CHAPTER 7 Port Planning

CHAPTER 7 PORT PLANNING

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7.1 Outlines

Pakistan's coastline faces the Arabian Sea and is approximately 1,100 km in length, of which 330 km is in Sind Province and 770 km is in Baluchistan Province. The ports of Karachi and Qasim are located in Sind Province and are the only deep sea ports in Pakistan as shown Figure 7.1.1.

Along the coastline there are several ports including two international ports; the ports of Karachi and Qasim. Other ports are mostly small fishery ports such as Jiwani, Gwadar, Pasni, Ormara, Sonmiani, and Keti Bunder

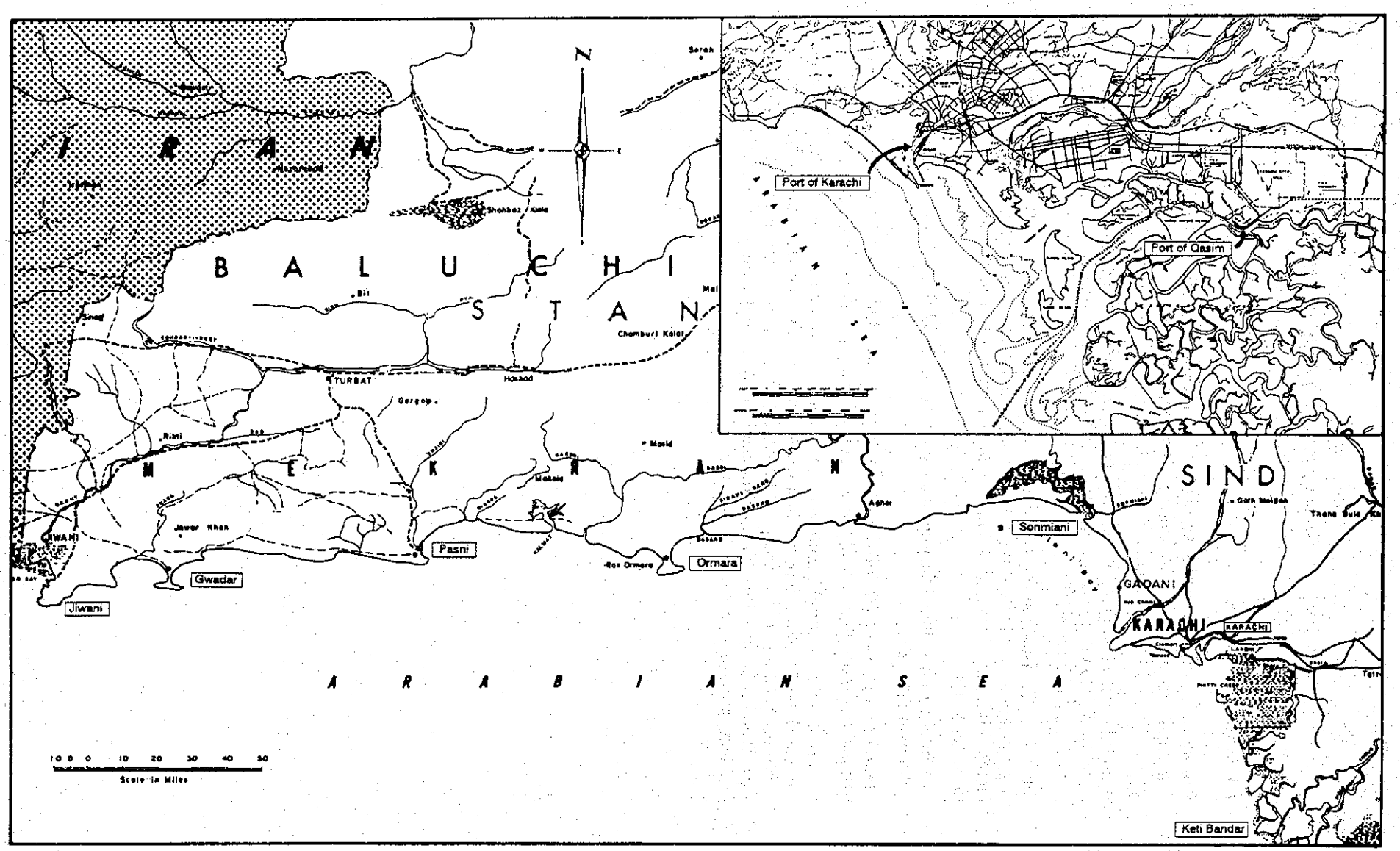
Since 1950 Pakistan has expanded its port facilities. Karachi port was originally Pakistan's only port. A second port was built at the port of Qasim and became operational in the early 1980's. The port facilities have been expanded, and the improvement of cargo handling facilities has been carried out in recent years.

The total cargo volume through the two ports in 1992-93 was 30.2 million tons, about twice the volume in 1982-83.

Therefore, the two ports of Karachi and Qasim are studied here in relation with the study on the national transport plan. Local ports should be studied separately in appropriate local/regional plans.

In this chapter; natural conditions and current port activities including management, cargoes, passengers and calling ships are first reviewed. Then, the current port facilities and their utilization at both ports are studied, and productivity of these facilities are analyzed. Next, the Seventh Five Year Plan (1988-89-1992-93) and the achievements under the plan are reviewed. Finally, current problems at these ports are investigated.

Figure 7.1.1 Karachi and Qasim Port Area



7.2 Natural Conditions

7.2.1 Geography

The Port of Karachi is located to the west of the mouth of the Indus River. The port is situated between the Western and Eastern Backwater. The Western Backwater is an area of approximately 35 km^2, and the Eastern Backwater is an area of about 6 km^2 and some of the area is covered with mangroves. The harbor entrance is protected by Manora Breakwater (480 m) and Keamari Groyne. The surface is mostly covered with mud and many creeks running through a shallow area.

The port of Qasim is located between Phitti, Kadiro and Gharo Creeks. The whole channel is divided into outer and inner channels with a total length of 43.7 km. The outer channel is open to waves approaching from the southwest during monsoon season, while the other is in the protected creek.

7.2.2 Tides

According to Pakistan Tide Tables, the major tidal levels are as shown in Table 7.2.2.1.

Table 7.2.2.1 Tidal Levels

Tidal Level		Karachi	Qasim
Highest Astronomic Tide	(H.A.T)	3.20 m	3.44 m
Mean Higher High Water	(M.H.H.W)	2.68 m	2.93 m
Mean Lower High Water	(M.L.H.W)	2.19 m	2.26 m
Mean Sea Level	(M.S.L)	1.65 m	1.74 m
Mean Higher Low Water	(M.H.L.W)	1.10 m	1.22 m
Mean Lower Low Water	(M.L.L.W)	0.43 m	0.55 m
Chart Datum		0.00 m	0.00 m
Lowest Astronomic Tide	(L.A.T)	-0.43 m	-0.58

Source: Pakistan Tide Tables

7.2.3 Currents

Observation of the maximum velocity and direction of the currents at the port of Karachi was carried out at the points near the top of Manora Breakwater in July and August, 1971. According to the observation, the direction of the flood currents is eastward at both points. The velocity of the flood currents is approximately 0.3 m/sec. The direction of the ebb currents is southwestward and the velocity is between 1 and 1.25 m/sec. These velocities are relatively low and can be considered not to affect the navigation of vessels.

