moved a further 22.5 kms upstream to Chalna in 1951. This was later found to be unsuitable and was moved 16 kms downstream to Mongla. In 1964 a feasibility study by Frederick R. Harris recommended the development of Mongla into a port and anchorage. Construction Commenced in the Seventies, and still continues.

The port is located on the East side of the Pussur River at its confluence with the Mongla Nulla River approximately 80 kms upstream from the sea and 50 kms downstream from Khulna.

(2) Organisation

Under the provisions of Port Act 1908, the Chalna Anchorage was established in 1950. Till May 1977, Chalna Anchorage continued to function as a Directorate. In order to expendite the work of developing the anchorage into a port of international standard, a full fledged autonomous organisation namely Port of Chalna Authority was created by the Government under the administrative control of the Ministry of Communications by the Chalna Port Ordinance 1976.

The Port Authority consists of Chairman and the pannel of Members not exceeding three. The Chairman is the Chief Executive of the Authority. The Board formulates the policy of operation, administration and development of the Port. At the moment there are four divisions of the Authority to carry out all the functions of the Authority broadly shown hereunder:

1. Administration Division: Headed by the Chief Executive, responsible for all administrative matters.

2. Operation Division: Headed by the Member (Operation) and responsible for the operational function including marine and traffic matters, pilotage etc.

3. Engineering & Development Division: Headed by the Member (Eng. & Dev.) and responsible for all constructions, maintenance and development of the port.

4. Finance Division: Headed by the Member (Finance) and responsible for accounts and finance of the Authority.

11.2 Port of Chittagong

11.2.1 Port traffic

Chittagong port handles approximately 75 percent of the Bangladesh imports and 25 percent of the exports. Imports for 1984/85 are distributed approximately 15 percent by rail 54 percent by road and 31 percent by water transport.

During 1978/79 Chittagong Port handled 4.535 million tonnes of cargo and 846 vessels. Average turn round of vessels was 6.92 days. This traffic has grown to 6.07 million tonnes in 1983/84. Cargo handled in 1985/86 is expected to exceed to 7 million tonnes with over 1000 ships calling at the port. Table 11.2.1 shows cargo handled at the Port since 1979/80 and shows container traffic through the Port.

11.2.2 Port performance

(1) General

The total amount of cargo flowing through a port is influenced by many factors. The main influence on recent port design, productivity and hence capacity has been the trend in one form or another to unitize cargo. Manhandling and head loading of individual boxes, bags, and barrels as individual units is time consuming, which at least from the view point of ocean going ships, must be avoided.

There are a number of reasons for present low throughput. Port statistics for October, November and December 1984 and again in July, August, and September 1984 list the identical problem.

(a) "Since mechanical equipment for handling cargo could not be made available as per requisition, the percentage of equipment available was below target". Equipment availability was listed at 39% and 40 percent.

(b) "Bad weather, inadequate supply of transport equipment for direct delivery". The statistical record goes on to say that these factors were responsible for the high detention of vessels.

(2) Planning

There are many factors that will influence present and future port productivity as it relates to actual and design capacity. They are as follows:

Space availability

Road and Rail access

Handling Equipment its maintenance and related availability

Inland movements and its scheduling

Customs clearance

Table 11.2.1 Clearance of Cargo Imports from Chittagong Port by Mode and Main Commodity (1983/84)

(In Tons '000)

Sl. No.	Commodity	Quantity Despatched							
		By rail	Per cent	By Road	Per cent	By River	Per cent	Total	Per cent
1.	Foodgrains	357	26	529	39	483	35	1.369	34
2.	Cement	45	8	276	50	227	42	549	14
3.	Coal	8	15	33	66	10	19	50	01
4.	Fertilizer	55	20	138	66	16	8	200	05
5.	POLs	73	100	-	0	-	0	73	02
6.	Others	64	4	1258	73	407	23	1.728	44
	Total	601				1142		3.977	
	Per cent of Total		15		56		29		100
		July 1984 - Jan. 1985 - (6 months)							
1.	Food grain	254	21	443	37	493	42	1.169	42
2.	Cement	9	3	162	51	149	46	320	11
3.	Coal	10	32	4	13	17	55	31	01
4.	Fertilizer	63	37	105	60	5	3	173	06
5.	POLs	43	100	-		-		43	02
6.	Others	48	4	850	78	195	18	1.094	38
	Total	427		1564		459		2.850	
	Per cent of Total		15		54		31		100

Source: Chittagong Port Authority

Table 11.2.2 Cargo Handled at Chittagong Port

In Metric Tons (ooo)

Principal Commodies	1979 / 80	1980 / 81	1981 / 82	1982 / 83	1983 / 84	1984 / 85
IMPORTS						
1) Food Grains	2.076	1.037	998	1.254	1.572	2060
2) Sugar	64	25	42	5	5	351
3) Cement	316	251	331	550	614	735
4) Fertilizer	446	240	309	208	232	430
5) Coal	129	183	197	93	32	1
6) POLs (Bulk)	1755	1795	1578	1535	1392	1605
7) Others	1212	1484	1512	1317	1837	1646
TOTAL	5.999	5.015	5147	4.963	5.680	6828
EXPORTS						
1) Jute	17	13	25	18	12	6
2) Jute Products	156	173	189	194	181	150
3) Tea	31	37	34	32	31	25
4) Hide	6	14	13	9	2	3
5) Napha/Molasses Banker	82	255	151	100	60	18
6) Others	38	56		93	106	128
TOTAL	334	548	503	454	393	330
Total Imports & Exports	6.343	5.563	5450	5.417	6.074	7158

Source : Chattagong Port Authority

Table 11.2.3 Number of Containers & Container Handling Vessels Chittagong Port

1979 - 1984 IMPORT

Year:	No. of Vessels:	No. of Loaded TEU:	No. of Empty TEU:	Cargo in Metric Tons (000):	Avg. Ton per loaded TEU:	Avg. No. Containers per vessel:	Total No. TEUs handled:
1979	23	550	-	9		24	550
1980	53	1032	134	11		22	1166
1981	81	1182	261	11		18	1143
1982	152	2911	1870	35		31	4780
1983	208	403	2052	59	14.6	29	6085
1984	302	7394	1130	106	14.3	28	8530
EXPORTS							
1979	23	410	-	13	3.17	18	410
1980	53	717	210	6	8.3	17.5	927
1981	81	931	117	7	7.5	13	1048
1982	152	3746	121	40	10.6	25	3867
1983	209	4918	1214	71	14.4	29	6132
1984	302	6651	3198	89	13.4	33	9849
1984 Total Import & Export		14045	4334	195			16379 TEU

Source : Chittagong Port Authority
Note : T.E.U. Twenty Foot Equivalent Unit

For planning purposes it is estimated that the general cargo handled in the port is averaging approximately 50 cubic feet to the tonne. Calculation of total storage space indicates there is 158 thousand square metres of space available in the transit sheds and godowns.

Under the present handling methods of hand trucks and hand stacking, the height of each cargo stack is from 1.2 to 2.4 metres. On average the stack height is 1.8 metres.

Assuming that pallets and forklift trucks or stacking conveyors were employed in the storage building, pallets or loose bags could be stacked to a total height of about 4.5 metres. Allowing for short stacks and broken lots, the average height would be about 3.6 metres. It is readily seen that the present handling methods are reducing storage capacity by 50 percent.

Over a 3 month period of July, Aug., Sept., 1984 the dwell time of general cargo within the port average 19 days. (An improvement over the same period in 1983 when dwell time averaged 23 days). This indicated a turn over of space 19 times a year. A target of 15 days for clearing cargo would provide a turn over of space 24 times per year. Excluding coal and POL the 1984 tonnage handled at the port was 3.48 million at 19 days dwell time would acquire 183 thousand tonne of capacity whilst a turn over of 15 days would only require a storage capacity requirement of 145 thousand tonnes. It is readily seen that closed storage space and transit shed space, if properly used, would be sufficient at its present capacity, (this calculation does not include open storage space).

(3) Habour

The tonnes of cargo handled per stevedore gang hour falls considerably below prevailing rates in world ports.

The port's statistical records provide actual records of tonnes per gang hour and ship average discharge of tonne per day. Taking the records, for July, August and September, 1984 the tonnes per gang hour were averaged in Table 11.2.4.

Table 11.2.4 Comparison of Handling Rates

Type of Cargo	Present Average Tonnes per gang / hr.	Average tonne / hr. world ports
General Cargo	4.9	10 + 12
Bagged Cargo	10.7	16 - 20
Fertilizer	8.24	16 - 20
Food Grains	16.96	20 - 22
*Containers (Ships gear)	1	4
Iron & Steel	8.5 est.	16

Source : Chattagong Port Authority

Present port throughput is in most cases less than half the expected norm. As a result, vessels are kept waiting for berth space on an average of 6.3 days.

The port cargo handling activities are carried out 24 hours a day. Two shifts are employed on a normal and overtime basis.

WORKING TIME TABLE OF CHITTAGONG PORT
DOCK LABOUR

1.	Normal Day Shift Morning	:	From 0730 hours to 1200 hrs. 4 1/2 hours
2.	Normal Day Shift Afternoon	:	From 1400 hrs. to 1700 hrs. 3 hours
3.	Lunch Break	:	From 1200 hrs. to 1400 hrs. 2 hours
4.	Evening Over-time	:	From 1700 hrs. to 2000 hrs. 3 hours
5.	Normal Night Shift	:	From 2000 hrs. to 0400 hrs. 8 hours
6.	Morning Over-time	:	From 0400 hrs. to 0730 hrs. 3 1/2 hours

Day Shift 10 1/2 hours
Night Shift 11 1/2 hours

Due to labour customs and practices and lack of labour discipline actual hours worked per shift appears to be 6. Reduced working hours are due to late starts, early quitting time and lengthy rest and lunch periods.

The large use of manual labour and multitude of stevedore companies employed (reported to number over 40) present an organizational problem where control over the individual labour is difficult.

This is but one aspect of low port cargo handling rates on an hourly basis.

(4) Utilization

The impact of unitized loading is already being felt by the port. Containers, as one form of unit load, is an example.

Although the principle of consolidating small packages of cargo into larger units is not new, the application of unitization to marine transportation has lagged in ports and trade routes employing inexpensive labour. However, with the steady increase in operating costs of ships, it has become increasingly evident that savings in port time resulting from faster handling of unitized cargo can more than offset the cubic vessel "loss" as well as the costs of containers, pallets or similar means of unitization.

Although the maximum benefits of unitization of cargo result from door-to-door shipment, substantial savings can result from pier-to-pier movements. Therefore, even in areas with abundant labour supply port operations have been increasingly mechanized to allow shorter berthing time for ships.

Pallets are an intermediate step in the unitization of cargoes that lead to the use of containers. It is observed that the Port of Chittagong

is experiencing problems associated with palletization. The port needs pallets for those shipments arriving as break bulk general cargo. Also handling equipment for pallets is in short supply.

Although a considerable amount of cargo is arriving at the Port unitized there is a large potential for more unitization on port supplied pallets. Cargo handling without palletizing is causing considerable manhandling, resulting in lost time, breakage and shortage of storage capacity due to low stacking height.

(5) Equipment

Based on the port's statistical records the cargo handling system in the port should be studied to determine the optimum requirements for cargo handling equipment, its maintenance and repair. From a design viewpoint, the port is beginning to suffer operational problems caused by the recent rapid changes in ship cargo handling requirements. These new requirements for open space container handling and storage with adequate room for maneuvering large trucks and handling equipment when resolved by the multi-purpose berth will rapidly make obsolete the need for many present permanent godowns and transit shed buildings. The port is faced during this transitional period with the difficulty of having to handle combination vessels with a mix of traditional break bulk general cargo and containers.

Port cargo handling equipment suffers deficiencies in maintenance and repair. These deficiencies are largely caused by inadequate repair facilities and a shortage of competent mechanics and other craftsmen. This problem is further aggravated by the lack of a systematic and procedural method for disposal and replacement of worn-out, unproductive machines. The procurement of spare parts for the equipment in many cases has been made difficult because of its foreign origin and, in some cases, because the model has been discontinued. Continued maintenance and repair to these uneconomic machines places an undue strain on the limited repair facilities.

Present cargo handling is further limited by inadequate supply of other mechanical equipment. The port, however, does provide hand trucks to stevedoers (reported to be at no cost to the stevedoers). The hand trucks are made locally at a cost of approximately $ 70 each. Although crude in structure, they perform at a higher rate of productivity than head loads as is customary in other Bangladesh ports. This is the only port where hand trucks are used.

The spare parts situation is aggravated by the acquisition of new equipment by grant, loan, barter or aid to replace present equipment that would be serviceable if it had been properly maintained and repaired and spare parts were readily available. For example there are 12 fork trucks in the Chalna Port, acquired by barter from Bulgaria. They are approximately 2 years old, and show no sign of wear except the drive tyres are worn out (an usual occurrence indicating improper usage.) The tyres are not standard and must be acquired from Bulgaria; to date the port has not been able to acquire replacements. Now this expensive equipment is useless.

(6) Containers

It can be expected that the rise in container movements will, over a period of time, tend to make some of the existing facilities obsolete or redundant. The ability of the port, through the early development of container berths to increase capacity, raises the important question of capital investment in planned port facilities improvements i.e. Chittagong berths 14-15, 16-17 that may not be required. This question and related present trends in cargo handling and ship design should be carefully and thoroughly reviewed before reconstruction of these berths is fully committed.

Present container yard storage space is limited and causing some problems in providing adequate area for manoeuvring the large fork trucks. It is also causing container stacking to be carried out in continuous lines with the units placed in rows with a front to back position. As a result, a container in the middle of the row can not be readily removed without employing an extra mobile crane. More efficient positioning would have the container stored side wise thus providing the fork truck with entrance to the container side fork truck lifting pockets. Containers should, when being loaded or unloaded, be moved to a separate area away from the access lanes and storage areas.

Progress is being made, at this time, in providing additional paved open area.

It is noted that some 600 containers are reported to have been in storage over 6 months. This matter should be investigated and the reasons determined with action taken to have these units removed by the owners from the port. They are now taking up much needed space.

Review of the container handling and storage system indicates that the present system of storage handling loading/unloading and locator file card system are adequate for the present volumes. The locator card file system is similar to that used in small Western Europe ports. It is maintained in good order and should prove adequate at present volumes. As container volumes increase the complexities of handling sorting and updating the present system will prove inoperable. Training for future container control computer usage should begin now.

(7) Customs

Customs clearance procedures are overly long with deficiencies in manning and the need to review present procedures for the purpose of more efficient and quicker customs clearance.

(8) Costs

The loss of equipment availability due to lack of spare parts or units carried as inventory that should be scrapped represents a large loss on return of equipment investment and contributes to the low rate of cargo handling productivity. The latter is reflected in the present conference liner services applying a 7.2% surcharge, down from 10%, on freight rates for a vessels serving Chittagong and Chalna Port. In addition to the surcharge there is the vessel delay cost of demurrage, a payment due to the vessel on the expiring of normal loading/unloading free time. A most modest estimate of this cost is as follows :

Demurrage charge

Average demurrage delay per vessel	:	7 days
Average daily number of ships on demurrage	:	15
Average demurrage per day	:	$5,000
Number of days per year	:	365
Annual charge (Paid in foreign currency)	:	$19 million

This is a loss recovered by the shipowner and is passed on by the port to the consignee and then to the cost to the consumers.

(9) Lighterage

Berths for vessels drawing more than 7.92m (draft) require excessive lighterage and double handling.

In addition to the vessels of Bangladesh Shipping Corporation engaged in lighterage, the local lighterage fleet consists of tankers each of approximately 1,000 tons capacity and coasters each of the capacity of 300 to 1,000 tons owned by the Public and Private Sectors are used. Besides these, country craft each of 20 to 80 tons capacity in the private sector and steel barges each of 300 to 500 tons capacity in the Public and Private Sectors are available to carry out lighterage work. The Cargo from such Lighters intended to be discharged at the Chittagong Port is handled at a vacant Jetty or in between the two vessels alongside the jetties. Cargo discharged into lighters at Outer Anchorage may also be directly transported to Inland river Ports.

Lightering of cargos is an intermediate step between the ship and the jetty. It lacks much of the adaptability of alongside berthing for the introduction of unitized mechanized handling. As the ports expansion plans progress, container cargos increase, general cargo break bulk handling productivity increases and channel and berth depths are maintained, lighterage will be reduced and in time eliminated except for foodgrains.

11.2.3 Port infrastructure

(1) Berths

The major elements of the port consists of 17 vessel berthing jetties, 9 transit sheds, 15 godowns open storage areas, rail serving all jetties, and open storage. At present 2 multipurpose berths primarily to be used for containers are under construction, with the completion expected in 1986. A berth improvement project is in progress and is viewed by the port as a requirement for additional throughput capacity to be utilized until the new multi-purpose berth construction is completed. Work on Berth 15 and 16 has already commenced. It is the opinion of the Consultants that work already in hand should be completed in order to make

the berths operatable. However, further additional work should be halted. There will be no need for additional berths, sheds or godowns if present facilities were utilized at their design potential and the multi-purpose berths are completed.

Berth number 14 utilizing a pontoon jetty for handling bagged cement should be lengthened to provide space for 5 ship hatches to operate at the same time. At present berth length, only 4 hatches can operate, requiring extended vessel delays for the unloading of 1 hatch. In addition this cement handling berth would be more productive if equipped with a conveyor from pontoon to the roadway.

(2) Cargo handling equipment

a) Mobile equipment

The port provides an impressive list of cargo handling equipment being available. However, much of this equipment is inoperatable. For example a recent port publication listed 40 fork trucks. On inspection of the maintenance repair shop facilities over 50 fork trucks were in a state of disrepair or should be scrapped. Only 12 fork trucks were available to serve 17 vesslls. Allowing a minimum of 4 fork trucks to each berth for adequate service the number of operational units available on a daily basis should be at least 68.

Due to the inadequate supply of handling equipment there is a high demand for that which is available. Because the private sector has a high degree of flexibility in their operations and can pay the price for priority, they have first opportunity leaving the Government owned Bangladesh Shipping Corporation at a disadvantage with consequent further delays to their vessels.

b) Cranes

There are 39 portal luffing electric cranes of 3 tonne capacity an electric gantry crane of 25 tonne capacity, and a 112 tonne floating crane.

In addition there are 27 road profile cranes of 6 tonne to 30 tonne capacity.

(3) Transit sheds and godowns

There are 16 transit sheds varying from 3840 sq·metres to 10,208 sq·metres with a storage capacity of 50,085 tonnes.

The 14 godowns vary from the small godown C at 779 sq·metres to the large godown G at 9410 sq·metres. The storage capacity is 22,775 tonnes. The theoretical capacity works out at 2.32 sq·metres to the tonne and with cargo at 50 cu·ft to the tonne this represents a stack 2.0 metres high. As described previously the capacity can be doubled by mechanical handling.

In addition there are passenger baggage sheds, tea export sheds, a hazardous godown and an automobile shed.

(4) Moorings and anchorages

a) River moorings

There are 9 river moorings, two with 7.62 in draft for dry cargo over the side work. Three moorings with 9.14 in draft have pontoon and shore connection, a similar berth is for crude oil. A 6.4 in draft mooring is for repairs and berth lay-off. No. 10 mooring is specially for dry bulk cargo and Lash ships.

b) Anchorages

There are three anchorages. 'A' is for vessels over 9.14M in draft. 'B' is for vessels entering the port within 24 hours and 'C' is for lightering and other vessels not scheduled to enter the Port within 24 hours.

(5) Lighter jetties

There are 4 lighter jetties of pontoon and shore connections for lighters and coasters and 4 jetties in concrete. The pontoons will accept vessels up to 76 m in length. The concrete jetties, except jetty "L". No. 1 have small faces (40 - 42 m) for vessels up to 76 m.

(6) Dredging

There are three Bars, one at the mouth of the Karnafuli river called the Outer Bar and the second the Inner Bar at 2.26 kms from the Outer Bar and the third is the Gupta Bar at 8.57 kms from the Outer Bar. The datum depth of the Outer Bar is maintained at 8.23 metre from the Indian Spring Low Water Level. The depth on the inner Bar and Gupta Bar are 6.71 m and 6.24 m respectively from the Indian Spring Low Water Level.

The port now has two dredging vessels that can not cope with the present problem of berth space siltation and outer bar channel blockage. The TFYP calls for acquiring a new suction hopper dredge, described as being more suitable for the port's purpose.

At this time there are few trained dredging personnel at the port. As a result the present equipment can not be operated properly or on a full time basis. Any new dredge equipment must involve lengthy training in its operation. It should operate on 2 shifts during the seasonal dredging period. In addition dredging personnel will not stay if pay scales and other benefits are set to low.

