6.2 Traffic Forecast

6.2.1 Basic Concept

The volume of cargo handled at a port is closely connected with the social and economic activities in the port's hinterland.

Thus, the port's future cargo handling volume is generally forecast based on the past correlation between cargo handling volume and major socioeconomic indices and future forecasts of these indices.

The basic cargo data of Dhaka and Narayanganj Ports for cargo forecast are shown below.

1. TAPP (Technical Assistant Project Proposal) by BIWTA
2. One Month Field Traffic Survey by the Study Team
3. Annual Ports & Traffic Reports 1982/83 by BINWA.

But each of these three sets of data are insufficient or incomplete.

As for TAPP, only the total cargo volume at both Ports is presented, and the cargo volume by commodity is not listed.

The One Month Field Traffic Survey presents the handling volume by commodity, by jetty and by vessel type and the OD by commodity for one month but because the study period was only one month, the annual handling volume and the seasonal variation are not presented.

The Annual Ports & Traffic Reports 1982/83 presents the anuual cargo flow by commodity between port and port in the entire nation, but these cargo flow figures are only based on registered vessels.

In this JICA report, the hinterlands of Dhaka and Narayanganj Ports are established based on their reports (including Annual Ports & Traffic Report 1982/83) prepared by BIWTA , and on the results of the OD survey carried out by the study team from February 18, 1986 through March 19, 1986, the study team uses the data of the Annual Ports & Traffic Report 1982/83 as the basic figures for the cargo forecast.

As for Chittagong and Chalna Ports, past cargo data are available for more than ten years.

The Third Five Year Plan (TFYP) starting from 1985/86 states various target values for the year 1989/90.

There are also various useful reports such as the "Intermodal Transport Study" and "Transport of Containers in Bangladesh" concerning Bangladeshi Transport. The study team refers to these reports in projecting future cargo handling volume at the study ports.

First, the study team forecasts national cargo volume by commodity based on past economic indices and the past cargo volume of imports and exports.

The study team then forecasts cargo handling volume at Dhaka Port (include Narayanganj Port) considering the future share of the three transportation modes and the future social and economic activities in the port's hinterland.

There are no plans for new industry in the Dhaka zone in the near future, so the study team forecasts future commodities mainly based on past data.

The study team only considers transportation between zone and zone, and excludes the movement of cargo within zones by country boats and passenger launches.

The number of passengers in the future is also forecast first for the entire nation, and the number of passengers to be carried by IWT in Dhaka zone is then forecast based on the future transportation mode share and the regional share.

6.2.2 Hinterlands of Dhaka and Narayanganj Ports

According to the study team survey and BIWTA's report, the major commodities via both ports at present are Food grains, Fertilizer, Cement, Iron & Steel, POL, Jute and Jute goods. At Dhaka port, incoming cargoes from Chittagong, Khulna and Jessore are transported to the Dhaka zone, Comilla, Mymensingh and Sylhet.

At Narayanganj port, incoming cargoes from Chittagong, Khulna, Comilla, Rangpur, Faridpur and Jamalpul are transported to the Dhaka zone, Mymensingh, Tangail, Jamalpur and Comilla. As for outgoing cargoes at Dhaka port, cargoes produced in the Dhaka zone are transported to Barisal, Khulna and Patuakhali.

At Narayanganj Port, cargoes produced in the Dhaka zone, Mymensingh, Rangpur, Tangail and Jamalpul are transported to Khulna, Comilla and Mymensingh.

The hinterlands of Dhaka and Narayanganj Ports by major commodity are considered below.

(1) Food grains

The staple food of Bangladesh is rice. The production of rice has been increasing recently.

However, the domestic production of rice is not sufficient to supply the national consumption, and thus Bangladesh is forced to import rice.

About 40% of the domestic rice production takes place in

Rangpur, Mymensingh, Tangail and Jamalpur, and these areas have a surplus of rice. Rice is carried into the Dhaka area from these surplus areas and from overseas.

According to the study team survey, imported rice is transported from Chittagong and Khulna to Dhaka, and domestic rice is carried from Comilla, Dinajupur, Pabna and Mymensingh to Dhaka.

(2) Fertilizer

At present, there are four fertilizer factories situated at Chittagong, Fenchugonj (Sylhet), Ghorasal (Dhaka) and Ashuganj (Comilla).

The annual production of the factories is 75 thousand tons at Chittagong, 66 thousand tons at Fenchgonj, 195 thousand tons at Ghorasal and 379 thousand tons at Ashuganj in 1983/84. (1984 - 85 Statistical Yearbook of Bangladesh) Thus 90% of the domestic fertilizer production takes place near Dhaka.

According to the study team survey, fertilizer is transported from Chittagong, Khulna and Comilla to Mymensingh, Tangail, Jamalpur, Faridpur, Barisal, Rajshahi and Rangpur via Dhaka.

(3) Cement

There are two cement factories, Chittagong and Sylhet (Chhatak), in Bangladesh at present.

According to BIWTA's report, cement is handled at Dhaka and Narayanganj Ports.

However, during the study team survey cement was only handled at Dhaka.

Part of the cement transported from Chittagong, Khulna and Jessore is consumed and stocked in the Dhaka area and the rest is transported to Mymensingh, Comilla, Sylhet, Tangail, Faridpur and Jamalpur via Dhaka. New fertilizer factories are proposed to be built at Bogra, Rangpur and Sylhet in the future.

If these factories are constructed, these areas will become self-sufficient in cement, and the volume of cement transported via Dhaka will decrease.

(4) Iron & Steel

Chittagong Steel Mill, the only steel plant in Bangladesh, produces rods and sheets using imported scrap and pig iron.

In addition, there are many steel rerolling mills in Dhaka, Chittagong and Khulna, but all of these steel mills depend on imports for most of their raw materials except for some local scrap.

According to the study team survey, iron & steel from Chittagong, Khulna and Barisal is mostly received at Dhaka Port and is consumed in the Dhaka area.

At present only a small volume of iron & steel is transported to other areas via Dhaka, but in the future iron & steel will be transported to northern areas via Dhaka as well as cement.

(5) Petroleum products

There is currently no production of crude oil in Bangladesh. Therefore, all crude oil and some petroleum products are imported at present.

Imported crude oil is refined at the only Bangladeshi

refinery located in Chittagong, and the petroleum products produced at Chittagong are then distributed to various storage facilities. Two of these petroleum products storage facilities, Fatullah (Dhaka) and Godnail (Narayanganj), are located in the Dhaka area. The study team could not grasp the transportation patterns of petroleum products at Fatullah and Godnail during the study team survey. However, according to BIWTA's report, pertoleum products are transported to Comilla and Pabne by IWT via Dhaka.

The study team presumes that the petroleum products which are transported to Mymensingh, Tangail and Jamalpur in the northern part of Dhaka via Dhaka are primarily used as fuel for motor vehicles and factories.

These petroleum products, like other products transported to the northern part of the Dhaka area, are carried by transportation modes other than IWT.

(6) Jute

Except for a small area in the south, jute is produced throughout Bangladesh. The jute is first gathered together at numerous pressing stations located throughout the country.

About 40% of the pressing stations are located in the Dhaka area.

According to the study team survey, almost all the incoming and outgoing jute in the Dhaka area is handled at Narayanganj Port.

Incoming jute is brought together from Comilla, Rangpur, Faridpur, Jamalpur, Mymensingh, Sylhet, Pabna and Dhaka, and is mostly carried out to the pressing stations in the Dhaka area. Outgoing jute is brought together from Dhaka, Mymensingh, Rangpur, Tangail and Jamalpur, and is mostly carried out to the

Dhaka area for production of jute products. The rest of the jute is carried out to Khulna and Chittagong for export.

About half of all the jute goods produced in Bangladesh are produced at jute mills of Dhaka and Adamjee (Dhaka).

(7) Jute goods

Like jute, almost all the jute goods in the Dhaka area are handled at Narayanganj port.

According to the study team survey, incoming jute goods are brought together from Comilla and other areas, and are mostly carried out to the Dhaka area.

Outgoing jute goods are mostly produced in the Dhaka area and carried out to Dhaka, Jessore, Chittagong and Pabna. Most of the jute goods that are transported to Khulna and Chittagong are then exported.

The port hinterlands by commodity based on the study team survey are shown in Fig. 6.2.1 - Fig. 6.2.3. The cargo movement between the Dhaka region and other regions based on the OD Table from BIWTA's report is shown in Fig. 6.2.4.

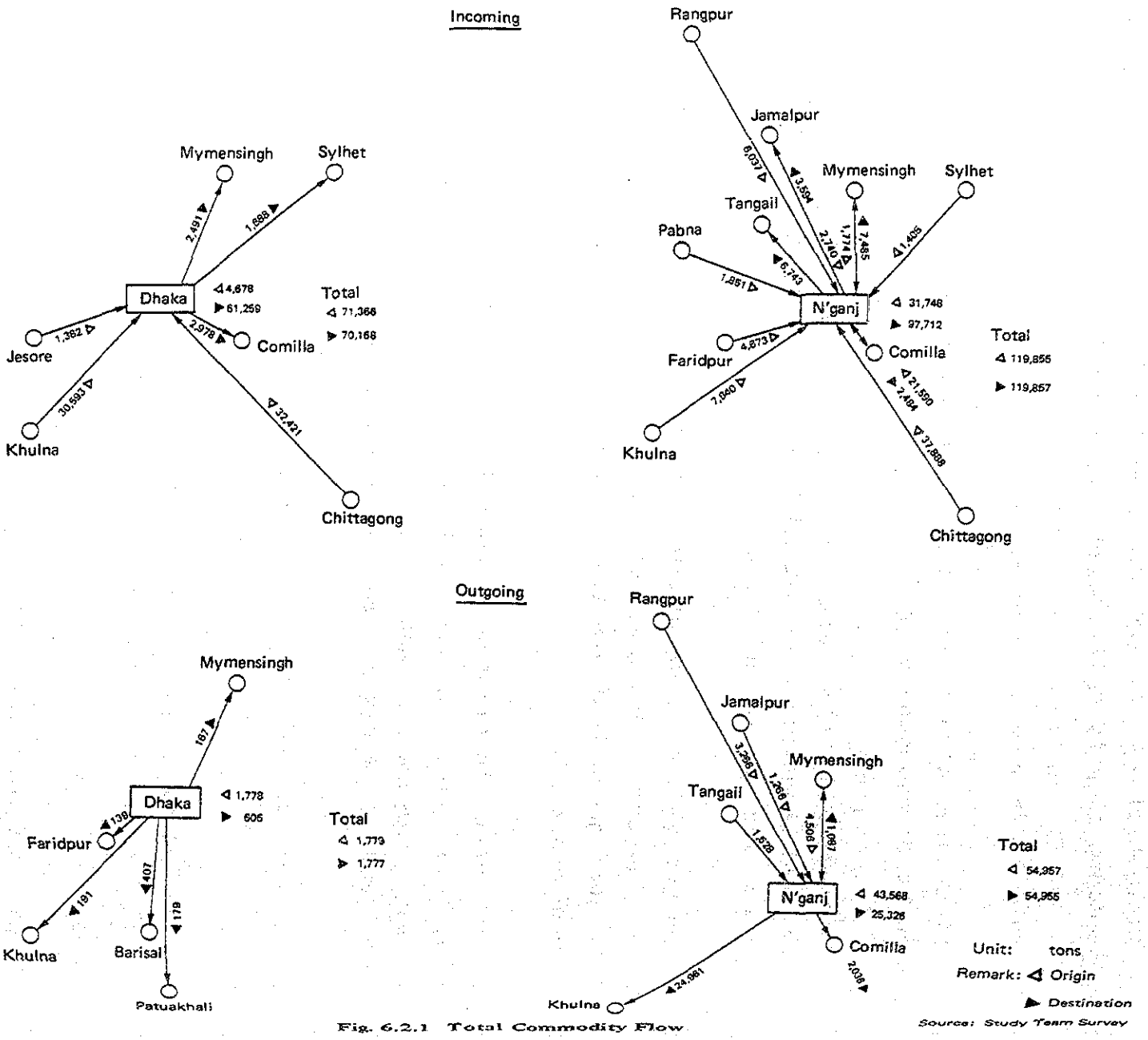
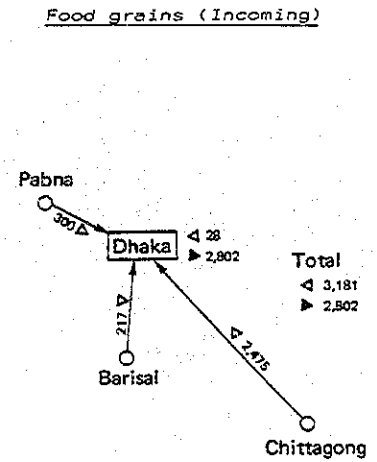
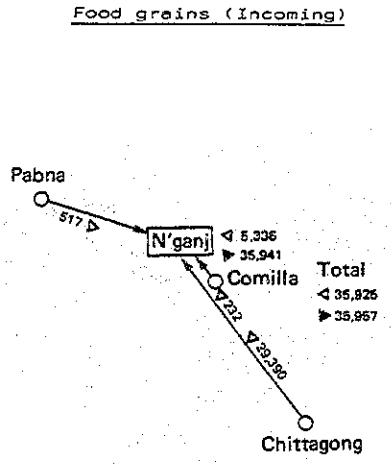
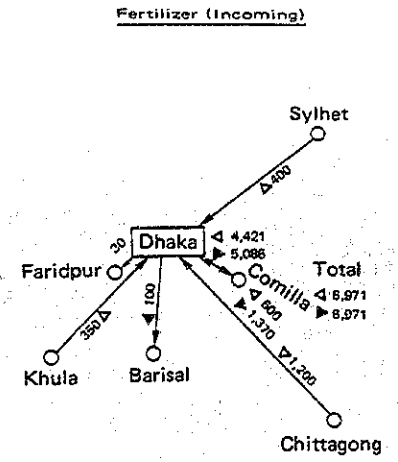
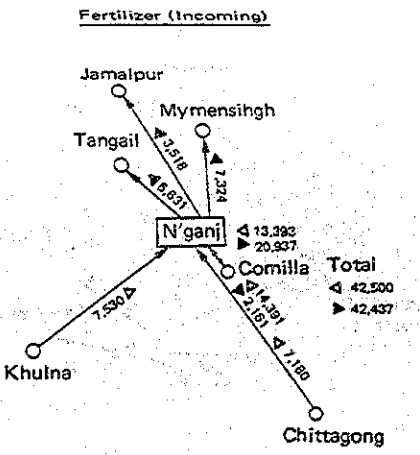


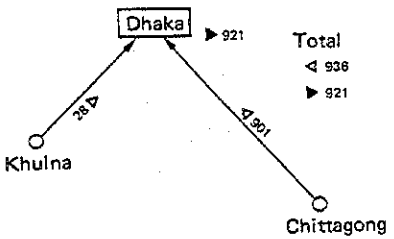
Fig. 6.2.1 Total Commodity Flow

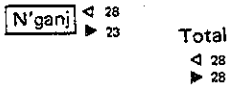


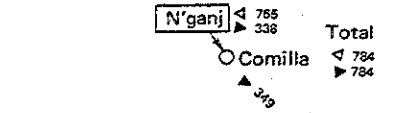












Unit: tons

Remarks: ◁ Origin

▶ Destination

Source: Study Team Survey

Fig. 6.2.2 Cargo Flow

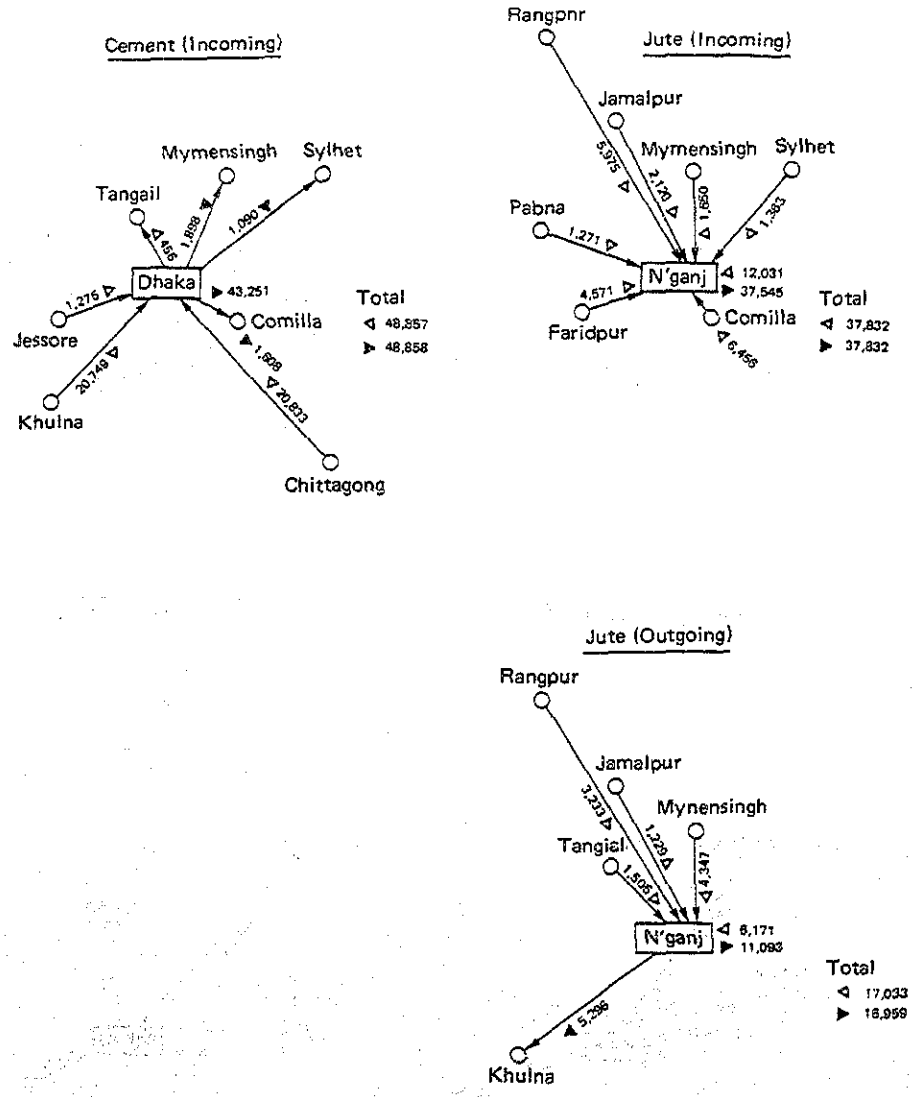
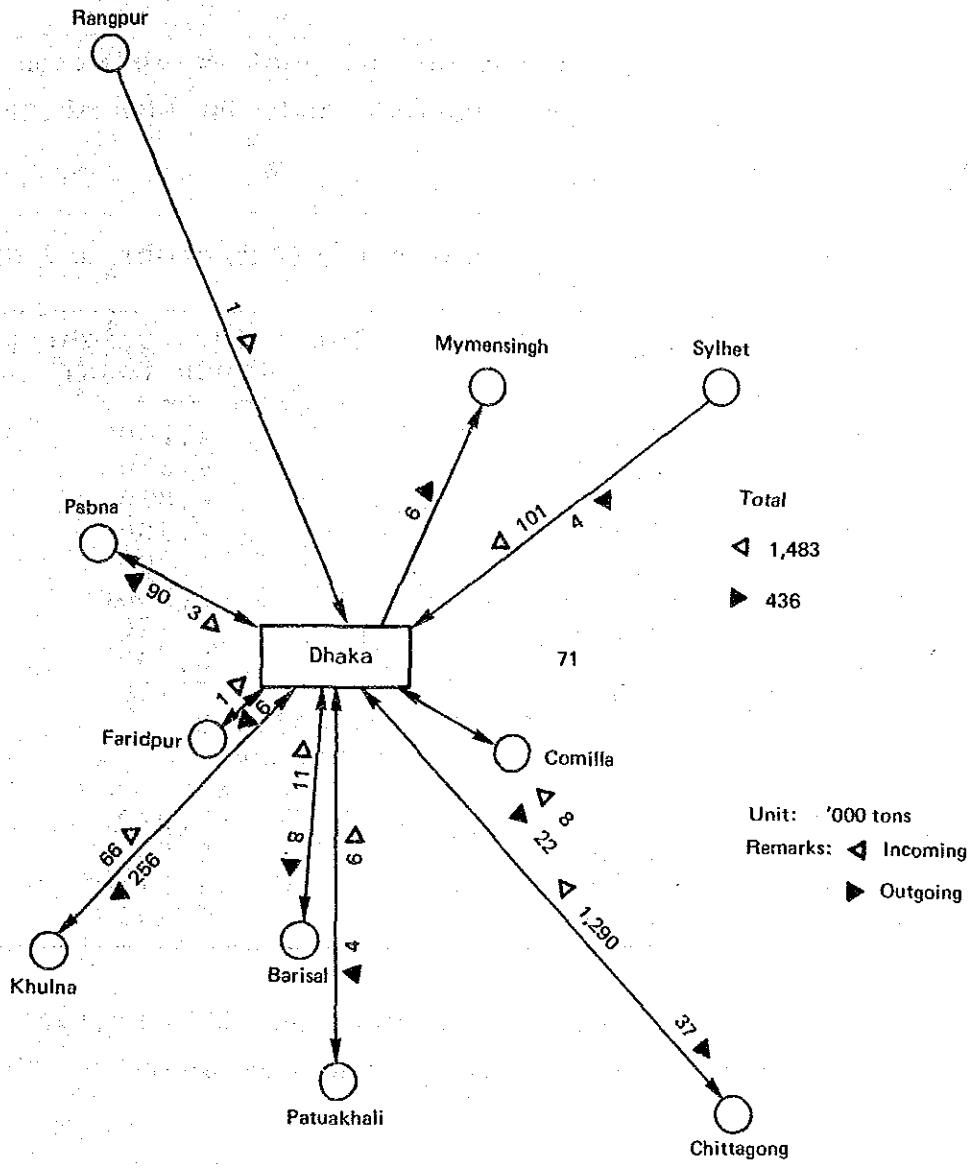


Fig. 6.2.3 Cargo Flow



Source: Annual Ports & Traffic Report 1982/83

Fig. 6.2.4 IWT Freight Flow 1982/83 (All Commodities)

6.2.3 Macro Forecast

The forecast is made based on the past correlation between the IWT freight of the whole country and the GDP of the whole country as shown in Table 6.2.1.