The maximum velocity and direction of the currents at the port of Qasim during spring tide at the outer channel was assumed based on the two points of current observations; the direction of the current inside Phitti creek is determined by the tides. Discharges of the rivers flowing into the creek are small, so their contributions are negligible. According to the Pakistani Chart (PAK-20), the maximum current velocity in the channel (near Buddo Island) during spring tide is 1.5 m/sec for flood current and 2.5 m/sec for ebb current. Velocities in Phitti creek are 1.25 m/sec for flood current and 1.5 m/sec for ebb current. It is understood that the current speed is generally not strong, however, during the spring tide period the maximum current could affect the navigation of ships in the narrow channel.

7.2.4 Earthquakes

Pakistan lies in the active seismic region which runs through Indonesia to the Himalayas. However, in the Karachi region, no earthquake of any considerable magnitude was reported.

According to a map of the seismic zone prepared by the Department of Meteorology and

Geophysics of West Pakistan, the seismic factor in Karachi region ranges from g/10 to g/20. On the other hand, according to "Soil Investigation Report for Marginal Wharf Project in Port of Qasim in 1976", the port area lies in a minor seismic zone, with acceleration ranging from g/15 to g/20, on the basis of the data published by the Geophysical Centra Quetta.

Therefore, these seismic factor values affect the design of port facilities and equipment considerably.

7.3 Port Management

7.3.1 General

Figure 7.3.1.1 of the appendix shows the related port and shipping administrative organization; the Ministry of Communications (MOC) controls the administration of ports and shipping in Pakistan. The Ports and Shipping Wing (PSW) of MOC is in charge of the overall administration of the various organizations related to ports and shipping. All practical works are conducted by organizations which are autonomous bodies under the control of PSW.

7.3.2 Karachi Port Trust (KPT)

The Karachi Port Trust is based on the Karachi Port Trust Act enacted in 1886. The highest decision-making organ is the Board of Trustees which consists of 11 members including the Chairman. The Chairman is appointed by the Federal Government, and the Trustees are representatives of ship owners, shippers, port laborers and the Government. Important matters such as the lease, sale and transfer of property, the general budget, major investments and the revision of port fees require prior approval by the Government. Figure 7.3.2.1 of appendix shows the organization chart of PQA.

7.3.3 Port Qasim Authority (PQA)

The Port Qasim Authority is based on the Port Authority Act of 1973. PQA controls the land, water area and various facilities inside the port area as prescribed by the Act. The highest decision-making organ is the Board consisting of not less than 3 and not more than 7 members including the Chairman, who is appointed by the Government. As at the port of Karachi, PQA must obtain the prior approval of the Government concerning important matters at the port of Qasim. Figure 7.3.3.1 of the appendix shows the organization charts of PQA.

7.3.4 Financial Status

(1) Port of Karachi

The income and expenditure account of KPT in 1990-91-1992-93 are shown in Table 7.3.4.1.

According to the table below, the major income in 1992-93 is from cargo handling (33.9%) and cargo storage (30.2%), while major expenditure is for labour (60.2%)

KPT's financial situation has generally been satisfactory, and the Port draws no fund from the Government for either operations or capital improvements. Funding is mostly based on foreign loans.

Table 7.3.4.1 Income and Expenditure Account of KPT

(Rs. in tho

	1990/91	1991/92	1992/93
Income			
Cargo Handling	560,136	893,422	1,169,159
Cargo Storage	540,383	774,000	1,042,759
Ship Movememnt & Ser	357,172	690,360	830,632
Property Management	78,763	94,747	90,035
Operating Income	1,536,454	2,452,529	3,132,585
Misc. Income			
- General	31,783	43,287	70,619
- Investment	43,704	10,686	247,995
Total Income	1,611,941	2,506,502	3,451,199
Expenditure			
Labour	919,534	1,151,376	1,387,516
Stevedoring	87,556	127,465	111,907
Material & Supplies	175,502	215,128	250,889
Fuel	29,280	32,192	41,391
Outside Repair & Mainte	33,828	125,063	202,826
Administration & Overhe	48,148	63,396	98,752
Depreciation	118,039	119,341	121,808
Provision for Doubtful D	-	5,000	10,000
Loan Interest	61,155	62,486	76,620
Loss on Exchange	1,686	2,665	2,219
Total Expenditure	1,474,728	1,904,112	2,303,928

Source: KPT

(2) Port of Qasim

At the port of Qasim there are two separate budgets, i.e. the development budget and revenue budget. The development buget is used for development projects, while the revenue budget covers regular operations and administrative expenses.

Therefore, at the planning stage, all development works at Qasim have been financed by Government funds and foreign loans arranged and guaranteed by the Government. However, in recent years, in line with the Government's policy to promote private sector participation in port development and operations, PQA has invited the private sector to develop and operate port facilities--the same way as KPT did.

The income and expenditure account in 1987-88-1990-91 and financial performance for the last five years are shown in Tables 7.3.4.2 and 7.3.4.3.

Table 7.3.4.2 Income and Expenditure Account of PQA

(Rs. in thou

	1987/88	1988/89	1989/90	1990/91
Income				
Steel Mills Terminal	135,335	134,923	136,103	134,649
Marginal Wharf				
Ship Movement & Service:	6,089	18,751	19,690	27,744
Berthage	5,066	18,734	17,155	18,423
Wharfage	18,984	28,670	22,715	45,547
Storage & Demurrage	2,500	3,334	14,466	10,477
Crafts Equipment Hire	6,956	6,455	7,592	6,597
Cargo Movement Charge	4,011	11,031	12,842	10,497
Other Income	19,577	23,948	28,591	-
Total Income	198,518	245,846	259,154	253,934
Expenditure				
Salaries, Wages & Staff Ber	71,638	80,642	106,738	139,329
Materials & Supplies	7,302	4,555	5,633	13,752
Maintenance Channel Dred	42,818	74,501	71,769	71,340
Repair & Maintenance	6,476	19,668	12,450	16,090
Administration & Overhead	17,480	22,533	27,651	34,756
Loan Interest	86,079	123,198	87,894	-
Depreciation	86,832	85,507	87,430	-
Total Expenditure	318,625	410,604	399,565	275,267

Source: PQA

More than half of the total income comes from the lease of a steel mill terminal to the Pakistan Steel Mill. Dredging of the maintenance channel accounts for a large share of total expenditure excluding interest and depreciation.

The financial performance of PQA showed a defect until 1991-92, however, in 1992-93, PQA showed a profit.