(7) Water craft

In addition to the land facilities, the port owns 43 vessels and other water craft for supplying fresh water to vessels at anchor, mooring launches, pilot boats, its own channel bouy tenders, tug boats, and dredges.

11.3 Chalna Port

11.3.1 Port traffic

During 1978/79 Chalna Port handled 1,703 million tonnes of cargo in 477 vessels with an average turnround of 6.92 days. This traffic increased slightly to 1.776 million tonnes in 1983/84.

Table 11.3.1 shows the import cargo handled at Chalna and Table 11.3.2 the export cargo. Table 11.3.3 shows the traffic summary with Table 11.3.4 giving the size of ships.

The ships size a disturbing trend. From 1978/79 to 1980/81 60% of the ships working Chalna Port were in the 5000 10000 gross tonnage. In 1982/83 and 1983/84 75% of the ships were in the 3000 to 8000 gross tonnage range. Though in 1983 84 the number of ships exceeding 8000 gross tonnes was marginally larger than 1982/83.

As an extension of the Chalna Port the Authority also operates the Roosevelt Jetty in Khulna City. Approximately 50% of the goods transferred from ships at Chalna Port and anchorage are moved by barge to Khulna for inland transport by rail and road. In 1982/83 this onward traffic approximated to rail 18% and road 31%. The remaining 51% was distributed to other inland areas by water transport.

11.3.2 Port performance

(1) General

The present port consists of 5 berths for sea-going vessels, a wide cargo landing apron with two godowns completed, two warehouses nearing completion and a number of wharf rail mounted cargo handling cranes. Cargo handling equipment, other than cranes is limited and in disrepair. As a result cargo is primarily handled by head load with low productivity. In addition transfer of goods between seagoing vessels, river barges and coastal vessels also takes place at 15 anchorages adjacent to the port.

Land access to the port is by a 40 km road from the port to a ferry boat station on the Pussur. The ferry landing on the west side of the road is in the midst of congested Khulna road traffic and while suitable for limited freight movements and workers access it is not seen as a long term solution to the full development of the port.

(2) Port access

The Harris report contained four schemes for the rail/road connection to the Port, scheme 4 being recommended. It shows a direct connection from the port of Chalna to the Khulna rail and road network. The proposed crossing is from a point on the West bank just south of Khulna to Rupsa on the East bank. A joint highway and railroad bridge was proposed, which was considered to be less expensive than two separate bridges.

Table 11.3.1 Import Cargo Handled at Chalna

(Figure in tonnes)

Sl. No.	Commodity	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84
1.	Foodgrain	545464	225160	584082	370992	847822	404468	409190	693419	605568
2.	Coal.	77920	-	28011	45606	18479	-	24126	20178	-
3.	Cement.	110442	115013	230657	392645	299719	264228	262104	226341	276537
4.	Fertilizer.	116740	15930	161817	222574	237116	164362	157353	120735	131700
5.	Wood Pulp	-	-	5276	5539	3477	4104	1048	1567	1910
6.	Machinery.	1871	407	1611	3554	3185	2489	1433	3141	1217
7.	Salt.	-	6610	47461	1702	-	-	15842	-	10011
8.	R/Seed.	6080	-	9607	-	-	-	-	-	-
9.	Cotton	1928	-	-	-	-	-	-	-	-
10.	Steel Pipes.	448	1384	1130	2507	-	970	970	-	905
11.	S/Oil.	4897	4450	4262		3874	319	-	-	-
12.	R.Seed Oil.	-	2776	7089	1509	-	748	2820	-	-
13.	C.I. Sheet.	5165	2045	15315	16354	4409	3821	6127	-	-
14.	Pig Iron.	-	-	-	-	710	-	-	-	4927
15.	Tobacco.	381	-	-	-	-	-	-	-	1100
16.	Bitumen.	7415	12415	10509	10509	22371	12666	-	-	-
17.	Milk Powder	2141	1319	242	242	285	451	-	-	-
18.	Palm Oil.	-	-	-	-	-	-	4739	-	-
19.	G. Cargo.	19197	16504	15329	15329	28553	26970	34326	33154	45571
	Total:-	900089	404013	1122398	1026291	1470000	885596	920078	1098535	1086726

Source: P.C.A.

Table 11.3.2 Export Cargo Handled at Chalna

(Figure in tonnes)

Sl No.	Commodity	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84
1.	Jute.	338905	384356	271650	329226	344720	338569	323338	389340	318364
2.	Jute Goo	275604	279137	326897	316197	300192	349608	369907	345215	336015
3.	Leather.	331	35	24	18	-	-	-	-	-
4.	Cow Bone.	1022	1755	1243	313	1892	-	575	303	103
5.	Newsprint.	4834	6590	21269	21348	13009	7765	2899	3982	80
6.	Shrimp.	1069	1537	1176	1369	1576	2121	2659	3951	4065
7.	Bamboo.	4234	2756	2916	2470	2213	5743	5642	5704	6136
8.	H/Hair.	-	-	-	-	18	35	182	27	35
9.	F/Leg.	94	221	183	247	119	219	357	322	494
10.	Sugar.	-	-	26108	-	-	-	-	-	-
11.	Fish.	-	-	-	-	-	115	21	-	51
12.	Fertilizer.	-	-	-	-	-	35497	-	50697	21622
13.	G. Cargo.	763	4549	2839	5621	11927	1768	2413	2986	2451
	Total:	626816	680936	654303	676809	675666	741440	707993	802527	689416

Source: PCA

Table 11.3.3 Import and Export Traffic Handled
(Figure in Tonnes)

Year	Import	Export	Total
1975/76	900,089	626,816	1,526,905
1976/77	404,013	680,936	1,084,949
1977/78	1,122,398	654,303	1,776,701
1978/79	1,026,291	676,809	1,703,100
1979/80	1,470,000	675,666	2,145,666
1980/81	885,596	741,440	1,627,036
1981/82	920,078	707,993	1,628,071
1982/83	1,098,535	802,527	1,901,062
1983/84	1,086,726	689,4	1,776,192

Source: PCA

Table 11.2.5 Operating Ratio
(Figure in Taka)

Year	Revenue Income	Revenue Expenditure	Operating Ratio
1975/76	21,629,995.55	14,558,000.00	1.49
1976/77	17,678,447.38	14,028,955.00	1.24
1977/78	30,004,744.17	24,964,317.29	1.20
1978/79	37,694,736.77	28,951,137.45	1.30
1979/80	47,939,549.27	32,046,999.85	1.49
1980/81	59,712,571.15	43,588,690.22	1.37
1981/82	79,928,571.15	50,451,333.08	1.58
1982/83	100,251,881.65	63,093,141.60	1.59

Table 11.3.4 Size and Number of Dry Cargo Vessels Loading and Discharging at Chalna Port

Gross tonnage	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84
0-999	10	17	3	4	13	10
1000-1999	14	19	13	8	23	15
2000-2999	17	17	19	26	40	33
3000-3999	27	56	36	29	100	95
4000-4999	32	41	41	28	60	53
5000-5999	43	56	30	31	92	90
6000-6999	72	89	63	77	58	45
7000-7999	45	36	37	51	28	34
8000-8999	57	44	41	45	7	10
9000-9999	79	81	84	86	7	9
10000-10999	29	29	26	34	2	4
11000-11999	15	11	1	7	2	11
12000-12999	8	14	22	27	2	6
13000-Over	27	26	14	17	19	12
Total:	475	536	430	470	453	427

Source: PCA

In April 1985 it was announced that a new study, would be undertaken on the feasibility of constructing a rail and road bridge from Khulna to Chalna. Such a direct connection would eliminate the present double handling and facilitate the potential growth of container movement inland by rail or road.

(3) Cargo handling

The Chalna Port berthing facilities are, at present, isolated from a rail or road interface. As a result the port only serves as a double handling freight transfer point from ship to inland water vessel. In practice the berth operations represent a double handling of goods that must be handled from ship to port to barge. Fifty percent of the import freight is again handled in Khulna and transferred to rail or truck.

Extracts from the Port records shows low productivity which is shown in Table 11.3.6.

Table 11.3.6 Tons Handled Per Hatch

ITEM	Name of the ship	Nature of cargo	Discharges during last 24 hours	Number of hooks		Tons per hour
				Day	Night	
1	WORLD AGRONAUT	Wheat (Bulk)	201.331	1	1	5.0
2	ARMONIA	Wheat (Bulk)	1079.125	2	3	11.0
3	CANOPY	Wheat (Bulk)	612.00	-	2	15.3
4	DINOS	Wheat (Bulk)	1120.983	1	4	11.2
5	MINIXING	Rice (Bulk)	202.191	-	2	5.0
6	BENGAL STAR	Rice (Bulk)	383.863	1	1	9.6
7	SUN STAR	T.S.P.(Bulk) (Fertilizer)	1035.55	4	3	7.4
8	SOLONECHONGRSK	"	605.00	2	2	7.6
9	DORY FOROS	"	1507.20	5	5	7.5
10	MOGESFLAM BOYAN	Cement (Bulk)	1016.25	4	3	7.3
11	MORAN BONG	Cement (Bulk)	668.95	2	3	6.7
12	LASH BARGE	General Cargo	31.00 (7.5 hours)	1	-	4.1

Source: PCA

Low productivity is the result of manual cargo handling by head loads and bagging cargo in the ships hold. As a result the tons per gang per hatch, with the exception of the ship CANOPY, is about half of that which would normally be expected.

Damage to the Roosevelt Jetty in Khulna has placed a heavy burden on BIWTA port transfer points. Largely due to the loss of this facility there is a backup of river vessels at the BIWTA available vessel berths. This is causing considerable delay in vessel unloading, giving rise to a shortage of available barges for servicing the sea going vessels at Chalna, with resulting sea going vessels unloading being delayed.

(4) Equipment

Although the Port of Chalna provides a list of available cargo handling equipment, for the most part they are either old and or fair-new but inoperable. Cargo handling of bagged goods is being done by head load.

The use of fork trucks and pallets for the movement from jetty to transport or godown should double the present handling rate. However, the use, or mis-use and lack of spare parts and maintenance based on present cargo handling equipment, is such that additional mechanical equipment and its cost may be difficult to justify.

It is therefore recommended that the Port supply hand trucks to the stevedore as is the practice in Chittagong Port.

(5) Containers

At present, empty containers are off-loaded at the Chalna Port for the stuffing of export jute. 40 foot containers are used for rolls of carpet backing and cannot be moved inland. The 20 foot units are filled with jute bales and jute products. As there is no rail or road access to Chalna most cargos other than jute arrive at the port by barge after transfer from the rail and road connection at Khulna. Jute and jute goods arrive at the port directly by water transport and account for 93 percent of the total export cargo of 64 thousand tons in 1983/84.

The question of using inland rail or road traffic for containers of jute with off loading and transfer of the containers in Khulna or other inland ports appears to be remote. At present jute arriving in Chalna is almost exclusively handled by inland water vessels. Jute factories are located on the inland waters and use their own private handling facilities direct to water transport, seldom being served by rail sidings. The construction of private facilities at jute factories to handle containers does not appear to be economically justified.

11.3.3 Port infrastructure

(1) Berths

a. Chalna

Berths 5 to 9 have been completed. Each is 182.9 metres long with 8.53 m of water alongside. These berths have completion of decking for two additional ocean going vessels above existing piles would also assist, and should take preference to construction of more sheds at this time.

The Roosevelt Jetty's modern structure was almost totally damaged by river bank erosion and is now largely restricted in its use. Prior to the collapse of this facility it provided approximately 490 metres of jetty length with an annual throughput capacity of 550,000 tonne and closed storage for 12,000 tonnes.

(2) Cargo handling equipment

a) Mobile equipment

A variety of small mobile equipment is held and is described below.

No.	Type and comments
9	Small Trailers of approximately 1.8 meters long and .9 meters wide with a 2 tons capacity.
3	Tractors for pulling trailers. This equipment was purchased from Bulgaria in 1978 and has not been used. Recorded tractor time in use since 1978-150 hours, 126 hours, 92 hours.
2	Electric fork trucks purchased in 1979 from Bulgaria arrived in port with broken batteries and have never been repaired or used.
12	Fork trucks purchased from Bulgaria. Nine are not in use due to worn rear tyres. Tyres are not standard size and replacements ordered previously are not available.
77	Dock cranes received second hand from Great Britain not operational awaiting spare parts.

b) Maintenance

Two small inadequate and poorly equipped repair shops are located, one in Khulna and one in Chalna. Equipment for a new repair facility has been in storage since 1982 awaiting construction of a maintenance repair facility at Chalna Port.

(3) Transit sheds and godowns

Two transit sheds have been completed. Each has an area of 4905 sq metres and a capacity of 7500 tonnes.

One godown is nearly complete which has twice the capacity of a transit shed.

There are two 3716 sq metre godowns at Khulna each with a 6000 tonne capacity.

(4) Moorings and Anchorages

a) Moorings

There are 12 swinging mooring buoys in the river with varying water depths.

b) Anchorages

There are 19 anchorages within 6.5 kms of the Port for over-the side working of dry cargo.

Water depths vary and are between 13.7 m and 5.79 m.

(5) Lighter jetties

Observation of the present wharf operations at the port indicates a shortage of wharf area for handling barges. Barges are occupying scarce ship berthing space. The sourth area of the present wharf is unusable for barge berthing due to in-place concrete piles. However, the north end of the wharf is adjacent to unimproved river bank. If a barge channel is dredged for 60 metres along the side the wharf adjacent to berth 9 additional barges could be handled in this area. This could possibly be accomplished when the present berth areas are dredged.

(6) Dredging

A number of studies of siltation have been made over the past 20 years. The most recent was completed in July 1984 by D.R.P. Farleigh, entitled "Port of Chalna Authority-Pussur River Study, Phase II Final Report". This study concludes that there is a solution to the siltation problem in the port area by dredging of the port reach and it leaves in question the problem of the outer bar. There are only two satisfactory schemes which can be implemented to obtain and maintain the required improvement in depths alongside the new berths at Chalna, and the choice must be made on the basis of the cost of either recurring annual maintenance dredging of some 0.4 million yd or building construction works plus compensatory capital dredging in the port reach.

With regard to dredging it should be noted that:-

i) The annual maintenance dredging requirement in the port reach is considered modest.

ii) Dredging operations would be more efficient with a modern self-propelled trailer dredger.

iii) Dredging on the outer bar would only be acceptable provided that the alignment of the navigable channel could be changed to take advantage of the best prevailing depths.

Discussions with Chalna Port engineers revealed that they would prefer to have some other organization i.e (BIWTA) operated the new dredger, when acquired. They claimed no experience in dredging.

(7) Water craft

The Port of Chalna has 36 vessels for port activities, pilot launches, tugs, fire fighting tug, launches, mooring boats, work boats, buoy tender and water barges.

(8) Khulna Port

a) Function

At present the Khulna Port, in addition to handling its own flow of goods and those to and from other ports by water, rail, or road, is also the rail and road forwarding station for distribution of goods arriving by barge from Chalna Port with the almost complete destruction of the Roosevelt Jetty, its remaining port handling facilities are now taxed beyond their limit. Immediate additional freight landing facilities either by the Chalna Port Authority or BIWTA are required, even if of a temporary nature.

If the Chalna Port rail and road connection are not completed the port of Khulna will continue to play a major role in handling import/export cargo from Chalna. With the completion of the road connection with a ferry crossing the role of Chalna will increase and the importance of Khulna decline.

b) The Roosevelt Jetty

A cursory inspection of the damaged jetty indicates that some 50 percent of the standing structures could be salvaged, provided no further deterioration takes place. The remaining portions appear to require clearing of rubble and complete rebuilding.

Water depths at the former berth are reported to be approximately 15 m indicating the need for pile supports being driven to about 26 m, a very costly undertaking. Any such attempt to replace or restore this structure should only be done after the river bank erosion problem is resolved.

In the absence of reconstruction of the Jetty, alternative berthing facilities will be required to handle the present and foreseeable Chalna rail and road port traffic.

11.4 Containerisation

11.4.1 The development of containerisation

The seaports of Bangladesh will be effected by the technological changes in world transportation, as were all world ports. From the mid-fifties to the mid-sixties new port construction wad designed to meet the requirements of standard general cargo vessels. By the latter part of the sixties container vessels were, for the most part, conversions from general cargo vessels, retaining much of their standard cargo handling equipment. They were generally referred to as combination ships and used standard general cargo berths. It was only when a company expanded its service into large numbers of containers that more sophisticated vessels and handling equipment were employed. With the rapid and unforeseen spread of container use that occured after 1965, even newly constructed or reconstructed ports and ships became obsolete on most routes.

In the past cities grew up around ports and in Bangladesh the cities crowded the port area. This was acceptable as transport from the port to the consummer or exporter was by hand labour. This encroachment of cities on ports was advantageous at that time and continued up until the early fifties. The advent of large highway trucks necessitated easy access to highways and the introduction of larger loads and containers. In the industrialized nations this created such congestion in the port cities that by the sixties and seventies major ports had to be relocated away from the city areas. This problem is now manifest in Bangladesh. Container technology is fostered by the more developed countries often against the interests of less developed countries where the infrastructure of transport is unable to cope. The economics of size and increased need for vessel productivity is at a cost less developed countries can ill afford. In the case of Bangladesh the entire transport infrastructure is unprepared and poor ly equipped to handle the container. As a result present container handling must be largely restricted to the confines of the port areas.

In the short term, the seaports must meet both the continuing cargo handling requirements of traditional general cargo vessels and the quite different requirements for combination general cargo and container carrying vessels. The future of Bangladesh seaports lies in accommodating this mix of vessels with each type requiring different handling methods. The role of the full container ship in Bangladesh is expected to be that of feeder vessels that can be accommodated in the restricted harbours and port water depths. Large full container ships are not expected to appear at Bangladesh ports for sometime to come.

11.4.2 Containers in Bangladesh

Bangladesh is not in a position to expand into the full door-to-door concept of containerization. Present roads cannot handle them. Widths of roads are generally such that container truck movement would be extremely hazardous in most areas. Rail has a better potential but requires interfaces with roads, and container handling equipment. Inland water depth restrictions limit the vessel size and carrying capacities, relegating full container vessels to the present size of coaster vessels.

Inland transport by waterways will also require costly container handling equipment and extensive inland water container port development. As a concept the organization and systemized requirements of operating a full container port are probably beyond present administrative capacity. The use of computers for tracking, selecting, loading and unloading control of containers is of prime importance to a successful operation. It is expected therefore that container handling will be largely restricted to the two seaports over the TFYR. During this period experience will be gained and further development to the inland port transport system can be considered in the FFYP. However, is is expected that limited container handling facility at Narayanganj will be developed.

The arrival of containers in Bangladesh has been developing slowly since 1977 when one vessel carried six containers to Chittagong. By 1982, 152 ships handled over 8,000 containers. Their impact in Chalna is in its early stage. The estimated number handled in 1984 was 6,000 units. However the potential for exports in containers is large and is being encouraged by receiving countries. The total potential for both ports is estimated at between 69,000 TEUs and 114,000 TEUs per year. The Chalna port in the export of jute alone has a present annual potential movement of containers of between 50,000 and 55,000 TEUs.

Both Chittagong and Chalna ports are proceeding with construction for container handling. Extensive lists have been prepared for the purchase of cargo handling equipment during the TFYP. In addition basic cost analysis estimates have been made on the transport system.

A set of Container system analysis guidelines is shown in Appendix A.11.1. In addition another set of guidelines is shown in Appendix A.11.2 so that customs procedures do not limit the productivity of container operations.

11.4.3 Numbers of containers

Tonnages of goods handled at the seaports in 1981/82 and of goods which might in future be expected to be handled in containers are shown in Table 11.4.1 in 1,000 TEU units.

Table 11.4.1 Container Flow (TEU, thousands) per Annums Based on 1981/82 Data

Item	Chittagong		Chalna		Total	
	Import	Export	Import	Export	Import	Export
Sugar and Salt	8.9		1.1		10.0	
Cotton goods	4.6		2		4.6	
Chemicals	2.3				2.3	
Tobacco	4.4				4.4	
Paper	23.6		0.1		0.1	
Machinery			0.1		0.1	
General cargo	23.6		1.2		24.8	
Jute goods		15.1		49.5		64.6
Tea		2.4				2.4
Fish etc.		0.1				0.1
Hides		0.7				0.7
Newsprint				0.2		0.2
Shrimp		0.4				0.4
Total	43.8	18.7	2.5	49.9	46.3	68.4

Source: Port Authorities
Note: Consultants calculations

In deriving the above data it was assumed, unlike the ESCAP report, that only 50% of the "General Cargo" would be containerisable, and the average load per container was taken as 14 tonnes, this being the measured load of a jute-filled container.