Table 6.2.1 Correlation between IWT Freight and GDP

Year	Total GDP (X) (10^6 Tk)	Total IWT Freight (Y) ('000 tons)
1976/77	263,013	4,260
77/78	284,589	4,830
78/79	297,451	4,890
79/80	301,347	4,980
80/81	321,574	4,900
81/82	324,534	5,360
82/83	336,550	5,470
83/84	349,922	5,580
84/85	361,587	5,730
	$Y = 959.59 + 0.0131295X$	
	$R^2 = 0.908324$	
1989/90	461,615	7,020
1994/95	615,155	9,036
1990/00	865,034	12,317
2004/05	1,259,290	17,493

A portion of the projected national IWT freight is then assigned to the two ports based on the GDP share of the ports' hinterland.

As mentioned before (6.2.2), the hinterlands of Dhaka and Narayanganj Ports differ somewhat by commodity.

For this forecast, however, the hinterland of the two ports is assumed to be comprised of five areas, Comilla, Jamalpur, Mymensingh, Tangail and Dhaka.

The projected GDP, the projected regional product of the ports' hinterland (the five areas), the GDP share of the hinterland, the projected national IWT and the projected cargo handling volume at the ports are all presented in Table 6.2.2.

Table 6.2.2 Future Cargo Handling Volume at Dhaka

Year	Total GDP (10^6 Tk)	Five Area's GDP (10^6 Tk)	Share of GDP (%)	Total IWT Freight ('000 tons)	Cargo Handling Volume at Dhaka and Narayanganj ('000 tons)
1989/90	461,615	148,997	0.323	7,020	2,267
1994/95	615,155	201,046	0.327	9,036	2,955
1999/00	865,034	289,979	0.335	12,317	4,126
2004/05	1,259,290	429,059	0.341	17,493	5,965

Based on this simple correlation analysis, the future cargo handling volume at Dhaka and Narayanganj will theoretically reach 2.955 million tons in 1994/95 and 5.965 million tons in 2004/05.

This projected cargo handling volume only considers transportation between zones, and excludes the transportation of cargo within zones by country boats.

6.2.4 Micro Forecast by Commodity

(1) Food grains

(a) Production and import of food grains in Bangladesh

Bangladesh is an agricultural country, and rice is the staple grain. Various types of rice which require different amounts of rainfall are produced in different seasons.

In Bangladesh, 80% of the annual rainfall is concentrated in the rainy season from June to October. During the dry season from November to February, there is almost no rainfall whatsoever.

Portions of the southern lowlands are regularily flooded during the rainy season, and thus cannot be used for growing rice. Also, relatively high areas may become too dry in the dry season, and also cannot be used for rice production. Overall, the production of rice is extremely unstable as the area where rice can be grown varies from year to year and from season to season due to varying weather conditions.

Basically, there are three main types of rice produced in Bangladesh: Boro (harvested in April-May), Aus (harvested in July-August), and Aman (harvested in November-December). Aman rice predominates, and accounts for approximately 60% of the national rice production. Thus, the supply-demand balance for rice is greatly affected by the conditions of the Aman rice crop each year.

The average yield of rice in Bangladesh is 1,282 kg/ha (average figure from 1978/79 through 1982/83). The total national rice production has been increasing year by year as weather conditions in recent years have been relatively good with the exception of the drought in the 1981/82 growing season.

About 40% of the national rice production is produced in Rangpur, Mymensingh, Tangail, Sylhet and Comilla. The rice is purchased by the government at one time and then distributed throughout the nation.

Unlike rice, wheat does not require much water. Recently, some farmers have begun cultivating wheat in the highlands in the dry season using limited irrigation.

The wheat production has been growing gradually, and is centered in northwest Bangladesh. The production of wheat is equal to approximately 10% of the production of rice.

The production of rice has also been increasing, but the domestic production is not sufficient to supply the domestic demand. Thus, Bangladesh regularly imports grain as noted in Table 6.2.3.

Table 6.2.3 Production and Imports of Food Grains

(Unit: '000 tons)

Year	Net Production			Internal Procurement			Off-take			Net Availability	Imports
	Rice	Wheat	Total	Rice	Wheat	Total	Rice	Wheat	Total		
1974/75	9,998	103	10,101	127	-	127	180	1,577	1,757	11,731	2,558
75/76	11,305	193	11,498	343	7	350	509	1,159	1,668	12,816	1,445
76/77	10,634	93	10,727	306	13	319	773	677	1,450	11,858	795
77/78	11,480	310	11,790	560	12	572	597	1,400	1,997	13,215	1,609
78/79	11,381	437	11,818	300	55	355	561	1,225	1,786	13,249	1,162
79/80	11,283	729	12,012	141	124	265	691	1,711	2,402	14,149	2,826
80/81	12,295	967	13,262	850	177	1,027	507	1,019	1,526	13,761	1,061
81/82	12,074	857	12,931	284	13	297	759	1,277	2,036	14,670	1,226
82/83	12,592	970	13,562	165	24	189	488	1,418	1,906	15,279	1,841
83/84	12,851	1,073	13,924	147	125	272	496	1,514	2,010	15,662	2,100

Source: 1984/85 Statistical Yearbook of Bangladesh
(Bangladesh Bureau of Statistics)

Note: Net production assumes a 10% loss for seed use, etc.

The annual per capita consumption and total consumption are calculated as shown in Table 6.2.4.

Table 6.2.4 Food Grains Consumption in Bangladesh

(unit: 000 tons)

Year	Net Availability	Imports	Population	Consumption/capita (Kg/capita)	Total Consumption	Surplus
1974/75	11,731	2,558	78,196	153	11,964	2,325
75/76	12,816	1,445	80,037	163	13,064	1,197
76/77	11,858	795	81,921	148	12,124	529
77/78	13,215	1,609	83,849	160	13,416	1,408
78/79	13,249	1,162	85,823	157	13,474	937
79/80	14,149	2,826	87,844	163	14,319	2,656
80/81	13,761	1,061	89,912	155	13,936	886
81/82	14,670	1,226	92,219	162	14,939	957
82/83	15,279	1,841	94,593	166	15,702	1,418
83/84	15,662	2,100	97,030	167	16,204	1,558

Source: Imports, Population , Consumption/Capita....1984/85 Statistical Yearbook of Bangladesh

The "surplus" food grains in Table 6.2.4 are stocked as store in case of poor harvest.

In order to estimate the future cargo handling volume of grain cargo, the future net production, consumption and imports are now forecast. First, the future net production is forecast based on the past correlation between net production and the GDP of the agricultural sector. The study team assumes that the per capita annual consumption of food grains will continue to grow from 166 kg (roughly the existing level) in 1990 to 170 kg in 1995, 180 kg in 2000 and 190 kg in 2005, and that approximately 1,400 thousand tons of grains per year will be held in stock. This figure is equal to approximately 80% of the capacity of existing warehouses (godowns).

The forecast figures are presented in Table 6.2.5.

Table 6.2.5 Future Food Grains Net Production, Consumption and Imports

Year	Agriculture GDP (10^6 Tk)	Net Production ('000 tons)	Consumption/capita (Kg/capita)	Population ('000)	Consumption ('000 tons)	Surplus or Shortage ('000 tons)	Stock ('000 tons)	Imports ('000 tons)
1974/75	143,998	10,101						
75/76	138,500	11,498						
76/77	133,622	10,727						
77/78	152,292	11,790						
78/79	157,232	11,818						
79/80	151,449	12,012						
80/81	150,073	13,262						
81/82	146,130	12,931						
82/83	158,543	13,562						
83/84	169,328	13,924						
	$Y = -2,725.58 + 0.09812 x$ $R = 0.9779$							
84/85	174,978	13,586	166	99,529	16,522	Δ2,936	Δ1,400	4,336
89/90	189,196	15,838	166	113,304	18,808	Δ2,970	Δ1,400	4,370
94/95	224,183	19,271	170	129,147	21,955	Δ2,684	Δ1,400	4,084
99/00	267,096	23,482	180	147,147	26,486	Δ3,004	Δ1,400	4,404
04/05	314,824	28,165	190	167,395	31,805	Δ3,640	Δ1,400	5,040

According to Table 6.2.5, food grains will have to be imported in the future as well.

However, based on the policy targets of the TFYP, the food grains production in 1990 should be 20,700 thousand tons, consumption 18,600 thousand tons and imports 1,500 thousand tons. Revising the figures forecast in Table 6.2.5 based on the target values in the TFYP, future food grains net production in

1990 should be 18,630 thousand tons (20,700 thousand tons x 0.9).

Thereafter, assuming that the food grains production will grow at the same rates forecast in Table 6.2.5 during each five year period, the future food grains imports are forecast from these revised food grains net production figures as shown in Table 6.2.6

Table 6.2.6 Future Food Grains Imports

Year	Net Production ('000 tons)	Population ('000)	Consumption/capita (Kg/capita)	Consumption ('000 tons)	Surplus/Shortage ('000 tons)	Imports ('000 tons)
1989/90	18,630 (20,700x0.9)	113,304	166	18,808	-178	1,500
94/95	22,668	129,147	170	21,955	+713	700
99/00	27,621	147,147	180	26,486	+1,135	0
04/05	33,129	167,395	190	31,805	+1,324	0

(b) Production and consumption of food grains at Dhaka

The historical production and consumption of food grains at Dhaka are shown in Table 6.2.7 from past data.

Table 6.2.7 Production and Consumption of Food Grains at Dhaka

Year	Production ('000 tons)			Net Production ('000 tons)	Consumption/capita (Kg/capita)	Population ('000)	Consumption ('000 tons)	Shortage ('000 tons)
	Rice	Wheat	Total					
1974/75	599	4	603	543	153	8,536	1,306	-763
75/76	726	5	731	658	163	8,785	1,432	-774
76/77	647	11	658	592	148	9,039	1,338	-746
77/78	721	14	735	662	160	9,304	1,489	-827
78/79	745	12	757	681	157	9,574	1,503	-822
79/80	741	13	754	679	163	9,853	1,606	-927
80/81	794	31	825	743	155	10,123	1,569	-826
81/82	810	74	884	796	162	10,713	1,736	-940
82/83	851	46	897	807	166	10,985	1,824	-1,017
83/84	801	50	851	766	167	11,263	1,881	-1,115

Source: 1984/85 Statistical Yearbook of Bangladesh

As shown above, the Dhaka area suffers a shortage of food grains. Future food grains production at Dhaka is calculated based on the share of the Dhaka agricultural sector in the national agricultural sector, and future consumption and shortage of food grains is calculated as shown in Table 6.2.8.

Table 6.2.8 Future Production and Consumption of Food Grains

Year	Total Net Production ('000 tons)	Dhaka Agriculture/ National Agriculture (%)	Dhaka Production ('000 tons)	Consumption/capita (Kg/capita)	Population ('000)	Consumption ('000 tons)	Surplus/Shortage ('000 tons)
1984/85	13,586	6.5	883	166	12,382	2,055	-1,172
89/90	18,630	6.5	1,211	166	15,241	2,530	-1,319
94/95	22,668	6.5	1,473	170	18,698	3,178	-1,705
99/00	27,621	6.0	1,657	180	22,865	4,116	-2,459
04/05	33,129	6.0	1,987	190	27,854	5,292	-3,305

Although the local food grains production will increase in the future, the Dhaka area will continue to suffer a shortage of food grains due to continued population growth.

The necessary food grains will be supplied from other areas of Bangladesh and from imports. But as shown in Table 6.2.6, after the year 2000 the shortage of food grains in Dhaka will all be supplied from internal surplus areas, and the imports will stop.

Future consumption, production and surplus or shortage by district are calculated based on the Intermodal Transport Study as shown in Table 6.2.9 - Table 6.2.11.

Table 6.2.9 Future Food Grains Consumption by District

District	Year							
	1989/90		1994/95		1999/00		2004/05	
	(percent)	('000 tons)	(percent)	('000 tons)	(percent)	('000 tons)	(percent)	('000 tons)
Chittagong	6.6	1,241	6.8	1,493	6.9	1,828	7.0	2,226
Ctg. Hill Tracts	1.3	245	1.7	373	2.0	530	2.5	795
Comilla	7.4	1,392	7.1	1,559	6.9	1,828	6.7	2,131
Noakhali	4.0	752	3.8	834	3.7	980	3.5	1,113
Sylhet	6.1	1,147	5.8	1,274	5.5	1,457	5.2	1,654
Dhaka	13.4	2,520	14.5	3,183	15.5	4,105	16.6	5,280
Faridpur	4.8	903	4.5	988	4.3	1,139	4.0	1,272
Jamalpur	2.7	503	2.6	571	2.6	689	2.5	795
Mymensingh	7.2	1,354	6.9	1,515	6.8	1,801	6.6	2,099
Tangail	2.6	489	2.6	571	2.5	662	2.4	763
Barisal	4.9	922	4.6	1,010	4.3	1,139	4.1	1,304
Jessore	4.6	865	4.7	1,032	4.7	1,245	4.7	1,495
Khulna	4.9	922	4.8	1,054	4.7	1,245	4.6	1,463
Kushtia	2.7	508	2.7	593	2.8	742	2.8	891
Patsuakhali	2.0	376	1.9	417	1.8	477	1.9	541
Bogra	3.2	602	3.3	725	3.4	901	3.4	1,081
Dinajpur	3.9	734	4.0	878	4.1	1,086	4.3	1,368
Pabna	4.0	752	4.1	900	4.2	1,112	4.3	1,368
Rajshahi	6.2	1,166	6.2	1,361	6.2	1,642	6.1	1,940
Rangpur	7.3	1,375	7.2	1,581	7.1	1,881	7.0	2,226
Bangladesh		18,808		21,955		26,486		31,805

Source: Percent by district (1989/90-1999/00)...Intermodal Transport Study

Note : Percent by district in 2004/05.....Population ratio by district in 2004/05

Table 6.2.10 Future Food Grains Production by District

District	1989/90		1994/95		1999/00		2004/05	
	(percent)	('000 tons)	(percent)	('000 tons)	(percent)	('000 tons)	(percent)	('000 tons)
Chittagong	4.9	913	4.8	1,088	4.7	1,298	4.7	1,557
Ctg. Hill Tracts	0.7	130	0.7	159	0.7	193	0.7	232
Comilla	6.6	1,230	6.2	1,405	5.9	1,630	5.9	1,955
Noakhali	4.1	764	3.8	861	3.5	967	3.5	1,160
Sylhet	7.1	1,323	6.8	1,541	6.5	1,795	6.5	2,153
Dhaka	6.1	1,136	6.1	1,383	6.2	1,713	6.2	2,054
Faridpur	3.4	633	3.8	861	4.0	1,105	4.0	1,325
Jamalpur	3.5	652	3.6	816	3.7	1,022	3.7	1,226
Mymensignh	9.7	1,807	9.3	2,108	9.1	2,514	9.1	3,015
Tangail	3.8	708	3.7	839	3.6	994	3.6	1,193
Barisal	5.3	987	5.9	1,337	6.8	1,878	6.8	2,253
Jessore	4.8	894	5.0	1,133	4.8	1,326	4.8	1,590
Khulna	3.8	708	3.5	793	3.3	911	3.3	1,093
Kushtia	2.4	447	2.3	521	2.2	608	2.2	729
Patuakhali	2.7	503	3.1	703	3.6	994	3.6	1,193
Bogra	4.9	913	4.6	1,043	4.2	1,160	4.2	1,391
Dinajpur	5.4	1,006	5.4	1,224	5.5	1,519	5.5	1,822
Pabna	4.5	838	4.7	1,065	4.8	1,326	4.8	1,590
Rajshahi	6.8	1,267	6.9	1,564	7.0	1,933	7.0	2,319
Rangpur	9.6	1,788	9.8	2,221	10.1	2,790	10.1	3,346
Bangladesh		18,630		22,668		27,621		33,129

Source: Percent by district (1989/90-1999/00)...Intermodal Transport Study

Note : Percent by district in 2004/05.....Study Team Estimate

Table 6.2.11 Future Food Grains Surplus or Shortage by District

District	Year			
	1989/90 ('000 tons)	1994/95 ('000 tons)	1999/00 ('000 tons)	2004/05 ('000 tons)
Chittagong	-328	-405	-530	-669
Ctg. Hill Tracts	-115	-214	-337	-563
Comilla	-162	-154	-198	-176
Noakhali	12	27	-13	47
Sylhet	176	268	338	499
Dhaka	-1,384	-1,800	-2,392	-3,226
Faridpur	-270	-127	-34	53
Jamalpur	144	245	333	431
Mymensingh	453	593	713	916
Tangail	219	268	332	430
Barisal	65	327	739	949
Jessore	29	101	81	95
Khulna	-214	-261	-334	-370
Kushtia	-61	-72	-134	-162
Patuakhali	127	286	517	652
Bogra	311	318	259	310
Dinajpur	272	346	433	454
Pabna	86	165	214	222
Rajshahi	101	203	291	379
Rangpur	415	640	909	1,120
Bangladesh	-178	713	1,135	1,324

Note: Surplus or Shortage by District (Table 6.2.11)
= Production by District (Table 6.2.10)
- Consumption by District (Table 6.2.9)

According to BIWTA's 1982/83 report, the volume of food grains transported from seaports to Dhaka by IWT is 324 thousand tons, about 18% of the volume of imported food grains in the same year. At present, established IWT routes for food grains are from Barisal, Khulna and Patuakhali to Dhaka according to the BIWTA's report, and future surplus areas of food grains are Barisal and Patuakhali. Therefore, food grains will be transported from Barisal and Patuakhali to Dhaka by IWT in the future.

The food grains from Barisal and Patuakhali transported to Dhaka by IWT are not sufficient to supply the shortage of food grains in Dhaka.

The remaining shortage of food grains in Dhaka will be transported from surplus areas to Dhaka by other modes.

The future transportation of food grains to Dhaka by IWT is shown in Table 6.2.12.

Table 6.2.12 Future Transportation of Food Grains to Dhaka

(Unit: '000 tons)

Year	Imports	From Barisal, Patuakhali	Total
1989/90	1,500x0.18=270	65+127= 192	462
94/95	700x0.20=140	327+286= 613	753
99/00	0	739+517=1,256	1,256
04/05	0	949+652=1,601	1,601

(2) Fertilizer

(a) Supply and demand in Bangladesh

The major farm products in Bangladesh are Rice, Wheat, Jute and Tea, and the cultivated area by crop in the past is shown in Table 6.2.13.

Table 6.2.13 Cultivated Area by Crop

(Unit: '000 acres)

Year	Rice	Wheat	Jute	Tea	Total
1974/75	24,196	311	1,417	107	26,031
75/76	25,525	371	1,277	106	27,279
76/77	24,419	395	1,603	103	26,520
77/78	24,779	467	1,805	106	27,157
78/79	24,992	654	2,051	107	27,804
79/80	25,105	1,071	1,874	107	28,157
80/81	25,474	1,461	1,569	109	28,613
81/82	25,847	1,320	1,412	112	28,691
82/83	26,158	1,283	1,425	110	28,976
83/84	26,064	1,300	1,435	110	28,909 (117,000km^2)

Source: 1984/85 Statistical Yearbook of Bangladesh.

Judging from Table 6.2.13, the total cultivated area has remained almost constant over the last few years, at about 28,900 thousand acres (117 thousand km^2).

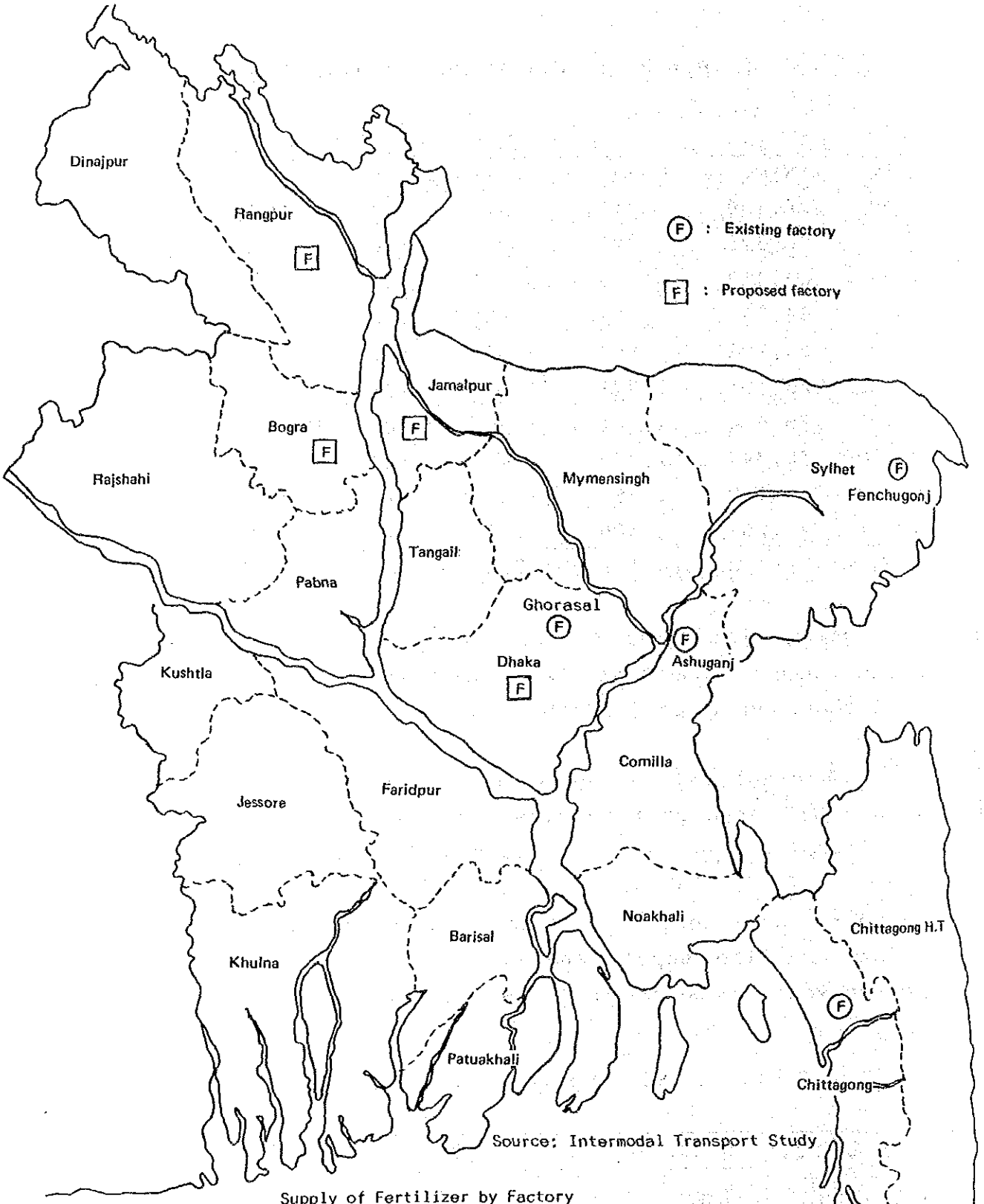
As 117 thousand Km^2 is equal to approximately 80% of the 144 thousand Km^2 area of Bangladesh, the study team presumes that the cultivated area will not increase significantly hereafter.