Table 7.3.4.3 Financial Performance of the Last Year at PQA

(Rs. in milli

Year	Income	Expenditure				Net
		Operating Expenses	Interest	Depre -ciation	Total	Surplus (Deficit)
1988/89	245.84	201.90	123.20	85.51	410.61	(164.7
1989/90	259.14	224.24	87.89	87.43	399.56	(140.4
1990/91	286.87	275.27	70.51	93.16	438.94	(152.0
1991/92	355.09	351.51	104.16	88.39	544.06	(188.9
1992/93	482.00	269.00	62.00	99.00	430.00	52.00

Source: PQA

7.3.5 Port Tariff

The present main tariff at both ports is shown in Table 7.3.5.1.

The tariff of PQA is about 20% cheaper than KPT's on the whole.

Table 7.3.5.1 Main Tariff of KPT and PQA

	KPT (Revied in Aug. 1993)	PQA (Revied in 1994)
Pilotage	US $ 0.13 /GRT	US $ 0.11 /GRT
Haulage and Towa	US $ 973.00 (two tugs	US $ 810.00 (two tugs)
Mooring Fee	US $ 0.04 /GRT/day	US $ 0.03 /GRT/day
Berthage Fee	US $ 0.07 /GRT/day	US $ 0.06 /GRT/day
Port Dues	US $ 0.40 /GRT	US $ 0.33 /GRT

Wharfage	Import Rs.	Export Rs.	Import Rs.	Export Rs.	
General Cargo	44.00	30.00	36.00	25.00	/ton
Iron, Steel & Scrap	45.00	45.00	37.00	37.00	/ton
Coal	38.00	38.00	32.00	32.00	/ton
Ores & Minerals	41.00	41.00	34.00	34.00	/ton
Food Grain	16.00	15.00	17.00	14.00	/ton
Fertilizers	12.00	10.00	12.00	9.00	/ton
Edible Oil	30.00	30.00	25.00	25.00	/ton
Crude Oil	25.00	25.00	21.00	21.00	/000 litı
Containers (Empty)					
Size 20'	615.00	615.00	512.00	512.00	Each
Size 40'	1,231.00	1,231.00	1,024.00	1,024.00	Each

Source: The Gazette of Pakistan

7.4 Port Facilities

7.4.1 Berthing Facilities

(1) Port of Karachi

The Port has five water areas: the Approach Channel, Channel Bend, Lower Harbour, Upper Harbour and Juna bunder. The berth facilities are comprised of the East Wharf, West Wharf, Juna Bubder Wharf, Barge Wharf and Oil Piers, which has transit sheds or plinth. The entrance to the port is protected from open sea waves by the Keamari Groyne and Manora Breakwater as shown in Figure 7.4.1.1.

There are a total of 28 berths, 17 at East Wharf and 11 berths at West Wharf including 4 berths at Juna Bunder Wharf. Three Oil Piers including Oil Pier No.V which is under construction are located at the lower harbour. The quay wall and apron area of Berth Nos.5 to 6 at West Wharf had slid down and the reconstruction works on these berths are expected to start in April 1994. Lists of the berths and storage facilities and channels are presented in Tables 7.4.1.1 to 7.4.1.3.

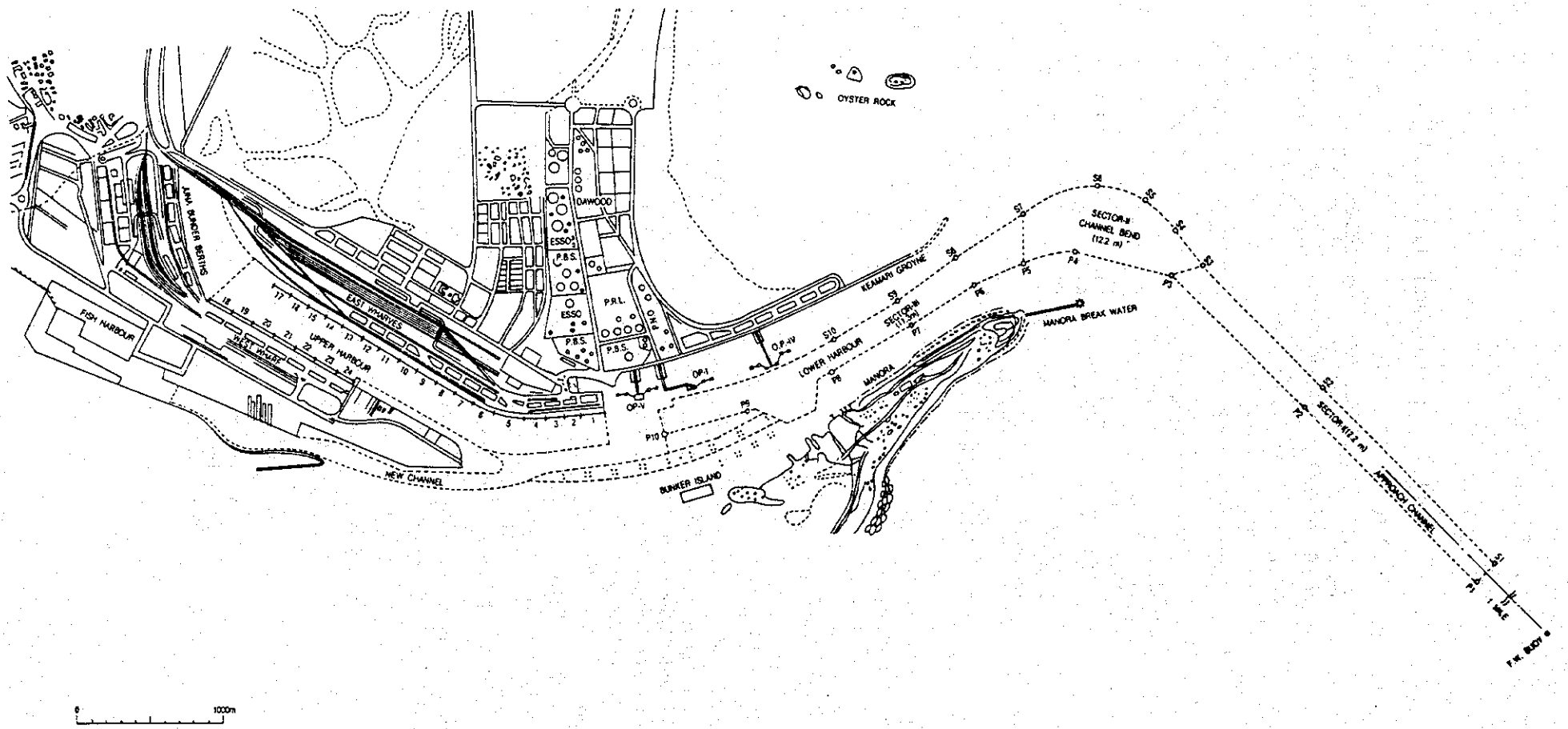
At present, the Jinnah Bridge Phase II (a continuation of Phase I) Project is under construction to reduce congestion of road transportation between the Port and Karachi city area.