This analysis indicates an annual throughput of 69,000, as against the ESCAP estimate of 114,000, both schedules being as for 1981/82. Both largely depend on jute, which is unlikely to show much increase, and it is noticeable that export demands predominate. It is also significant that there would be a surplus of import containers at Chittagong a deficiency of containers for export, at Chalna. However, the actual balance at Chittagong is entirely dependent on the use of containers for general cargo imports; without this the movement would be in balance.

Within the limits of foreseeable accuracy, the demand during the next five years is unlikely to exceed 6,000 TEUs per month, with a future maximum for space planning purposes of 9,000. Of the 6,000 movements, 4,000 per month should be expected to be imported and exported through Chalna, mostly for jute export. The remaining 2,000 through Chittagong will be more in balance.

11.4.4 The internal movement of containers

Some 75%, 65,000 TEU will be stuffed with jute for export and some 20,000 TEUs may be imported empty. The empty containers will be stuffed in the godowns at the sea ports.

Some goods will arrive in containers, particularly "General Cargo" at Chittagong, though the number cannot be accurately forecast, and should justify onward movement to the Dhaka area by rail. It thus follows that considerable planning to ensure minimum wasted journeys and minimum delay to the boxes will be required, particularly as the hire charge for each box is considerable. This will involve planning problems, as individual shipping agents are responsible for internal movements.

Actual container flow is presently indeterminate as it will be dependant on outside factors, as well as on the management of the total movement within Bangladesh. However, there is a case for movement of many boxes for stuffing with jute to Dhaka, although the majority are expected to continue to be handled at Chalna. Under present movement patterns 87% of jute goes to Chalna, and, of that, 85% was by inland boat and 5% by rail. Of the 13% shipped at Chittagong, 55% went by rail, 28% by boat, and 17% by road.

11.4.5 The east-west and transit movement of containers

It is postulated that an inland container terminal will be built, in the Dhaka area, during the TFYP. Before the FFYP is formulated the movement pattern will have to be clarified, and the need for others can then be estimated with accuracy. Through the Narayanganj/Dhaka area 60% of the jute moves and jute is the major, almost the only, export material suited for containerisation. Of this 95% is shipped by water, mostly to Chalna, the remaining 5% going on by rail to Chittagong (BTS survey). The unknown factor at this stage is whether most of this will move to seaports in bales as at present, or whether it will be stuffed in the Dhaka area resulting in a decline of such movements in Chalna.

It can be expected that loaded containers for Nepal and for Bhutan will travel from Chittagong by rail, crossing the Jamuna on the Metre gauge rail wagon ferry at Bahadurabad Ghat, which has the capacity (though physical obstructions must be raised for clearance). Returning containers are expected to be empty, and should be routed back through the Dhaka area for stuffing there.

11.5 Operational Issues

11.5.1 Comparison of Chittagong and Chalna Port Vessel Productivity

The mix of cargoes handled at each port is not the same, and neither is the design layout of the facilities. Thus, an equal comparison of cargo handling productivity may be biased. However, the use of hand trucks and limited use of fork trucks in Chittagong Port seems to result in a higher level of productivity as shown in tonnes per hour handled.

Commodity	Chittagong Tonnes/per/hour	Chalna Tonnes/per/hour
General Cargo	4.9	4.1
Food Grains	16.9	10.6 (avg.)
Fertiliser	8.24	7.5

Source : Port Authorities.

In both ports the tonnes of cargo handled could be increased with a modest investment in cargo handling equipment.

11.5.2 Chalna Port container operations

Should more containers be handled at Chalna Port, as expected, it will be essential to achieve a better ship and inland water tranfer turnround from the wharfs than is managed at present.

Additional analysis is required of potential future container growth. At this time much of the present vessel berthing area is being used for barge operations and the handling from ships of bagged food grain and fertilizer. If container movements should rapidly increase, the space these barges and ships now occupy will be needed for container ships. This will require additional wharf construction for the handling of bagged goods or containers. At this time grain and fertilizer vessel occupancy at the wharf is high due to bagging of bulk shipments in the ships holds. This type of operation can be reduced if new bulk handling and automatic bagging facilities are constructed.

An example would be the bulk handling facility at Meherhar Pasha Central Storage Depot in Khulna now nearing completion. However, new bulk handling facilities should be designed for ocean going vessels.

It is understood that a detailed analysis is planned to be made on the expansion and operation of the port by consultants.

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APPENDIX TO CHAPTER 8

A8.1 Issues for Management

Section 8.1.6 introduced four issues for management to consider in preparing a strategic plan.

A8.1.1 Operational control

The General Managers are directly responsible to the Director General for train operations, all aspects of these operations. It is therefore required that all elements affecting rail traffic are under the responsibility of the General Manager.

The method of achieving this control by the general manager was given in Section 8.1.8 with a team approach through a Management Matrix.

This requires a managerial matrix organization whereby the Section Chiefs are responsible to the General Manager for the performance of that section, but are also responsible to their Director for the technical quality of their section. This system does not destroy the normal vertical structure of a railway organization but it strengthens the homogenity and resilience of the organization at the commercial level, by emphasizing the horizontal linkage necessary to raise efficiency at the local working level.

For this to function the General Manager must chair regular business meetings to ensure that matters affecting train operations are made known to all sections which affect operations.

The team or business meeting would comprise no more than six to eight people and should comprise the General Manager; Chiefs of Engineering; M & E; S & T; together with the Chiefs of Operations and Commerce.

These meetings must be oriented to the resolution of matters affecting train operations and not dissolve into inter-discipline squabbles.

For example:

Rehabilitation and renewal work will be continuing at various locations for many years, and it is necessary that this work is built into the control structure. It is a management objective to get this work completed as quickly as possible with the minimum interference to trains. It is necessary that the other Section Chiefs are aware of the works in progress and coordinate maintenance activities with rehabilitation work so that the minimum interference and wasted effort and expense occurs.

This management system creates a team approach and gives direct operational control to the General Manager.

The same management matrix can be exercised at lower levels of line management and at higher levels too, to ensure a full team approach to railway operations.

A8.1.2 Operational efficiency

To achieve operational efficiency it is necessary to have accurate statistics available to be used as a basis for decisions, and for line managers to administer the operational control of train operations.

(1) Statistics

The present system of management information services, and the accounting practices used must be reviewed to determine the validity of the data produced, as the preparation of this Study has shown that the reliability of the data was suspect.

The deterioration observed is considered due to the failure to maintain the computerised system that had existed prior to 1970, plus a downgrading in the effectiveness of the reporting methods and the accuracy of the data given. This statistical base must be re-established.

Other traditional matters such as cash flow, profits, betterment and depreciation of assets should be reviewed. It is probable that this is an objective that cannot be obtained by the Railway Division now and Consultancy Services will be required to establish methodology and an original data base. However once established the basic formula can be re-used with new statistics whenever required.

Raw data is meaningful data for management to consider at the General Manager's business meetings with the Section Chiefs where performance can be monitored, as the results can be considered in short term or over the longer term as the data is established.

Government has indicated that it is not an open "money tap" to finance uneconomic methods. Deeper financial aspects need examination, such as the actual value of railway plant and equipment, the value of the loans received and the efficiency obtained from the loan. The examination should examine comparative costs between rail and competing transport and use these to outline railway tariff policies. This can only be achieved by a statistical study.

The Railway Division needs a reliable data base and this must be re-established to an accuracy existing in 1969.

(2) Staff

The operational staff must be organized into correct functional roles such that no overlaps or gaps exist which can be exploited by unscrupulous staff or angry patrons.

a) Operating Manager.

Traditional train control and operations. This role covers train operations, signalling and safe working, punctuality, train preparation, accidents and incidents. The normal day-to-day running of trains.

b) Terminal Manager

Station operations whether these are passenger, freight, parcel or trans-shipment functions. The Manager is responsible through Station Masters for all station activities and hence customer relations. Primarily the function of customer service describes these activities with functions for both passenger and freight traffic. A major function is to reduce terminal times. Transit and transfer traffic would be included in this function at Indian border crossing points, inter-modal transfer points and at the Jamuna crossings.

c) Train Crew Manager

Responsible for drivers, firemen, guards, inspectors-all personnel who travel on and operate the train. These functions are traditionally held by the M & E Section for footplate staff and Operations for guards and inspectors. This re-orientation ensures no split responsibilities and all train operating staff are directly responsible to the General Manager. This is a major break with tradition but represents the current trend in railway operational philosophy. It has an in-built advantage as the senior train staff can be used directly to supervise the performance of the younger and less experienced trainmen directly in the operation of the trains without causing inter-departmental friction.

These three managers are required to run the trains to meet the operational efficiency objective.

A8.1.3 Effective maintenance

There are two factors involved; adequate finance and adequate labour.

a) Finance

Maintenance is financed by revenue, but any "betterment" is a capital fund account item.

Too much maintenance is being carried out under "betterment" or capital projects funded by loans. This has established the principal of "deferred maintenance" where minimal maintenance is carried out i.e., repairing failures only in track, and then carrying out a "betterment" programme under a capital improvement programme. This policy was well established in the United States in the 1960's and early 1970 s to improve the annual financial statements. The spate of serious accidents caused by track and vehicle defects showed up the consequence of neglecting maintenance funding. Adequate funds must be provided for tools, materials and small parts.

b) Labour

Labour is essential for maintenance and represents the largest item of a maintenance budget. Howhver it must be equitably distributed between the maintenance organizations and the workload of the departments. It was observed in Reference 10 appendix-1 that there is a serious imbalance between qualified mechanical engineers and civil engineers and

in order to produce a 1:1 ratio common on railways many qualified mechanical engineers must be recruited. This situation continues.

Maintenance must be performed by competent skilled artisans and again the same reference shows up to 27% shortage of artisans at Saidpur depot. Any target based on a theoretical manning cannot achieve the objective when there is an acute shortage of manpower in essential artisan skills.

To achieve adequate maintenance the correct resources must be made available to the using department. Money must be made available for the withdrawal of spares and stock from stores to keep services in operation and trained employees available to carry out the maintenance.

c) Training

Training is an essential requirement of management. Many skills are passed on or acquired by experience and in this matter older staff or superannuated employees should run skill enhancement programmes to hand on their knowledge to small employee groups during working hours in an organized programme. Many railway tasks are considered to be labouring tasks only. This is no longer correct and whilst many tasks do not required skill they do require technique to raise productivity levels. These techniques are as important as kills.

A8.1.4 Effective marketing

The businessman no longer turns always to the railway system for his transportation needs. Whilst the passenger traffic is growing, the freight business is falling away.

The Bangladesh Railway has only one product to sell - transportation and the Commercial Department must be specially organized to sell this product. It is essential that the Department operates with the General Managers to seek out new business and to ensure that the transportation service is attractive to the user.

The modern commercial department is a marketing team and it must be customer, i.e., shipper oriented. Fierce competition from roads and waterways dictates that close attention be given to the particular needs of a shipper or industry. The shipper is only marginally interested with the operating procedures of the railway. The shipper is most concerned with reliability of service, transit time, the frequency of loss, damage or pilferage (and the promptness in setting claims) the willingness to render service (regardless of the shipper or commodity or size of the shipment), the availability of the special services that a product may require, and the cost.

It is the marketing function that is the main function of the commercial department, though they are also required to collect freight charges, prepare invoices, settle claims, and prepare quotations and negotiate the contract. Marketing requirements must have the leading voice in designing the product being sold and therefore the Operating Department must respond positively to the requirements for schedules and vehicle requirements. This co-ordination must be at General Manager level.

The decline of railways in the USA and in Britain in the 50's & 60's was due to the inflexibility of the Operating Departments to meet the challenges of new markets. This is happening on Bangladesh Railways. A positive policy in granting greater responsibility, authority and in turn answerability needs to be invoked.

A8.2 Value of Freight Traffic

A8.2.1 Comparative value

A comparative analysis of revenue per ton between the benchmark year and current years is not possible due to inflationary effects and varying tariff rates. Therefore to consider the value of the traffic to the railway in one year in comparison with another year an artificial method has been used to obtain an approximation. Table A8.2.1 refers.

This was done by comparing the ratio of the earnings percentages to tonnage percentages for 1969/1970 with the same ratio for the 1982/83 earnings and tonnages. Then 1982/1983 ratio was expressed as a plus or minus percentage of the 1969/70 ratio. A similar process was used for the 1983/84 results.

$$\text{Ratio} = \frac{\text{Earnings \%}}{\text{Tonnage \%}}$$

The percentage change is considered to be an indication of the present value to the railway of the commodity related to the benchmark year. Whilst no exact judgement can be made it is suggested that anything less than + 15 to + 20% is not making a real contribution to growth and probably is earning less than costs.

A8.2.2 Comparative revenue per ton

An examination was made by relating the top 10 in the earnings percentages to the comparative value ratios for 1983/84. This showed that Fertilizer, Paddy, Rice, Sugar Cane had ratios below unity indicating that these items had low revenues per ton ranking No. 18, 27, 23 & 30 respectively out of 30 commodities listed. Collectively these account for 23% of all freight earnings and 31% of the tonnage.

An additional examination was made of those commodities which showed a negative change together with a ratio of less than unity. Fertilizer and rice showed again together with, Coal, Cotton-manufactured, Jute-manufactured, Military traffic, Molasses, Oil seeds, and Provisions. Military Traffic is ignored as it is not a matter of railway control. This is shown in Table A8.2.2.

Coal:	Below average increase in revenue per ton since 1969/70 & low value
Cotton-Manufactured:	Very low increase in revenue per ton since 1969/70
Jute-Manufactured:	Inexplicable sudden drop in revenue per ton since 1982/83
Molasses:	Drop in revenue per ton since 1982/83 and low revenue per ton.

Oil Seeds: Low increase in revenue per ton since 1969/70 and reduced income in 1983/84.

Provisions: A 55% drop in revenue per ton since 1982/83.

The tariffs for these commodities are less than the relative tariff in 1969/70 and because these represent a major block of tonnage carried account for poor earnings performance. Whilst these figures do no involve the haulage distance factor, they indicate that some increased business can mean a reduced income in some commodities and that income must be monitored.

Table A8.2.2 Change in Income

Tonnes in 1000's Earnings in Tk 1000's.

Commodity	1969/70			1982/83			1983/84			% Change on 1969/70	
	Tonnage	Rev.	Tk/t	Tonnage	Rev.	Tk/t	Tonnage	Rev.	Tk/t	82/83	83/84
Coal	138	3,060	22.7	49	8,437	172.2	40	4,627	115.7	+658.6	+409.7
Cotton (Manufactured)	3	204	68.0	-	43	-	1	192	192.0	-	+182.4
Jute (Manufactured)	47	2,208	47.0	22	7,406	336.6	18	3,879	215.5	+616.2	+358.5
Molasses	24	853	35.5	19	5,013	263.8	36	7,415	206.0	+643.1	+480.3
Oil seeds	18	734	40.8	4	981	245.3	4	924	231.0	+501.2	+466.2
Provisions	56	4,430	79.1	1	482	482.0	2	435	217.5	+509.3	+175.
Average	4878	163,831	33.58	2998	760,023	253.5	2939	706,596	240.4	754.9	615.9

Source : Bangladesh Railways
Consultants Calculations.

Table A8.2.1 Comparative Value of Freight Traffic

Commodity from 1984 year Book		1969/70 ratio (A)	1982/83 ratio (B)	1983/84 ratio (C)	Change $\frac{B-A}{A}$%	Change $\frac{C-A}{A}$%
1	Cement	0.84	1.53	1.27	+82%	+51%
2	Coal	0.66	0.69	0.49	+3%	-26%
3	Cotton Raw	1.42	-	2.00	-	+41%
4	Cotton Manufactured	2.00	-	0.67	-	-67%
5	Firewood & Other fuel	0.76	0.40	1.06	47%	+40%
6	Fertilizer	1.15	1.05	0.97	-9%	-16%
7	Fodder	0.70	-	0.86	-	+23%
9	Gram & Pulses	0.92	0.86	1.14	-7%	+24%
10	Iron & Steel	1.32	1.07	1.16	-19%	-12%
11	Jute raw	1.45	1.38	1.46	-5%	NIL
12	Jute manufactured	1.41	1.31	0.90	-8%	-36%
13	Kerosine oil	1.25	1.29	1.05	+3%	-16%
15	Marble & stone	0.63	0.90	0.97	+43%	+54%
16	Military traffic	0.88	0.50	0.45	-43%	-49%
17	Molasses	1.04	1.02	0.86	-2%	-17%
18	Oil fuel	0.80	1.09	0.83	+36%	NIL
19	Oil seeds	1.19	1.00	0.93	-16%	-22%
21	Provisions	2.38	2.00	0.86	-16%	-64%
22	Petrol	1.95	0.86	1.15	-56%	-41%
23	Paddy	0.54	0.70	0.72	+30%	+33%
24	Rice	1.01	0.83	0.87	-18%	-14%
26	Salt	1.47	1.42	1.29	-3%	-12%
27	Sugar Cane	0.20	0.40	0.39	+100%	+95%
28	Sugar	0.92	1.20	1.24	+30%	+35%
29	Tea	1.81	1.60	1.30	-12%	-28%
30	Tobacco	1.71	1.86	1.86	+9%	+9%
31	Vegetable Oil	1.00	1.26	1.06	+26%	+6%
32	Wheat	0.90	0.96	1.02	+7%	+13%
33	Wood	1.06	1.12	1.09	+6%	+3%
34	All other commodities	1.32	2.04	1.53	+55%	+16%

Source: Consultants Calculations

Table A8.4 Railway Problem Overview

SECTOR	REPRESENTATIVE PROBLEMS	APPARENT CAUSE
SENIOR MANAGEMENT AND ADMINISTRATION	- Removed from problem interfaces - Can be indecisive - May be misinformed - Is often constrained by social interest - Is hampered by poor communication - Confused by inaccurate data - Often limited by government policies - Until recently, composed of older personnel - Bifurcation of railway	- Overstaffing - Inadequate timely information - Poor communications - Thwarted personal goals - Overaged & undermaintained equip. - Under qualified & motivated staff - Due partition & liberation dislocation - Decentralization policy
PRODUCTIVITY	- Excessive wagon turn-rounds - Declining wagon availability - Declining carriage availability - Low locomotive availability - Low psgr. loco. hours per day - Low goods loco. hours per day - Modest tonne-km growth - Low paid to ticketless pass. ratio - Low traffic units per staff member	- Failure to maintain wagon brakes - Wagon surplus & incomplete roller prog. - BR fund shortage - Shortage of maintenance funds - Track/signal conditions & carriage bogies - Failure to maintain wagon brakes - Entirely due to increased loads - Poor collection & inadequate equip. - Tradition and ticketless travel
FINANCE	- BR land assets appear under-productive - Inadequate depreciation schedule - Indefined assets - Inactive costing cell - Inappropriate classification of GOB funding - Inappropriate customs duties assessments - 1982-'83 loss exceeding 270 million Taka	- No commercial objectives - Indefined assets - Out-of-date register - Lack of support & training - Inadequate timely GOB inputs - Absence of a clear Govt. policy or effective railway representation - Principally due low density branch lines and failure to collect 3rd class fares
TRAINING	- Currently inadequate throughputs - Inadequate facilities at workshops - Inadequate equipment at workshops - Rudimentary curriculum - Unprofessionally structured curriculum	- Facilities, accommodation & equipment - Separate funding from academy - Separate funding from academy - Inexperience - Inexperience
OPERATIONS	- Absolute pass. train priority - Low priority for goods locomotives - Constrained pass. train speeds - Constrained goods train speeds - Low rolling stock availability - Unreliable marine interfaces	- Traditional - Traditional - Type of carriage bogie and/or track - Lack of braking and/or psgr. priorities - Shortage of maintenance & funds - Systems & communications
COMMERCIAL ACTIVITIES	- Demand exceeds carriage supply - Demand exceeds goods loco. supply - Food grains have priority - Irregular service alienates private sector - Enroute theft alienates private sector - Failure to follow up new opportunities	- Maintenance - Maintenance & actual shortfall - Govt. policy - Low goods priority - Low goods priority & inadequate security - Shortage of experience & resources

Source. CIDA Report

A8.3 Track Rehabilitation Works

Figure A.8.3.1 is a schematic diagram of the CIDA review of trackwork rehabilitation.

Figure A.8.3.2 represents the CIDA evaluation of future trackwork priorities.

Before any new rail is installed, a ballast programme should be undertaken and kept ahead of the rail laying, otherwise the new rail will be crippled. The Chhatack Bazaar ballast source of is inadequate to supply this project in the West zone. Therefore, it is proposed that the ballast is obtained from neighbouring Indian sources where an adequate supply is available.