There are four fertilizer factories in Bangladesh at present, and the supply and demand of fertilizer during the past ten years is shown in Table 6.2.14.

Table 6.2.14 Supply & Demand of Fertilizer

Year	Total Area ('000 acres)	Production ('000 tons)	Imports ('000 tons)	Consumption ('000 tons)	Consumption/acre (Kg/acre)	Surplus/Shortage ('000 tons)
1974/75	26,031	106	144	389	14.9	-139
75/76	27,279	320	327	282	11.5	365
76/77	26,520	313	41	458	17.3	-104
77/78	27,157	265	812	512	18.8	565
78/79	27,804	333	1,140	718	25.8	755
79/80	28,157	363	564	742	26.4	185
80/81	28,613	425	350	834	29.1	-59
81/82	28,691	486	464	830	28.9	120
82/83	28,976	770	299	954	32.9	115
83/84	28,909	715	357	1,128	39.0	-56

Source: 1984/85 Statistical Yearbook of Bangladesh



Source: Intermodal Transport Study

Supply of Fertilizer by Factory

(Thousand tons)

	1974 -75	1975 -76	1976 -77	1977 -78	1978 -79	1979 -80	1980 -81	1981 -82	1982 -83	1983 -84
Fenchugonj	59	47	70	75	49	83	110	114	84	66
Ghorasal	23	234	200	152	225	222	242	244	271	195
Chittagong	24	39	43	38	59	58	73	66	84	75
Ashuganj	–	–	–	–	–	–	–	–	331	379
Total	106	320	313	265	333	363	425	486	770	715

Source: 1984/85 Statistical Yearbook of Bangladesh

Fig. 6.2.5 Location of Fertilizer Factories

The target production, consumption and imports of fertilizer in 1985 and in 1990 are set in the TFYP.

The study team assumes that the future cultivated area will remain the same as the existing cultivated area, and that fertilizer production will increase to 2,150 thousand tons in 1990 as projected in the TFYP.

Future fertilizer production is planned to grow by more than 2.5 times from 806 thousand tons in 1985 to 2,150 thousand tons in 1990, as four new fertilizer factories are scheduled to begin operations during this period. The locations of existing fertilizer factories and future proposed fertilizer factories are shown in Fig 6.2.5. According to the TFYP, fertilizer consumption per acre is 43.6 kg/acre in 1985, and this is estimated to increase to 64.0 kg/acre in 1990.

The study team assumes that future fertilizer consumption per acre will be 80.0 kg/acre in 1995, 100.0 kg/acre in 2000 and 120.0 kg/acre in 2005.

Judging from Table 6.2.14, imported fertilizer includes reserves as there are shortages of fertilizer in some years. National fertilizer storage (godown) capacity is 350 thousand tons at present (1984/85 Statistical Yearbook of Bangladesh).

The study team assumes that the stock capacity for fertilizer is 1,000 thousand tons/year based on a stock turnover of three times per year, and the relation of fertilizer supply and demand in the future is shown in Table 6.2.15.

Table 6.2.15 Future Supply and Demand of Fertilizer

Year	Area ('000 acres)	Production ('000 tons)	Import ('000 tons)	Consumption ('000 tons)	Consumption/acre (Kg/acre)	Stock ('000 tons)
1984/85	28,900	*806	*666	*1,260	43.6	212
1989/90	28,900	*2,150	*1,044	*1,850	64.0	1,344
94/95	28,900	2,150	1,162	2,312	80.0	1,000
99/00	28,900	2,150	1,740	2,890	100.0	1,000
04/05	28,900	2,150	2,318	3,468	120.0	1,000

Remark: * TFYP value

(b) Supply and demand in Dhaka

There is presently only one fertilizer factory in the Dhaka area which is located in Ghorasal.

The cultivated area of major farm products, and the local supply and demand in the past are shown in Table 6.2.16.

Table 6.2.16 Supply and Demand of Fertilizer in Dhaka

Year	Cultivated Area ('000 acres)	Production (Ghorasal) ('000 tons)	Consumption ('000 tons)	Consumption/acre (Kg/acre)	Surplus/Shortage ('000 tons)
1974/75	1,501	23	31	20.6	-8
75/76	1,457	234	31	21.3	203
76/77	1,529	200	50	32.7	150
77/78	1,518	152	46	30.3	106
78/79	1,557	225	65	41.7	160
79/80	1,502	222	67	44.6	155
80/81	1,522	242	75	49.2	167
81/82	1,538	244	91	59.2	153
82/83	1,555	271	86	55.3	185
83/84	1,521	195	113	74.3	82

Source: 1984/85 Statistical Yearbook of Bangladesh
Note : Cultivated Area = Rice + Wheat + Jute (1,501 = 1,363 + 14 + 124)
Consumption = National Consumption x Consumption Ratio in Dhaka (31 = 389 x 0.08)

Judging from Table 6.2.16, the cultivated area in Dhaka has also remained more or less constant for several years. The volume of fertilizer produced at Ghorasal is sufficient to supply the Dhaka area despite the fact that fertilizer consumption per unit area in Dhaka is larger than in other areas in Bangladesh.

According to the BIWTA report, 50 thousand tons of fertilizer is carried into Dhaka and 100 thousand tons of fertilizer is carried out from Dhaka to other areas by IWT in 1982/83. This mean that Dhaka is a transit base for fertilizer. The study team assumes that the cultivated area in Dhaka will remain 1,520 thousand acres in the future. As a new fertilizer factory is proposed to be built in the Dhaka area in the future, the study team assumes that fertilizer production will reach 640 thousand tons combining the production of the new factory of about 340 thousand tons ((2,150 - 806)/4) with

the production of the existing factory of about 300 thousand tons. (The full production capacity of the existing factory).

The projected future supply and demand of fertilizer in Dhaka is shown in Table 6.2.17.

Table 6.2.17 Future Supply and Demand of Fertilizer at Dhaka

Year	Area ('000 acres)	Production ('000 tons)	Consumption ('000 tons)	Consumption/acre (Kg/acre)	Surplus/Shortage ('000 tons)
1984/85	1,520	300	122	80.0	188
1989/90	1,520	640	152	100.0 (64.0)	488
94/95	1,520	640	175	115.0 (80.0)	465
99/00	1,520	640	205	135.0 (100.0)	435
04/05	1,520	640	236	155.0 (120.0)	404

Remark: Figures in Parentheses are national averages.

As shown in Table 6.2.17, the supply of fertilizer in Dhaka will continue to be sufficient in the future.

At present, three of the four operating fertilizer factories (other than Chittagong) are located near Dhaka, and the northern part of Bangladesh including Dhaka, Comilla, Sylhet, Jamalpur, Mymensingh and Tangail seems to be supplied by these three fertilizer factories.

The supply and demand of fertilizer in these areas is shown in Table 6.2.18.

Table 6.2.18 Supply and Demand of Fertilizer in Six Areas

Year	Cultivated Area in Six Areas ('000 acres)	Production (excluding Chittagong) ('000 tons)	Total Consumption ('000 tons)	Six Areas Consumption Share (%)	Consumption in Six Areas ('000 tons)	Surplus/Shortage ('000 tons)
1974/75	9,175	82	389	40	156	-74
75/76	9,960	281	282	44	124	157
76/77	9,078	270	458	42	192	78
77/78	9,629	227	512	42	215	12
78/79	9,792	274	718	45	323	-49
79/80	10,154	305	742	42	312	-7
80/81	10,551	352	834	42	350	2
81/82	10,682	420	830	41	340	80
82/83	10,791	686	954	42	401	285
83/84	10,356	640	1,128	39	440	200

Source: 1984/85 Statistical Yearbook of Bangladesh 1983/84

The supply of fertilizer in the six areas is also more or less sufficient. Especially, the surplus of fertilizer from 1983 seems to be due to the opening of the Ashuganj fertilizer factory in Comilla. The total cultivated area in the six areas has remained fairly constant for some years. Thus, the study team assumes that the cultivated area in the future will remain 10,800 thousand acres, and fertilizer production will total 1,400 thousand tons between the production capacity of the existing factories (about 700 thousand tons) and of the two new factories which will produce about 680 thousand tons ((2,150-806)/4 x 2). Consumption per unit area is assumed to be the same as the national average.

Accordingly, the future supply and demand of fertilizer in the six areas is shown in Table 6.2.19.

Table 6.2.19 Future Supply and Demand of Fertilizer in Six Areas

Year	Area ('000 acres)	Production ('000 tons)	Consumption/acre (Kg/acre)	Consumption ('000 tons)	Surplus/Shortage ('000 tons)	Dhaka	Excluding Dhaka
1984/85	10,800	640	43.6	471	169	188	-19
1989/90	10,800	1,400	64.0	691	709	488	221
94/95	10,800	1,400	80.0	864	536	465	71
99/00	10,800	1,400	100.0	1,080	320	435	-115
04/05	10,800	1,400	120.0	1,296	104	404	-300

Thus, the fertilizer production in the six areas in the future will be sufficient to supply the local demand in these areas.

According to the study team survey and the BIWTA report, fertilizer is currently carried out from Dhaka to Barisal, Patuakhali and Faridpur by IWT.

Therefore, the study team assumes that the surplus fertilizer in Dhaka in the future will also be carried out to Barisal, Patuakhali and Faridpur by IWT.

(3) Cement

(a) Supply and demand of cement in Bangladesh

At present there are two cement factories in Chittagong and Chhatak (Sylhet) in Bangladesh. Three new cement factories are proposed to be built in Bogra, Rangpur and Sylhet in the future as shown in Fig 6.2.6. The supply and demand of cement in Bangladesh is shown in Table 6.2.20.

Table 6.2.20 Supply and Demand of Cement in Bangladesh

(Unit: '000 tons)

Year	Production	Import	Consumption
1972/73	29	374	403
73/74	53	129	182
74/75	143	417	560
75/76	159	234	393
76/77	307	207	524
77/78	338	407	745
78/79	320	456	776
79/80	336*1	616*2	
80/81	345*1	515*2	
81/82	326*1	593*2	
82/83	307*1	777*2	
83/84	268*1		1,326*1

Source: 1972/73 - 1978/79; Review and Updating of BTS Study (Planning Commission, January 1980)
*1: The Third Five Year Plan 1985 - 90 (Planning commission, Nov. 1985)
*2: 1984/85 Statistical Yearbook of Bangladesh

Future cement consumption in Bangladesh is forecast based on the past correlation between the GDP of the construction sector and cement consumption as shown in Table 6.2.21.

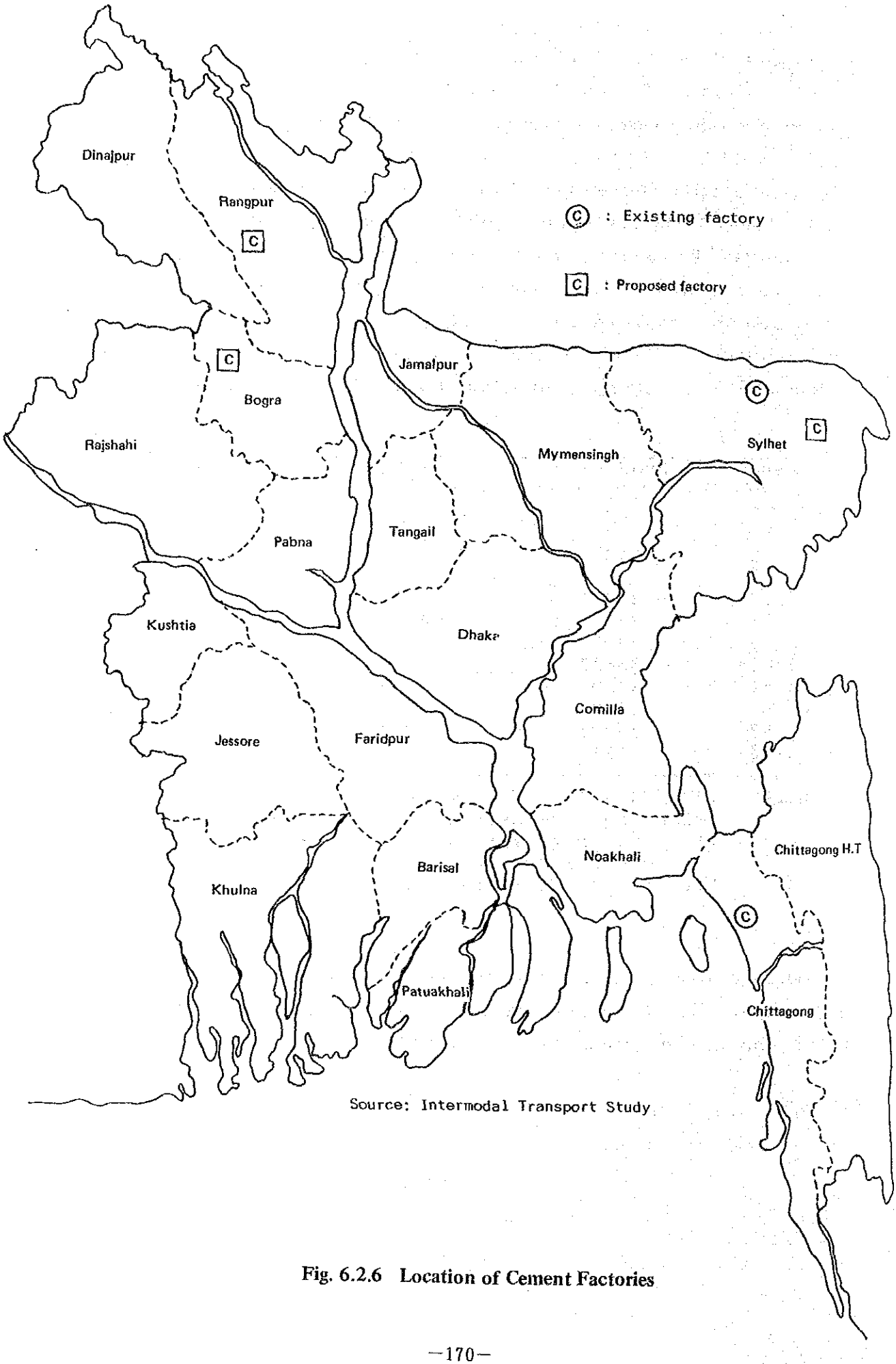


Fig. 6.2.6 Location of Cement Factories

Table 6.2.21 Future Cement Consumption in Bangladesh

Year	Construction GDP (X) (10^6 Tk)	Consumption (Y) ('000 tons)
1972/73	6,857	403
73/74	9,174	182
74/75	10,376	560
75/76	13,319	393
76/77	14,554	514
77/78	14,867	745
78/79	16,623	776
	$\bar{Y}$=-215,187+0.0632495X	
	R^2=0.621694	
1984/85	19,036	1,035
89/90	26,041	1,431
94/95	36,853	2,114
99/00	59,376	3,538
04/05	95,706	5,838

Future cement imports are forecast based on the difference between forecast consumption and production as shown in Table 6.2.22.

Table 6.2.22 Future Imports of Cement in Bangladesh

(Unit; '000 tons)

Year	Production	Consumption	Imports
1984/85	240*	1,035	711*
89/90	850*	1,605*	890*
94/95	1,000	2,114	1,114
99/00	1,500	3,538	2,038
04/05	1,500	5,838	4,338

Remark: * TFYP value

Future cement production is estimated as 850 thousand tons in 1990, the target value of the TFYP, and the study team assumes that cement production in 2000 will reach 1,500 thousand tons considering the new cement factories which are planned.

(b) Supply and Demand of Cement in Dhaka

There is no cement factory in Dhaka at present, but there is a cement factory in Sylhet, in northeast Bangladesh. Imported cement and some domestic cement seems to be transported to Dhaka at present.

Part of the cement transported to Dhaka is consumed in Dhaka and the rest is transported to Dinajpur, Rangpur, Bogra and Rajshahi.

New cement factories are proposed in Rangpur and Bogra in northwest Bangladesh in the future, but the cement which will be produced at these factories will be consumed locally, so Dhaka will continue to depend primarily on imported cement.

According to the study team survey, cement is transported to Comilla, Mymensingh, Jamalpur and Tangail via Dhaka.

As the future total national consumption of cement is forecast based on the GDP of the construction sector, the volume of cement which will be handled at Dhaka is forecast based on the ratio of the GDP of the construction sector in Dhaka, Comilla, Mymensingh, Jamalpur, Tangail, Pabna and Faridpur (the "regional" construction GDP) to the national construction sector GDP. Thereafter, the volume of this cargo which will be carried by IWT is forecast based on the IWT share of 41.4% presented in the BTS report (Review and Updating of BTS Study). The calculation results are presented in Table 6.2.23.

Table 6.2.23 Future Volume of Cement Transported by IWT at Dhaka

Year	Total Consumption ('000 tons)	Regional Construction GDP/Total Construction GDP (%)	Regional Consumption ('000 tons)	IWT Share (%)	Volume of Cement at Dhaka ('000 tons)
1984/85	1,035	41.2	426	41.4	176
89/90	1,431	41.2	590	41.4	244
94/95	2,114	41.2	871	41.4	361
99/00	3,538	41.2	1,458	41.4	604
04/05	5,838	41.2	2,405	41.4	996

Cement factories are proposed for Rangpur, Bogra and Sylhet in the future, and the cement produced at these new factories will be sufficient to supply the demand in these areas.

Thus, the areas of Sylhet, Dinajpur, Rangpur, Bogra and Rajshahi will no longer be part of the hinterland of Dhaka for cement in the future.

(4) Iron and steel

(a) Supply and demand of iron & steel in Bangladesh

There is presently only one Bangladeshi steel plant. The plant is located in Chittagong, and uses imported scrap and pig iron to make rods and sheets.

The past supply and demand of iron & steel in Bangladesh is shown in Table 6.2.24.

Table 6.2.24 Supply and Demand of Iron and Steel in Bangladesh

(Unit: '000 tons)

Year	Production	Import	Consumption
1972/73	52	98	150
73/74	53	61	114
74/75	59	44	103
75/76	72	70	142
76/77	84	69	153
77/78	87	100	187
78/79	141	157	293
79/80	135*1	230*2	
80/81	137*1	221*2	
81/82	107*1	136*2	
82/83	47*1	129*2	
83/84	72*1	188*2	

Source: 1972/73 - 1978/79 - Review and Updating of the BTS Study
*1: The Third Five Year Plan 1985 - 90
*2: 1984/85 Statistical Yearbook of Bangladesh

Future iron and steel consumption in Bangladesh is forecast based on the past correlation between the GDP of the construction sector and iron and steel consumption as shown in Table 6.2.25.

Table 6.2.25 Future Consumption of Iron and Steel in Bangladesh

Year	Construction Sector GDP (X) (10^6 TK)	Consumption (Y) ('000 tons)
1972/73	6,857	150
73/74	9,174	114
74/75	10,376	103
75/76	13,319	142
76/77	14,554	153
77/78	14,867	187
78/79	16,623	293
	$\hat{Y} = -96.9478 + 0.0227335X$	
	$R^2 = 0.822509$	
1984/85	19,036	352
89/90	26,041	494
94/95	36,853	740
99/00	59,376	1,251
04/05	95,706	2,076

Future iron and steel import is forecast from the difference between production and consumption as shown in Table 6.2.26.

Table 6.2.26 Future Import of Iron and Steel in Bangladesh

(Unit: '000 tons)

Year	Production	Consumption	Import
1984/85	101*	352	251
89/90	230*	494	264
94/95	350	740	390
99/00	350	1,251	901
04/05	500	2,076	1,576

Remark: * TFYP value

The TFYP sets iron and steel production in 1990 as 230 thousand tons. The study team assumes that iron and steel production in 2005 will reach 500 thousand tons, about twice the 1990 value because the development of the construction sector is emphasized in the national economic policy.

(b) Handling volume of iron and steel at Dhaka

Iron and steel handled at Dhaka is transported in the form of finished products or middle products from Chittagong and Khulna.

According to the study team survey, iron and steel transported to Dhaka is consumed in Dhaka only, and is not transported to other areas.

However, iron and steel will be transported to other areas via Dhaka in the future. The study team assumes that the hinterland for iron and steel comprises Comilla, Jamalpur, Mymensingh and Tangail besides Dhaka. The iron and steel consumption in the five areas is first calculated based on the ratio of the construction sector GDP in the five areas to the national construction sector GDP. The transportation of iron and steel by IWT is then calculated considering the past share of IWT for iron and steel products in the five areas based on the BIWTA report.

The past figures as well as the estimated future transport volume of iron and steel by IWT in Dhaka are shown in Table 6.2.27.

Table 6.2.27 Future Iron and Steel Volume by IWT in Dhaka

Year	Total Consumption ('000 tons)	5 Area Construction GDP/Total Construction GDP (%)	5 Area Consumption ('000 tons)	BIWTA Report ('000 tons)	BIWTA Report/5 Area Consumption (%)	IWT ('000 tons)
1976/77	153	31.9	49	14	28.6	-
77/78	187	31.9	60	16	26.7	-
78/79	293	31.9	93	33	35.5	-
82/83	302	31.9	96	45	46.9	-
					34.4(Average)	
1984/85	352	31.9	112	-	34.4	39
89/90	494	31.9	158	-	34.4	54
94/95	740	31.9	236	-	34.4	81
99/00	1,251	31.9	399	-	34.4	137
04/05	2,076	31.9	662	-	34.4	228

(5) Petroleum products

(a) Supply and demand in Bangladesh

Crude oil is not produced in Bangladesh at present. Therefore, all crude oil and some petroleum products are imported from other countries.

Imported crude oil is refined at Bangladesh's only refinery. The refinery is located in Chittagong, and the petroleum products produced at Chittagong are distributed to various storage facilities.

Imported crude oil and petroleum products, the Chittagong refinery production, and the consumption of petroleum products in Bangladesh are shown in Table 6.2.28.

Table 6.2.28 Import and Consumption of Petroleum Products

(Unit: '000 tons)

Year	Import			Refinery Production	Consumption
	Crude Oil	Petroleum Products	Total		
1972/73	547	580	1,127	475	1,055
73/74	557	497	1,054	502	999
74/75	774	559	1,333	731	1,290
75/76	1,194	357	1,551	1,086	1,443
76/77	1,052	260	1,312	1,048	1,308
77/78	1,012	351	1,363	974	1,325
78/79	1,023	381	1,404	1,038	1,419

Source: Review and Updating of BTS Study

The projected energy consumption pattern by kind of energy from 1979/80 to 1989/90 is shown in the TFYP as shown in Table 6.2.29.