Table 7.4.1.1 Navigation Channels at Port of Karachi

Name of Chann	Length (m)	Width (m)	Depth (m)	Remark
Approach Chan	2,920	183	12	
Channel Bend	1,550	400	12	
Lower Harbour	2,600	227	11	
Upper Harbour	2,900	311	9	

Source: KPT

Figure 7.4.1.1 Port of Karachi



KARACHI HARBOUR

Table 7.4.1.2 Berth Facilities at Port of Karachi

Wharf	Berth No.	Length (m)	Depth (m)	Constructed Year	Remarks
East Wharf					
	No. 1	153.92	9.1	1975	
	No. 2	152.40	9.1	1975	
	No. 3	167.64	9.1	1975	
	No. 4	152.40	9.1	1975	
	No. 5	147.52	8.5	1964	
	No. 6	167.64	8.5	1964	
	No. 7	147.52	8.5	1964	
	No. 8	167.64	10.4	1964	
	No. 9	147.52	10.4	1964	
	No. 10	147.52	10.4	1964	
	No. 11	167.64	10.4	1964	
	No. 12	147.52	10.4	1964	
	No. 13	167.64	10.4	1964	
	No. 14	147.52	10.4	1964	
	No. 15	147.52	10.4	1964	
	No. 16	167.64	10.4	1964	
	No. 17	147.52	10.4	1964	
Total	17	2,644.75			
West Wharf					
	No. 18	167.64	9.8	1930	
	No. 19	167.64	10.4	1930	
	No. 20	182.88	10.4	1930	
	No. 21	190.50	10.4	1930	
	No. 22	182.88	11.0	1973	
	No. 23	213.36	11.6	1973	
	No. 24	152.40	10.4	1973	
Total	7	1,257.30			
Juna Bunder					
	No. 25	149.35	9.1	1981	
	No. 26	163.68	9.1	1981	
	No. 27	163.68	9.1	1981	
	No. 28	162.15	9.1	1981	
Total	4	638.86			
Barge Wharf					
East	No. 17A	36.58	8.1	1960	
West	No. 24A	37.80	5.5	1973	
	No. 18A	374.60	7.3	1968	
Total	3	448.98			
Oil Berth					
	OP-I	196.24	11.3	1966	Max. 35,000 DWT
	OP-IV	321.56	13.4	1978	Max. 75,000 DWT
	OP-V	300.00	14.3		Max. 75,000 DWT
Total	3	817.80			

Note: 1) the quay wall and apron area berth No.5 to 6 had slid down, the reconstruction work is expected to start in April 1994. 2) OP-V is under construction.

Source: KPT

Table 7.4.1.3 Storage Facilities at Port of Karachi

Location	Transit Shed (m2)	Marshalling Yard (m2)	Container Yard (m2)	Remark
East Wharf	53,918	99,021	16,375	
West Wharf	50,690	174,750		
Juna Bund	12,450	26,115		
Keamari			101,208	
Pak Shaheen			9,222	
M1 Yard			87,034	
Total	117,058	299,886	213,839	

Source: KPT

(2) Port of Qasim

The Port is located about 60 km south-east of the port of Karachi, and became fully operational in 1983. It has an entrance navigation channel of about 44 km in length, which allows the passage of 50,000 DWT ships at high tide and 25,000 DWT ships in all weather conditions as shown in Figure 7.4.1.2.

There is one 279 m specialized berth for bulk handling of iron ore and coal of Pakistan Steel, which is connected to the stockyard with a 4.5 km conveyor system, as well as a multi-purpose terminal called "Marginal Wharf" of 1,400 m length divided into seven berths of 200 m each. Berth Nos 1 to 4 can take fully laden ship up to 25,000 DWT while ships upto 35,000 DWT can be brought on berth No. 5, 6 and 7. The temporary oil berth was converted from multi-purpose No.1 on emergency requirement of furnace oil supply in February 1990. And as maritime industrial and commercial port, the port owes a total 12,000 acres of land for its development. The back up area, 300 m wide behind the quaywall of Marginal Wharf, contains two transit sheds, railway lines and roads.

Lists of the berths, storage facilities and channels are presented in Tables 7.4.1.4 to 7.4.1.6.

Table 7.4.1.4 Navigation Channels at Port of Qasim

Name of Chan	Length (km)	Width (m)	Depth (m)	Remarks
Approach Chann	14.1	185	12.4	
Inner	25.1	180	11.3	
Reach	4.5	180	10.0	

Source: PQA

Table 7.4.1.5 Berth facilities at Port of Qasim

Wharf	Berth No.	Length (m)	Depth (m)	Constructec Year	Remarks
Iron and Coal Berth		279.00	12.0	1980	
Multi Purpose Berths					
	No. 1	200.00	10.0	1980	(Temporary Oil Be
	No. 2	200.00	10.0	1980	
	No. 3	200.00	10.0	1980	
	No. 4	200.00	10.0	1980	
	No. 5	200.00	12.0	1982	
	No. 6	200.00	12.0	1982	
	No. 7	200.00	12.0	1982	
Total	7	1400.00			