(1) Priority 1

Bonapara to Kanchan (165.4 kms)

The traffic densities are high for the west zone as shown below for 1983/84:

Bonarpara - Kaunia:	14.0 passenger 3.73 Freight
Kaunia - Parbatipur:	17.0 passenger 3.05 Freight
Parbatipur - Kanchan:	17.0 passenger 2.64 freight

a) Existing condition

The existing track is 60 lb. rail on steel trough sleepers at N + 3 sleepers per rail length (N = No. of yards in a standard rail length) with wood sleepers through station yards also at N + 3 density. The ballast is crushed rock with an average depth of 50-75 mm.

The present alignment is very poor mainly due to inadequate ballast to resist lateral thrust. This is particularly true in sections where steel trough sleepers are used.

There are 25 short span bridges which are to be upgraded under the CIDA project. There are 10 other short span bridges in this section that were dropped from the project due to lack of funds which also require upgrading. In addition, there are two long span and 24 short span bridges between Parbatipur and Kanchan which have never been assessed as to the need for upgrading.

b) Proposed rehabilitation

It is proposed to rehabilitate this line using Canadian 75 lb. "A" rail on steel trough sleepers at N + 5 density. The steel sleepers proposed to be used in this project can be rehabilitated under a British program. Track sections through yards at Bonapara, Kaunia and Parbatipur, where S.I.D.A. (Swedish Aid Program) is proposing installation of electric interlocking systems, would be laid on wood sleepers.

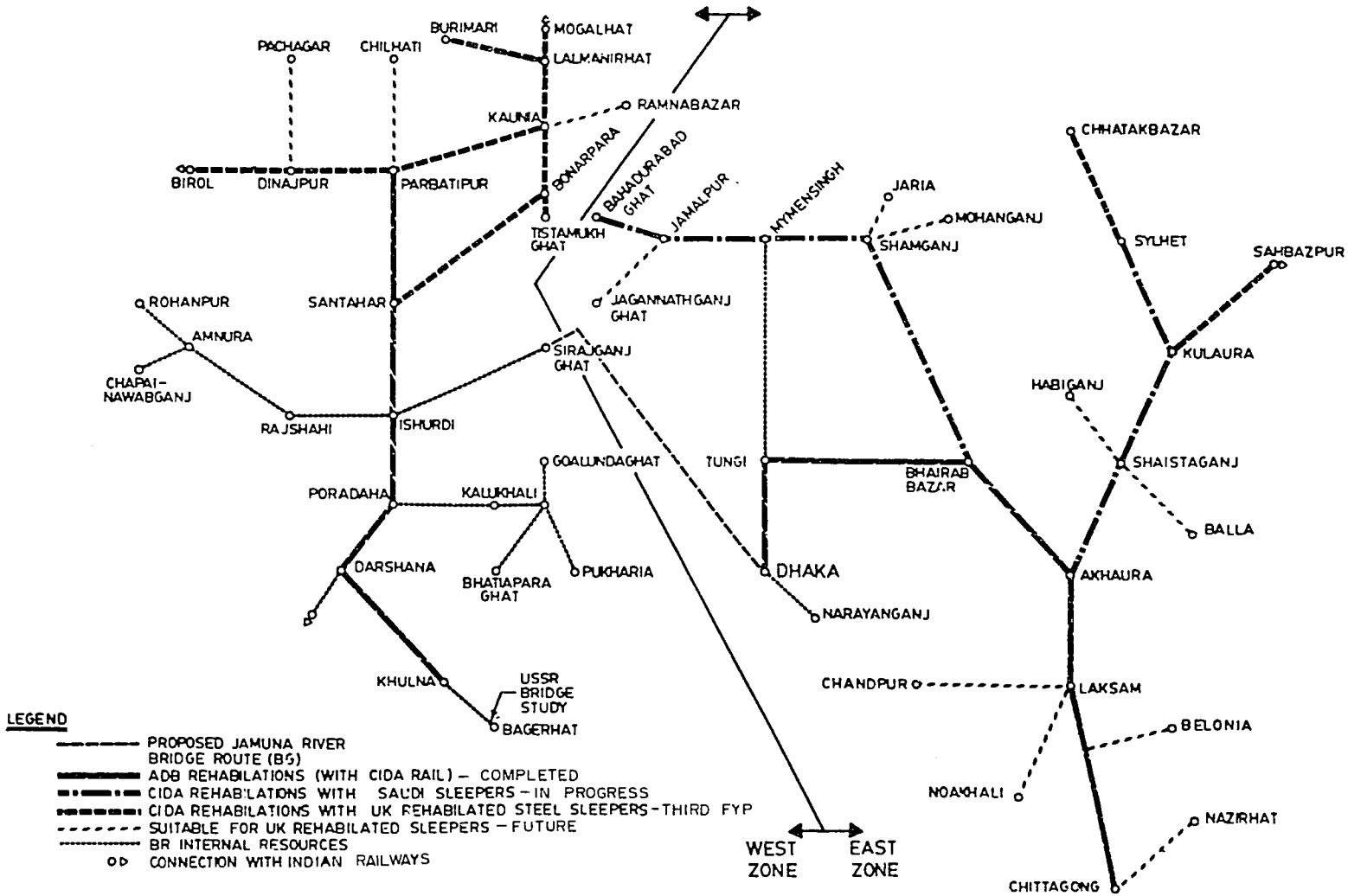


Figure A 8.3. 1 TRACKWORK REHABILITATION

Source CIDA

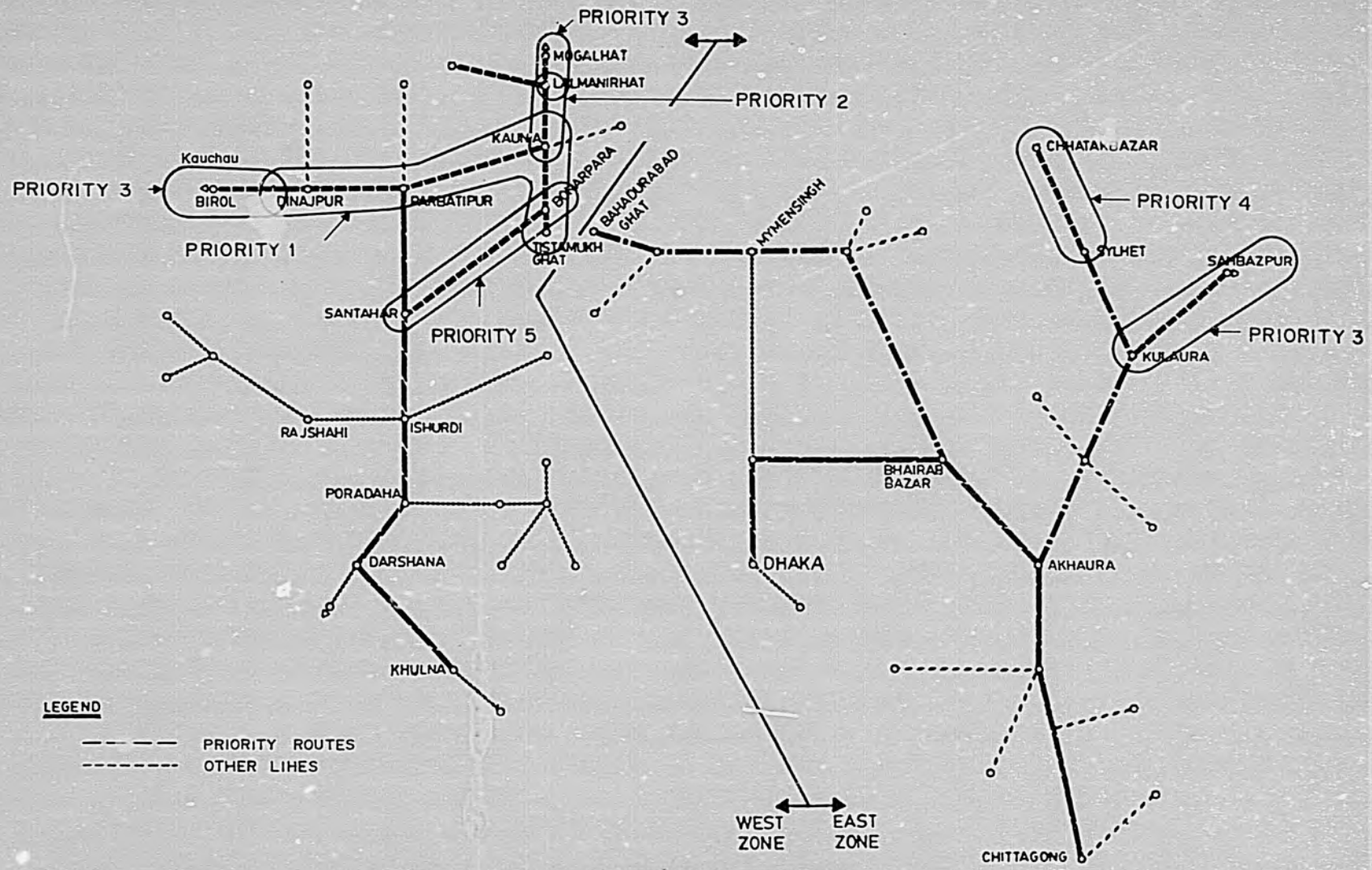


Figure A 8.3. 2 TRACKWORK PRIORITY

Source : CIDA

It is proposed to upgrade these 34 short and two long span bridges would probably have to be rehabilitated by a Canadian contractor. The short span bridges could be erected by BR bridge crews but some of these spans would no doubt require fabrication in Canada.

c) Recommendation

This line is an important link on the Chittagong to Nepal route having the potential for considerably increased freight traffic. It is also an important link for passenger traffic between the east and west zones which are presently connected by a ferry service across the Jamuna River.

(2) Priority 2

Kaunia to Lalmanirhat (15.7 kms)

The highest traffic density in 1983/84 with 18.0 passenger and and 1.87 freight.

a) Existing condition

The section from Kaunia Junction (km 433.7) to Lalmanirhat Junction (km 449.4) consists of 60 lb. "R" rail of which a portion was rolled in 1918 and the balance in 1931. All sections show a wear weight loss of about 8% and 4.4 kms of tracks are on wood sleepers 20% of which are unserviceable. The remaining 11.3 kms of tracks are on steel trough sleepers of which 20% to 25% are unserviceable due to elongated holes. All sleepers are N + 2 or N + 3 density. Ballast is crushed rock with an average depth of 5 inches.

There are four short span and one long span bridges on this line.

b) Proposed rehabilitation

It is proposed to rehabilitate this line with additional ballast, new Canadian 75 lb. rail and rehabilitated steel sleepers at N + 5 density fitted with Pandrol clips. Funding is required for purchase of ballast from India and supply of rail and fastenings. It is proposed that the steel trough sleepers be rehabilitated and fitted with Pandrol clips by Bangladesh Railways with assistance from the U.K.

These bridges all require upgrading with the actual amount of steel replacement to be determined by detailed inspection and assessment to be carried out at the early stages of the proposed program.

c) Recommendation

There is an unrecorded amount of freight traffic from Kaunia through Lalmanirhat to the Indian border. This traffic is

increasing since BR is able to obtain bridge route freight traffic through the port of Chittagong destined for Nepal. Rehabilitation of the section is therefore necessary to support this increasing freight traffic.

(3) Priority 3

These all connect into Indian Railways.

This project includes upgrading of 64.75 kms of tracks and rehabilitation of 48 short span bridges in the following three sections

Kulaura - Shahbazpur - Indian Border
Lalmanirhat - Mogalhat - Indian Border
Kanchan - Biral - Indian Border

Present traffic is

Kulaura - Shahbazpur:	8 passenger	
Lalmanirhat - Mogalhat:	2 passenger	
Kanchan - Biral:	4 passenger	0.22 freight

a) Existing condition

The existing condition of these lines is poor and below standard.

b) Proposed rehabilitation

It is proposed to upgrade these lines by increasing the depth of ballast as required. It is also proposed to relay the track with reusable 60 lb. rail and steel sleepers released by the rehabilitation of main line tracks. It will be necessary to rehabilitate the bridges on all three lines. The extent of this rehabilitation cannot be determined accurately until each bridge has been examined and assessed in the initial stages of the project.

c) Recommendation

All of these rail lines are important arteries since they interconnect with India's railway system. The line from Kulaura to Shahbazpur is the only interconnection in the East zone, while the lines from Lalmanirhat to Mogalhat and Kanchan to Biral are in the west zone. Upgrading of these sections will ensure the potential for Indian bridge traffic between west Bengal/Bihar and Assam/Tripura/Meghalaya.

(4) Priority 4

Sylhet to Chhtak Bazar (33.0 kms)

Traffic density is not high with 10.00 passenger trains and 0.13 freight.

(i) Existing condition

The track condition on this section is very poor. The rails are 60 lb. "R" and "BS" rolled in 1910 and show average wear weight loss from 9% to 10%. Sleepers are of oil treated Garjan wood at N + 2 and N + 3 density with approximately 40% unserviceable.

Ballast is only 1" to 2" in depth except for three miles which have already been reballasted and new sleepers installed.

The bridges on this section are all being rehabilitated under the CIDA 806 program.

(ii) Proposed rehabilitation

It is proposed that this track be rehabilitated with CIDA funding for supply of 75 lb. "A" rails and fittings for the whole 33 km length. Sleepers and ballast will be required for 28.2 kms of the track. Steel sleepers, rehabilitated with U.K. assistance, fitted with Pandrol clips could be installed by Bangladesh Railways at N + 5 density. The ballast for this project can be supplied from Chhatak Bazar.

(iii) Recommendation

This is an important part of the network, serving the only source for boulders and ballast. Rehabilitation of this section is essential to ensure dependable ballast supply to BR track projects.

(5) Priority 5

Bonarpara - Santahar (83.4 kms)

Traffic density is 10 passenger and 0.96 trains per day.

a) Existing condition

The track is 60 lb. rail and from km (Santahar) to km 335 shows 3% wear weight loss. From km 336 to km 365 (Bonarpara) rail shows a wear weight loss of 6 to 8 percent. Sleeper density is N + 3 and the sleepers generally are steel through except through station yards where they are of treated wood. Five to eight percent of steel sleepers are unserviceable due to elongated holes while 35 - 36% of wood sleepers are unserviceable. Ballast is stone and is only 30 mm to 75 mm thick.

There are 48 short span bridges on this section which will require detailed assessment and rehabilitation during this project. A study prior to implementation will determine the extent of bridge rehabilitation necessary.

b) Proposed rehabilitation

It is proposed to rehabilitate this line if CIDA funding is available for the supply of 75 lb. rails and fittings. Rehabilitated steel sleepers with Pandrol clips could be used. Ballast would have to be supplied from India if required before 1995. After completion of ballasting on the East Zone, ballast could probably be available from Chhtak Bazar.

c) Recommendation

This line & links the broad gauge line to Bonarpara where it connects with the metre gauge lines to Kaunia and also to the ferry service across the Jamuna river to the east zone of the railway. This section is a priority projects of Bangladesh Railway.

(6) Observations

There are five components to the proposed CIDA track rehabilitation programme. In rank order they are Bonarpara to Kanchan, Kaunia to Lalmanirhat, three short connections to Indian border exchange points, Sylhet to Chhatak Bazar and Bonarpara to Santahar. The last two components are presented at this time as optional programmes as it is not at all clear that the total programme could be completed within the proposed main project period of ten years.

All sections are on the metre gauge and all but the Sylhet to Chhatak Bazar and one short Indian border connection, are in the west zone. All sections are in rank order of traffic density except the three border connections and the Sylhet to Chhatak Bazar section.

The three Indian connections are proposed for reballasting utilizing Indian sourced ballast, with low level upgrades comprising recovered rather than rehabilitated steel sleepers and cascaded rather than new rail.

Generally, the justification for all but the Sylhet to Chhatak Bazar upgrades are strictly commercial. These are the long distance trunk routes and each offers long and short term opportunities for increased traffic between Nepal and Chittagong (perhaps from 80,000 tons per year to 500,000 tons per year) and for substantial bridge traffic between the Indian provinces of West Bengal, Assam and Tripura, (perhaps as much as 300,000 tons per year). Upgrading will allow higher speeds (an estimated 20% increase) and higher levels of service for both passengers and freight. Deteriorated and worn facilities will be brought up to acceptable operating standards.

The justification for the section between Chhattak Bazar and Sylhet is partly economic (there is only one prior section with a higher line density, Bonarpara to Santahar), but mainly in the interests of sector coherence. Sylhet to Chhak Bazar will be the remaining important section not rehabilitated in the east zone once present programmes are complete and in addition Chhtak Bazar is the source of all east zone ballast. For this reason, we recommended its rehabilitation

ahead of the Bonarpara to Santahar section which has a higher priority on a line density basis.

The increase in speed possible by the works, particularly on the longer sections offers the operational advantages in increased rolling stock utilization.

The importance of the ballast supply is stressed, as the fundamental track support system adequate depth in track is necessary to sustain the higher speeds and efficiences necessary to improve performance.

A8.4 Track Standards

BG: Primary Lines: 90 lbs "R or A" rails on N + 5 wooden or concrete sleepers (N+6 on curves) with elastic fastenings and welded at site to form 3 rail panels. Joint Sleepers to be spaced 300mm centres. In the case of concrete sleepers continuous welding to be done, excepting on sharp curves of 3° and above.

On Secondary Lines, the sleeper density may be reduced to N + 3 and no welding need be done. On Tertiary Lines, second hand rails may be used on N + 3 density new sleepers.

MG: Primary Lines: 75 lbs "R or A" rails on N + 5 wooden or concrete sleepers (N+6 on curves) with elastic fastenings and short welded rails to form 3 rail panels. Joint sleepers to be spaced 250mm centres. In the case of concrete sleepers continuous welding to be done excepting on sharp curves of 3° and above.

On Secondary Lines: Sleeper density may be reduced to N + 3 and no welding need be done. On Tertiary Lines, second hand rails on N + 3 density new sleepers may be used.

In place of "R or A" rail sections, equivalent UIC sections may also be adopted. It should be ensured that combination fish plates should invariably be provided to match the rail sections on adjoining lengths.

Source : RDPP

Note : Reconditioned steel sleepers recommended in the West Zone.

A8.5 Comparative Costs of Concrete and Steel Sleepers

(1) Introduction

No study in Bangladesh was undertaken on parmanent way activities, and the data used in this examination is based on observations from other railway Administrations.

(2) Concrete sleepers

There are approximately 8 sleepers to the tonne for metre gauge & 6 for broad gauge. This makes each sleeper 125 kg and 167 kg respectively.

In Japan the standard pre-cast concrete sleeper costs US$45-50 for 1,067 gauge and in Thailand US$40-45 for metre gauge without fasteners. Using the latter figure for Bangladesh manufacture and extrapolating for broad gauge a cost of US$52-58 is obtained.

JNR factors for sleeper renewals by hand are 166 sleepers per 100 m per 2 hours by 13 men or 1 kilometre equals 260 manhours.

The estimated life of concrete sleepers in the FRG is 50 years with no scrap value.

(3) Steel sleepers

A steel sleeper weighs about 50 kg for metre gauge and 67 kg for broad gauge. The estimated current price for a steel sleeper is about US$580-600 per tonne.

This gives a cost of about $30 each in metre gauge and US$40 in broad gauge.

JNR does not have any steel sleeper experience, but due to similar weight to a hardwood sleeper the hand re-sleepering factors of JNR are used with 10% added to allow for the differences with the steel.

JNR is 166 sleepers per 100 m in 2 hours with 5 men or 1 kilometre equals 100 manhours plus 10% or 110 manhours.

The life of steel sleepers is 60 years in Germany with a scrap value of 10% of cost at time of scrapping.