Table 6.2.29 Energy Consumption During 1979/80 ~ 1989/90

	1979/80		1984/85		1989/90	
	Quantity (10^6 ton)	Percent (%)	Quantity (10^6 ton)	Percent (%)	Quantity (10^6 ton)	Percent (%)
Natural Gas	1.042	36.5	2.31	56.3	4.39	68.2
Petroleum	1.52	53.2	1.50	36.6	1.60	24.8
Coal	0.139	4.9	0.08	2.0	0.16	2.5
Hydro power	0.155	5.4	0.211	5.1	0.291	4.5
Total	2.856	100	4.101	100	6.441	100
Per Capita (Kg/capita)	32.75		41.35		58.29	

Source: The Third Five Year Plan 1985/86-1989/90

Judging from Table 6.2.29, the growth rate of petroleum consumption from 1984/85 to 1989/90 is about 1.29%/year.

The projected import volumes in the TFYP are 1,000 thousand tons of crude oil and 600 thousand tons of petroleum products for a total 1,600 thousand tons.

The existing refinery capacity is 1,500 thousand tons/year and the operating ratio is generally about 70%.

Assuming that the operating ratio of the refinery will remain 70% in the future, the import of crude oil in the future will in fact total 1,000 thousand tons in 1990.

The study team assumes that the product ratio at Chittagong from crude oil to petroleum products will remain 90% as at present.

The future import and consumption of petroleum products in Bangladesh is thus forecast as shown in Table 6.2.30.

Table 6.2.30 Future Import and Consumption of Petroleum Products in Bangladesh

(Unit: '000 tons)

Year	Import			Refinery Production	Petroleum Products Consumption
	Crude Oil	Petroleum Products	Total		
1984/85	913	587	1,500*	822	1,409
89/90	1,000*	600*	1,600*	900	1,500
94/95	1,000	710	1,710	900	1,610
99/00	1,000	820	1,820	900	1,720
04/05	1,000	940	1,940	900	1,840

Remark: * TFYP value

(b) Handling volume of petroleum products at Dhaka

There is no refinery in Dhaka, so all the petroleum products consumed locally have to be imported or transported from Chittagong.

The study team assumes that the hinterland of Dhaka for petroleum products comprises Comilla, Jamalpur, Mymensingh and Tangail besides Dhaka. Almost all the petroleum products are used for the transport sector. The transport sector GDP in the five areas comprises 37% of the national transport sector GDP in 1984/85.

There are many storage facilities for petroleum products located throughout the country including two storage facilities at Fatullah and Godnail in Dhaka.

Therefore, assuming that the future volume of petroleum products transported by IWT in Dhaka will be equal to 37% of the national total, the future volume of petroleum products by IWT in Dhaka is shown in Table 6.2.31.

Table 6.2.31 Future Volume of Petroleum Products by IWT at Dhaka

(Unit: '000 tons)

Year	Total Consumption	Dhaka Handling Volume
1984/85	1,409	521
89/90	1,500	555
94/95	1,610	596
99/00	1,720	636
04/05	1,840	681

(6) Jute

(a) Jute in Bangladesh

Jute and Jute goods are the major Bangladeshi exports, accounting for 70 - 80% of the total national exports.

As shown in Table 6.2.32, Jute is produced throughout the country.

Table 6.2.32 Area and Production of Jute by District

District	1976-77		1977-78		1978-79		1979-80		1980-81		1981-82	
	Area (acres)	Production (bales)	Area (acres)	Production (bales)	Area (acres)	Production (bales)	Area (acres)	Production (bales)	Area (acres)	Production (bales	Area (acres)	Production (bales)
Chittagong	295	755	180	482	305	705	280	630	235	580	320	620
Chittagong H.T.	485	1,140	425	999	420	1,045	385	1,025	320	735	400	920
Comilla	85,175	246,155	80,455	867,915	105,275	391,620	36,075	359,320	80,415	289,495	79,060	285,405
Noakhali	13,035	35,715	9,500	20,710	19,040	57,120	23,770	63,935	19,895	65,055	5,935	19,405
Sylhet	12,220	24,320	5,200	5,200	8,015	16,030	8,170	18,380	6,840	18,810	8,885	28,875
Dhaka	138,500	516,605	150,705	559,116	164,800	619,650	150,400	586,560	125,885	438,080	127,020	447,110
Faridput	133,790	508,400	172,475	534,673	192,695	624,330	175,855	590,870	147,190	425,380	150,860	425,425
Jamalpur	-	-	-	-	116,555	334,670	96,535	239,605	80,800	226,240	77,615	256,905
Kishoregonj	98,970	238,515	103,830	205,583	129,485	271,920	134,070	366,010	112,215	276,050	99,335	317,870
Mymensingh	229,175	623,355	264,575	740,810	265,840	765,695	124,870	374,610	104,515	290,550	115,765	390,130
Tangail	113,485	363,150	131,005	394,325	141,790	438,130	129,400	389,495	108,310	272,940	65,900	188,475
Barisal	10,180	20,565	15,600	27,300	19,955	40,310	18,210	36,600	15,240	36,730	8,100	14,500
Jessore	141,670	454,760	172,035	533,309	215,825	733,805	196,970	638,180	164,860	511,065	157,110	504,325
Khulna	33,040	97,470	44,260	114,191	49,835	155,985	45,480	140,080	38,065	102,775	23,675	70,790
Kushtia	58,130	143,000	74,975	212,179	82,715	252,280	75,485	210,605	63,180	202,805	60,240	191,565
Patuakhali	1,250	1,900	1,200	1,713	1,055	1,340	965	2,855	805	1,230	1,095	1,820
Bogra	45,120	114,155	48,185	129,136	60,375	181,125	56,100	165,300	46,120	168,340	52,710	177,105
Dinajpur	61,010	145,815	69,010	191,484	73,455	204,940	67,035	188,370	56,110	182,355	47,380	165,830
Pabna	60,950	179,195	72,825	220,660	94,905	305,595	86,610	264,160	72,490	255,890	33,930	122,150
Rajshahi	51,905	148,965	62,560	184,552	63,755	180,660	58,185	170,480	48,700	165,095	28,835	99,480
Rangpur	315,045	941,985	326,225	1,014,560	362,100	1,220,275	330,455	1,100,415	276,590	1,012,320	267,700	936,950
BANGLADESH	1,603,430	4,805,920	1,805,275	5,359,260	2,051,640	6,442,560	1,874,305	5,962,545	1,568,780	4,942,520	1,411,870	4,645,655

Source: Statistical Yearbook of Bangladesh

The national cultivated area, production and export of Jute in the past are shown in Table 6.2.33.

Table 6.2.33 Cultivated Area, Production & Export of Jute

Year	Cultivated Area ('000 acres)	Production ('000 tons)	Export ('000 tons)
1972/73	2,215	1,173	488
73/74	2,196	1,080	472
74/75	1,417	626	265
75/76	1,277	709	405
76/77	1,603	865	413
77/78	1,805	965	293
78/79	2,051	1,160	358
79/80	1,874	1,073	362
80/81	1,569	890	352
81/82	1,412	836	348
82/83	1,425	879	408
83/84	1,435	939	330

Source: 1984/85 Statistical Yearbook of Bangladesh

According to the TFYP, the annual production of Jute is planned to increase from 828 thousand tons to 1,080 thousand tons, that is 5.33%/year, during 1985/86 - 1989/90, and export of Jute is planned to increase from 252 thousand tons to 306 thousand tons, or 3.89%/year, during the same period.
However, as shown in Table 6.2.33, the cultivated area of Jute has been decreasing year by year and production has been decreasing since it peaked in 1978/79. Thus, the study team presumes that contrary to the TFYP target, the production of Jute will actually remain more or less constant at the current level, and that exports of Jute will also remain constant at about 306 thousand tons/year.

(b) Jute at Dhaka

The cultivated area and the production of Jute at Dhaka are shown in Table 6.2.34.

Table 6.2.34 Cultivated Area and Production of Jute at Dhaka

Year	Cultivated Area ('000 acres)	Production ('000 tons)
1972/73	184	108
73/74	171	90
74/75	124	61
75/76	94	62
76/77	139	93
77/78	151	101
78/79	165	112
79/80	151	106
80/81	126	79
81/82	127	80
82/83	120	75
83/84	114	76

Source: 1984/85 Statistical Yearbook of Bangladesh

As can be seen from the table, the cultivated area and the production of Jute at Dhaka are decreasing.

Based on the OD Table from the BIWTA report, Jute is brought from Comilla, Faridpur, Pabna and Rangpur into Dhaka, and is carried out to seaports together with the Jute produced in the Dhaka area.

According to the Transport of Containers in Bangladesh, 49% of this Jute is transported from Dhaka by IWT.

Therefore, there is both incoming and outgoing Jute at Dhaka. Incoming Jute totals about 4 thousand tons per year at present.

The study team assumes that in the future incoming Jute will total about 6 thousand tons, and future outgoing Jute will comprise 49% of all export Jute. Thus, the future movement of Jute at Dhaka is estimated as shown in Table 6.2.35.

Table 6.2.35 Future Movement of Jute at Dhaka

(Unit: '000 tons)

Year	Incoming	Outgoing
1984/85	4	129
89/90	6	150
94/95	6	150
99/00	6	150
04/05	6	150

(7) Jute goods

(a) Jute goods in Bangladesh

The production and export of Jute and Jute goods in Bangladesh is shown in Table 6.2.36

Table 6.2.36 Production & Export of Jute & Jute Goods in Bangladesh

(Unit: '000 tons)

Year	Jute Production	Jute Export	Jute goods Production	Jute goods Export
1972/73	1,173	488	446	418
73/74	1,080	472	500	436
74/75	626	265	444	368
75/76	709	405	478	455
76/77	865	413	490	462
77/78	965	293	546	522
78/79	1,160	358	501	455
79/80	1,073	362	523	448
80/81	890	352	581	494
81/82	836	348	577	529
82/83	879	408	561	506
83/84	939	330	536	468

Source: 1984/85 Statistical Yearbook of Bangladesh

As shown in Table 6.2.36, the growth ratio of production and export of Jute goods were 1.67%/year and 1.03%/year respectively during 1972/73 - 1983/84.

However, according to the TFYP, the export of Jute goods will increase from 480 thousand tons to 590 thousand tons, that is 4.13%/year during 1985/86 - 1989/90.

The study team assumes that the future export of Jute goods will remain constant at about 590 thousand tons per year.

The estimated future Jute production, Jute export and Jute goods export are shown in Table 6.2.37.

Table 6.2.37 Future Production and Export of Jute and Jute Goods in Bangladesh

(Unit: '000 tons)

Year	Jute Production	Jute Export	Jute goods Production	Jute goods Export
1984/85	828	252	576	480
89/90	1,080	306	774	590
94/95	1,080	306	774	590
99/00	1,080	306	774	590
04/05	1,080	306	774	590

(b) Jute goods at Dhaka

The production of Jute good by zone is shown in Table 6.2.38.

Table 6.2.38 Jute Goods Production by Zone

(Unit: '000 tons)

Year	Adamjee	Dhaka -1	Dhaka -2	Chittagong	Khulna	Total	Dhaka Area
1974/75	61	81	83	98	122	444	224(50.5%)
75/76	59	84	94	107	134	478	237(49.6%)
76/77	66	78	90	105	150	487	234(47.9%)
77/78	74	67	108	117	160	526	249(47.3%)
78/79	62	79	107	108	145	501	248(49.5%)

Source: Review and Updating of BTS Study

In Table 6.2.38, Adamjee, Dhaka 1 and Dhaka 2 are all located in Dhaka, and about half of Jute goods produced in Bangladesh are produced in the Dhaka area.

According to the Transport of Containers in Bangladesh, 37% of the exported Jute goods are transported to seaports from Dhaka by IWT.

Assuming that this ratio will remain the same in the future, the future volume of IWT of Jute goods at Dhaka is calculated as shown in Table 6.2.39.

Table 6.2.39 Future Export and Jute Goods by IWT from Dhaka

(Unit: '000 tons)

Year	Export	Jute Goods at Dhaka
1984/85	480	178
89/90	590	218
94/95	590	218
99/00	590	218
04/05	590	218

(8) Others

(a) Incoming Bulk

According to the BIWTA report, the volume of incoming bulk in 1982/83 by commodity is as shown in Table 6.2.40.

Table 6.2.40 Incoming Bulk by Commodity

(Unit: '000 tons)

Commodity	Fertilizer	Bricks	Coal	Firewood	Lime	Salt	Sand	Stone	Timber	Total
Quantity	50	1	9	5	2	21	13	92	2	195

Source: Annual Ports & Traffic Report 1982/83

There is currently a surplus of fertilizer in the hinterland, and there will continue to be a surplus in the future as new factories will be built. Fertilizer will still be handled at the ports in the future as surplus fertilizer will continue to be transported to shortage areas via Dhaka.

Stone, which is produced in Bholagonj (Sylhet), will also continue to be handled at the port. Thus, the study team estimates that the volume of Incoming Bulk will remain about 200 thousand tons as at present.

(b) Incoming Non-Bulk

Non-bulk commodities are Milk products, Animal and vegitable oil, Oil seeds, Garments (raw material), Chemicals, Machinery and so on.

The future import of Non-bulk items in Bangladesh is forecast based on the past correlation between the GDP in Bangladesh and the import of Non-bulk items as shown in Table 6.2.41.

Table 6.2.41 Future Import of Non-Bulk

Year	Total GDP (X) (10^6 TK)	Import Non-Bulk ('000 tons)
1975/76	258,766	706
76/77	263,013	493
77/78	284,589	787
78/79	297,451	917
79/80	301,347	917
80/81	321,574	1,216
81/82	324,534	1,180
82/83	336,550	985
83/84	349,922	1,162
84/85	361,587	1,389
	$\bar{Y}$= -1,290.88 + 310.783 In (X) R^2 = 0.984786	
1989/90	461,615	1,812
94/95	615,155	2,408
99/00	865,034	3,115
2004/05	1,259,290	3,894

The volume of Non-bulk items transported from seaports to Dhaka is calculated based on the share of the GDP in Dhaka, Comilla, Jamalpur, Mymensingh and Tangail. At present, the share of import cargo transported to Dhaka by IWT is 22.2%, according to the Transport of Containers in Bangladesh.

Transportation costs by train, truck and coaster are compared in Fig 6.2.7.

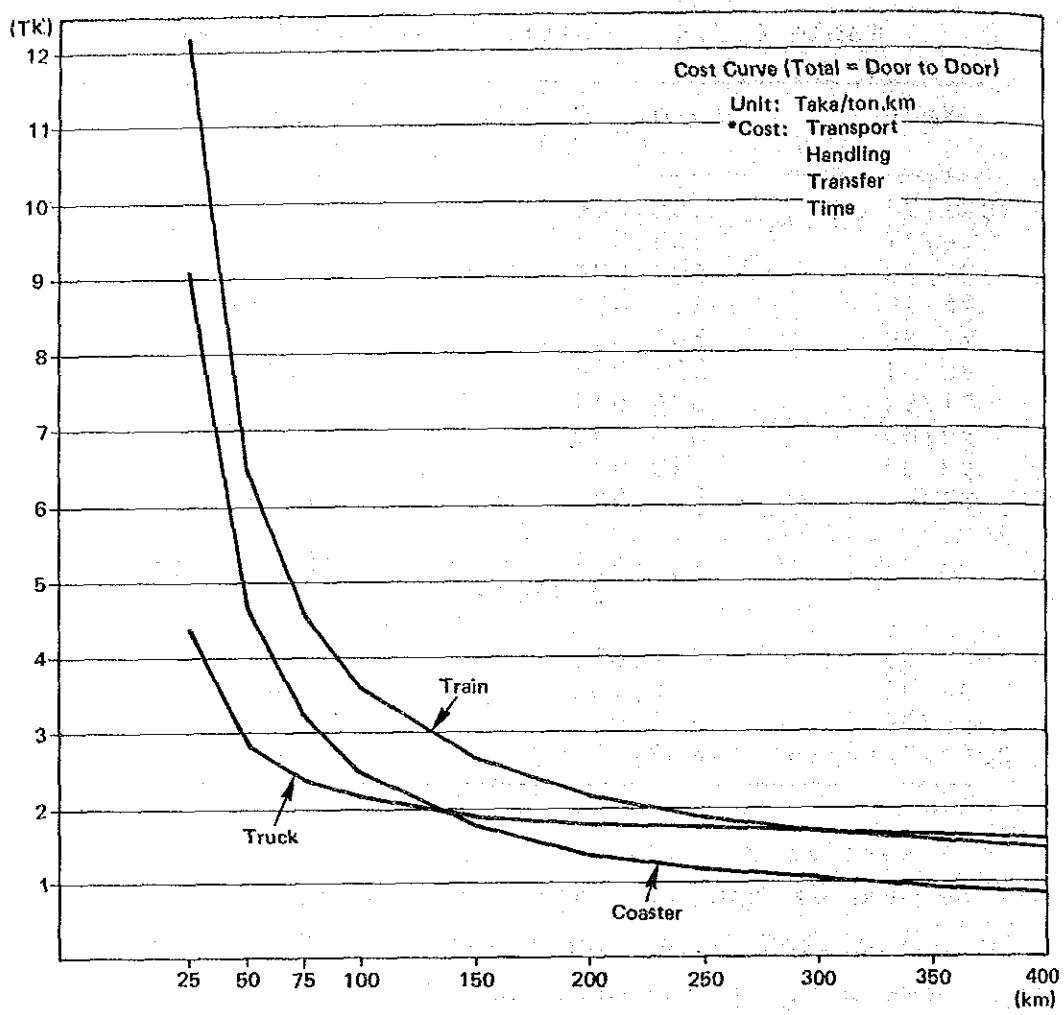


Fig. 6.2.7 Cost Curve by Train, Truck and Coaster

The cost by truck is cheaper than the cost by train or coaster for short distances, but the cost by coaster is the cheapest in the case of long distance transport.

The cost by mode is also compared in the Intermodal Transport Study. It seems that IWT is the cheapest mode for virtually any distance under the prevailing rates.

The existing share of 22.2% by IWT is projected to increase to 40% in the future, as the cost by IWT is cheaper than the cost by the other modes. The future incoming Non-bulk items in Dhaka are forecast as shown in Table 6.2.42.

Table 6.2.42 Future Incoming Non-Bulk Items at Dhaka

(Unit: '000 tons)

Year	Import Non-bulk	Regional GDP/ Total GDP	Regional Cargo	IWT Share	Incoming Non-Bulk at Dhaka
1984/85	1,389	31.3%	435	22.2%	97
89/90	1,812	31.5	571	40.0	228
94/95	2.408	31.8	766	40.0	306
99/00	3,115	32.2	1,003	40.0	401
04/05	3,894	32.5	1,266	40.0	506

(c) Outgoing Bulk

According to the BIWTA report, the volume of each commodity in 1982/83 is as shown in Table 6.2.43.

Table 6.2.43 Outgoing Bulk by Commodity

(Unit: '000 tons)

Commodity	Bricks	Cement	Food grain	POL	Salt	Sand	Stone	Total
Quantity	2	3	2	94	2	4	1	108

Source: Annual Ports & Traffic Report 1982/83

The volume of petroleum products is assumed to increase in the future based on the increase rate calculated in Section (5), above.

Based on a volume of 470 thousand tons in 1982/83, the volume of petroleum products will be 555 thousand tons in 1990, 595 thousand tons in 1995, 633 thousand tons in 2,000 and 681 thousand tons in 2005.

Other outgoing bulk items are assumed to total 20 thousand tons per year in the future.

Thus, the forecast volume of outgoing bulk items is shown in Table 6.2.44.

Table 6.2.44 Future Outgoing Bulk at Dhaka

(Unit: '000 tons)

Year	POL	Other	Total
1984/85	94	14	108
89/90	111	20	131
94/95	119	20	139
99/00	127	20	147
04/05	136	20	156

(d) Outgoing Non-Bulk

The main commodities of outgoing non-bulk are Tea, Leather, Frozen foods and Garments. The future export of non-bulk items is forecast based on the past correlation between the GDP of the industrial sector except for jute and jute goods and the volume of non-bulk exports as shown in Table 6.2.45

Table 6.2.45 Future Export of Non-Bulk Items

Year	Total Industry GDP (X) (10^6 Tk)	Export Non-Bulk Items (Y) ('000 tons)
1975/76	19,742	77
76/77	21.702	102
77/78	22,172	103
78/79	27,248	104
79/80	29,769	95
80/81	31,489	96
81/82	31,459	122
82/83	32,754	128
83/84	30,945	117
84/85	31,260	143
	Y = -12.99 + 4.0903 X	
	R = 0.8228	
1989/90	49,350	189
94/95	76,006	298
99/00	120,453	480
04/05	195,190	785

The volume of non-bulk items carried from Dhaka to the seaports is calculated based on the share of the industrial sector GDP in Dhaka, Comilla, Jamalpur, Mymensingh and Tangail.

At present, the share of the non-bulk items carried from Dhaka by IWT is 13.5% according to the Container Study.

According to the Intermodal Transport Study, the existing 22.2% share of IWT is expected to increase to 40% in future.

Therefore, the transportation by IWT from Dhaka to the seaports is calculated assuming a 40% IWT share. The estimated volume of future outgoing non-bulk items in Dhaka is shown in Table 6.2.46.

Table 6.2.46 Future Outgoing Non-Bulk Items at Dahka

(Unit: '000 tons)

Year	Export Non-Bulk Items	Regional Industry GDP/Total Industry GDP	Regional Cargo	IWT Share	Outgoing Non-Bulk at Dhaka
1984/85	143	42.1%	60	13.5%	8.1
89/90	189	43.4	82	40.0%	33
94/95	298	43.4	129	40.0%	52
99/00	480	45.6	219	40.0%	88
04/05	758	45.6	358	40.0%	143

6.2.5 Container Traffic in Bangladesh

(1) Container Cargo in Bangladesh

Container cargo in Bangladesh is the lowest volume among South Asian Countries. The container cargo volume in the past is shown in Table 6.2.47.

Containerized cargo comprises non-bulk cargo, and the containerized ratio in Table 6.2.47 shows the share of actual container cargo in total non-bulk cargo.

Table 6.2.47 Container Data in Bangladesh

Year		1980/81	1981/82	1982/83	1983/84	1984/85
Import	Container Cargo ('000 tons)	14	24	50	82	166
	Non-Bulk Cargo ('000 tons)	1,216	1,180	985	1,162	1,389
	Containerized Ratio (%)	1.2	2.0	5.1	7.1	12.0
Export	Container Cargo ('000 tons)	12	24	75	118	118
	Non-Bulk Cargo ('000 tons)	971	1,029	1,072	964	864
	Containerized Ratio (%)	1.2	2.3	7.0	12.2	13.7

Source: Transport of Containers in Bangladesh (The World Bank, December 1985)

The volume of Non-Bulk cargo forecast by the study team is shown in Table 6.2.48.