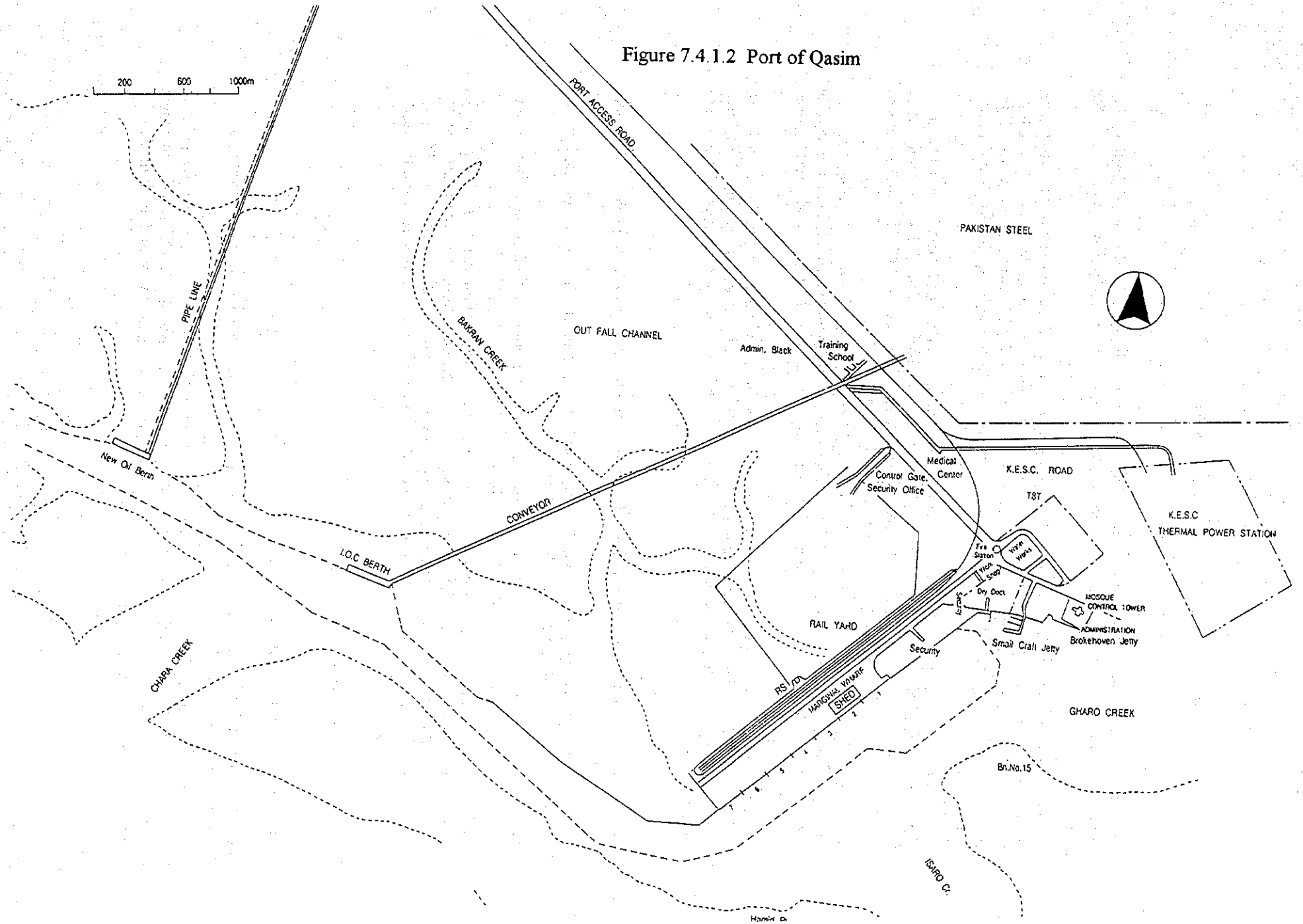
Source: PQA

Table 7.4.1.6 Storage Facilities at Port of Qasim

Location \ Facilities	Transit Sh (m2)	Marshalling Yard (m2)	Remark
Multi Purpose Terminal			
No. 1 - 4	20,000	116,000	
No. 5 - 7		116,000	
Total	20,000	232,000	

Source: PQA

Figure 7.4.1.2 Port of Qasim



7.4.2 Cargo Handling Equipment and Harbour Crafts

(1) Port of Karachi

The cargo handling equipment of the port of Karachi is mainly used for dry bulk handling and container handling. KPT's existing cargo handling equipment is shown in Appendix Table 7.4.2.1.

According to the table, KPT's cargo handling equipment is divided into three kinds of equipment such as ordinary equipment, cranes and quay cranes. Ordinary equipment such as tractors, forklifts, towing-unit, truck and trolley total 578 units, of which 57% is in bad condition. Fifty two of the 64 cranes are in need of replacement ,and 64% of the 77 quay-cranes are in bad condition.

Dry bulk handling equipment such as hoppers and evacuators is arranged by the National Logistic Cell (NLC). Container handling at Berth No.17 and 24 including container yard immediately behind these berths is carried out by Premier Mercantile Services Ltd. (PMS) and American President Lines (APL) using their own cargo handling equipment.

KPT has its own harbour crafts; 6 tugs, 6 dredgers, 5 hopper barges and several service boats, as shown in Appendix Tables 7.4.2.2 and 7.4.2.3 Dredging of the maintenance channel and basin is carried out by the 6 dredgers, however, five of dredgers were built in 1960's and have become superannuated.

As mentioned above, the present condition of cargo handling equipment and floating crafts is not sufficient, therefore, KPT planned to purchase a new bucket dredger and improve and modernize cargo handling equipment in the Seventh Five Year Plan, however, its was not carried out due to budget reduction.

(2) Port of Qasim

PQA's cargo handling equipment and harbour crafts are shown in Appendix Tables 7.4.2.4 and 7.4.2.5.

The bulk handling equipment for wheat at the multi-purpose berths has been supplied by the private companies and operated by their own labor.

The iron and coal berth has two unloaders with 1,200 tons per hour nominal capacity by Pakistan Steel, which is connected to the stockyard with a 4.5 km conveyor system.

Unlike KPT, PQA does not own a dredger, therefore, the maintenance dredging works contracted out to foreign firms. The annual dredging volume totals about 3.0 million cub. meters, which accounts for a large share of the total expenditure. Under these circumstances, PQA has been requesting the Government to procure a dredger since 1987, but it has not been realized.

7.5 Cargo Traffic through the Ports

7.5.1 Cargo Handling Volume

Table 7.5.1.1 and Tables 7.5.1.1, 7.5.1.2 of the Appendix show the cargo tonnage handled at the ports of Karachi and Qasim.

The annual cargo throughput at the port of Karachi grew steadily from 17.7 million tons in 1987-88 to 22.2 million tons in 1992-93. Of this total, imports comprised 17.3 million tons, of which liquid bulk accounted for 11.1 million tons, general cargo was 4.2 million tons and dry bulk was 1.9 million tons, while exports comprised 4.9 million tons.

Table 7.5.1.1 Volume of Cargo Handled at Ports

unit: tons

Commodities	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93
Import:						
Dry Cargo						
Cement	12,069	23,996	3,356	19,115	7,074	44,465
Coal	809,781	909,786	1,023,735	979,504	985,041	1,044,003
Dyes & Chemic	179,211	177,107	161,400	135,995	166,748	172,207
Fertilizer	1,044,421	782,402	1,066,758	1,254,806	1,169,441	1,470,939
Iron Ore	1,504,510	1,396,628	1,547,304	1,501,621	1,622,743	1,701,136
Iron Scrap	666,830	333,133	167,472	247,640	596,363	353,195
Iron & Steel	455,156	444,952	418,664	439,586	395,148	399,445
Papars	169,045	185,140	138,304	168,502	126,895	161,299
Phosphate	251,111	263,398	271,052	252,562	313,592	308,030
Sugar	323,081	27,437	178,604	453,654	124,435	70,759
Wheat	579,448	2,353,947	2,125,620	1,009,998	2,219,486	2,866,194
Others	2,379,332	2,679,708	2,618,382	2,799,030	3,184,754	3,633,829
Sub-total	8,373,995	9,577,634	9,720,651	9,262,013	10,911,720	12,225,501
Liquid Cargo						
Crude Oil	3,840,994	3,570,790	3,507,095	4,011,951	4,037,873	4,029,173
Edible Oil	876,604	882,813	1,068,958	1,029,360	1,047,086	1,493,158
Petroleum Prodi	4,134,860	4,639,681	5,523,848	4,912,910	5,621,398	6,997,026
LPG	0	0	0	0	0	10,219
Sub-total	8,852,458	9,093,284	10,099,901	9,954,221	10,706,357	12,529,576
Total	17,226,453	18,670,918	19,820,552	19,216,234	21,618,077	24,755,077
Export:						
Dry Cargo						
Cement	0	0	0	51,347	40,073	17,002
Chrome Ore	40,527	40,514	33,270	43,234	42,228	43,965
Clinker	0	0	0	0	25,087	33,995
Coke	0	0	65,000	28,111	27,500	0
Cotton,etc.	507,229	679,742	262,187	309,543	559,671	367,112
Rice	1,203,563	688,210	636,290	1,339,566	1,338,631	839,895
Steel	26,622	111	1,829	1,871	290	72
Taxtiles	101,519	72,296	61,859	124,924	211,650	199,196
Others	1,319,963	1,793,020	1,969,882	1,986,363	2,100,414	2,411,367
Sub-total	3,199,423	3,273,893	3,030,317	3,884,959	4,345,544	3,912,604
Liquid Cargo						
Crude Oil	0	135,400	259,321	325,064	350,114	424,713
Molasses	749,994	755,910	1,134,928	705,425	1,081,307	1,013,426
Petroleum Prodi	263,923	181,768	141,458	234,446	216,907	125,177
Sub-total	1,013,917	1,073,078	1,535,707	1,264,935	1,648,328	1,563,316
Total	4,213,340	4,346,971	4,566,024	5,149,894	5,993,872	5,475,920
Grand Total	21,439,793	23,017,889	24,386,576	24,366,128	27,611,949	30,230,997