(4) Ballast

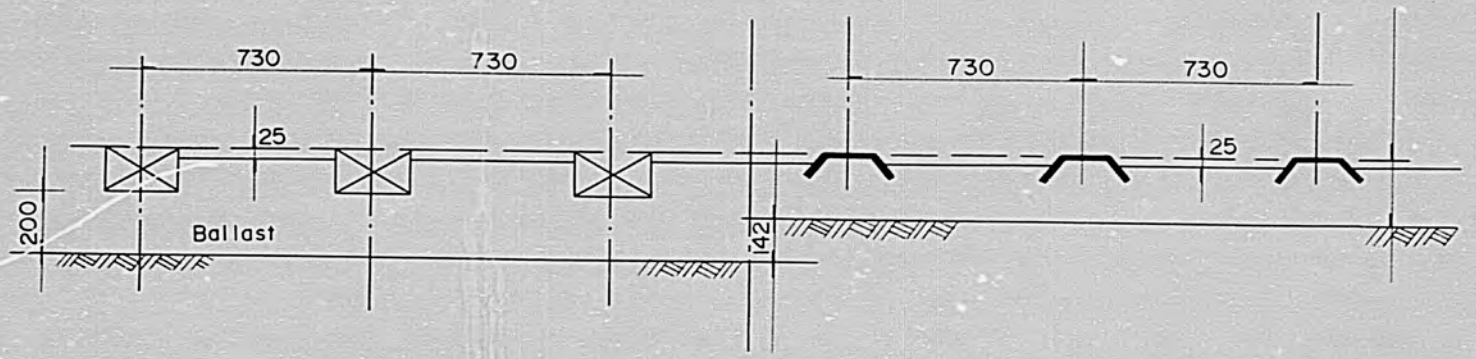
The ballast requirement is 200 mm below bearing, see figure A8.5.1.

(5) Summary

Table A8.5.1 depicts the advantages of steel over concrete sleepers:

Table A8.5.1

	Factor	Concrete	Steel	% adv.
1.	Weight (Metre gauge)	125 kg	50 kg	60%
2.	Cost (Metre gauge)	$40-45	$30	25%
3.	Manpower per km (manhrs.	260	110	58%
4.	Life	50	60	20%
5.	Ballast savings/m.width	0.209	0.137	34%
6.	Scrap value	Nil	10%	-



Standard Sleeper
9"x 6" (228x150mm)
N+5 spacing (730mm)
Volume stone
Per Sleeper Spacing Per Metre Width
= 0.730 x 0.200 + (0.730 - 0.228)x(0.150 - 0.025)x1.0
= 0.20875 cu m.

Steel Sleeper
15"x 3/8" (367 x 8mm)
N+5 spacing (730mm)
Volume stone (Ignore steel)
Per Sleeper Spacing per Metre Width
= (0.730 x 0.208) - 0.025 x (0.730 - 0.150)
= 0.13734 cu m.
Sawing = 34.208 %

Fig A8.5.1 COMPARATIVE BALLAST VOLUMES

APPENDIX TO CHAPTER 9

A9.1 Summary of Traffic Survey Results 1984/85

(MAIN AND INTERDISTRICT ROADS)

A. Trucks & Buses

		Trucks	Buses
Avg. Trip Length	Km	170	148
Avg. Veh. weight - loaded	Tons	11.7	10.7
Avg. Veh. weight - empty	Tons	5.0	4.5
Estimated percentage of Empty truck	%	30.0	-
Avg. Load	Tons	4.7	6.2
Avg. running speed	km/hr.	29.8	31.6
Avg. Travel speed	km/hr.	* 28.0	23.5

* Not included ferry break time

B. Passenger Trips

	Avg. No. of Passenger	Avg. Passenger Trip Length Km
Buses	53.4	113.0
Minibuses	25.7	85.9
Car/Jeeps	3.2	91.7
Average	-	90.0

C. Traffic Vehicle Component.

Trucks	44.3
Buses	22.7
Minibuses	10.4
Cars/Jeeps	12.7
Others	9.9
Total :	100.0%

D. Freight Movement 84/85 ---------- 2,460 million ton - km
(Arterial Road)

E. Passenger Movement 84/85 ---------- 15,460 million pass-km
(Arterial Road)

A9.2 Survey Form

FORM – B

GOODS MOVEMENT SURVEY FIELD RECORD FORM

Sheet no ( )

ROAD _____ DATE _____ TRAFFIC DIRECTION: FROM _____ TO _____

LOCATION _____ DAY _____ TIME _____ RECORDER _____

TYPE OF VEHICLE	VEHICLE CAPACITY	AXLE – LOAD SURVEY						O-D SURVEY			(A x B)
		AXLE	LOAD TONNES		TOTAL	A	* *	(UPAZILA)		B	MOVEMENT OF GOODS
		1st	2nd	3rd		TOTAL WEIGHT TONNES	MAJOR COMMODITY	ORIGIN	DESTINATION	TRIP LENGTH (Km)	(tonne-km)
TOTAL		Total nos of vehicles ... ( )						—	—	—	

INTERMODAL TRANSPORT STUDY

FORM – C

PASSENGER MOVEMENT SURVEY FIELD RECORD FROM

Sheet No

ROAD _____ DATE _____ TRAFFIC DIRECTION: FROM _____ TO _____

LOCATION _____ DAY _____ TIME _____ RECORDER _____

TYPE OF VEHICLE	SEATING CAPACITY	O-D SURVEY (Person Trip)					REMARKS
		NUMBER OF PASSENGER	(UPAZILA)			TRIP LENGTH (Km)	
			ORIGIN	VIA	DESTINATION		
TOTAL		TOTAL NUMBER OF PASSENGER ( )					

A9.3 Link No. and Road Condition (RHD Arterial Road Network)

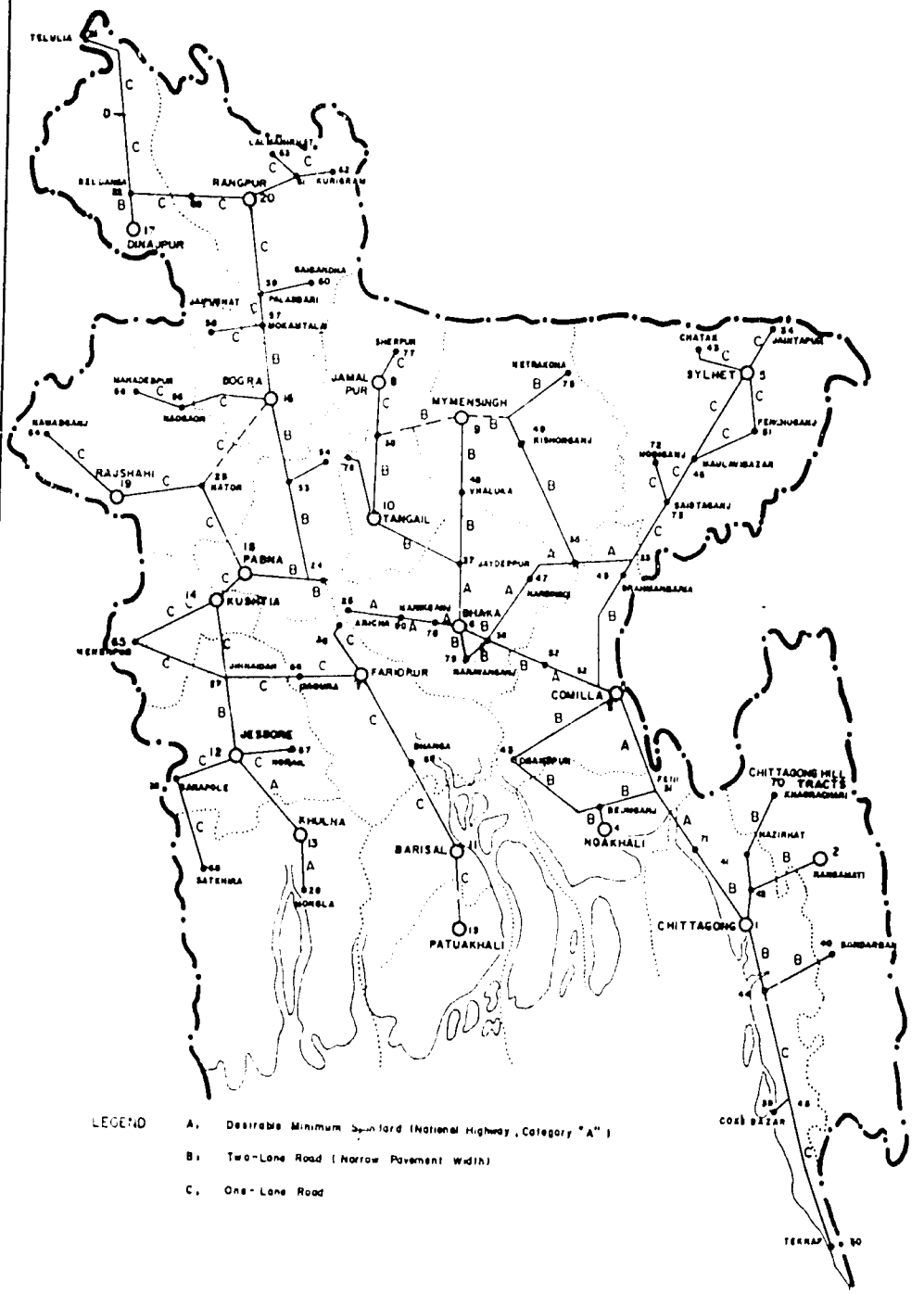


FIG A9.3.1 LINK NO. AND ROAD CONDITION MAP

Table A9.4.1 Details of the Estimated AADT in 1985 Dhaka - Comilla - Chittagong - Taknaf

Link No. (Ref. Fig. A9.3.1)	Name of Road/ Road Section	Length (km)	RHD Survey		Seasonal Variation Factor	Seasonality Adjusted ADT	Annual Growth rate (%)	L.T.S. Survey 1985	Estimated(1985) AADT(veh)
			Date	Value					
6-36	Dhaka/Kachpur	14			1.04	4215	-	4384	4220
36-52	Kachpur/Chandina	28	May/83	1817	1.04	1747	8.0		2040
52-3	Chandina/Comilla	52	Apr/83	1250	1.05	1190	"		1390
3 -31	Comilla/Feni	60	Apr/84	1634	1.04	1571	"		1700
31-4	Feni/Noakhali	48	Apr/84	1095	1.05	1043	"		1130
3-43	Comilla/Chandpur	75	May/84	355	1.04	341	"		370
3-43	Noakhali/Chandpur	85	Apr/84	184	1.05	175	"		190
31-71	Feni/Mirsharai	47	May/84	2445	1.05	2329	"		2520
71-1	Mirsharai/Chittagong	60			1.04	4413	-	4589	4410
41-42	Nazirhat/Hathazare	18	Mar/84	828	1.05	789	8.0		850
41-70	Nazirhat/Khazirchare	68	Mar/84	828	1.05	789	"		850
1-1	Chittagong/Ctg.H.T.	76	Feb/84	154	1.05	432	12.0		480
1-44	Chittaong/Keranirhat	53	Jan/84	1065	1.04	1024	12.0		1150
44-40	Keranirhat/Bandarban	23	Feb/84	215	1.05	205	8.0		220
44-39	Keranirhat/Cox's Bazar	98	Feb/84	862	1.05	821	"		890
39-30	Cox's Bazar/Teknaf	80	Feb/84	372	1.05	354	"		380
6-79	Dhaka/Narayangonj	14	Mar/84	4556	1.05	4625	"		5000

Table A9.4.2 Details of the Estimated AADT in 1985 Dhaka - Tangail - Jamalpur - Mymensingh

DHAKA - TANGAIL - JAMALPUR - MYMENSINGH

Link No. (Ref. Fig. A9.3.1)	Name of Road/ Road Section	Length (km)	RHD Survey		Seasonal Variation Factor	Seasonality Adjusted ADT	Annual Av. Growth rate %	L.T.S. Survey 1985	Estimated 1985 AADT (Veh)
			Date	Volume					
6 - 37	Dhaka/Joydevpur	34			1.04	3357	-	3491	3360
37 - 48	Joydevpur/Valuka	47	Mar/82	456	1.12	407	8.0		510
48 - 9	Valuka/Mymensingh	40			1.04	781	-	812	780
37 - 10	Joydevpur/Tangail	61	Jan/84	706	1.07	660	8.0		710
10 - 76	Tangail/Bhuanpur	23	Jan/84	262	1.07	245	8.0		260
10 - 38	Tangail/Modhupur	51	Jan/84	500	1.07	467	8.0		500
38 - 8	Modhupur/Jamalpur	42	Feb/84	239	1.10	217	8.0		230
8 - 77	Jamalpur/Sherpur	11	Feb/84	213	1.10	194	8.0		210
38 - 9	Modhupur/Mymensingh	45	Mar/84	251	1.12	224	8.0		240
9 - 49	Mymensingh/Kishorganj	62	Mar/84	225	1.12	201	8.0		220
9 - 75	Mymensingh/Netrokona	38	Mar/84	70	1.12	63	8.0		70
					DHAKA - ARICHA				
6 - 78	Dhaka/Mirpur	11	Apr/84	5147	1.12	4596	120		5150
78 - 50	Mirpur/Manikganj	55	May/84	1915	1.12	1710	8.0		1850
50 - 25	Manikganj/Aricha	22			1.08	1233	-	1332	1230

Table A9.4.3 Details of the Estimated AADT in 1985 Comilla - Brahmanbaria - Sylhet Dhaka - Narsingdi - Sarail

COMILLA - BRAHMANBARIA - SYLHET

DHAKA - NARSINGDI - SARAIL

Link No. (Ref. Fig. A9.3.1)	Name of Road/ Road Section	Length (km)	RHD Survey		Seasonal Variation Factor	Seasonality Adjusted ADT	Annual Av. Growth rate %	L.T.S. Survey 1985	Estimated 1985 AADT (Veh)
			Date	Volume					
32 - 45	Mainamoti/Brahmanbaria	64	Mar/83	607	1.08	562	6.0		630
45 - 33	Brahmanbaria/Sarail	10	Jan/82	316	1.07	295	6.0		350
33 - 46	Sarail/Maulavibazar	127	Feb/83	645	1.08	597	6.0		670
46 - 5	Maulavibazar/Sylhet	61			1.07	2242	-	2399	2240
5 - 34	Sylhet/Jaintapur	55	Jan/83	1127	1.07	1053	6.0		1180
5 - 43	Sylhet/Chatak	36	Jan/83	442	1.07	413	6.0		460
73 - 72	Saistaganj/Habiganj	13	Mar/83	414	1.08	383	6.0		430
36 - 47	Kachpur/Narsingdi	31	Mar/83	1040	1.08	963	6.0		1080
47 - 35	Narsingdi/Bhairab	40	May/83	402	1.03	390	6.0		440
35 - 33	Bhairab/Sarail	14	May/83	581	1.03	564	6.0		630

Table A9.4.4 Details of the Estimated AADT in 1985 Pabna - Kushtia - Jessore - Khulna

PABNA - KUSHTIA - JESSORE - KHULNA

Link No. (Ref. Fig. A9.3.1)	Name of Road/ Road Section	Length (km)	RHD Survey		Seasonal Variation Factor	Seasonality Adjusted ADT	Annual Av. Growth rate %	L.T.S. Survey 1985	Estimated 1985 AADT (Veh)
			Date	Volume					
18 - 14	Pabna/Kushtia	13	May/84	289	1.04	278	6.0		290
14 - 65	Kushtia/Meherpur	58	Mar/82	223	1.07	208	6.0		250
65 - 27	Meherpur/Jhinaidah	65	Apr/82	364	1.06	343	6.0		410
14 - 27	Kushtia/Jhinaidah	47	Oct/78	422	0.89	474	6.0		710
27 - 66	Jhinaidah/Magura	43	Apr/82	494	1.06	466	6.0		560
27-12	Jhinaidah/Jessore	47			1.07	1295	-	1386	1300
12 - 28	Jessore/Benapole	38	Mar/82	512	1.07	479	6.0		570
28 - 68	Benapole/Satkhira	42	Mar/82	283	1.07	264	6.0		320
12 - 67	Jessore/Narail	53	Aug/78	193	0.88	219	6.0		330
12 - 13	Jessore/Khulna	61			1.07	1602	-	1714	1600

RAJBARI - FARIDPUR - BARISAL - PATUAKHALI

26 - 7	Rajbari/Faridpur	26	Jan/83	1210	1.01	1198	6.0		1350
7 - 66	Faridpur/Magura	36	May/83	551	1.04	530	6.0		600
7 - 69	Faridpur/Bhanga	32			1.07	633	-	677	630
69 - 11	Bhanga/Barisal	97	May/83	402	1.04	387	6.0		430
11 - 15	Barisal/Patuakhali	42	Apr/83	243	1.06	229	6.0		260

Table A9.4.5 Details of the Estimated AADT in 1985 Nagarbari - Bogra - Rangpur - Dinajpur

NAGARBARI - BOGRA - RANGPUR - DINAJPUR

Link No. (Ref. Fig.A9.3.1)	Name of Road/ Road Section	Length (km)	RHD Survey		Seasonal Variation Factor	Seasonality Adjusted ADT	Annual Av. Growth rate %	L.T.S. Survey 1985	Estimated 1985 AADT (Veh)
			Date	Volume					
24 - 53	Nagarbari/Sirajganj	71			1.08	736	-	795	740
53 - 16	Sirajganj/Bogra	53	July/77	490	0.91	538	8.0		990
16 - 23	Bogra/Nator	68	Apr/82	576	1.12	514	8.0		650
16 - 55	Bogra/Naogram	49	Feb/82	524	1.10	476	8.0		600
55 - 56	Naogram/Mahadevpur	22	Mar/82	364	1.12	325	8.0		410
16 - 57	Bogra/Makamtala	23	Aug/77	278	0.86	323	8.0		560
57 - 58	Makamtala/Jaipurhat	47	Oct/79	165	0.87	190	8.0		300
57 - 59	Makamtala/Palashbari	30	Oct/79	345	0.87	397	8.0		630
59 - 60	Palashbari/Gaibandha	23	Oct/79	309	0.87	355	8.0		560
59 - 20	Palashbari/Rangpur	56			1.08	734	-	793	730
20 - 61	Rangpur/Kaunia	32	Sep/79	100	0.86	116	8.0		180
61 - 62	Kaunia/Kurigram	12	83 /84	73	n. a	73	8.0		80
61 - 63	Kaunia/Lalmanirhat	16	83 /84	56	n. a	56	8.0		60
20 - 69	Rangpur/Saidpur	43	Sep/79	517	0.86	601	8.0		950
69 - 22	Saidpur/Beladanga	24	Jun/79	1263	1.11	1138	8.0		1810
22 - 17	Beladanga/Dinajpur	14	Jun/79	367	1.11	331	8.0		530
22 - 21	Beladanga/Tetulia	119	83 /84	204	n. a	204	8.0		220
					NAGARBARI - PABNA - NATORE - RAJSHAHI				
24 - 18	Nagarbari/Pabna	56			1.08	561	-	606	560
18 - 23	Pabna / Natore	70	May/84	531	1.12	474	6.0		500
23 - 19	Natore/Rajshahi	40	Apr/82	861	1.12	769	6.0		920
19 - 64	Rajshahi/Nawabganj	48	Mar/82	190	1.12	170	6.0		200

A9.5 Road Distance for OD Analysis

(DISTANCE.)

O– D MATRIX

Length in km		CHITTAGONG	CTG HILL TRACKS	COMILLA	NOAKHALI	SYLHET	DHAKA	FARIDPUR	JAMALPUR	MYMENSINGH	TANGAIL	BARISAL	JESSORE	KHULNA	KUSHTIA	PATUAKHALI	BOGRA	DINAJPUR	PABNA	RAJSHAHI	RANGPUR
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CHITTAGONG	1		76	166	154	428	361	385	444	381	351	513	500	592	476	555	489	679	422	531	599
CTG HILL TRACTS	2			241	230	504	336	460	520	456	426	589	576	637	552	631	565	755	497	607	674
COMILLA	3				108	262	95	219	278	216	185	348	335	396	311	[illegible]	323	513	256	365	433
NOAKHALI	4					370	203	327	336	323	293	455	442	504	418	497	431	621	364	473	541
SYLHET	5						359	481	541	405	447	610	597	658	573	652	586	776	518	628	695
DHAKA	6							121	183	121	90	253	240	301	216	294	228	418	161	270	338
FARIDPUR	7								233	237	140	129	126	187	126	171	179	368	111	220	288
JAMALPUR	8									87	93	362	319	410	325	404	338	528	270	380	447
MYMENSINGH	9										97	365	352	414	328	407	341	531	274	383	451
TANGAIL	10											269	256	317	232	311	245	434	177	286	354
BARISAL	11												254	315	254	42	307	497	240	349	417
JESSORE	12													61	93	296	249	439	148	222	359
KHULNA	13														154	357	311	500	209	283	420
KUSHTIA	14															296	156	346	55	129	265
PATUAKHALI	15																349	539	282	391	256
BOGRA	16																	190	137	108	109
DINAJPUR	17																		327	298	80
PABNA	18																			109	246
RAJSHAHI	19																				217
RANGPUR	20																				

Table A9.5.1 Jamuna Crossing

FERRY. (BIWTC) Aricha ⟷ Nagarbari
Aricha ⟷ Daulatdia
ALL VEHICLE PER MONTH

YEAR / MONTH	79 - 80	80 - 81	81 - 82	82 - 83	83 - 84	84 - 85	5 years AVERAGE (79/80-83/84)	INDEX.
JULY	12,850	13,245	18,633	16,210	21,538	22,223	16,500	0.91
AUGUST	12,089	11,169	16,591	16,542	20,526	25,203	15,400	0.85
SEPTEMBER	12,702	11,298	16,857	16,635	20,094	22,264	15,500	0.85
OCTOBER	12,758	13,536	17,326	16,093	21,495	26,247	16,200	0.89
NOVEMBER	12.335	14,930	16,574	16,780	19,602	26,688	16,000	0.88
DECEMBER	13,880	17,062	19,849	19,677	24,377		19,000	1.04
JANUARY	14,385	17,695	20,591	19,596	26,767		19,800	1.09
FEBRUARY	14,182	16,861	20,980	18,224	26,160		19,300	1.06
MARCH	15,283	16,383	20,810	20,044	27,573		20,000	1.10
APRIL	14,562	18,099	20,129	20,686	26,684		20,000	1.10
MAY	14,910	18,506	20,600	22,405	27,459		20,800	1.14
JUNE	16,082	17,405	19,303	23,037	25,685		20,300	1.12
Total	166,018	186,189	228,323	225,929	287,960		218,900	
Ave.(Month	13,835	15,516	19.027	18,827	23.997		18,200	1.00

Table A9.5.2 Maghna & Daudkandi

FERRY. (R.H.D.)