Table 6.2.48 Forecast Non-Bulk Cargo

(Unit: '000 tons)

Year		1989/90	1994/95	1999/00	2004/05
Import	Non-Bulk	1,812 (1,834)	2,408 (2,286)	3,115 (3,115)	3,894 (3,465)
Export	Jute	306	306	306	306
	Jute Goods	590	590	590	590
	Non-Bulk	189	298	480	785
	Total	1,085 (976)	1,194 (1,084)	1,376 (1,198)	1,681 (1,355)

Remark: Figures in parentheses are from the Transport of Containers in Bangladesh

Non-bulk cargo by commodity for import and export in 2005 is calculated based on the commodity share in the Transport of Containers in Bangladesh as shown in Table 6.2.49.

Table 6.2.49 Non-Bulk Cargo in 2005

Import				Export			
Commodity	1984/85 ('000 tons)	Ratio (%)	2004/05 ('000 tons)	Commodity	1984/85 ('000 tons)	Ratio (%)	2004/05 ('000 tons
Milk Products	29	2.0	78	Tea	25	17.5	137
Animal, Vegetable Oil	142	10.0	389	Frozen foods	15	10.5	82
Oil Seeds	28	2.0	78	Leather	13	9.0	71
Material for Garments	153	11.0	428	Garments	34	23.8	186
Finished Garments	25	2.0	78	Others	56	39.2	309
Paper & Wood	27	2.0	78				
Chemicals	13	1.0	39	Total	143	100.0	785
Metal	222	16.0	623				
Machinery	14	1.0	39				
Others	736	53.0	2,064				
Total	1,389	100.0	3,894				

Source: Cargo volume by commodity in 1984/85 & Ratio....Transport of Containers in Bangladesh

The containerized ratio by import and export in 2005 is calculated for each of the commodities in Table 6.2.49 as shown in Table 6.2.50.

Table 6.2.50 Containerized Ratio of Imports and Exports in 2004/05

Import				Export			
	Cargo in 2005	Containerized Ratio	Container Cargo		Cargo in 2005	Containerized Ratio	Container Cargo
Milk Products	78	100	78	Jute	306	50	153
Animal, Vegetable Oil	389	100	389	Jute goods	590	70	413
Oil Seeds	78	100	78	Tea	137	90	123
Material for Garments	428	70	300	Frozen foods	82	90	74
Finished Garments	78	100	78	Leather	71	100	186
Paper & Wood	78	100	78	Garments	186	80	247
Chemicals	39	50	20	Others	309	90	64
Metal	623	70	436				
Machinery	39	70	27				
Others	2,064	50	1,032				
Total	3,894		2,516	Total	1,681		1,260
Total Containerized Ratio (%)		65		Total Containerized Ratio (%)		75	

The containerized ratios in 1900, 1995 and 2000 are calculated based on a growth curve (logistic curve) as shown below:

$$\text{Import} \quad \ldots\ldots y = \frac{0.65}{1+0.7^{(t-1990)}}$$

$$\text{Export} \quad \ldots\ldots y = \frac{0.75}{1+0.7^{(t-1990)}}$$

y: containerized ratio
t: year

Finally, the future container cargo volume is forecast, based on each containerized ratio in 1990, 1995, 2000 and 2005 as shown in Table 6.2.51.

Table 6.2.51 Future Container Cargo in Bangladesh

(Unit: '000 tons)

Year		1989/90	1994/95	1999/00	2004/05
Import	Non-Bulk Cargo	1,812	2,408	3,115	3,894
	Containerized Ratio(%)	32.5	52.9	63.2	65
	Container Cargo	589	1,274	1,969	2,516
Export	Non-Bulk Cargo	1,085	1,194	1,376	1,681
	Containerized Ratio (%)	37.5	64.2	72.9	75
	Container Cargo	407	767	1,003	1,260

(2) Container cargo forecast at Dhaka

At present, containers are not handled at Dhaka. Containers are handled at seaports as part of the foreign trade cargo.

However, based on the cargo forecast, containers will be used in the future between Dhaka and the seaports, as IWT is the cheapest of the three transport modes. Incoming non-bulk

others, outgoing jute and jute goods and outgoing non-bulk others will be transported by containers in the future at Dhaka. The future incoming container cargo volume at Dhaka is calculated based on the containerized ratio of import cargo.

The volume of outgoing container cargo at Dhaka is calculated based on a growth curve (logistic curve) as shown below.

$$\text{Jute} \ldots\ldots y = \frac{0.5}{1 + 0.7^{(t-1990)}}$$

$$\text{Jute goods} \ldots\ldots y = \frac{0.7}{1 + 0.7^{(t-1990)}}$$

$$\text{Non-Bulk Others} \ldots\ldots y = \frac{0.88}{1 + 0.7^{(t-1990)}}$$

y : containerized ratio

t : year

The future container cargo volume at Dhaka is estimated as shown in Table 6.2.52.

Table 6.2.52 Future Container Cargo at Dhaka

(Unit: '000 tons)

Year		1989/90	1994/95	1999/00	2004/05
Incoming	Non-Bulk Others	228	306	401	506
	Containerized Ratio (%)	32.5	52.9	63.2	65.0
	Container Cargo	74 (6,727)	162 (14,727)	253 (23,000)	329 (28,909)
Outgoing	Jute	150	150	150	150
	Containerized Ratio (%)	25.0	40.7	48.6	50.0
	Container Cargo	38 (3,455)	61 (5,545)	73 (6,636)	75 (6,818)
	Jute goods	218	218	218	218
	Containerized Ratio (%)	35.0	57.3	68.1	70.0
	Container Cargo	76 (6,909)	125 (11,364)	148 (13,455)	153 (13,909)
	Non-Bulk Others	33	52	88	143
	Containerized Ratio (%)	44.0	73.3	85.6	88.0
	Container Cargo	15 (1,364)	38 (3,455)	75 (6,818)	126 (11,455)
Total		203 (18,455)	386 (35,091)	549 (49,909)	683 (62,091)

Remark: Figures in parentheses are TEU
1 TEU = 11 tons

6.2.6 Conclusion

A summary of the cargo forecast is presented in Table 6.2.53, and the same information by incoming and outgoing traffic is presented graphically in Fig. 6.2.8 and 6.2.9.

Table 6.2.53 Future Cargo Handling Volume by Commodity at Dhaka

(Unit: '000 tons)

Year	1982/83	1989/90	1994/95	1999/00	2004/05
Incoming					
(Bulk)					
Food grains	337	462	753	1,253	1,601
Cement	343	244	361	604	996
Iron & Steel	45	54	81	137	228
POL	470	555	595	636	681
Others	197	200	200	200	200
(Non-Bulk)					
Jute	4	6	6	6	6
Others	87	228	306	401	506
Incoming-Total	1,483	1,749	2,302	3,240	4,218
Outgoing					
(Bulk)					
Fertilizer	110	488	465	435	404
Others	108	131	139	147	156
(Non-Bulk)					
Jute	119	150	150	150	150
Jute-goods	88	218	218	218	218
Others	11	33	52	88	143
Outgoing-Total	436	1,020	1,024	1,038	1,071
Total	1,919	2,769	3,326	4,278	5,289

Remark: 1982/83 shows movement between Dhaka and other regions based on the OD Table from BIWTA's report.

The results of the macro forecast and the micro forecast are much the same.

The study team adopts the results of the micro forecast by commodity for plannning purposes.

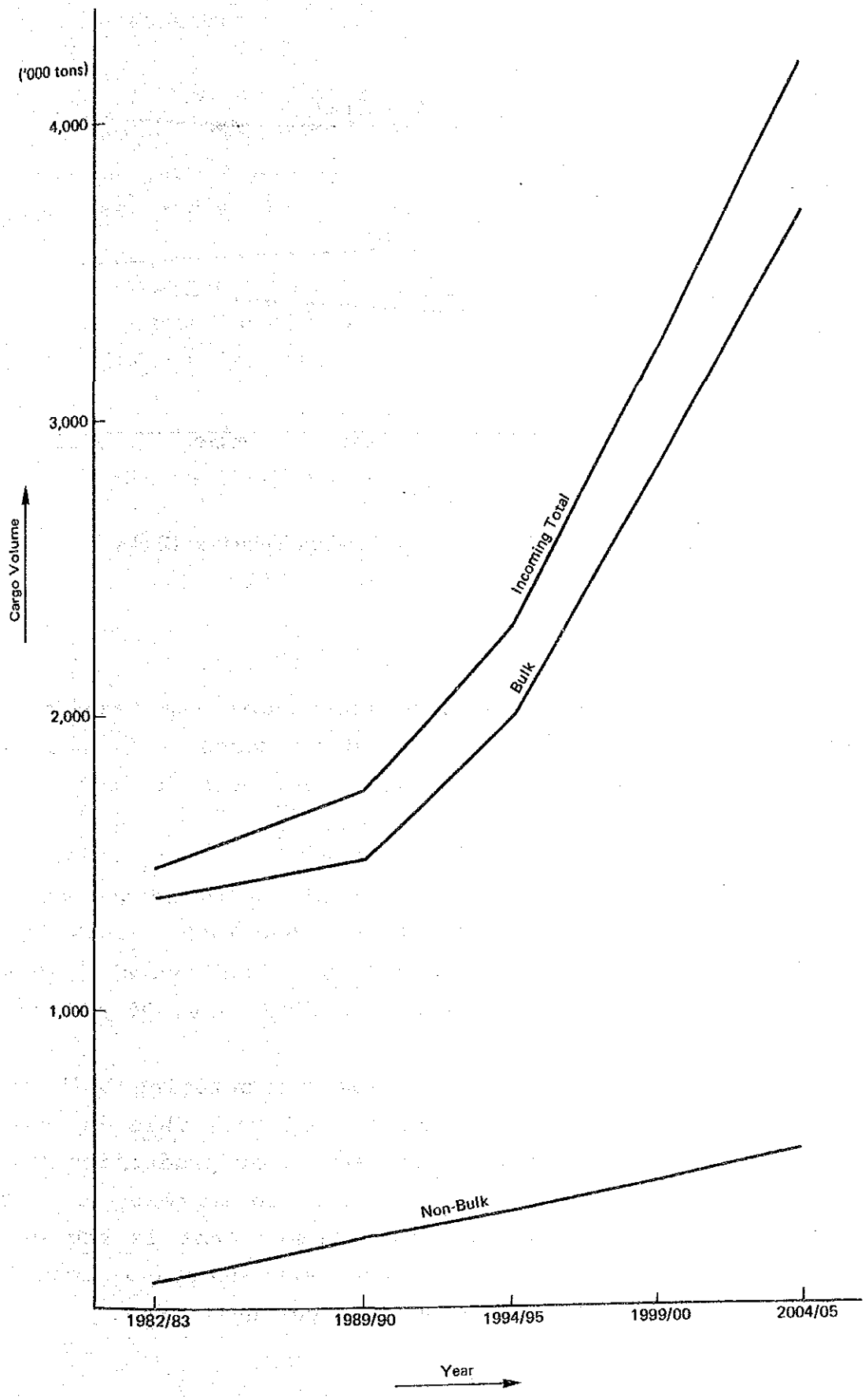


Fig. 6.2.8 Future Incoming Cargo Handling Volume at Dhaka

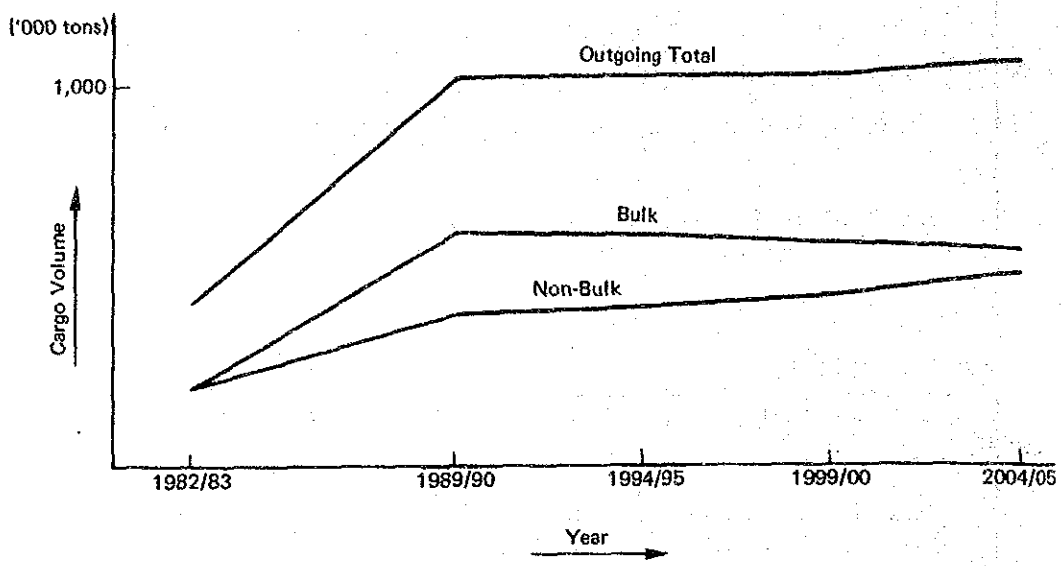


Fig. 6.2.9 Future Outgoing Cargo Handling Volume at Dhaka

The cargo movement in 1982/83 only shows the transport of cargo between the Dhaka area and other zones - it does not include transport within the Dhaka area - and it is based on the OD table in the BIWTA report.

The average annual growth rate of total cargo handling volume from 1990-2005 is 3.67% during 1990-1995, 5.05% during 1995-2000 and 4.25% during 2000-2005. The overall average annual growth rate during the entire period is 4.39% per year.

It will be noted that the volume of outgoing bulk cargo decreases after 1990 (refer to Figure 6.2.9). This is because despite the projected increase in fertilizer production in the Dhaka area, the consumption is projected to increase at even a greater rate, and thus the surplus volume, that is the volume which will be shipped out of the area, will decrease along with the marked increase in the consumption per unit area.

6.2.7 Passengers

There are passenger terminals at Dhaka and Narayanganj Ports and a large number of passengers travel within the Dhaka region on short distance trips and between Dhaka and Barisal, Patuakhali and Khulna on long distance trips.

The number of future IWT passengers in Bangladesh is forecast based on the past correlation between IWT passengers in Bangladesh and the national population as shown in Table 6.2.54.

Table 6.2.54 Future IWT Passengers in Bangladesh

Year	Total Population (X) ('000 persons)	Total IWT Passengers (Y) ('000 persons)
1975/76	80,037	77,500
76/77	81,921	82,900
77/78	83,849	88,500
78/79	85,823	94,600
79/80	87,844	98,000
80/81	89,912	102,900
81/82	92,219	120,800
82/83	94,592	127,400
83/84	97,030	134,000
84/85	99,529	141,000
	$Y = -3,478,890 + 314,454 \ln(X)$ $R^2 = 0.973168$	
1989/90	113,304	180,672
94/95	129,147	221,712
99/00	147,147	262,857
04/05	167,395	303,398

The number of passengers at Dhaka is calculated based on the projected share of the population of Dhaka in the national population in the future as shown in Table 6.2.55.

Table 6.2.55 Future IWT Passengers at Dhaka

(Unit: '000 persons)

Year	Total IWT Passengers	Total Population	Dhaka Population	Dhaka Population/ Total Population (%)	Dhaka IWT Passengers	Trips/person
1984/85	141,000	99,529	12,382	12.4	17,484	1.6
1989/90	180,672	113,304	15,241	13.5	24,391	1.6
94/95	221,712	129,147	18,698	14.5	32,148	1.7
99/00	262,857	147,147	22,865	15.5	40,743	1.8
04/05	303,398	167,395	27,854	16.6	50,364	1.8

According to BIWTA's data, passengers at Dhaka and Narayanganj Ports in 1983/84 were 15,467 thousand persons and 5,516 thousand persons respectively for a total of 20,983 thousand persons. The study team forecast in Table 6.2.55 only considers IWT passengers.

However, another method to predict the future number of IWT passengers is to look at the total number of passengers in the future by all three transport modes, that is IWT, rail and road, and then to consider the future share of each of these transport modes. Past passenger share by mode in Bangladesh is shown in Table 6.2.56.

Table 6.2.56 Historical Share of Passengers by Mode

(Unit: Million persons)

Year	Road	Rail	IWT	Total
1975/76	93.1 (34.1)	102.4 (37.5)	77.5 (28.4)	273.0 (100.0)
76/77	99.5 (34.6)	105.1 (36.6)	82.9 (28.8)	287.5 (100.0)
77/78	106.3 (35.1)	107.8 (35.6)	88.5 (29.3)	302.6 (100.0)
78/79	113.6 (35.6)	110.5 (34.7)	94.6 (29.7)	318.7 (100.0)
79/80	121.3 (36.5)	113.4 (34.1)	98.0 (29.4)	332.7 (100.0)
80/81	129.6 (37.2)	116.3 (33.3)	102.9 (29.5)	348.8 (100.0)
81/82	139.1 (36.7)	119.3 (31.5)	120.8 (31.8)	379.2 (100.0)
82/83	149.2 (37.4)	122.3 (30.7)	127.4 (31.9)	398.9 (100.0)
83/84	160.1 (38.2)	125.5 (29.9)	134.0 (31.9)	419.6 (100.0)
84/85	171.8 (38.6)	132.5 (29.7)	141.0 (31.7)	445.3 (100.0)

Sourcer: Intermodal Transport Study (The Planning Commission, December 1985)
Remark: Figures in parentheses show percent

As shown in Table 6.2.56, the passenger share by Rail used to be the largest of the three modes, but the share by Rail has decreased gradually, and the passenger share by Road is now the largest. The passenger share by IWT is increasing gradually. The future number of passengers is forecast based on the past correlation between the number of passengers and the population of Bangladesh as shown in Table 6.2.57.

Table 6.2.57 Future Number of Passengers

(Unit: '000 persons)

Year	Population	Total Passengers
1984/85	99,529	445,300
89/90	113,304	544,175
94/95	129,147	651,641
99/00	147,147	759,380
04/05	167,395	865,537

Relation equation: $Y = -9,038,530 + 823,410 \ln(X)$

Correlation coefficient: $R^2 = 0.970431$

The present passenger share by IWT is 31.7%

According to the Intermodal Transport Strudy, the future passenger share by IWT will increase somewhat. The future number of IWT passengers is calculated based on the future IWT share and the future total passengers.

Future IWT passengers at Dhaka are then calculated by the future population share of the Dhaka Area presented in Table 6.2.55, as shown in Table 6.2.58.

Table 6.2.58 Future IWT Passengers at Dhaka

(Unit: '000 persons)

Year	Total Passengers	IWT Share	Total IWT Passengers	Population Share	Dhaka IWT Passengers
1984/85	445,300	31.7	141,160	12.4	17,504
89/90	544,175	34.0	185,020	13.5	24,978
94/95	651,641	36.0	234,591	14.5	34,016
99/00	759,380	39.0	296,158	15.5	45,904
04/05	865,537	39.0	337,559	16.6	56,035

In summary, the future number of IWT passengers at Dhaka is calculated using two different methods, and the calculation results are presented in Tables 6.2.55 and 6.2.58. The estimated number of passengers using the second method is slightly larger than the estimate under the first method. However, the difference is not significant, and in this report, the study team adopts the first estimate, that is the estimate presented in Table 6.2.55.

6.3 Land Demand for Urban Activities

In this section, the future change of the urban structure of DNMA is discussed and the future land demand for urban activities around the port area is estimated.

6.3.1 Future Population Distribution in DNMA

The population of DNMA has been increasing at the rate of 5.6% per annum. This high growth rate is a result of the natural increase plus the in-migration of an average of 120 thousand persons per year from the countryside into DNMA.

If the annual growth rate of 5.6% continues in the future, the population of DNMA will reach 15,500 thousand in 2005 (Case 1).

On the other hand, if the annual average in-migration continues at a constant 120 thousand persons and the natural increase rate decreases along with the national average, the population will be 11,600 thousand in 2005 (Case 2). The most probable scenario is that the natural increase rate will decline slowly and the in-migration will increase slightly because of the population growth and the socioeconomic factors in rural areas.

In conclusion, it is assumed that the future population will change along the average of Case 1 and Case 2 (see Table 6.3.1). According to this assumption, the population of DNMA will increase from 5.2 million in 1985 to 13.5 million in 2005, a growth of 2.6 times.

In IUDP the urban capacity by zone is calculated when the future population distribution in Dhaka conurbation is studied. In this JICA study, a few corrections are made for Keraniganj and Bandar to accommodate more population. The amended estimates based on the IUDP figures are presented in Table

Table 6.3.1 Future Population of DNMA

	1985	1990	1995	2000	2005	Annual Growth Rate (%)			
						1985/90	1990/95	1995/2000	2000/05
Case 1	5,230	6,860	9,010	11,830	15,540	5.6	5.6	5.6	5.6
Case 2	5,140	6,450	7,950	9,650	11,580	4.6	4.3	4.0	3.7
Recommended Case	5,180	6,650	8,480	10,740	13,560	5.1	5.0	4.8	4.8

Note: Case 1 assumes that the population growth rate will continue at a constant 5.6% per year

Case 2 assumes that the average in-migration to DNMA will continue at a constant 120 thousand persons per year, while the natural increase rate will decrease gradually along with the national average.

The recommended case is the average of Case 1 and Case 2.

6.3.2.

Table 6.3.2 Urban Capacity by Zone

(thousand persons)

Zone	Urban Capacity
Port Related Zone	4,040
DND Triangle	2,240
Keraniganj	660
Narayanganj	420
Bandar	720
Central Zone	2,760
North Zone	7,780
North Dhaka	1,620
Tongi-Joydebpur	3,790
Savar	2,370
Total	14,580

Source: IUDP

IUDP proposes the strategic residential development of the northern part of Dhaka conurbation up to 2000. However, urbanization is actually proceeding in the southern part of Dhaka including the DND Triangle. From the long-range view, it is necessary to assume substantial urbanization in the Port-related Zone. Planners at DIT consider that almost all of the DND Triangle will be urbanized by the year 2000.

Then, in this study, it is assumed that urbanization will advance to the north in the near future, but that after the second half of the 1990's the Port-related Zone will become an object of rapid urban development which will make it necessary to prepare some regulatory plans coordinated with flood control schemes.

The pace of urbanization by zone is assumed as follows:

Central Zone: reach the capacity by 1990

(North Zone)

North Dhaka:	reach the capacity by 1995
Tongin Joydebpur:	reach 80% of the capacity by 2000, 100% by 2005
Savar:	reach 40% of the capacity by 2000, 100% by 2005

(Port Related Zone)

Narayanganj:	reach the capacity by 1990
DND Triangle:	reach two-thirds of the capacity by 2005
Keraniganj:	reach 80% of the capacity by 2005
Bandar:	reach 80% of the capacity by 2005

Future zonal population is estimated as shown in Table 6.3.3, based on the above-mentioned assumptions and the estimated future population of DNMA.