Source: KPT, PQA

Meanwhile, the total cargo throughput at the port of Qasim has increased year by year from 3.7 million tons in 1987-88 to 8.1 million tons in 1992-93. Of that total, imports comprised 7.5 million tons, while exports accounted for 0.5 million tons; 6.1 million tons of total import dry bulk includes 2.8 million tons of wheat and 2.7 million tons of iron ore and coal.

As shown in Tables 7.5.1.2 and 7.5.1.3 container cargo traffic increased rapidly from 2.8 million tons or 281,437 TEUs in 1987-88 to 5.1 million tons or 507,124 TEU in 1992-93 despite the absence of a full-scale container terminal. Percentage of containerization grew from 54.8% in 1987-88 to 71.8% in 1992-93. The cargo volume is approximately 14 tons/TEU and 12 tons/TEU in import and export for the past six years.

Table 7.5.1.2 Container Traffic at Port of Karachi

Year	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93
(Import)						
Empty Container						
40'	11,049	18,728	16,926	21,148	28,281	23,164
20'	11,194	15,013	11,501	12,882	22,277	17,388
Total (TEU)	33,292	52,469	45,353	55,178	78,839	63,716
Loaded Container						
40'	22,943	24,155	27,122	30,656	35,881	44,307
20'	62,976	68,376	74,413	79,729	85,178	102,542
Total (TEU)	108,862	116,686	128,657	141,041	156,940	191,156
Cargo Volume (t	1,444,706	1,620,051	1,800,890	2,002,241	2,217,676	2,638,874
Tons/TEU	13.3	13.9	14.0	14.2	14.1	13.8
Empty Ratio (%)	23.4	31.0	26.1	28.1	33.4	25.0
(Export)						
Empty Container						
40'	4,137	2,331	3,877	3,904	5,061	7,815
20'	17,780	11,104	21,519	17,692	14,472	26,363
Total (TEU)	26,054	15,766	29,273	25,500	24,594	41,993
Loaded Container						
40'	29,251	41,983	38,268	47,316	58,886	59,733
20'	54,727	70,824	63,127	74,036	91,560	90,793
Total (TEU)	113,229	154,790	139,663	168,668	209,332	210,259
Cargo Volume (t	1,317,661	1,813,107	1,620,080	1,944,380	2,444,023	2,502,969
Tons/TEU	11.6	11.7	11.6	11.5	11.7	11.9
Empty Ratio (%)	18.7	9.2	17.3	13.1	10.5	16.6
Total TEU	281,437	339,711	342,946	390,387	469,705	507,124

Source: KPT

Table 7.5.1.3 Percentage of Containerization

Year	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93
(Import)						
Volume of General Cargo	3,155,663	3,408,032	3,289,853	3,884,881	3,805,161	4,186,915
Volume of Container Car	1,444,706	1,620,051	1,800,890	2,002,241	2,217,676	2,638,874
Containerization (%)	45.8	47.5	54.7	51.5	58.3	63.0
(Export)						
Volume of General Cargo	1,889,684	2,425,358	2,232,386	2,313,087	2,865,854	2,977,646
Volume of Container Car	1,317,661	1,813,107	1,620,080	1,944,380	2,444,023	2,502,969
Containerization (%)	69.7	74.8	72.6	84.1	85.3	84.1
(Total)						
Volume of General Cargo	5,045,347	5,833,390	5,522,239	6,197,968	6,671,015	7,164,561
Volume of Container Car	2,762,367	3,433,158	3,420,970	3,946,621	4,661,699	5,141,843
Containerization (%)	54.8	58.9	61.9	63.7	69.9	71.8

Source: KPT

7.5.2 Passenger Traffic

The movement of passenger and pilgrims traffic is shown in Table 7.5.2.1. The traffic reached its peak in 1989-90 with 42.2 thousand persons in the past decade and around 30 thousand persons in 1992-93.

Table 7.5.2.1 Passenger and Pilgrims Traffic at Port of Karachi

Year	1988-89	1989-90	1990-91	1991-92	1992-93
Regular Pasengers					
Disembarked	4,748	8,949	9,604	6,438	8,931
Embarked	4,546	11,407	2,018	2,702	2,918
Sub total	9,294	20,356	11,622	9,140	11,849
Pilgrims					
Disembarked	7,368	11,134	12,799	10,138	8,842
Embarked	12,233	10,847	7,725	7,740	7,728
Sub total	19,601	21,981	20,524	17,878	16,570
Passengers & Pilgrims					
Disembarked	12,116	20,083	22,403	16,576	17,773
Embarked	16,779	22,254	9,743	10,442	10,646
Total	28,895	42,337	32,146	27,018	28,419

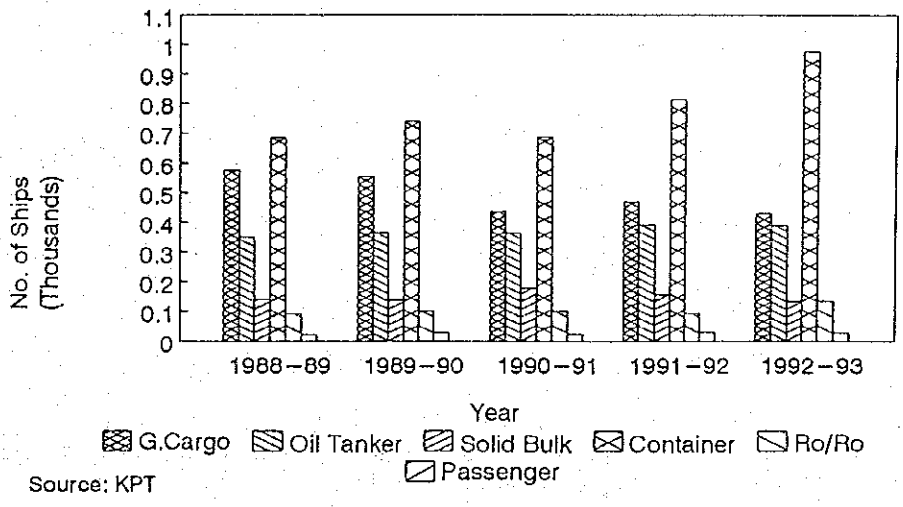
Source: KPT

7.6 Port Activities

7.6.1 Vessel Calls at Ports

According to KPT's classification, vessels called at the port of Karachi are divided into seven types; general cargo vessels, oil tanker, dry bulk carriers, container vessels, Ro/Ro vessels, lash vessels and passenger vessels as shown in Figure 7.6.1.1. According to the actual record in 1992-93, around 2,000 vessels called at the port. Almost half of the vessels that called at the port are container vessels accounting for 46.4% (976 vessels) of total number. General cargo vessels, oil tanker followed the container vessels accounting for 29.4% (429 vessels) and 18.5% (389 vessels). In terms of the volume of cargoes handled at the port, the oil tankers accounted for 56.6% of the total volume, and container vessels, dry bulk carriers and general cargo vessels accounted for 23.2%, 11.1% and 9.1% as shown in Table 7.6.3.1.