ALL VEHICLE PER Day

YEAR / MONTH	79 - 80	80 - 81	81 - 82	82 - 83	83 - 84	84 - 85	4 years AVERAGE (80/81-83/84)	INDEX
JULY		973	1,292	1,118	1,310	1,503	1,173	0.94
AUGUST		977	1,167	1,112	1,259		1,129	0.91
SEPTEMBER		1,080	1,213	1,187	1,380		1,215	0.98
OCTOBER		1,123	1,207	1,143	1,121		1,149	0.92
NOVEMBER		1,126	1,173	1,188	1277		1,191	0.96
DECEMBER		1,140	1,344	1,274	1,367		1,281	1.03
JANUARY	1,020	1,152	1,286	1,268	1,394		1,275	1.02
FEBRUARY	972	1,125	1,324	1,191	1,499		1,285	1.03
MARCH	945	1,108	1,335	1,274	1,647		1,364	1.09
APRIL	957	1,195	1,204	1,238	1,515		1,288	1.02
MAY	974	1,147	1,202	1,273	1,451		1,268	1.02
JUNE	1,022	1,126	1,297	1,300	1,612		1,338	1.07
Total		13,272	15,044	14,566	16,832			
Ave. (Day)		1,106	1,254	1,214	1,403		1,246	1.00

Table A9.5.3 Sherpur (Sylhet)

FERRY. (R.H.D.)

ALL VEHICLE PER MONTH

YEAR / MONTH	79 - 80	80 - 81	81 - 82	82 - 83	83 - 84	84 - 85	AVERAGE (80/81-83/84)	INDEX.
JULY		6086	6421	6767	7177	9792	6613	0.88
AUGUST		5684	6319	6947	7191	9293	6535	0.87
SEPTEMBER		6452	6635	8262	6895	8372	7061	0.94
OCTOBER		7201	8005	8402	7081	9682	7672	1.02
NOVEMBER		6777	6548	7783	6346	9923	6864	0.92
DECEMBER		6825	9044	8876	7770	9871	8129	1.09
JANUARY	5/3790	6353	8379	9339	8122		8048	1.08
FEBRUARY	5646	6018	7545	8298	8624		7621	1.02
MARCH	6632	6326	9602	9031	8760		8430	1.13
APRIL	6123	6184	8917	8349	7968		7855	1.05
MAY	7211	6560	9495	5853	7165		7268	0.97
JUNE	6618	6528	7953	7200	9247		7732	1.03
Total		76994	94863	95107	92346		89828	
Ave (Month)		6,416	7,905	7,926	7,696		7,486	1.00

Table A9.5.4 Kamarkhali (Faridpur)

FERRY. (R.H.D.)

ALL VEHICLE PER MONTH

YEAR / MONTH	79 - 80	80 - 81	81 - 82	82 - 83	83 - 84	84 - 85	4 years AVERAGE (80/81-83/84)	INDEX.
JULY		8936	10,705	10,435	12,316	11,575	10,598	0.91
AUGUST		8559	9,646	9,545	10,928	12,685	9,670	0.83
SEPTEMBER		8552	10,314	10,2~~4~~9	11,080	13,302	10,060	0.87
OCTOBER		9938	10,907	10,601	12,347	13,782	10,948	0.94
NOVEMBER		11,069	10,572	11,511	11,290	13,942	11,111	0.96
DECEMBER		14,748	12,617	13,217	12,791	14,173	13,343	1.15
JANUARY	9,107	12,303	14,245	12,344	14,733		13,406	1.16
FEBRUARY	8,968	10,253	13,198	10,526	13,647		11,906	1.03
MARCH	9,356	11,502	13,210	12,066	13,457		12,559	1.08
APRIL	9,171	9,669	12,413	11,722	12,949		11,688	1.01
MAY	9,257	10,461	12,837	12,311	13,299		12,227	1.05
JUNE	9,538	10,375	11,155	12,316	12,777		11,656	1.01
Total		126,365	141,819	136,888	151,614		139,172	
Ave (Month)		10,530	11,818	11,407	12,635		11,598	1.00

Table A9.5.5 Baeramera (Kushtis)

Table 9.5.5
BAERAMERA (Kushtis)

FERRY. (R.H.D.)

ALL VEHICLE PER MONTH

YEAR / MONTH	79 - 80	80 - 81	81 - 82	82 - 83	83 - 84	84 - 85	2 years AVERAGE (82/83-83/84)	INDEX.
JULY				9,464	7,346	10,541	8,405	1.13
AUGUST				6,034	6,937	9,478	6,486	0.87
SEPTEMBER				7,086	8,304	8,778	7,695	1.04
OCTOBER				6,405	8,672	9,678	7,539	1.01
NOVEMBER				8,171	7,064	8,487	7,618	1.03
DECEMBER				8,[illegible]18	7,227	7,608	7,773	1.05
JANUARY			9,153	8,812	7,474		8,143	1.10
FEBRUARY			8,488	6,952	7,535		7,244	0.98
MARCH			8,803	7,374	6,989		7,182	0.97
APRIL			6,911	6,171	6,943		6,557	0.88
MAY			8,592	7.130	6,717		6,924	0.93
JUNE			9,948	7,993	7,163		7,578	1.02
Total				89,910	88,371		89,144	
Ave.(Month)				7,493	7,364		7,429	1.00

Sectoral Deflator

Year	Agriculture	Construction	Energy	Industry	Service	Transport	Consumer Price Index
1973/74	27.2	20.5	28.1	27.1	26.2	20.9	28.3
1974/75	39.2	34.4	35.2	33.9	36.1	25.8	39.3
1975/76	74.9	62.3	42.8	41.4	56.1	32.6	63.0
1976/77	48.9	63.5	39.3	37.7	50.7	36.5	55.3
1977/78	47.2	56.3	39.8	38.3	48.1	37.4	51.8
1978/79	64.9	58.4	62.3	58.3	53.5	43.2	61.3
1979/80	75.1	61.4	69.5	60.7	66.5	43.2	66.9
1980/81	81.7	75.1	76.4	75.5	77.2	51.0	76.9
1981/82	84.9	92.8	83.6	81.4	85.6	78.9	83.1
1982/83	94.1	106.4	91.1	90.1	96.5	98.3	96.0
1983/84	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source : Bangladesh Energy Planning Project

A 10.1 IWT Freight Flows

Table A 10.1.1 IWT freight flows - food, 1982/83

District	No.	COMMODITY - FOOD		
		Inter District		INTRA DISTRICT
		OUT TON	IN TON	TON
Chittagong	1	318717	234	6673
CHT	2	-	-	-
Comilla	3	6362	2389	-
Noakhali	4	389	-	-
Sylhet	5	788	2143	-
Dhaka	6	2194	338297	125
Faridpur	7	588	23359	-
Jamalpur	8	-	-	-
Mymensingh	9	182	392	-
Tangail	10	-	-	-
Barisal	11	19704	68672	9241
Jessore	12	-	1900	-
Khulna	13	124037	5713	380307
Kushtia	14	-	-	-
Patuakhali	15	4329	34039	575
Bogra	16			
Dinajpur	17			
Pabna	18		152	
Rajshahi	19			
Rangpur	20			
Bangladesh		477290	477290	396921

Source : BIWTA

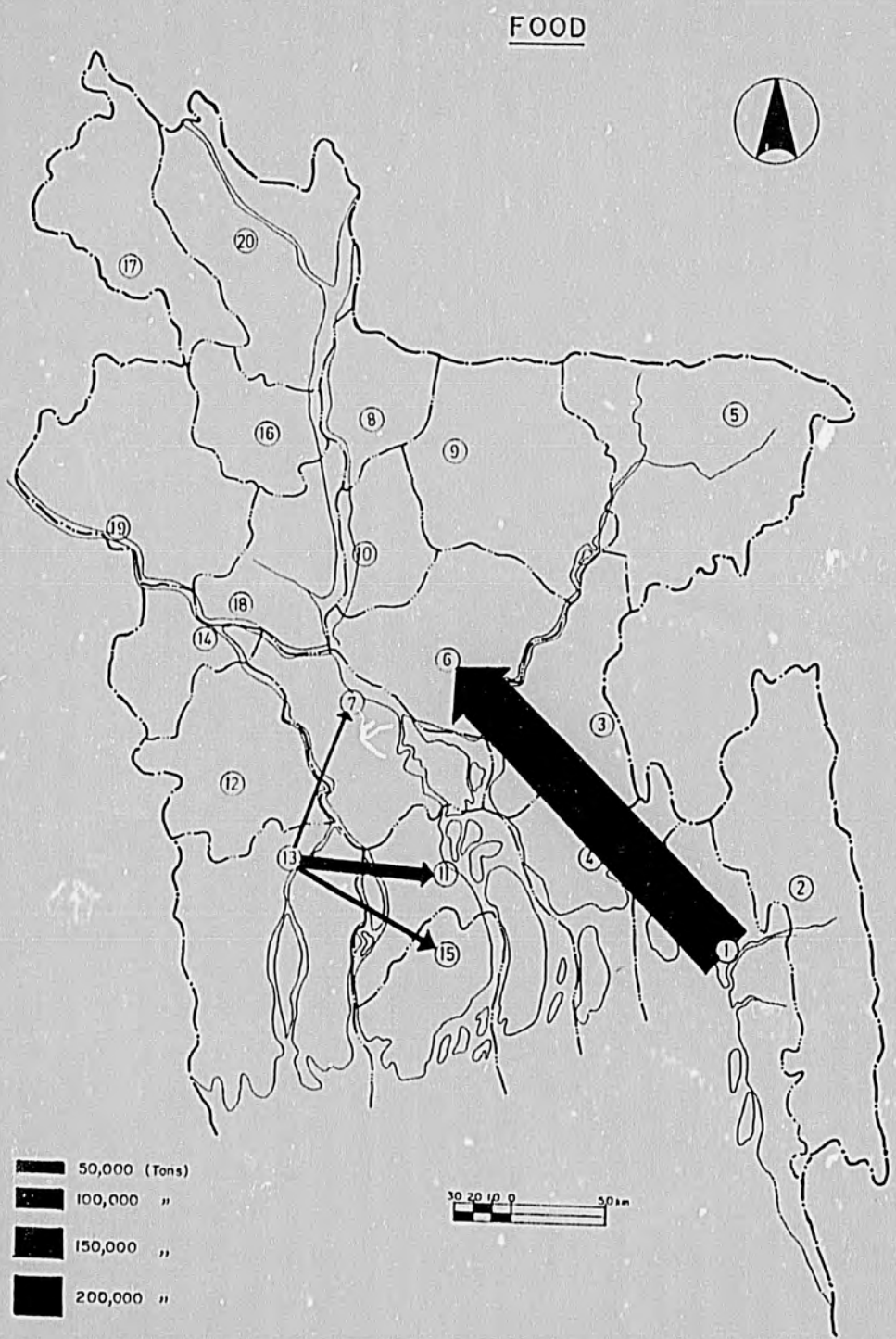


FIG. A10.1 1 IWT MAJOR INTERDISTRICT MOVEMENTS OF FOOD 1982/83

Table A10.1.2 IWT freight flows - fertilizer, 1982/83

District	No.	COMMODITY - FERTILIZER		
		Inter District		INTRA DISTRICT
		OUT TON	IN TON	TON
Chittagong	1	65718		10625
CHT	2			
Comilla	3	21723	7478	989
Noakhali	4		1946	
Sylhet	5		220	
Dhaka	6	110171	50127	62246
Faridpur	7		7551	
Jamalpur	8			
Mymensingh	9		7380	
Tangail	10			
Barisal	11		48533	
Jessore	12			
Khulna	13	17682	74947	37723
Kushtia	14			
Patuakhali	15		5823	
Bogra	16			
Dinajpur	17			
Pabna	18		11289	
Rajshahi	19			
Rangpur	20			
Bangladesh		215294	215294	118583

Source : BIWTA

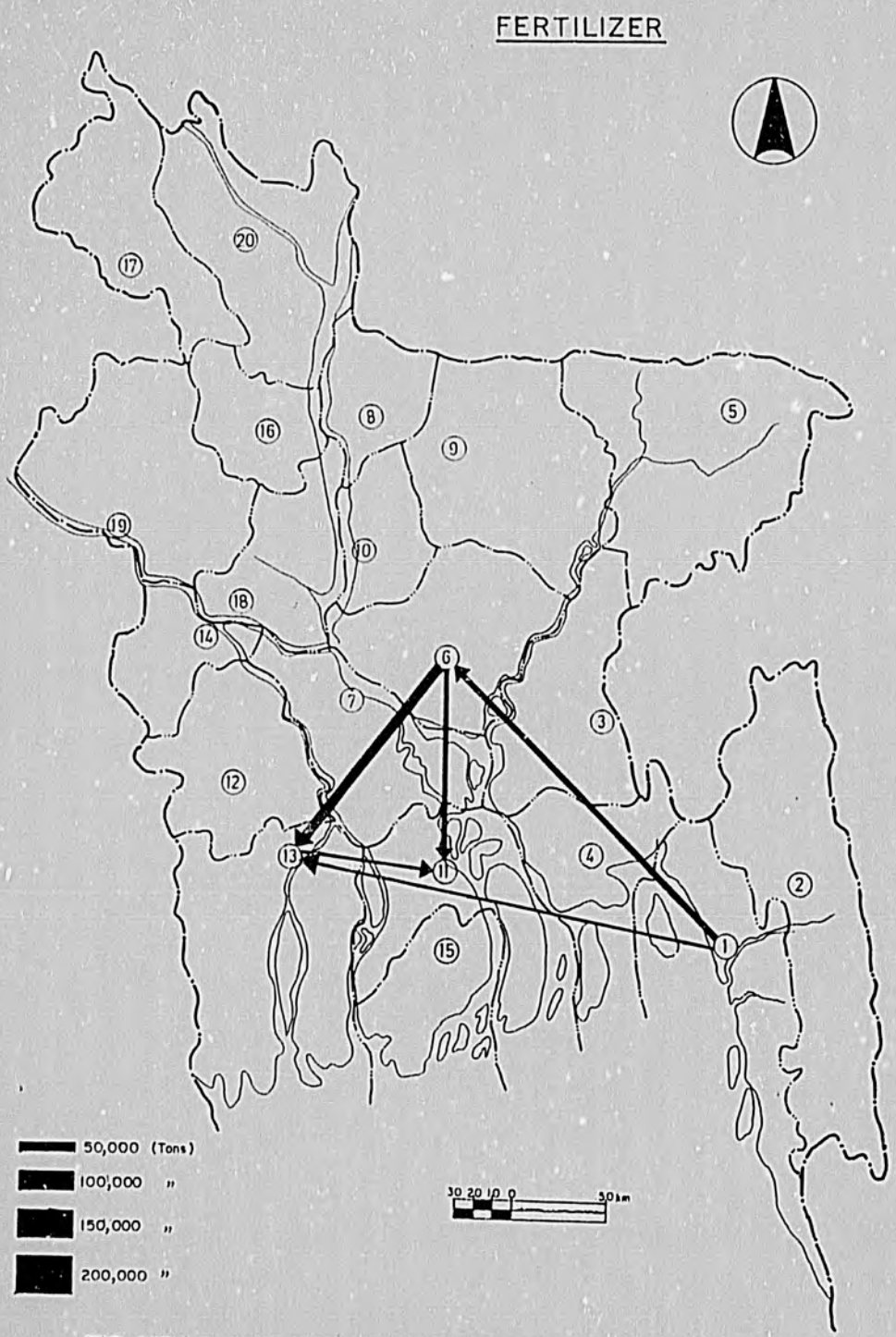


FIG. AIO.1.2 IWT MAJOR INTERDISTRICT MOVEMENTS OF FERTILIZER 1982/83

Table A10.1.3 IWT freight flows - jute and products, 1982/83

District	No.	COMMODITY - JUT F AND PRODUCTS		
		Inter District		INTRA DISTRICT
		OUT TON	IN TON	TON
Chittagong	1	305	38070	
CHT	2			
Comilla	3	11854	1805	
Noakhali	4			
Sylhet	5		313	
Dhaka	6	207629	5064	1375
Faridpur	7	1141	350	
Jamalpur	8			
Mymensingh	9	2490	408	
Tangail	10			
Barisal	11	713	1	
Jessore	12			
Khulna	13	6314	188506	216941
Kushtia	14			
Patuakhali	15			
Bogra	16			
Dinajpur	17			
Pabna	18	3418	250	
Rajshahi	19			
Rangpur	20	903		
Bangladesh		234767	234767	218316

Source : BIWTA

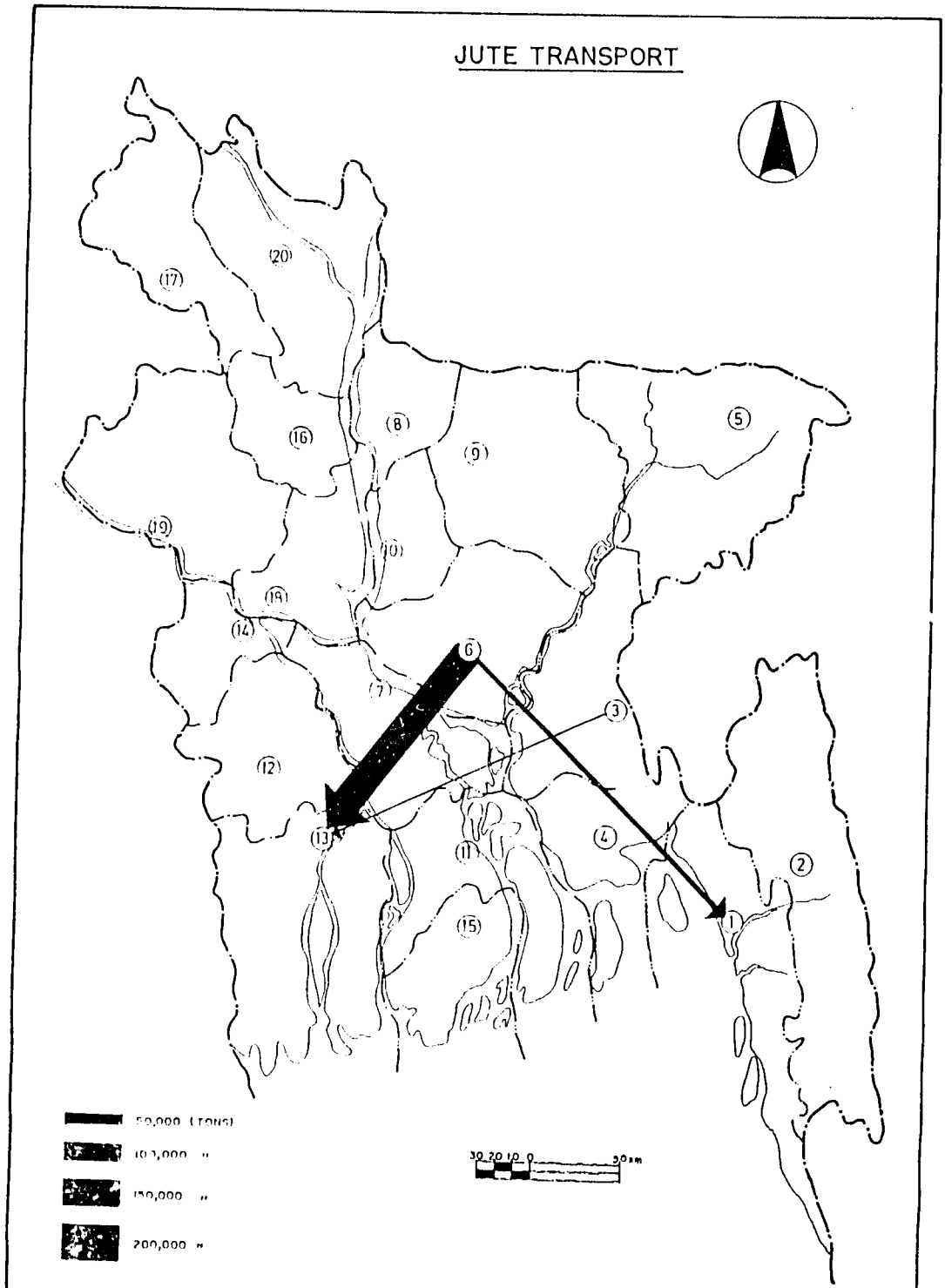


FIG. A10.1.3 IWT MAJOR INTERDISTRICT MOVEMENTS OF JUTE 1982/83

Table A10.1.4 IWT freight flows - cement, 1982/83

District	No.	COMMODITY - CEMENT		
		INTER-DISTRICT		INTRA DISTRICT
		OUT TON	IN TON	TON
Chittagong	1	328488	1861	1550
CHT	2	-	-	-
Comilla	3	2645	3449	-
Noakhali	4	-	-	-
Sylhet	5	30373	-	137
Dhaka	6	3433	342791	-
Faridpur	7	-	-	-
Jamalpur	8	-	-	-
Mymensingh	9	-	1550	-
Tangail	10	-	-	-
Barisal	11	60	13601	-
Jessore	12	-	-	-
Khulna	13	33000	18949	83260
Kushtia	14	-	-	-
Patuakhali	15	-	4762	-
Bogra	16	-	-	-
Dinajpur	17	-	-	-
Pabna	18	-	11036	-
Rajshahi	19	-	-	-
Rangpur	20	-	-	-
Bangladesh :		397999	397999	84947