6.3.2 Future Employment Distribution in DNMA

If the population of DNMA grows as shown in Table 6.3.1 (the recommended case), DNMA's share of population in the Dhaka Region will rise from the present 42% to 49% in 2005. The crude activity rate of the Dhaka Region is estimated to change from the present 31% to 34% in 2005. Based on these changes, the crude activity rate of DNMA can be estimated, showing a growth tendency from the existing 35% to 38% in 2005 (see Appendix 2).

Table 6.3.4 shows the forecast future total employment in DNMA

Table 6.3.3 Future Population Distribution in DNMA

(thousand persons)

Zone	Urban Capacity	1984/85	1989/90	1994/95	1999/00	2004/05
Port Related Zone	4,040	1,260	1,440	1,840	2,380	3,020
DND Triangle	2,240	300	350	640	1,030	1,500
Keraniganj	660	260	300	350	430	520
Narayanganj	420	380	420	420	420	420
Bandar	720	320	370	430	500	580
Central Zone	2,760	2,470	2,760	2,760	2,760	2,760
North Zone	7,780	1,450	2,450	3,880	5,600	7,780
North Dhaka	1,620	900	1,520	1,620	1,620	1,620
Tongi-Joydebpur	3,790	310	650	1,690	3,030	3,790
Savar	2,370	240	280	570	950	2,370
Total	14,580	5,180	6,650	8,480	10,740	13,560

Table 6.3.4 Future Total Employment in DNMA

	1984/85	1989/90	1994/95	1990/00	2004/05
Crude Activity Rate in Dhaka Region (%)	30.6	31.2	31.7	32.7	34.2
DNMA's share of Population (%)	41.8	43.6	45.4	47.0	48.7
Crude Activity Rate in DNMA (%)	34.0	34.5	34.9	36.0	37.5
Population of DNMA (thousand persons)	5,180	6,650	8,480	10,740	13,560
Total Employment in DNMA (thousand persons)	1,760	2,290	2,960	3,870	5,090

The total employment in DNMA is also divided into population-related employment and basic employment. Population-related employment is assumed to grow at the same rate as the population, while basic employment is the residual calculated by deducting population-related employment from the total.

Among basic employment, agricultural employment is assumed to decrease gradually to zero in 2004/05, while non-agricultural employment is assumed to increase in proportion to the growth rate of each sector's GDP.

The estimated sectoral employment is shown in Table 6.3.5.

Population-related employment is distributed proportionally based on future zonal population. The distribution of basic employment is decided by applying the future zonal employment distribution calculated by IUDP.

The distributions of population-related employment and basic employment are shown in Table 6.3.6 and Table 6.3.7, respectively.

Table 6.3.5 Future Employment by Sector

(thousand persons)

	1984/85	1989/90	1994/95	1999/00	2004/05
Population-related Employment					
Manufacturing	70	90	110	140	180
Services	810	1,040	1,330	1,680	2,120
Total P.R.E.	880	1,130	1,440	1,820	2,300
Basic Employment					
Agriculture	130	100	70	40	0
Manufacturing	210	290	420	600	850
Services	540	770	1,030	1,410	1,940
Total B.E.	880	1,160	1,520	2,050	2,790
Total	1,760	2,290	2,960	3,870	5,090

Table 6.3.6 Future Distribution of Population-related Employment in DNMA

(thousand persons)

	Port-related Zone	Central Zone	North Zone	Total
1984/85				
Manufacturing	20	30	20	70
Services	190	390	230	810
Total	210	420	250	880
1989/90				
Manufacturing	20	35	35	90
Services	225	430	385	1,040
Total	245	465	420	1,130
1994/95				
Manufacturing	25	35	50	110
Services	290	430	510	1,330
Total	315	465	560	1,440
1999/00				
Manufacturing	30	35	75	100
Services	370	430	880	1,680
Total	400	465	955	1,820
2004/05				
Manufacturing	45	35	100	180
Services	470	430	1,220	2,120
Total	515	465	1,320	2,300

Table 6.3.7 Future Distribution of Basic Employment in DNMA

(thousand persons)

		Port-related Zone	Central Zone	North Zone	Total
1984/85	Agriculture	35	10	85	130
	Manufacturing	90	70	50	210
	Services	170	340	30	540
	Total	295	420	165	880
1989/90	Agriculture	30	5	65	100
	Manufacturing	105	80	105	290
	Services	215	490	65	770
	Total	350	575	235	1,160
1994/95	Agriculture	25	0	45	70
	Manufacturing	130	95	195	420
	Services	275	625	130	1,030
	Total	430	720	370	1,520
1999/00	Agriculture	15	0	25	40
	Manufacturing	170	110	320	600
	Services	340	770	300	1,410
	Total	525	880	645	2,050
2004/05	Agriculture	0	0	0	0
	Manufacturing	225	120	505	850
	Services	400	940	600	1,940
	Total	625	1,060	1,105	2,790

6.3.3 Land Demand for Urban Activities in the Port-related Zone

Here the future land demand for urban activities in the Port-related Zone is estimated as a basis for studying the land use around the port area described in Chapter 8.

The land demand is calculated only for basic industries, considering that the land demand for population-related industries will be absorbed in the gross demand of residential areas.

a. Land for Manufacturing Industries

From Table 6.3.7, it is calculated that the employment in manufacturing industries will increase by 135 thousand persons between 1985 and 2005; 40 thousand

during the first decade and 95 thousand during the second one. This increase of employment is proportional to the industrial land demand.

A survey of 1893 factories in DMC (1981) shows that the average size of factory land holdings is 400 sq. m, and another industrial estate survey shows that the average typical plot size at the Shampur Industrial Estate near Pagla is 2000 sq.m. On the other hand, a survey of 2,026 factories in the Dhaka Region (1985) indicates that the average number of employees per establishment is 115 in the Dhaka Region and 298 at Shampur.

Based on these figures, the average plot area per employee can be calculated as 3.5 sq.m. in the Dhaka Region and as 6.7 sq.m. at Shampur. These figures are very small, and imply that the manufacturing industries in Bangladesh are extremely labor intensive.

The unit land area per employee in the Port-related Zone might be near that at Shampur. But considering that some of the employment increase will be absorbed by existing factories, a rough estimation of the land demand is made assuming 5 sq.m. per employee (see Table 6.3.8).

Table 6.3.8 Land Demand for Manufacturing Industries in the Port-related Zone

	Increase of Employment (thousand persons)	Land Demand (ha)
1985 - 1995	40	20
1995 - 2005	95	48
Total	135	68

b. Land for Service Industries

In the Port-related Zone, the increase of employment in the service industries will total 105 thousand persons between 1985 and 1995 and 125 thousand persons between 1995 and 2005, totalling 230 thousand persons over the twenty year period. According to the IUDP study, about 30% of the basic service employment is estimated to consist of construction and transportation (especially port related) employment, which will require very little land in the Port-related Zone. However, the other service industries will require some land.

It is difficult to obtain reliable data to estimate the unit land demand per employee in the service sector. Considering that the unit land area per employee in the manufacturing sector in DNMA is very small, the same unit demand of 5 sq.m. per employee is applied for a rough estimation. The result is shown in Table 6.3.9.

Table 6.3.9 Land Demand for Service Industries in the Port-related Zone

	Increase of Employment (thousand workers)*	Land Demand (ha)
1985 - 1995	74	37
1995 - 2005	88	44
Total	162	81

*Excluding construction and transportation workers
Source: Study Team Estimate

CHAPTER 7
ENGINEERING ASPECTS OF PORT FACILITIES

CHAPTER 7 ENGINEERING ASPECTS OF PORT FACILITIES

7.1 Design Guideline

The following items should be included in the guideline on designing port facilities: practical use of local engineering, application of Japanese design standards, designing facilities which can accommodate both present and future cargo handling systems and which can also be used year-round despite heavy water level fluctuations.

1 Practical use of local engineering

The civil engineering of Bangladesh is consistent with the local social and economic situation as well as with the local technical level at present. Local engineers have experience constructing several types of structures throughout the country.

From the viewpoint of maximizing the utilization of the local manpower and materials, local engineering techniques should be applied wherever possible for designing and constructing the facilities.

2 Application of the Japanese design standards

"The Technical Standards for Port and Harbour Facilities in Japan" should be used in the design of mooring facilities to ensure engineering reliability. Other Japanese design standards should also be used for other facilities as appropriate.

3 Designing facilities which can accommodate both present and future cargo handling systems.

Cargo handling at Bangladeshi ports relies mainly on

human power at present due to the readily available inexpensive labor pool. In the future, however, the cargo handling system may change towards mechanized operations to increase efficiency.

As the facilities will have to serve for a long time, they must be able to accommodate potential future mechanized cargo handling methods as well as the present methods using human labour.

4 Designing facilities which can be used year-round.

The yearly water level fluctuation is as great as 5 to 6 meters at both Dhaka and Narayanganj ports. The ports should be able to accommodate cargo and passengers at any time throughout the year regardless of the water level.

7.2 Basic Design Conditions

7.2.1 General conditions

(1) Construction standard base level: P.W.D.

(2) Ground elevation of the port storage area: +7.00 m P.W.D.

(3) Water depth for navigation channel and basin:

-3.57 m P.W.D. (-4.27m (-14 feet) S.L.W.)

(4) Design vessels: 1000 DWT

7.2.2 Natural conditions

(1) Water level

1 The highest water level on record: 7.087 m
2 H.W.L.: +5.70 m
(The water level on 95% of the yearly H.W.L. days is lower than this)
3 L.W.L.: +0.70 m (S.L.W.)
(The water level on 95% of the yearly L.W.L. days is higher than this)

(2) Current velocity:

The maximum current velocity is considered to be 1.30 m/s

(3) Waves:

The wave height is considered to be 0.40 m based on wave hindcasting.

(4) Earthquake intensity: Kv = 0 kh = 0.06

(5) Soil conditions: As shown in Fig. 7.2.1 and Fig. 7.2.2.

7.2.3 Volume Weight in Units

Reinforced Concrete:	2.45 t/m^3
Plain Concrete:	2.30 t/m^3

7.2.4 Allowable Stress Level

(1) Allowable Stress Level for Steel Materials:

The allowable stress level during ordinary conditions for steel pipe piles (SKK 41), reinforcing rods (SR 24) and steel members is considered to be 1,400 kg/cm^2. In addition, when considering such short-term loads as earthquakes, these levels can be increased within a range equal to 50% of the allowable stress levels under normal conditions.

(2) Allowable Stress Level for Concrete:

Standard design strength: $\sigma 28 = 210$ kg/cm^2
Allowable Compression Stress Level under Ordinary Conditions:

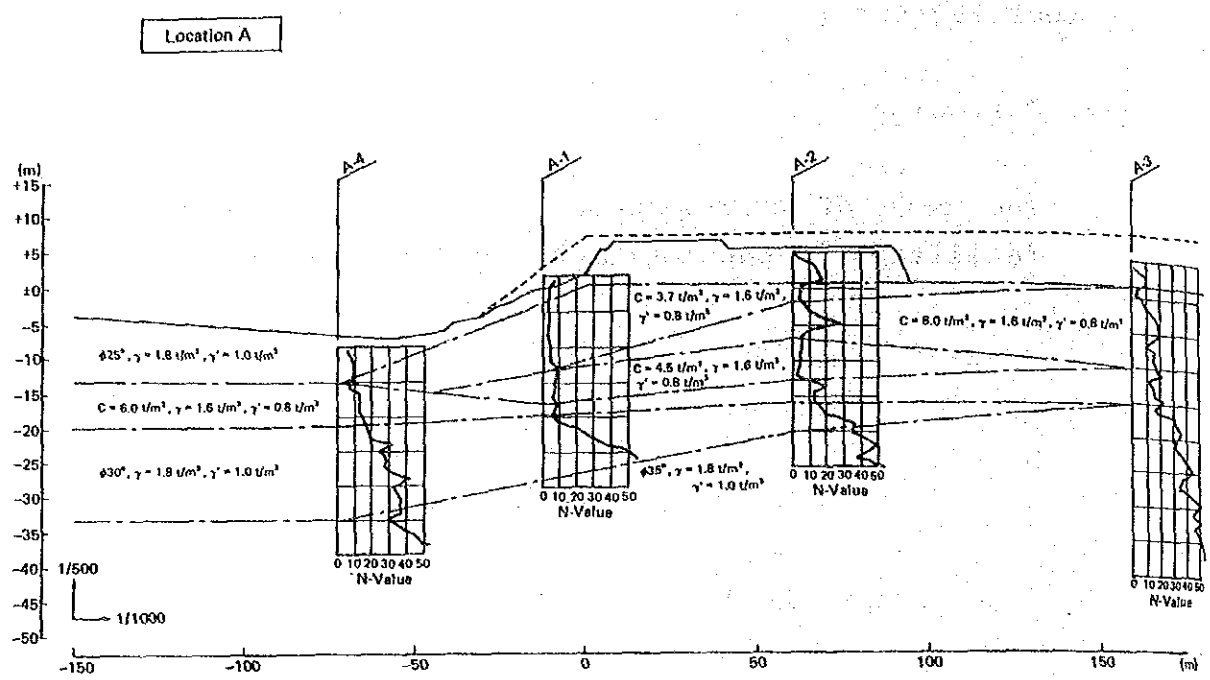
$\sigma ca = 70$ kg/cm^2

In times of earthquakes, the increase in stress level is considered to be the same as that for steel materials.

7.2.5 Other Factors

(1) Corrosion

The rate of corrosion for steel materials at mooring facilities is considered to be 0.15 mm/year.



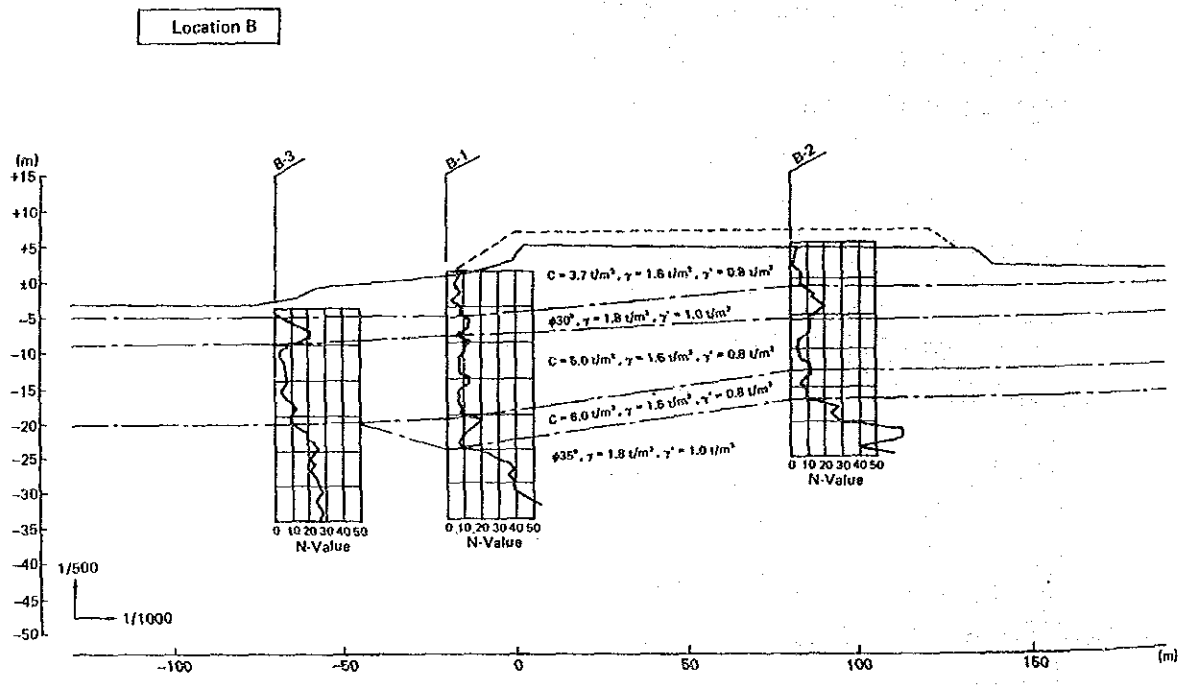


Fig. 7.2.1 Soil Conditions (1)

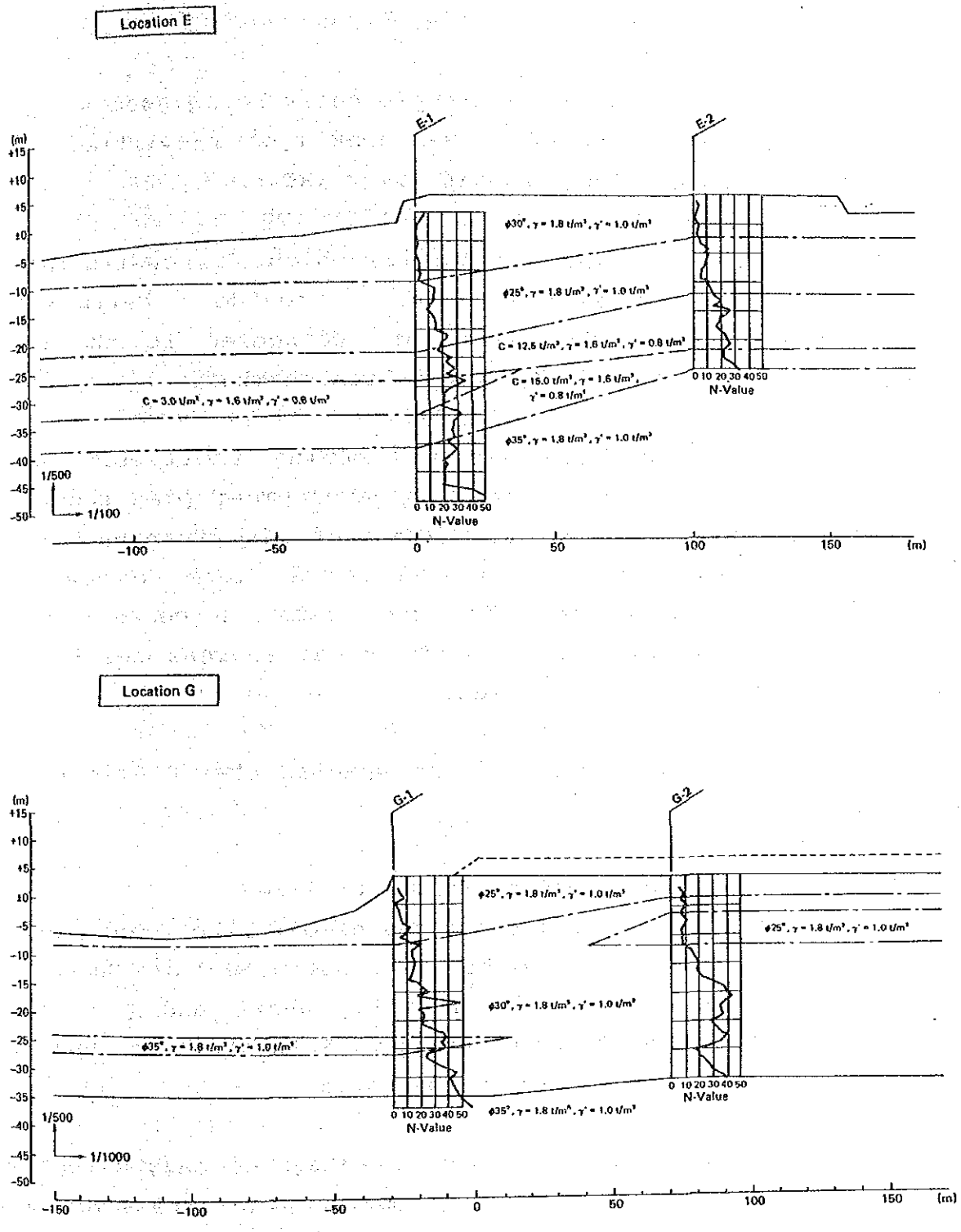


Fig. 7.2.2 Soil Conditions (2)

7.3 Fundamental Type of Mooring Facilities

Most of the mooring facilities presently being used at Dhaka and Narayanganj ports are off river bank type facilities. The mooring facilities are installed in river water.

There is another type of facility which is constructed by dredging the bank and adjacent land to provide a berth and a basin. Some of these facilities are connected to the river directly. Others are connected via a lock chamber.

Thus, the fundamental type of mooring facilities to be constructed at the two ports for the development plan should be selected among the three existing types of off river bank type, dredged type and dredged type with a lock chamber in consideration of the construction and operation costs and the ability to accommodate vessels in different seasons despite the marked fluctuations in water level.

Following is an outline of the special characteristics of each type.

(1) Off river bank type mooring facilities

There are two practical types of off river bank mooring facilities which could be constructed at Dhaka and Narayanganj ports: a floating wharf and a concrete jetty with an approach bridge. Both of these types are currently being used at the ports.

These facilities have the advantage of easy extension. These off river bank type mooring facilities are also the easiest type to construct, and the least expensive as they require no dredging during the construction and relatively little dredging thereafter if they are constructed in good locations which remain deep enough to berth vessels. On the other hand, they suffer from changes in the water level.

(2) Dredged Mooring Facilities without a Lock Chamber

Facilities of this type are constructed in two stages: first the river bank and adjoining land area are dredged, and second the mooring facility is constructed at the edge of the newly dredged basin. This type of facility has the same disadvantage as the off river bank type.

As the basin water level fluctuates along with the river water, the facilities must be carefully designed so that cargo can be handled throughout the year despite the great fluctuations of the water level. Furthermore, expansion of this type of facility requires suspension of port operations. The separation of the water area of the basin from the river has two effects. On the one hand, vessels berthing at these facilities do not interfere with vessel navigation in the river. On the other hand, the different water flow between the basin and the river intensifies the possibility of sedimentation, and thus dredged facilities require regular maintenance dredging. The total construction costs of this type of facility are slightly higher than the total construction costs of off river bank facilities.

(3) Dredged Type Mooring Facilities with a Lock Chamber

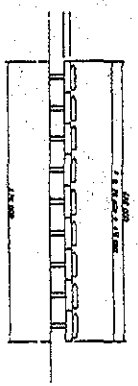
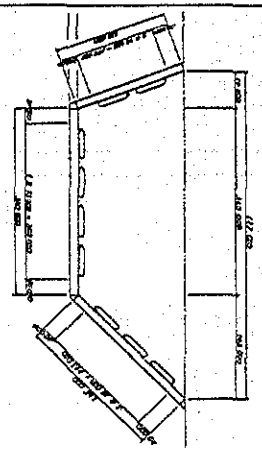
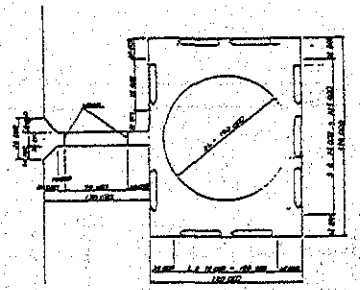
In this type of facility, the port water area is separated perfectly from the river and is connected to it by means of an approach channel and a lock chamber. This type of berth can maintain a constant water level throughout the year. Fixing the water level at the LWL makes the crown elevation of the mooring facilities low, so the mooring facilities may be small and inexpensive. However, sedimentation is likely to occur at the entrance to the approach channel which requires

maintenance dredging. The total construction and maintenance costs are the highest among the three types, because they includes funds for construction and maintenance of the lock chamber and pumps as well as a huge amount of earth works for dredging the basin and berth and banking to prevent flooding.