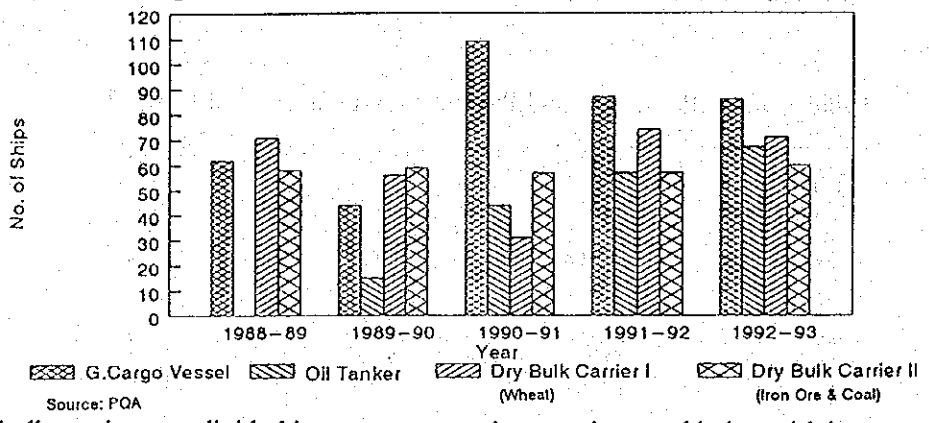
Figure 7.6.1.1 Number of Vessel Calls at Port of Karachi



Source: KPT

The vessels called at the port of Qasim are divided into three types; general cargo vessels, oil tanker, dry bulk carriers as shown in Figure 7.6.1.2.

Figure 7.6.1.2 Number of Vessel Calls at Port of Qasim

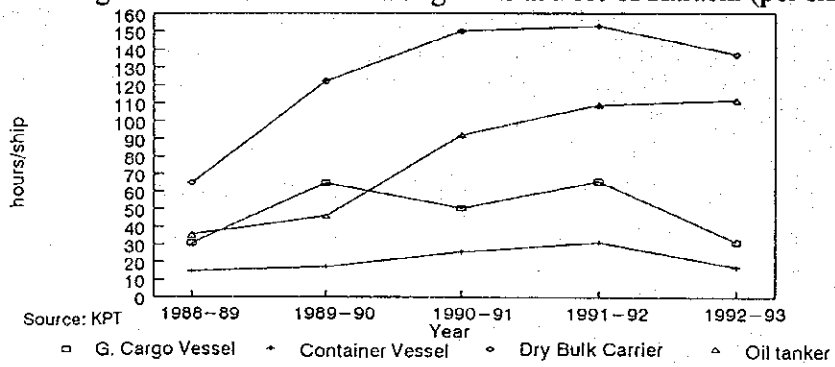


The dry bulk carriers are divided into two categories, one is vessel laden with iron ore and coal and the other with wheat. There were 284 vessel calls in 1992-93. In terms of the volume of cargoes handled at port, the wheat carriers and iron ore and coal carriers accounted for 35.6% and 34.0 %. Oil tanker and general cargo vessels (bagged rice and urea) followed the dry bulk carriers accounting for 19.2% and 8.9% as shown in Table 7.6.3.2. The size of vessels at the port is shown in Appendix Table 7.6.1.1.

7.6.2 Waiting Time for Berthing

According to the KPT's record in 1988-89-1992-93, average waiting time of dry bulk carriers and oil tankers reached 136.9 hours per ship and 111.4 hours per ship respectively in 1992-93: a long waiting time. Container vessels had an average waiting time of 17.1 hours per ship; this relatively short time is due to the excessive priority given to them as shown in Figure 7.6.2.1.

Figure 7.6.2.1 Vessel Waiting Time at Port of Karachi (per ship)



According to record in 1990-91, the average waiting time at the port of Qasim is rather longer than at KPT due to the long navigation channel and the limited navigation hours to day time; cargo carrier laden with bagged rice and urea experienced 231.6 hours per ship at the port. General cargo vessels, two types of dry bulk carrier and tankers followed the bagged cargo carriers, accounting for 96.5, 78.8, 61.0 and 38.0 hours per ship respectively.

7.6.3 Utilization of Berths and Cargo-Handling Productivity

The utilization of berths at the ports of Karachi and Qasim is divided into types of vessels, because at both ports, most of the berths are used on a non-exclusive basis for handling various types of cargo. Detailed records by type and by berth are not available.

The utilization of berths at the port of Karachi is divided into four types of vessels, namely, general cargo vessels, container vessels, dry bulk carriers and tankers as shown in Table 7.6.3.1.

There are 28 berths used for loading and unloading dry cargoes and 2 oil berths. According to the record of cargo-handling operation in 1992-93, 23 berths of the 28 berths and the 2 oil berths are operational. The total number of ships which moored at the 23 berths and 2 oil berths was 1,714 and 389; by vessel type, there was 604 general cargo vessels, 976 container vessels, 134 dry bulk carriers and 384 oil tankers. The average berthing/operation time per ship of dry bulk carriers is 366.1 hours, which is the longest of the four types of vessels. General cargo vessels, container vessels and tankers followed the dry bulk carriers accounting for 120.3 hours, 42.0 hours and 40.8 hours, respectively. The average volume of cargoes handled per vessel is 32,249 tons per tanker, 18,362 tons per dry bulk carrier, 5,268 tons or 519 TEUs per container vessel and 3,349 tons per general cargo vessel.

The cargo-handling productivity of the general cargo vessels laden with various kinds of cargoes was less than 30.0 tons per hour on the average and was lower than the 39.1 tons per hour of PQA's maximum record. Average container handling productivity in 1990-91 reached 142.9 tons per hour, however, it dropped to 125.4 ton per hour in 1992-93. Basedon the volume of 0.5 million TEU handled in 19923-93, loading and unloading productivity is assumed at 12.2 TEUs per hour. As for the loading and unloading of liquid oil products, the average productivity is 790.4 tons per hour, exceeding planned average handling productivity of 750 tons per hour. Therefore, at present, additional berth OP-V is under construction. After completion of berth OP-V, the average handling productivity is planned to be 1,250 tons per hour.