Source : BIWTA

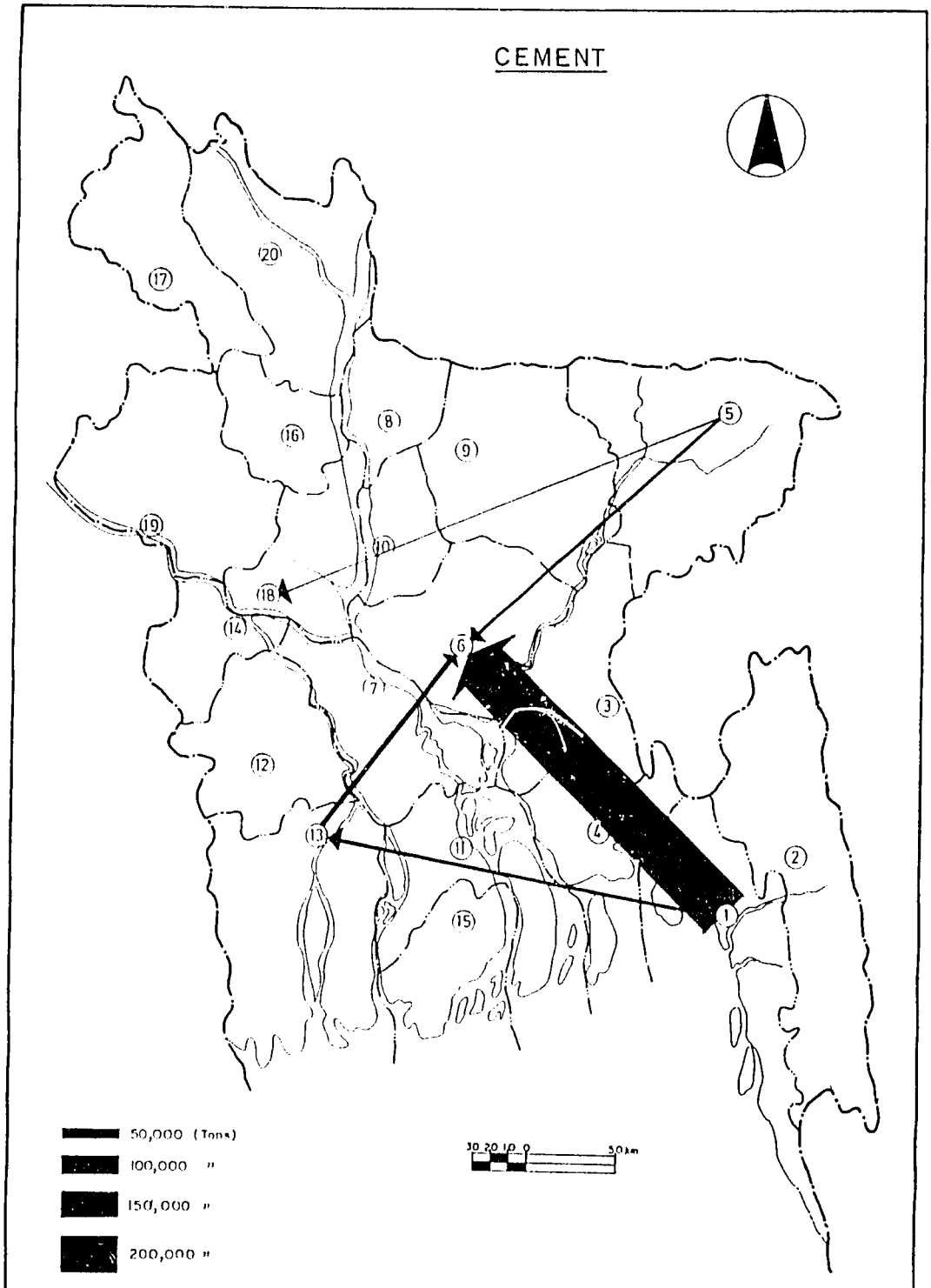


FIG. A 10.1.4 IWT MAJOR INTERDISTRICT MOVEMENTS OF CEMENT 1982/83

Table A10.1.5 IWT freight flows - stone, sand and shingle, 1982/83

District	No.	COMMODITY - STONE, SAND, SHINGLE		
		Inter District		Intra District
		OUT TON	IN TON	TON
Chittagong	1	-	1749	-
CHT	2	-	-	-
Comilla	3	165	33723	-
Noakhali	4	-	-	-
Sylhet	5	143513	-	
Dhaka	6	5150	105495	-
Faridpur	7	23520	1489	-
Jamalpur	8	-	-	-
Mymensingh	9	-	536	-
Tangail	10	-	-	-
Barisal	11	-	8194	-
Jessore	12	-	329	-
Khulna	13	-	16242	-
Kushtia	14	-	-	-
Patuakhali	15	-	1467	-
Bogra	16	-	-	-
Dinajpur	17	-	-	-
Pabna	18	-	3124	-
Rajshahi	19	-	-	-
Rangpur	20	-	-	-
Bangladesh		172348	172348	-

Source : BIWTA

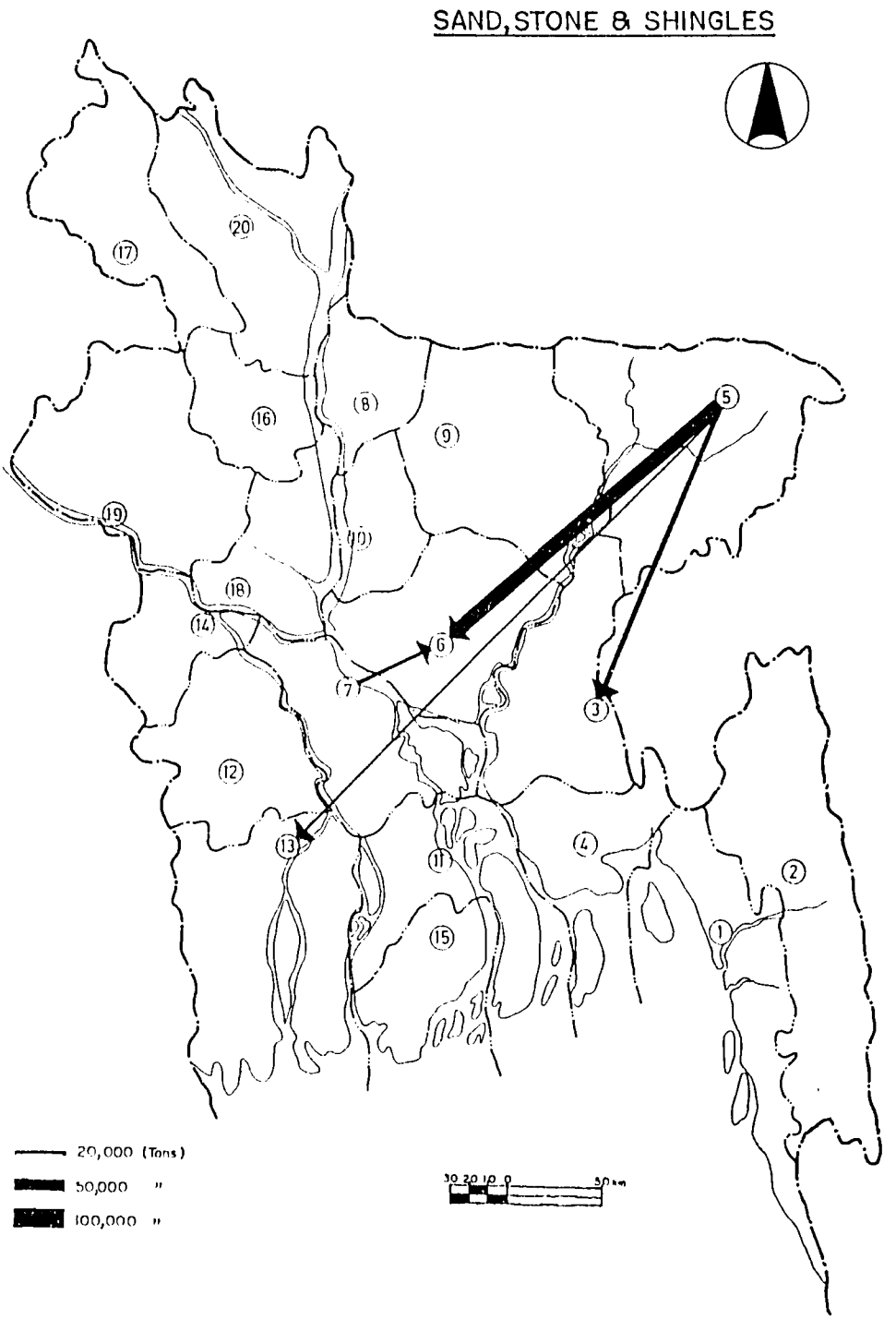


FIG. A 10.1.5 IWT MAJOR INTERDISTRICT MOVEMENTS OF SAND, STONE & SHINGLES 1982/83

Table A10.1.6 IWT freight flows - iron and steel, 1982/83

District	No.	COMMODITY - IRON AND STEEL		
		Inter District		INTRA DISTRICT
		OUT TON	IN TON	TON
Chittagong	1	47781	300	-
CHT	2	-	-	-
Comilla	3	100	-	-
Noakhali	4	-	-	-
Sylhet	5	-	69	-
Dhaka	6	300	44681	-
Faridpur	7	-	280	-
Jamalpur	8	-	-	-
Mymensingh	9	-	-	-
Tangail	10	-	-	-
Barisal	11	-	2062	-
Jessore	12	-	-	-
Khulna	13	2861	3650	1024
Kushtia	14	-	-	-
Patuakhali	15	-	-	-
Bogra	16	-	-	-
Dinajpur	17	-	-	-
Pabna	18	-	-	-
Rajshahi	19	-	-	-
Rangpur	20	-	-	-
Bangladesh :		51042	51042	1024

Source : BIWTA

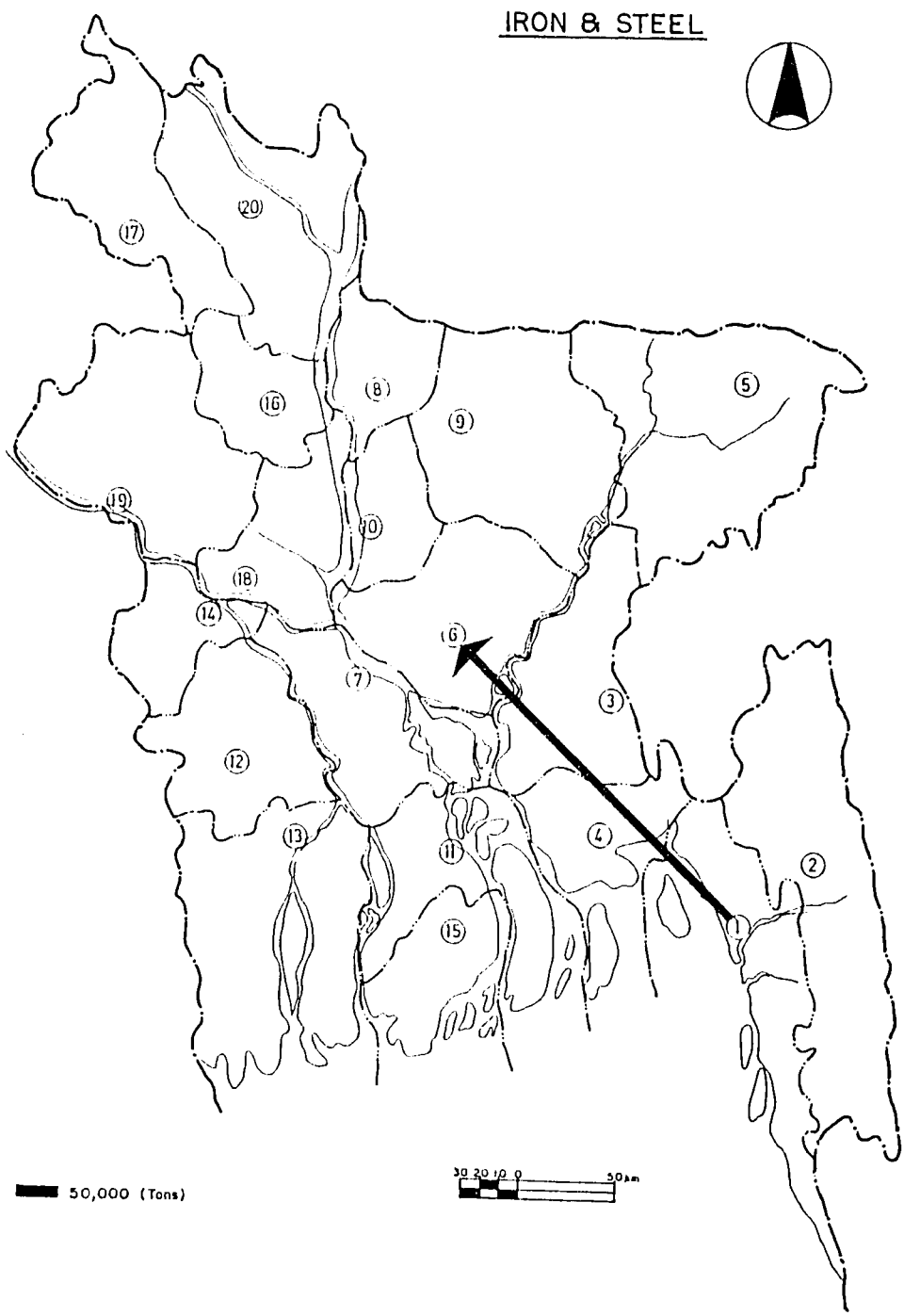


FIG. A 10.1.6 IWT MAJOR INTERDISTRICT MOVEMENTS OF IRON & STEEL 1982/83

Table A10.1.7 IWT freight flows - P.O.L., 1982/83

District	No.	COMMODITY - P.O.L.		
		Inter District		INTRA DISTRICT
		OUT TON	IN TON	TON
Chittagong	1	929084	-	12881
CHT	2	-	43787	-
Comilla	3	-	33924	-
Noakhali	4	-	-	-
Sylhet	5	-	-	-
Dhaka	6	104580	45191	-
Faridpur	7	-	-	-
Jamalpur	8	-	-	-
Mymensingh	9	-	25583	-
Tangail	10	-	-	-
Barisal	11	-	20989	-
Jessore	12	-	-	-
Khulna	13	-	353778	-
Kushtia	14	-	2887	-
Patuakhali	15	-	-	-
Bogra	16	-	-	-
Dinajpur	17	-	-	-
Pabna	18	-	80525	-
Rajshahi	19	-	-	-
Rangpur	20	-	-	-
Bangladesh :		1033664	1033664	12881

Source : BIWTA

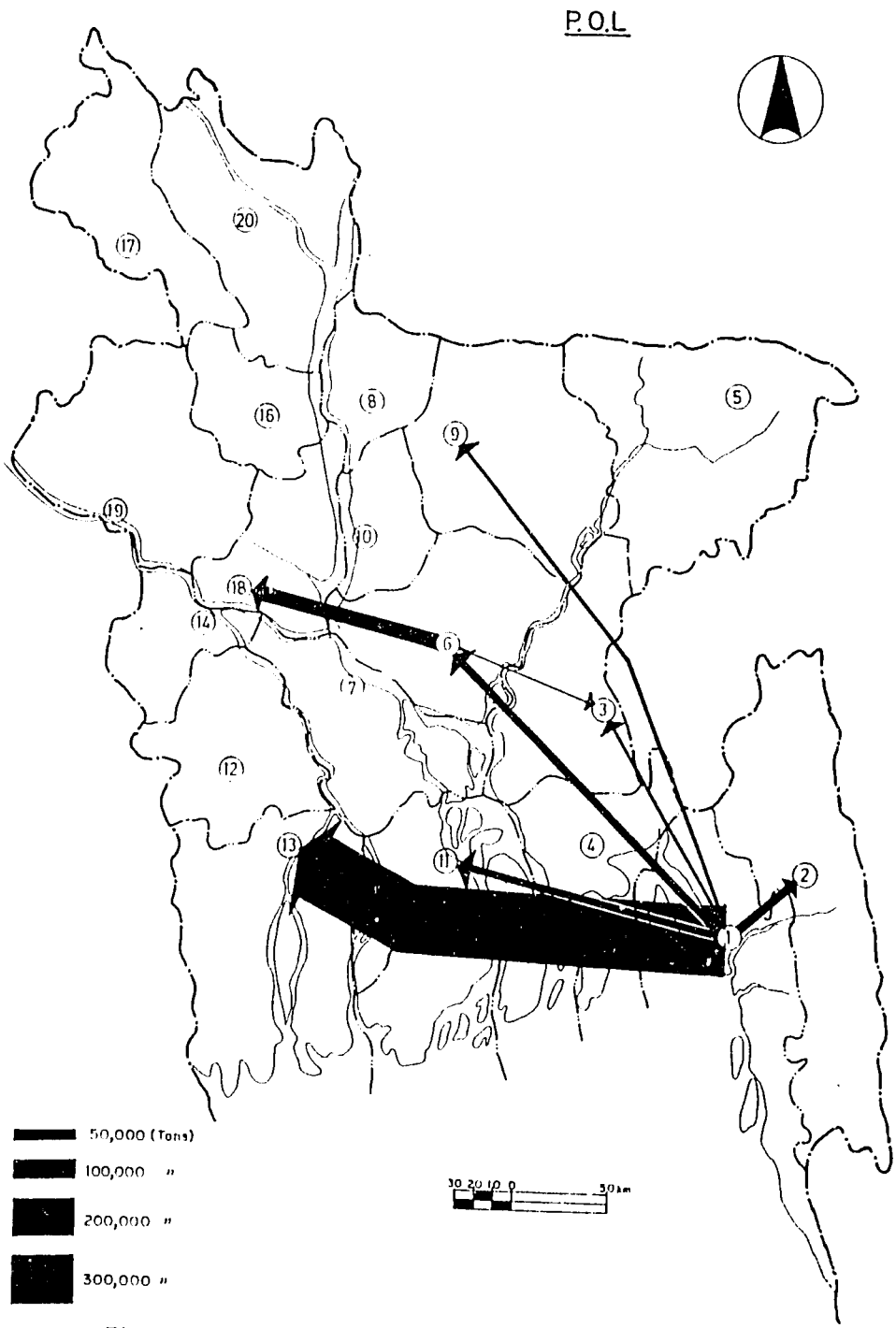


FIG. AIO.I.7 IWT MAJOR INTERDISTRICT MOVEMENTS OF P.O.L 1982/83

Table A10.1.8 IWT freight flows- sundries, 1982/83

District	No.	COMMODITY - SUNDRIES		
		Inter District		INTRA DISTRICT
		OUT TON	IN TON	TON
Chittagong	1	154490	15166	8422
CHT	2	12573	14723	-
Comilla	3	7955	38871	-
Noakhali	4	1784	1682	-
Sylhet	5	4467	12035	11037
Dhaka	6	13160	127230	751
Faridpur	7	1244	511	196
Jamalpur	8	-	-	-
Mymensingh	9	329	1351	-
Tangail	10	-	-	-
Barisal	11	8406	10058	4026
Jessore	12	-	-	-
Khulna	13	42552	18540	120222
Kushtia	14	-	-	-
Patuakhali	15	5270	5002	145
Bogra	16	-	-	-
Dinajpur	17	-	-	-
Pabna	18	851	7912	200
Rajshahi	19	-	-	-
Rangpur	20	-	-	-
Bangladesh		253081	253081	144999