A comparative evaluation of the three fundamental types of facilities is shown in Table 7.3.1, and the plan sketches of these three types are shown in Fig. 7.3.1 , Fig. 7.3.2 and Fig. 7.3.3.

The off river bank type is the best type for this project because the construction cost is the lowest, and this type is flexible allowing for future development of the ports.

Table 7.3.1 A COMPARISON OF THE FUNDAMENTAL TYPES OF MOORING FACILITIES

Item	Off River Bank Type Mooring Facilities	Dredged Mooring Facilities	
		Without Lock Chamber	With a Lock Chamber
Rough overall form (comparison with 9 berths)			
Countermeasures for water level fluctuation	The crown height of piers is set to be higher than HWL for flood season operation		Water level in the basin is kept constant by means of year-round pumping
Influence on River navigation	Slight Effect	None	None
Influence on River Bank	Total length of the pier head line is the same as the length of the river bank	The total length is longer than the river bank	A small portion of the river bank is occupied with the lock chamber
Widening of Harbor: flexibility to develop the port in the future	Possible	Difficult	Difficult
Necessity of Maintenance Dredging	None	Yes	Small Amount
Rough estimate of construction costs	57,000,000 Tk per Berth	92,000,000 Tk per Berth	153,000,000 Tk per Berth
General appraisal	◎	○	△

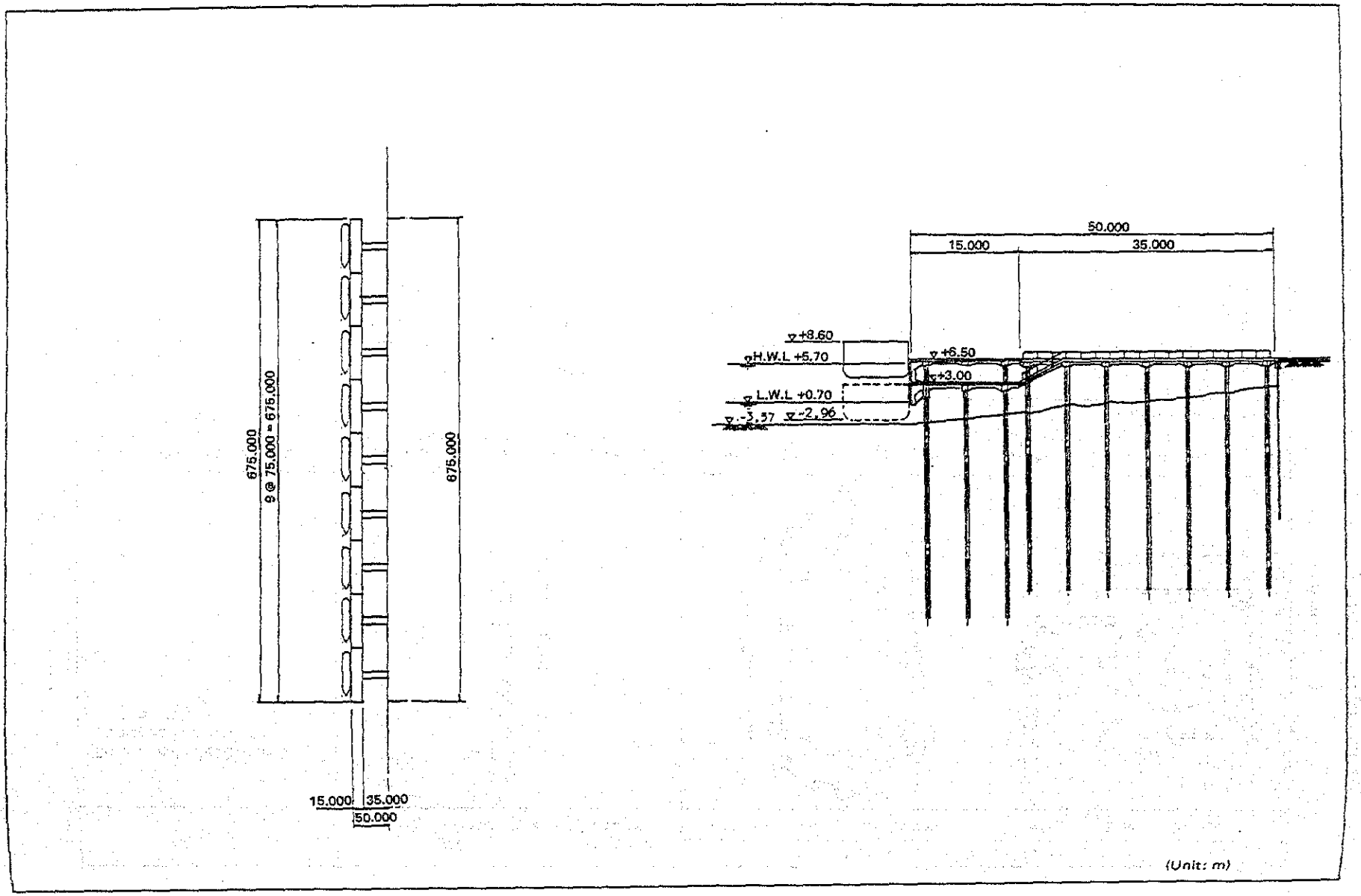


Fig. 7.3.1 Off River Bank Type Mooring Facilities

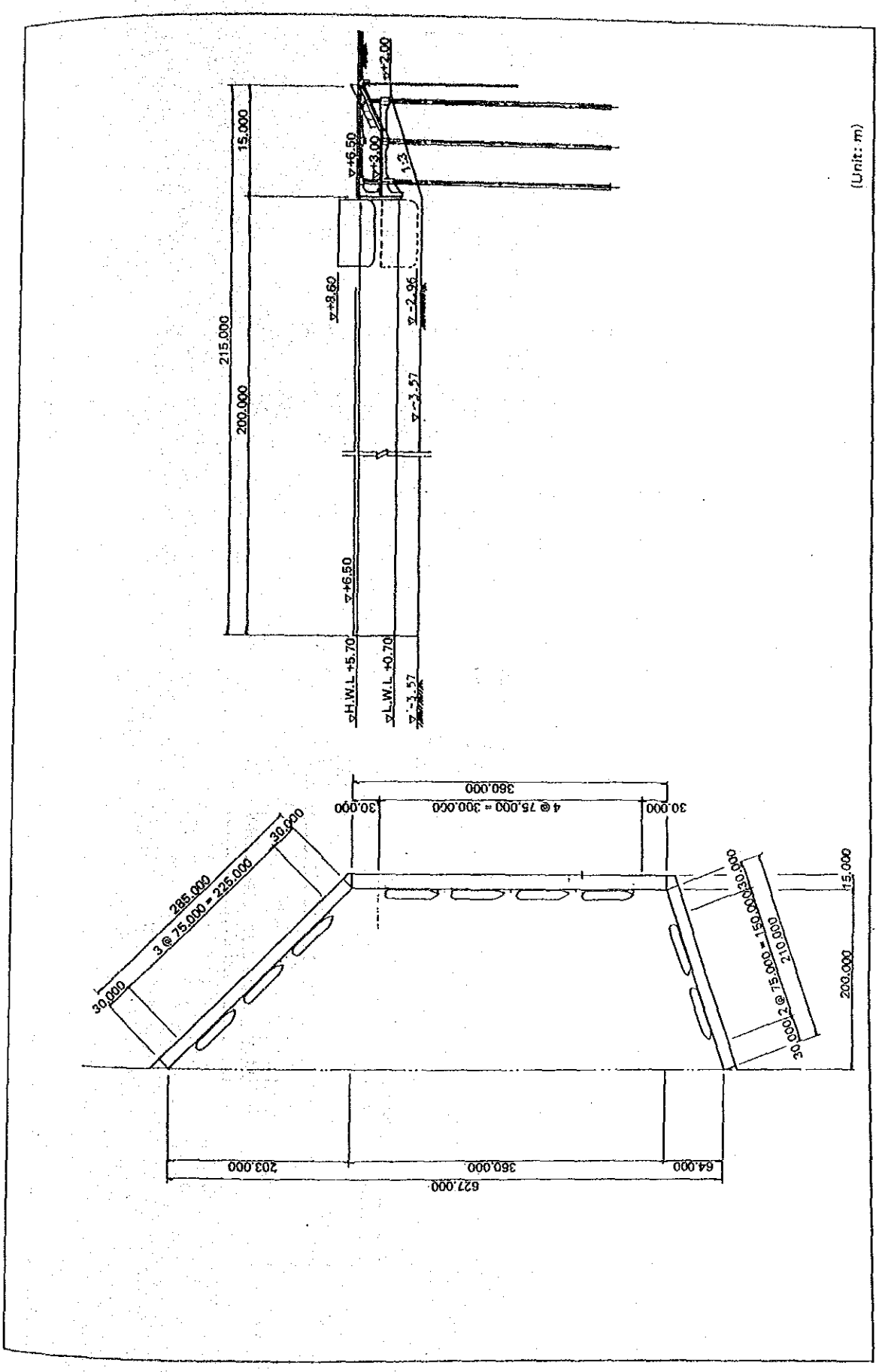


Fig. 7.3.2 Dredged Mooring Facilities Without a Lock Chamber

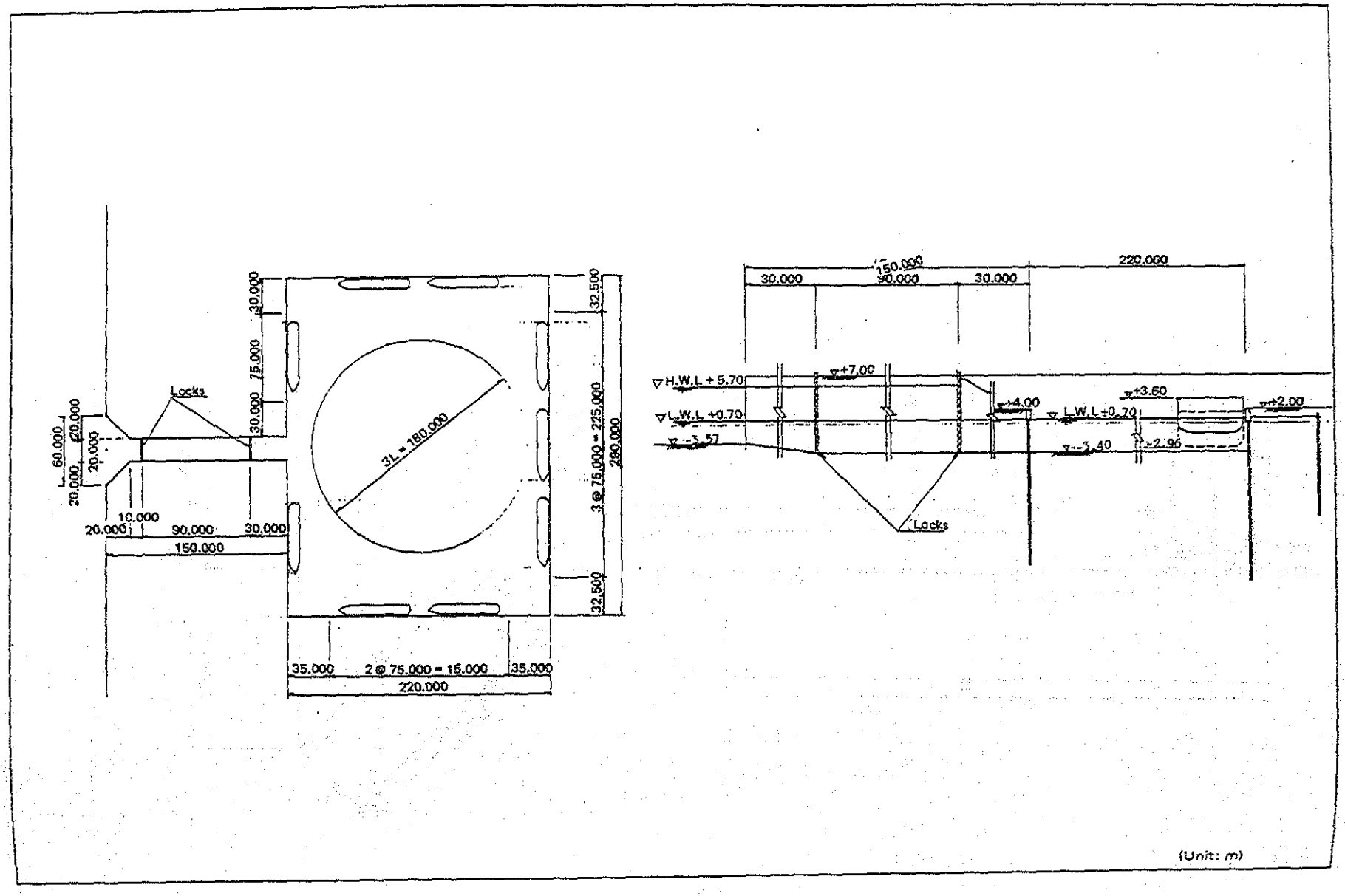


Fig. 7.3.3 Dredged Mooring Facilities With a Lock Chamber

CHAPTER 8
MASTER PLAN

CHAPTER 8 MASTER PLAN

8.1 Port Planning

8.1.1 Present Problems

Dhaka and Narayanganj Ports play a very important role in supporting the economic activities of the Dhaka Metropolitan Area which is the largest urban center in Bangladesh. These ports should function smoothly, and the development of these ports should take place in harmony with the development of the entire urban area in order to maximize the benefits of the development project. There are currently various problems which interfere with smooth port operations as outlined below.

(Planning Aspects)

(1) Currently, portions of the waterfront areas at the ports are being used for activities which are not directly related with port activities. As the waterfront areas are limited, ideally all of the waterfront space should be used for port facilities and port-oriented industries to support the local and national economy.

(2) At present, the navigation in the port areas is disorderly, and the port areas are congested despite the fact that the Buriganga and Lakhya Rivers are sufficiently deep and Dhaka and Narayanganj Ports thus have a high potential as inland river ports. As a large volume of the inland water transport is carried by country boats, country boat operations tend to contribute greatly to the port congestion and confusion. If the navigation in the port areas were more orderly, the congestion would be significantly reduced. So, it is important to plan navigation in the port areas to improve the flow of vessels.

(3) In order to make an effective long-range development plan, it is essential to have good data concerning present and past port operations. At Dhaka and Narayanganj Ports, the available data is quite limited. Especially, the data necessary for port planning such as the arrival and departure pattern of vessels, the cargo handling volume by jetty and the vessel waiting time is not sufficient.

(Port Facilities and Operations)

(1) At the subject ports, presently only the Khanpur R.C.C. jetty area functions efficiently as a comprehensive wharf. The R.C.C. jetties all have the potential to handle a large volume of cargo, but at present, the cargo handling system is inefficient. Jetties, cargo sorting areas and godowns should be organized systematically to improve the cargo handling. In most areas of the ports such as at Badamtali, cargo sorting areas are located some distance from the jetties, and the cargo is handled directly between the vessels and the trucks and push carts which are used to carry the cargoes overland. Cargoes are frequently stocked directly at the river banks. This type of unorganized cargo handling results in low productivity and traffic congestion.

(2) Sadarghat, Badamtali and Mill Barracks are the three main areas at Dhaka port in terms of facility scale, cargo handling volume and number of passengers. Unfortunately, the access roads in these area are very narrow, and at Badamtali the traffic is especially congested with a large number of rickshaws and auto rickshaws. Furthermore, there are also no good railway connections at the ports despite the fact that the national railway system is relatively well developed.

(3) There are three main types of jetties in Bangladesh river ports: ' R.C.C. jetty, pontoon with gangway and wooden

jetty. The scale arrangement, type and structure of the jetties at the subject ports should be specified or standardized in order to ensure smooth and consistent port operations. Then, accordingly, different size vessels should be allocated to appropriate berths. In actual operations, the objective vessel size for each berth is not clear, and several types of vessels carry out operations at each jetty.

(4) The only mechanical equipment provided by BIWTA at the ports are the mobile cranes at Badamtali and at Mill Barracks. However, the cranes have not been well maintained, and are actually out of order.

(Buriganga River Bridge Project)

At Postogola in Dhaka Port a bridge is currently being constructed using Chinese aid, and the structure will be completed in April 1990.

(1) The channel width and the height of objective vessels (the clearance of the bridge) will be restricted by this new bridge crossing the Buriganga River. According to the structural design, the conditions are as follows:

Navigational Main Span	76.20m
Clearance	H.W.L. + 12.2m
	(H.W.L. = 5.70m)
	(L.W.L. = 0.70m)

The minimum channel width actually secured in the Dhaka Port Area is approximately 140m.

(2) It is very difficult to obtain empirical vessel dimension data, especially on the height of masts. Some sample data of large coasters are shown in Table 8.1.1.

Table 8.1.1 Some Sample Data of Height of Masts

Vessel Name	Height of Mast (empty condition, from water level)
M.V. Al-Flash	22.4 m
M.V. Saleem	20.6 m
M.V. Olympic Energy	19.2 m

Source: BIWTA

The coasters engaged in Inland Water Transport in Bangladesh are mostly second-hand vessels purchased from foreign countries, and half of them are from Japan.

After analysing statistically the vessel dimensions based on the data of similar Japanese vessels, the relation between the height of masts and other dimensions can be summarized as follows:

$$\text{Log G.T} = -0.366 + 1.015 \text{ Log D.W.T.} \quad (\text{No. of Data} = 1786,\ R = 0.906)$$

$$\text{Log H.M.} = 0.606 + 0.239 \text{ Log G.T.} \quad (\text{No. of Data} = 57,\ R = 0.896)$$

where, G.T. = Gross Tonnage
D.W.T. = Dead Weight Tonnage
H.M. = Height of Mast

Based on the data for 88 coasters, the relationship between water level, bridge clearance, D.W.T. and the number of days of secured clearance is presented in Fig. 8.1.1. The percentage of days each year that various groups of coasters will be able to clear the bridge is presented in Fig. 8.1.2.

(3) Judging from the above data, it can be stated that approximately only 19 coasters will be able to clear the new bridge on 50% of the days each year. In other words, most of the coasters in Bangladesh will be severely restricted in terms of channel navigation by the new bridge.