Source : BIWTA

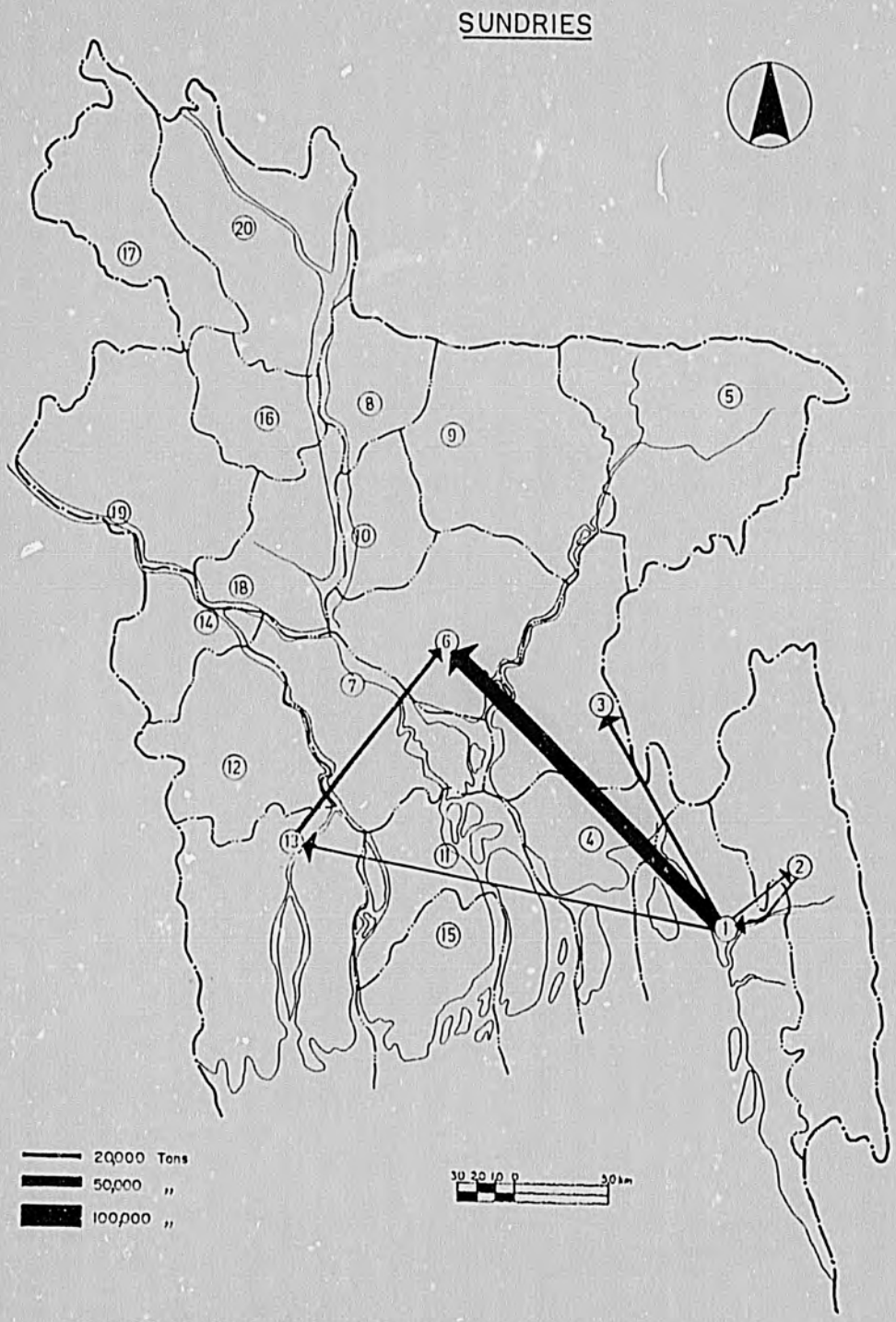


FIG. A10.1.8 IWT MAJOR INTERDISTRICT MOVEMENTS OF SUNDRIES 1982/83

APPENDIX TO CHAPTER 11

A11.1 Container System Analysis Guidelines

At the request of the Asian Development Bank the following is provided as System Analysis Guidelines for the analysis of future container handling, its space requirements, equipment, its maintenance, storage of containers, receiving and delivery, and the sorting of freight in containers with more than one consignee. The scope of these guidelines will be limited to the conceptual over view for the operational plan.

A11.1.1 Discussions

A container terminal must be analysed as a system. It consists of many elements in the process of container and freight movement to and from the ship and consignee. Each of these elements should perform at a capacity that does not retard the overall designed throughput capacity of the system or the overall throughput will be limited by that element with the least ability to perform. For example, a long delay in the clearance of container freight by customs could be a major limiting factor in the planned throughput of the terminal. Another example could be yard space limitations for the handling and storage of container units, resulting in yard congestion handling problems.

The elements to the system are essentially as follows :

(1) Vessel berth availability and the proce s of moving the vessel to and from the berth.

(2) Berth occupancy (time the vessel is at the wharf)

(3) The movement of containers between the ship and the berthing wharf or pier.

(4) The movement of containers between the berthing area and the storage yard.

(5) Storage yard space requirement and the ability to identify and select the required container.

(6) Customs and customs clearance.

(7) The movement of the container to the selected mode from the storage area on to its final destination.
Each of the above should be so designed and operated as not to limit the desired and designed throughput of the facility.

Note : According to the Chittagong Port Authority Year Book 1982-1983. The container terminal is expected to handle 40,000 units by 1985-86 and 90,000 containers per year by 1989-90. This assumption of projected growth must be carefully reviewed as the number of containers to be handled is the determining factor in the terminal design and equipment needs. Alongwith this analysis the question of seasonal variations, if any, must be carefully checked. It is also noted that in the initial years of container handling vessel

equipment will be used for the movement from ship to wharf. This could be a major factor in the reduction of throughput. Unless the vessel is specifically designed for container handling the rate of discharge will be limited to about 4 to 5 units per hour per vessel. In addition to the number of containers to be handled there are extensive time elements lost in the removal and replacement of vessel hatch covers. Other delay factor are the usual need to unload and reload containers over stowed, for other destinations. This factor can be as high as 10% of the total units handled. Involved with the restow problem is the need to restow for vessel stability purposes. Provision for the future use of rail mounted wharf container cranes, with handling capacities of 20 to 25 containers per hour, should be included in the berth design.

A11.1.2 Container storage

It is assumed that there will not be direct movement from the wharf to the next element of operation without a period of yard storage delay. This is also a factor to be considered for inbound containers, both loaded and empty. Therefore, it is important in the determination of yard space requirement to analyse the storage requirements. In the case of Chittagong the storage of containers awaiting either the next handling element or the arrival of the next company vessel for the outbound move could be lengthy. This could result in the need for an extremely large, heavily paved storage area. In this regard and tntil computer tracking and storage location information is available for control, the best method of yard storage is to provide leased and separate space to the shipping companies. Another method for controlling long terminal for storage is to require the container owners to store their own containers in areas outside of the port terminal. Containers would only be moved into the terminal at the vessel arrival and during its stay at the berth.

Sufficient berth availability is the first element of the system that can limit the design through-put. The time spent by a vessel awaiting a berth can vary in accordance with the following factors.

(a) The number of container vessels that may arrive at a given time.

(b) The length of time it takes to load and unload a vessel and move it from the berth.

(c) The number of berths available and the amount of handling equipment on hand to service the containers.

(d) Working hours of the terminal.

(e) Availability of tug boat assistance and, possibly, of pilots.

If these variables are reasonably known through port records, the theoretical waiting time and number of berths required can be calculated.

A11.1.3 Container transfer between the wharf and the storage yard

The most practical method for moving containers to and from the ship is by direct movement from shipyard trailer and yard tractor. The tractor design should provide for a short turning radius. The yard trailer is a rugged but simple and relatively inexpensive. It can be designed to handle both the standard container sizes of 20 feet and 40 ft.

The number of tractors and trailers required is based on two factors, first the distance between the ship side and the storage area and secondly the speed at which the containers are handled on and off the vessel.

For example : If it is assumed that the round trip distance between the vessel and the centre of the storage area is say 1,600 metres, the average speed should be approximately 13 - 16 km/hour. At this speed the movement should take about 6 minutes. Adding say, four minutes for the off loading by a fork truck in the storage yard, the cycle time will be 10 minutes. On this assumption the number of tractor trailer combinations required would be as follows :

Moves to/from Vessel/Hour	Vessel Cycle Time (Min)	Tractor Cycle Time	Number of Tractor/ Trailers Required
6	10	10	1
18	3.3	10	3
24	2.5	10	4
30	2.0	10	5

(Allow for at least 1 additional tractor/trailer as a spare)

A11.1.4 Yard storage

There are four (4) basic yard handling and storage methods employed by ports and vessel owners. Each has its own space requirements, cost disadvantages. They are :

1) Storage on over-the-road truck trailers (from ship to storage to delivery),

2) Grounded storage using a fork truck equipped with an overhead automatic spreader for engaging the corner casting of the container.

3) Straddle carrier

4) Large traveling overhead straddle crane.

For this analysis the first method can be eliminated. It is a costly, but highly productive, relatively damage free system. It is employed where super highways are the primary method for inland movement, and where storage space and special tractors and trailers are readily available.

The grounded storage method using fork trucks is the preferred system for use in Bangladesh.

It provides the least cost and good use of storage areas. However, this method can cause significant container damage if the fork truck operators are not well trained and careful.

The sizes of fork truck say of 10 tonnes can be used for handling empty units and 25 tonne units can be used for full containers, of 20 tonne.

Under this system loaded containers are stocked 2 high and 2 deep and empty containers three or even four high and three deep. In practice this usually average at 1.5 high for loaded containers, empty containers averaging 2 high.

One draw back to this system is the need to rehandle containers. Often the unit required is at the bottom of the stack, thereby requiring the top unit to first be relocated for accesability to the bottom unit.

When the number of moves that can be expected, that is from yard trailer to ground and from ground to outbound vehicle, (rail, truck or barge) or from inbound vehicle to ground, from ground to ship, from ground to customs areas, or from ground to yard trailer to a container freight station and return are reasonably known the number of fork trucks required can then be assessed.

However, a rule of thumb can be applied. That is, each machine, if maintained properly, should produce about 3000 working hours per year. The estimated economic life for this type equipment is only 7 years. Annual maintenance costs can be estimated on the accepted basis of 5% percent of purchase cost.

This will equate to about 290 loaded TEU per hectare (twenty foot equivalent units, a mix of 40 feet and 20 feet units), Empty containers should store at the rate of 500 TEU.

The question regarding the advantage or disadvantages of using fork trucks with overhead, adjustable spreaders for the handling of containers, or mobile straddle carriers, has been controvercial for 20 years, with advocates for both system. The early use of straddle carriers by most terminal operators proved disasterous, the units initially purchased not being designed for container handling. As a result they spent more time under repair than in operation. More recent users and the manufactures now claim they are superior to the fork truck. The straddle carrier is propelled by an independent motor generator driving electric motors on each of the four wheels. The fork truck is driven by a conventional petrol or diesel engine. It would appear from a maintenance and repair aspect better to use the single engine fork truck instead of the six drive components of the straddle carriers.

However if wheel loading in the storage of handling areas is a major consideration fork trucks are more damaging, due to high wheel loadings.

The larger overhead straddle carrier is used when space is limited, and allows for high density storage. Containers can be stored six or more wide and 3 or more high. The disadvantages of this system are poor accessibility for a selected container, very high initial cost and high, maintenance and operating costs. If this machiner breaks down it stops most other elements in the terminal.

For the following reasons the fork truck with overhead adjustable lifting spreader bar is recommended.

i) It is less expensive to acquire and operate than other systems,

ii) It is more practical in a system where there are multiple users,

iii) The Chittagong port already has such equipment and should be familiar with its operation.

iv) Down time of one unit does not impact on the system as would a large overhead straddle crane.

Major disadvantages is it requires about one third more storage and operating space.

A11.1.5 Container freight station

It can be expected that a certain percent of the inbound and outbound containers will have freight for more then one consignee (This matter must be studied on the basis of a present and future growth). These are known as L.C.L. (Less then container Load). In these cases a separate building is provided for stripping and packing the container freight. This building is known as the container freight station (CFS). The size of the freight station and its required container backing in space must be determined for both the present and future.

As a part of this analysis the density of the expected freight must be estimated. At this time the inbound freight per container appears to average 11.5 tonnes.

For half the year open air stuffing is feasible. However during the rainy season some semi-covered space with ready access must be available for the stuffing.

If small electric fork truck are used in the CFS storage heights should be approximately 5 to 6 feet. Approximately 40 percent of the floor space will be utilized for aisles. Again, the amount of time the freight stays in the station will greatly effect the design size of the building. Requirements are based on the expected number of containers to be handled in a day and the production loading/unloading rate of the workers.

As each container at the station represents more then one consignee the freight must be segregated and prepared for arriving pick up trucks or rail cars. As the number of trucks or rail cars will be greater than containers, sufficient back up space or rail sidings at the loading platform must be available.

A11.1.6 Vehicle entrance & exit to the container terminal

It is assumed that the terminal complex will be fenced for security reasons.

For the same reasons the gates should be restricted to one location. The number of gates will be determined by the amount of freight that will have to be passed through for local delivery, or receiving.

A11.1.7 Maintenance

The amount of handling equipment required in the container terminal can not be determined until throughput analysis is made. Hence the equipment maintenance repair shop space requirement can not be determined until this studied. It will however, be greater than at present and provision for spare aprts and tools provided. Space must also be provided, at a convenient area, for a fueling station.

A11.1.8 Rail movement

Inland rail movement of full containers and freight from the CFS could be provided. Examination of present rail way bogie wagons indicates that their size and loading limits (17 to 37 ton) would be adequate for the rail movement. Selected rail cars, would have to be stripped to the bare frame and provision made for securing the container corner castings to the rail car. (Assuming wagons are available in the number required). Covered wagons would be used for the L.C.L freight from the C.F.S. Space. Sidings would have to be provided for storage and handling wagons. Again the fork truck with adjustable overhead spreader would be the recommended means for handling. Unlike wagons, the container access doors are at the rear of the unit. This means that any selected rail terminal away from the port would have to be equipped with a handling method to load or unload the container from the wagons. Additional facilities at these locations may also be required for the LCL freight. The new railway linercrane for containers, now under trial in the U.K. may provide the economic answer.

A11.1.9 Reefer containers

Refrigerated containers will also have to be handled. A forecast of this traffic must be made and provision for electric power provided for the refrigerated units while in the storage yard.

A11.1.10 Facilities maintenance

If a facilities maintenance shop is not already available, an area for its equipment and supplies, along with a work shop, should be provided.

Consideration should also be given to the provision of a worker's shelter, lunch room and toilets.

A11.1.11 Water transport

Three methods of transporting containers by water should be examined. They are :

i) by low draft flat decked barge.

ii) by Roll-on-Roll-off type ferries,

iii) small feeder ships for open water bay crossings.

Each may have its disadvantages the barge concept of landing the container on the deck with out wheels will necessitate additional handling equipment at both ends of the voyage. Draft limitations may allow storage on deck of only one unit per space.

Roll-on-Roll-off ferries would require each container be mounted on wheels with tractors available at both ends.

A11.1.12 Terminal tariff charges

It is readily seen that the building and operation of a container terminal can be expensive and its operation highly costly. The building and operations expenses can be costed with a fair degree of accuracy. Each element of the terminal will have to bear its share of these costs as provided in a Port Container Terminal Tariff. In addition to setting forth the charges the tariff should also carefully set forth the Rules and Regulations regarding the entire operation. The tariff is detailed study in itself.

A11.1.13 Terminal traffic and control

A control process must be established and policed. The process must be strict and once established, adhered to. Container locations and their contents must be carefully checked in order to avoid confusion and losses. The movement of containers, vehicles, and people in and out of the Terminal must also be controled. Pilferage of small items in the world's ports has always taken place, now it is pilferage of entire containers.

All containers in or out bound at the terminal must be inspected for damage, in order to avoid damage claims against the terminal operation.

The container storage yard foreman should not release a container without a specific order. Origin, destination, consignee, shipper, contents, weight, location time in, time out, shipping company, vessel, size of item, forwarder and mode must all be documented.

The container control office should at all times knows exactly where any given container is located. For example, in storage in customs, in the CFS, on rail, on vessel its destination etc. This information should be checked daily and the dates & times noted.

A11.1.14 Wharf container crane

Due to the probable major use of vessels (barges) for the inland movement of containers, thus double handling early consideration should be given to the use of wharf container cranes. These are very expensive but have handling capacity of about 25 containers per hour. For vessel loading and unloading these can be used approximately 40 percent of the time to both load & unload the vessel simultaneously. The transfer from ship to wharf and then to barge without such cranes will lead to excessive vessel delay berth costs and should lead to long delays, resulting in vessel delay charges.

A11.2 Customs Procedures

Customs receipts represent a major source of the Government income. Review of present operating practices indicates a serious need to improve its efficiency, as they represent yet another delay factor in the movement of goods from ship to consignee.

Many of the present rules, regulations and formalities are outdated and must be revised to reflect increased volumes of freight. The recent introduction of General Cargo in containers and pre-strapped unitized shippers pallets makes this revision imperative.

Delays associated with customs clearance have an economic impact on the cost of inventory. Long delays in customs clearance are a cause of the present shortage of godown space. (Sub-section 11.2.2 2 Planning).

The primary reasons for customs delay are :

a) Disputes on the valuation of goods, and excessive time in evaluation.

b) Late arrival of the Bill of Entry after cargo is discharged from the vessel.

c) Importers, in many cases understating the value of the goods.

d) Lack of readily available guidelines for goods classification (the present listings are not organized and call for time-consuming paging).

e) Restricted banking hours for the handling of letters of credit, pay orders and other required banking functions.

f) Inadequate facilities for Customs Agents at the godowns and jetties.

g) Inaccurate tallies of cargo by the stevedore checkers.

h) Individual shipments are separated and sent to various storage areas, causing location and tally count problems.

i) Excessive opening of cargo shipments for customs inspection when random sampling is usual elsewhere.

j) The issuing by the Port Authority of large numbers of licences for stevedores, many of whom employ unskilled tally clerks, supervisors and labour. This result in poor tally counts, delays to goods clearing due to misplaced shipments in storage.

k) More rigid standards are required to certify bonafide clearing Agents.

l) Improvements are required in the coordination between Customs and the Port Authority.

Present Customs procedures are such that goods are often detained for periods of 30 days and longer. A clear need is evident that the formalities of customs clearance must be streamlined to the point of clearing goods within 7 working days. This applies particularly with containers with large daily hire charges.

As an example of unnecessary delay, customs control the goods off-loaded from inbound ships to lighters, coastal vessels or barges until they are landed in the port. Cargo off-loaded while at anchorage comes under what is known as the Green Boat Rules and is taken to a special secured port area until an unloading jetty is available. When an off-loading jetty is available the vessel is released from the security area and is placed under Blue Boat Rules. However, due to the lack of jetty space, the vessel may wait 10 to 15 days under the Green Boat Rules.

It is evident that a total study review of present customs practices and procedures must be made to increase its efficiency. The economic costs of vessels delayed, godown space requirements, delays in shipments, especially in spare parts for maritime, industrial machines and handling equipment, is judged to be extremely high, unnecessary and questionable as to its benefits in revenue collection.

In the United States, port arriving vessels, particularly container ships, are cleared by customs before the vessel arrives at its berth. Vessels cargo manifests are forwarded to customs. They pre-determine those shipments that are to be opened for inspection and gives prior notice to the consignee of their intent.