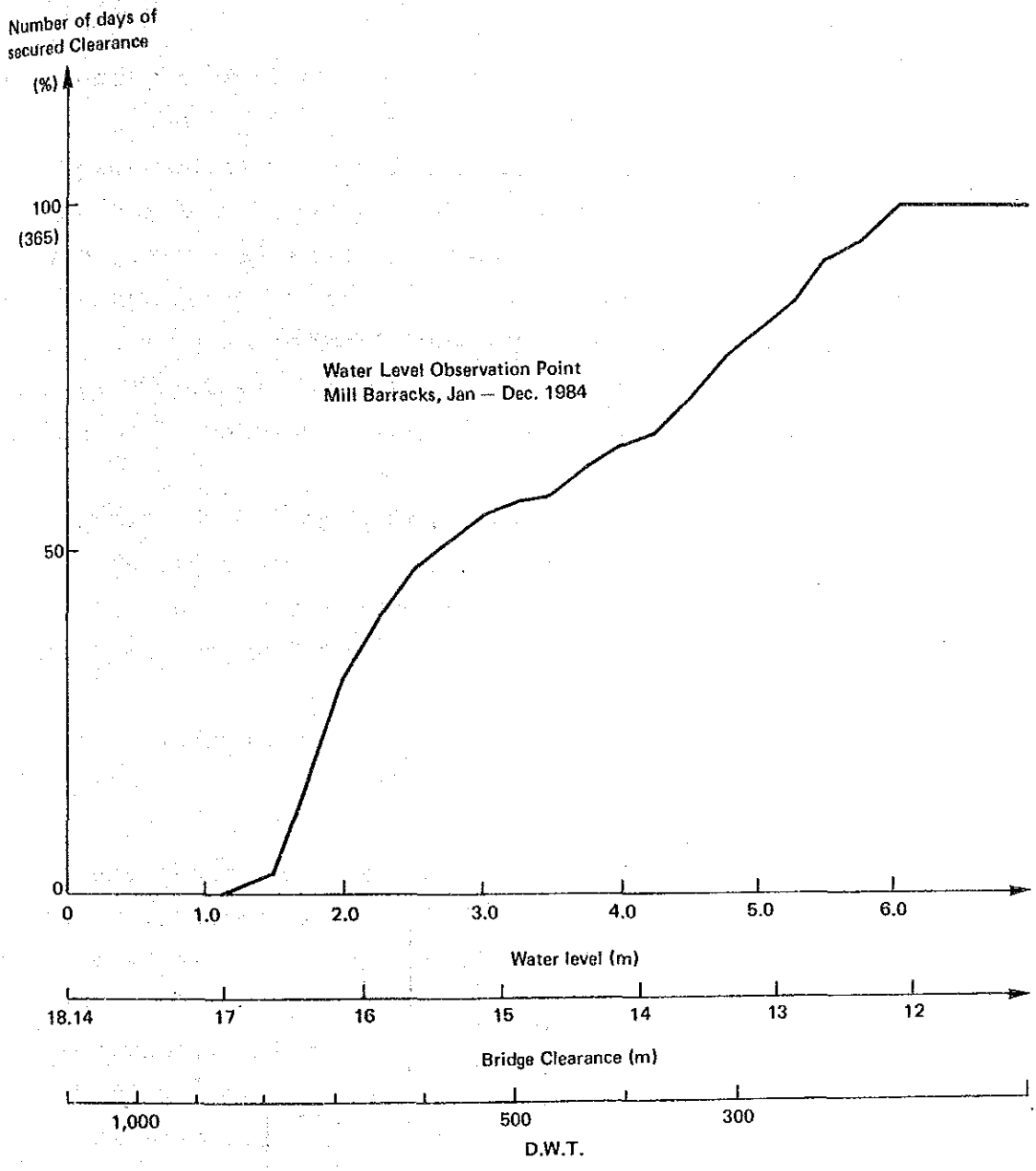


Fig. 8.1.1 Number of Days of Secured Clearance for Coasters

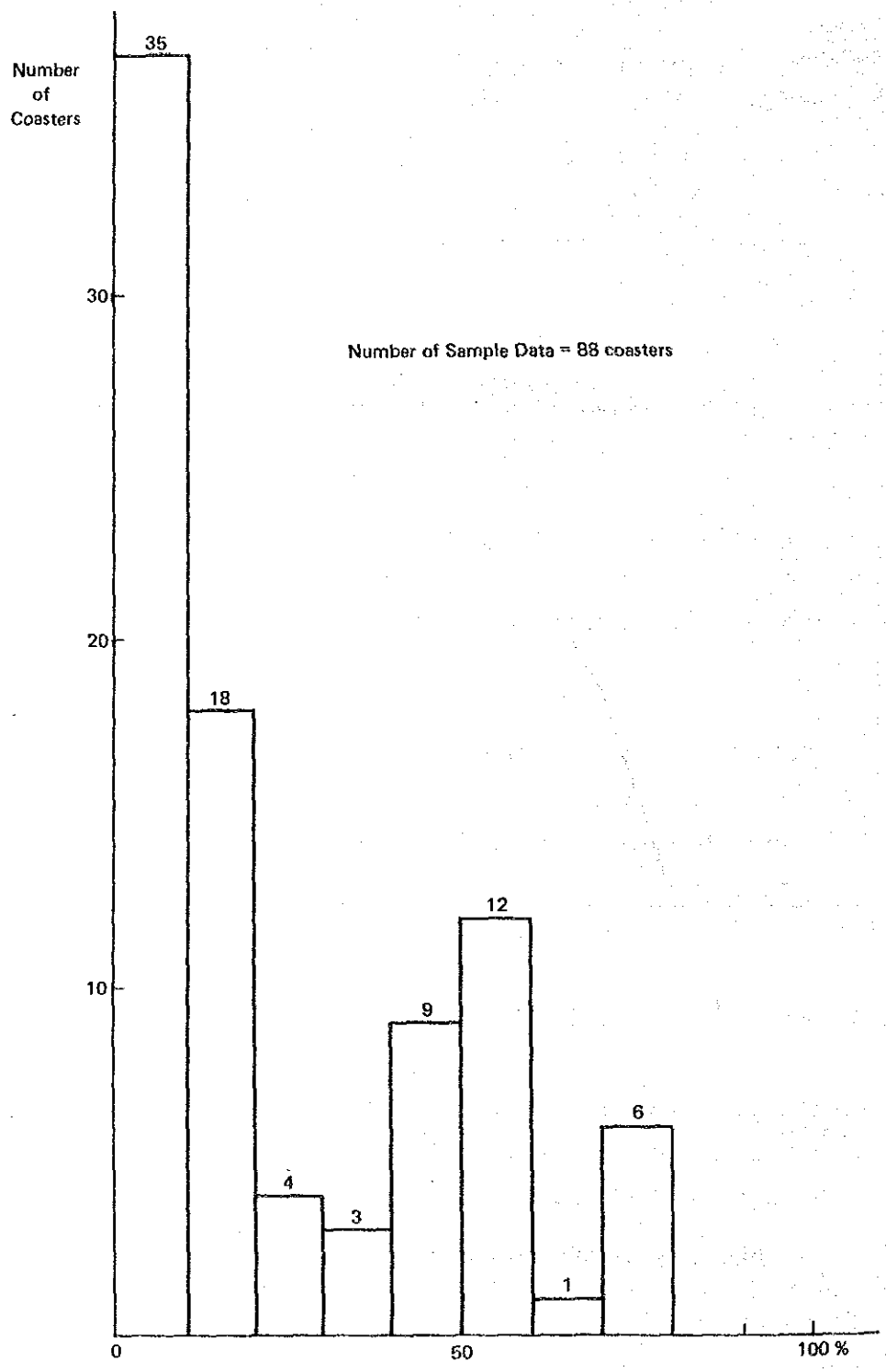


Fig. 8.1.2 Percent of Days per Year that Groups of Coasters can Clear the Bridge

8.1.2 Port Planning Concepts

(1) Concepts of the Master Plan

Based on an examination of the actual problems presented in section 8.1.1, the field survey findings, projected port traffic, etc., alternative Master Plans are prepared for Dhaka and Narayanganj Ports targeted for the year 2005. The alternative plans are evaluated in term of effectiveness, economy, flexibility for future expansion, and contribution to the regional economy. The best Master Plan is then selected.

Within the framework of the selected Master Plan, a Short-term Development Plan is formulated which covers facilities urgently required in order to meet the forecast demand for port cargoes and passenger traffic in the year 1995.

(2) Allocation of port functions between Dhaka and Narayanganj Ports

Dhaka Port handles mainly general consumer cargoes to support the local urban activities and primary industries are not located in the port area.

Narayanganj Port handles bulk cargoes such as raw jute, jute goods, grain, fertilizer and P.O.L.. In both port areas there are many Jute Mill factories, grain terminals and P.O.L. terminals.

There are many available and suitable project sites at both ports, but it is necessary to develop the ports efficiently using the existing concentration of port and urban facilities when appropriate. In this connection, the present facilities at the Port of Dhaka must be utilized as much as possible.

The basic port functions are allocated as follows.

(Dhaka Port)	- To support the urban consumer activities - To offer land to port related urban activitie in harmony with port development.
(Narayanganj Port)	- To handle the overflow cargo movement of Dhaka Port. - To support the activities of primary industries. - To offer land to port-oriented industries in the future.

(3) Containerization

The container movement at Chittagong and Chalna Ports has increased year by year. Approximately 60% of the import cargo at the said ports is carried to the Dhaka/Narayanganj Area, and most of this cargo is transported by road. Needless to say, the main merit of container transportation is "door to door" service which includes the direct transport of containers from seaports to inland destinations.

In Bangladesh, most of the roads and railways cannot be used to transport containers due to their poor conditions and inappropriate gauge. It would be very costly to upgrade the inland transportation infrastructures so that they could be used to carry containers.

On the other hand, Inland Water Transport could be used to carry containers between Dhaka/Narayanganj and Chittangong/ Chalna, and the required investment would not be so costly compared with the costs of upgrading the other transportation infrastructures. The investment would require improving the facilities at the ports and some slight improvement of the vessels.

There are many studies concerning to the containerization of Inland Water Transport in Bangladesh. Especially, "Containerization in Relation to Inland Transport" (ESCAP, 1983) and "Transport of Containers in Bangladesh" (World Bank, 1985) include the cost analyses, and outlines of the results are presented below.

(ESCAP study) Trunk line Transport Cost

	containerized cargo (TK/TEU)	general cargo (TK/Ton)
road	3430	410
I.W.T.	2900	243
railway	1900	320

*1 -- Between Chittagong and Dhaka

*2 -- I.W.T. uses a two barge system

(World Bank study) Trunk line Transport Cost

	containerized cargo (TK/TEU)	general cargo (TK/Ton)
road	2109	233
I.W.T.	1467	229
railway	1586	513

* -- Between Chittagong and Dhaka

* -- I.W.T. uses 60 TEU Coasters

Judging from these data, the container transport by I.W.T. will be optimized if exclusive container vessels are utilized. Needless to say, it is necessary to carefully study the feasibility of construction of inland container depots and especially the modal split between the sea ports and the metropolitan area. The ongoing "Transport of Containers in Bangladesh" study considers related issues; its main objectives are:

a) to carry out technical, engineering and financial studies to identify and develop the required facilities (civil

works, vessels and cargo handling equipment) and to determine the reqired level of investment.

b) to identify and develop the institutional and procedural changes required to establish an efficient system for the movement of containers to as close to the consingnee's door as possible.

Another ongoing study concerning the inland container transportation is being conducted by the Asian Development Bank. This study examines the possibility of transporting containers from Chittagong to the Dhaka Area using railways. The modal split between IWT, roads and railways and the comprehensive inland container transport plan are outside the scope of this JICA study.

Thus, herein the Study Team Proposes only the appropriate location and scale of the container terminal.

(4) Effective Cargo Handling

In Bangladesh, there are many unemployed labourers so the port labour force is sufficient and its cost is not so high. Mechanical cargo handling is not always ideal considering the employment situation. On the other hand, there is a necessity to increase the cargo handling capacity to meet the future demand. The cargo handling capacity is an important item for the expansion of the commodity flow and the improvement of productivity. In this connection, an effective cargo handling system including limited mechanization and efficient layout of the cargo handling area must be examined carefully.

(5) Passenger Transport

The role of I.W.T. in domestic passenger transport is very important, and its share is approximately 31% of all domestic passenger transport in 1983/84.

There are two groups of I.W.T. passenger services running to and from Dhaka/Narayanganj Ports. One of these is the short distance routes serving Dhaka and Comilla Districts. The other is the middle to long distance routes serving Barisal, Khulna and Patuakhali Districts.

In September 1986, the Study Team interviewed approximately one hundred passengers using the long distance IWT passenger services to identify the reasons for their trips, their opinions on the level of the fare, their reasons for choosing the IWT mode and their opinions on service. The results of the interviews are shown in Fig. 8.1.3 - 8.1.6. As is clear from these Figures, IWT passenger service will continue to play an important role, and the demand from users to improve the related passenger facilities will increase over time.

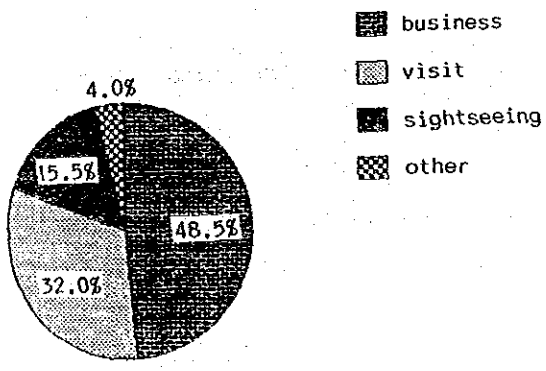


Fig. 8.1.3 Reasons for Travelling

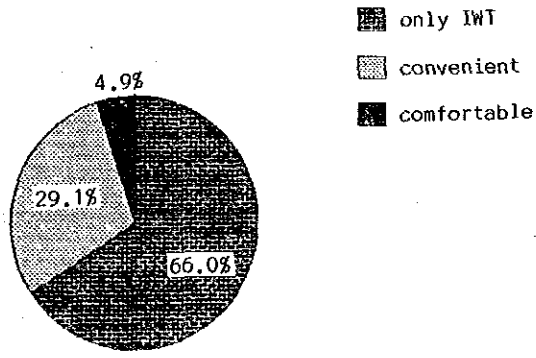


Fig. 8.1.5 Reasons for Choosing the IWT Mode

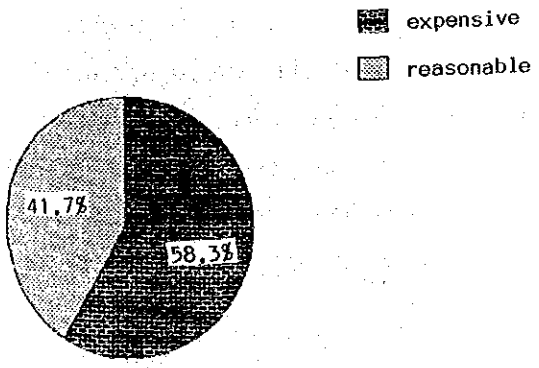


Fig. 8.1.4 Fare Level

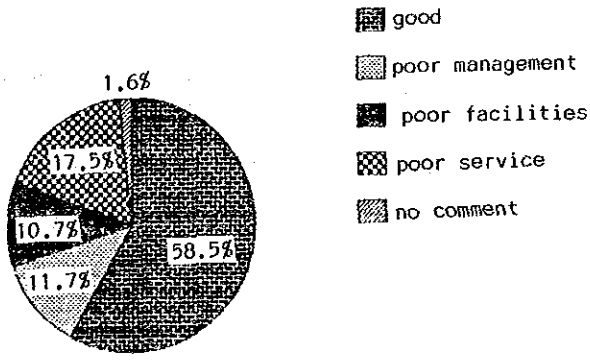


Fig. 8.1.6 Comments on IWT Service

Because of the development of the road network, the Meghna Bridge Project and the progress of motorization in the future, it is not likely that the short distance services by I.W.T. will grow from now on. On the other hand, the middle to long distance services will continue to play an important role as there are many big rivers, such as the Jamuna River, between Dhaka/Narayanganj and southwestern Bangladesh, and the construction cost of new bridges is higher than the cost of developing I.W.T. passenger terminals.

In this connection and in terms of relieving the port congestion from passengers and passenger launches, a new passenger terminal exclusively for middle and long distance services is proposed in the Master Plan. The new terminal should improve the service level and ensure effective access transportation to the terminal.

(6) Influence of the Buriganga River Bridge Project

As mentioned in Section 8.1.1, the coasters which presently use the port facilities at Badamtali and Mill Barrack may be unable to use these facilities after the completion of the Buriganga River Bridge.

One possible countermeasure would be to cut the masts of the existing coasters, enabling them to pass under the new bridge and to continue using the present facilities. Approximately one hundred coasters are operating in Bangladesh at present, but it is very difficult to obtain data concerning the height of their masts as the vessel registration process is incomplete. It will be necessary to improve the vessel registration process and the regulations concerning river traffic after the construction of the new bridge to ensure safe navigation.

Furthermore, there are presently many problems in the Badamtali area such as lack of sorting and storage space and the heavy congestion of access roads. It will be difficult to maintain port functions at Badamtali in the future. On the other hand, the port facilities of Mill Barrack are presently operated as the Central Storage Depot of the Food Department in conjunction with the storage godowns located behind the jetties. It would be expensive to replace these godowns.

Overall, it seems best that Badamtali not be used by coasters after the completion of the Buriganga River Bridge, and that Mill Barrack continue to function as the Central Storage Depot. The cargo handling facilities for Coasters should be replaced by new facilities to be located downstream of the new bridge. The existing facilities at Badamtali and Mill Barrack can continue to accomodate smaller size vessels.

8.2 Land Use around the Port Area

8.2.1 Existing Projects around the Port Area

In Table 8.2.1 the ten main projects related to the port planning are listed and their locations are indicated in Fig. 8.2.1.

Table 8.2.1 Development Projects Related to the Port Planning

	Project	Responsible Body	Remarks
1.	Development of Shampur Industrial Area	DIT	Ongoing
2.	Development of Narayanganj Commercial Area	DIT	Ongoing
3.	Construction of Ullon-Badda--Zoarshahara Road	DIT	Ongoing
4.	Extension of Dholaikhal Road/ North-South Road up to the River Bank	DIT	Third Five Year Plan
5.	Extension of the Bangabandhu Road (Narayanganj)	DIT	Third Five Year Plan
6.	Development of Buckland Bund and its Adjoining Area	DIT	Third Five Year Plan
7.	Construction of Dhaka-Chittagong Road By-pass	RHD	Ongoing
8.	Construction of Postogola Bridge	RHD	Ongoing
9.	Construction of Badamtali Bridge	RHD	Under Study
10.	Underdraining and Construction of a Road in Old Dhaka	DMC	Under Study

Among these projects, the construction of the Postogola Bridge is the most important one affecting the port planning.

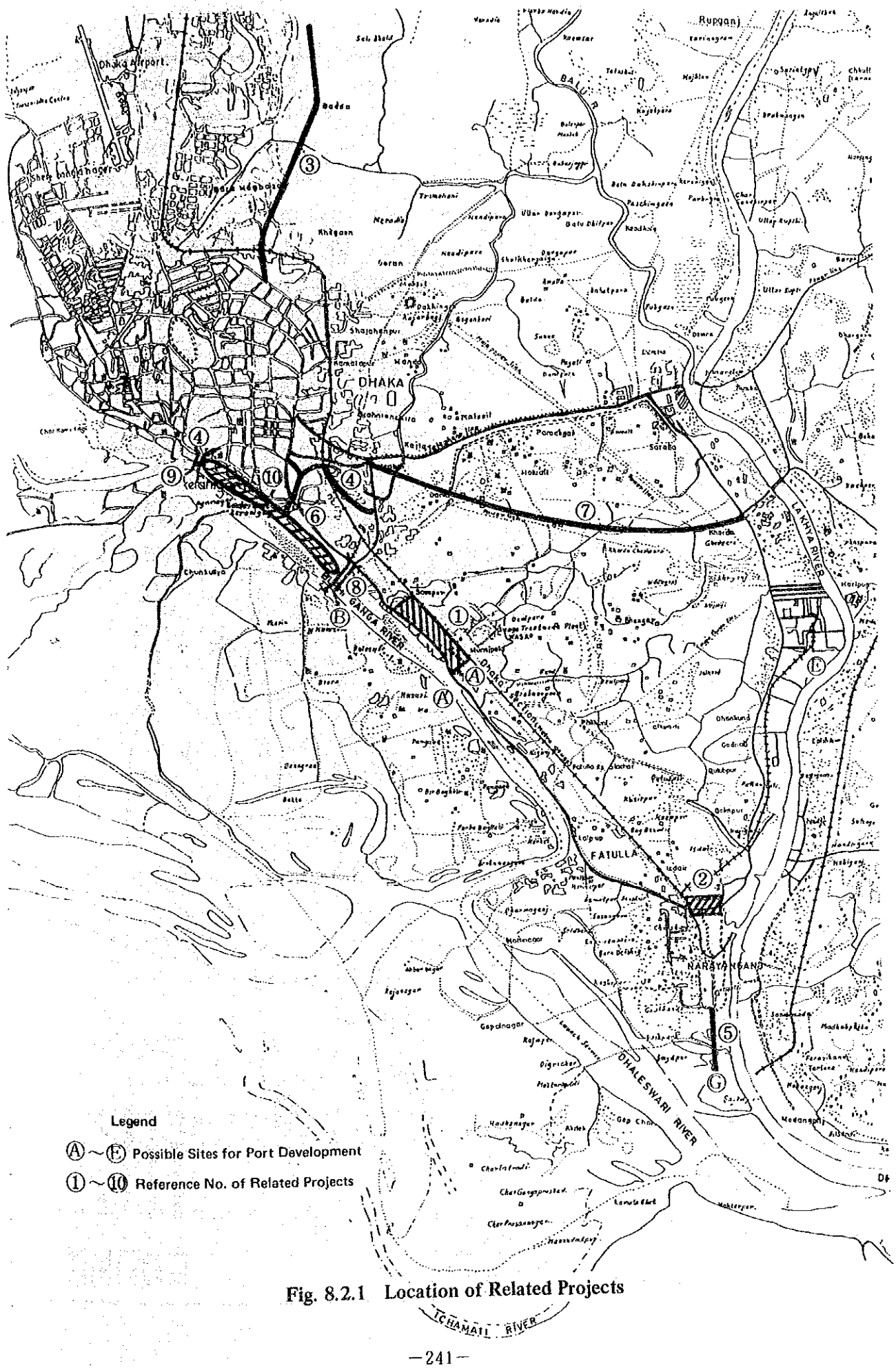


Fig. 8.2.1 Location of Related Projects

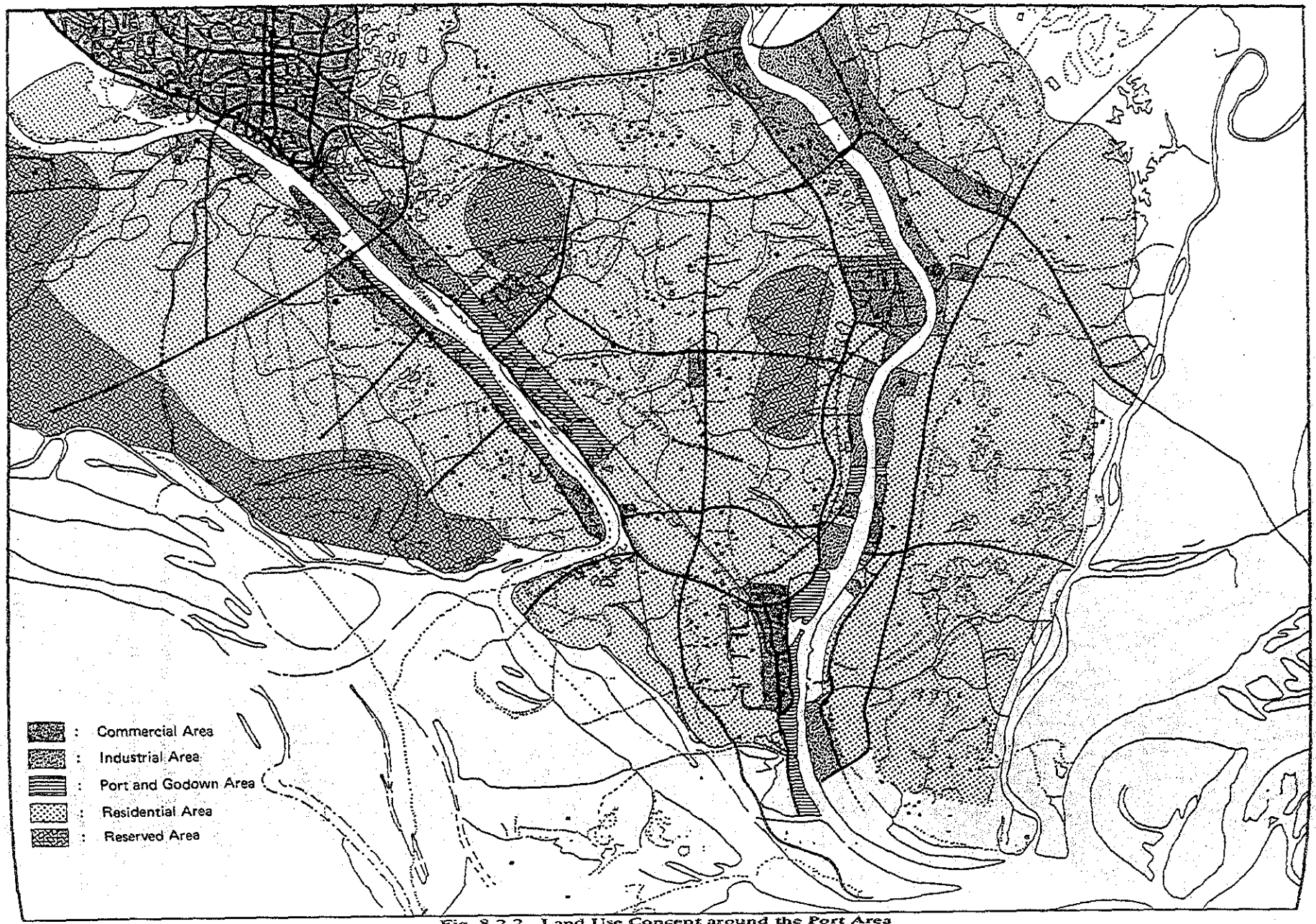


Fig. 8.2.2 Land Use Concept around the Port Area