Table 7.6.3.1 Utilization of Berths at Port of Karachi

Vessel Type \ Year	1988-89	1989-90	1990-91	1991-92	1992-93
General Cargo Vessel					
No. of Ships	696	703	576	607	604
Waiting Time(hours/ship)	30.6	64.4	50.1	65.5	31.0
Operation Time(hours/ship)	133.5	115.8	133.2	141.8	120.3
Turn-round Time	164.1	180.2	183.3	207.3	151.3
Volume Handled (tons)	2,774,544	2,303,779	1,851,347	2,009,316	2,022,618
Average(tons/ship)	3,986	3,277	3,214	3,310	3,349
Average(tons/hour)	29.9	28.3	24.1	23.3	27.8
Container Vessel					
No. of Ships	686	741	687	814	976
Waiting Time(hours/ship)	14.7	17.2	25.5	31.1	17.1
Operation Time(hours/ship)	40.0	36.8	40.2	45.6	42.0
Turn-round Time	54.7	54.0	65.7	76.7	59.1
Volume Handled (tons)	3,055,846	3,218,459	3,946,621	4,661,699	5,141,943
Average(tons/ship)	4,455	4,343	5,745	5,727	5,268
Average(tons/hour)	111.4	118.0	142.9	125.6	125.4
Dry Bulk Carrier					
No. of Ships	141	130	178	156	134
Waiting Time(hours/ship)	64.7	121.8	150.0	153.0	136.9
Operation Time(hours/ship)	311.2	301.8	319.5	306.2	366.1
Turn-round Time	375.9	423.6	469.5	459.2	503.0
Volume Handled (tons)	1,867,430	2,255,363	2,520,832	2,561,029	2,460,520
Average(tons/ship)	13,244	17,349	14,162	16,417	18,362
Average(tons/hour)	42.6	57.5	44.3	53.6	50.2
Oil Tanker					
No. of Ships	349	366	364	391	389
Waiting Time(hours/ship)	35.2	45.7	91.9	108.8	111.4
Operation Time(hours/ship)	42.1	40.7	42.4	39.0	40.8
Turn-round Time	77.3	86.4	134.3	147.8	152.2
Volume Handled (tons)	10,166,362	11,297,487	10,390,935	11,220,823	12,544,923
Average(tons/ship)	29,130	30,867	28,547	28,698	32,249
Average(tons/hour)	691.9	758.4	673.3	735.8	790.4

Source: KPT

The utilization of berths at the port of Qasim is divided into five types of vessels, namely, general cargo vessels including various kinds of vessels, dry bulk carriers laden with wheat, dry bulk carriers laden with iron ore and coal, bagged cargo carrier and tankers as shown in Table 7.6.3.2.

Table 7.6.3.2 Utilization of Berths at Port of Qasim

Year	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93
Vessel Type						
General Cargo Vessel						
No. of Ships	8	19	17	19	16	34
Waiting Time(hours/ship)	N.A.	N.A.	47.3	96.5	N.A.	N.A.
Operation Time(hours/ship)	206.7	131.1	358.2	277.0	97.3	170.8
Turn-round Time	N.A.	N.A.	405.5	373.5	N.A.	N.A.
Handled Volume(tons)	35,801	59,559	146,519	155,912	60,904	180,376
Average(tons/ship)	4,475	3,135	8,619	8,206	3,807	5,305
Average(tons/hour)	21.7	23.9	24.1	29.6	39.1	31.1
Bulk Cargo Vessel(wheat)						
No. of Ships	21	71	56	31	74	71
Waiting Time(hours/ship)	N.A.	N.A.	113.0	61.0	221.0	N.A.
Operation Time(hours/ship)	244.0	283.0	241.0	226.5	212.0	203.7
Turn-round Time	N.A.	283.0	354.0	287.5	433.0	203.7
Handled Volume(tons)	579,448	2,254,730	1,861,824	1,009,998	2,214,976	2,866,194
Average(tons/ship)	27,593	31,757	33,247	32,581	29,932	40,369
Average(tons/hour)	113.1	112.2	138.0	143.8	141.2	198.2
Bagged Cargo Carriee(Rice & Urea)						
No. of Ships	67	43	27	90	71	52
Waiting Time(hours/ship)	N.A.	N.A.	142.0	231.6	N.A.	N.A.
Operation Time(hours/ship)	240.0	350.0	412.0	289.1	300.7	300.7
Turn-round Time	N.A.	350.0	554.0	520.7	N.A.	N.A.
Handled Volume(tons)	792,217	496,690	394,423	1,152,395	1,112,021	721,333
Average(tons/ship)	11,824	11,551	14,608	12,804	15,662	13,872
Average(tons/hour)	49.3	33.0	35.5	44.3	52.1	46.1
Liquid Bulk Carrier						
No. of Ships			15	44	57	67
Waiting Time(hours/ship)			24.0	38.0	N.A.	N.A.
Operation Time(hours/ship)			47.4	56.0	50.8	46.5
Turn-round Time			71.4	94.0	N.A.	N.A.
Handled Volume(tons)			338,121	828,221	1,133,862	1,547,959
Average(tons/ship)			22,541	18,823	19,892	23,104
Average(tons/hour)			475.6	336.1	391.6	496.9
Dry Bulk Carrier(Iron Ore & Coal)						
No. of Ships	58	58	58	59	57	60
Waiting Time(hours/ship)	N.A.	N.A.	144.0	78.8	N.A.	N.A.
Operation Time(hours/ship)	93.5	116.5	106.3	101.1	122.0	111.0
Turn-round Time	N.A.	N.A.	250.3	179.9	N.A.	N.A.
Handled Volume(tons)	2,314,291	2,342,728	2,571,039	2,509,867	2,637,319	2,745,139
Average(tons/ship)	39,902	40,392	44,328	42,540	46,269	45,752
Average(tons/hour)	426.8	346.7	417.0	420.8	379.3	412.2

Source: PQA

There are 7 berths including 1 oil berth used for loading and unloading commercial cargoes and 1 exclusive use berth for iron ore and coal. According to the record of cargo-handling operation in 1992-93, the total number of ships which moored at the 7 berths and 1 iron ore and coal berth was 224 and 60; by vessel type there were 34 of general cargo vessels, 71 dry bulk carriers laden with wheat, 52 bagged cargo carriers and 67 oil tankers. The average mooring time per ship of bagged cargo carriers is 300.7 hours, dry bulk carriers laden with wheat, general cargo vessels, tankers followed the bagged cargo carriers accounting for 203.7 hours, 170.8 hours, while iron ore and coal carrier registered 110.0 hours. The average volume of cargoes handled per vessel is 45,752 tons per iron ore and coal carrier, 40,369 tons per dry bulk carrier, 23,104 tons per tanker, 13,872 tons per bagged cargo carrier, 5,305 tons per general cargo vessel.

The cargo-handling productivity of the general cargo vessels in 1991-92 reached 39.1 tons per hour on the average from 23.9 tons in 1988-89. The average productivity of dry bulk carrier laden with

wheat increased from 112.2 tons per hour in 1988-89 to 198.2 ton per hour with the increase in its handling volume. As for discharging of iron ore and coal, average is 412.2 tons per hour. Considering that the capacity of existing unloaders (nominal capacity is 600 tons per hour per unit), the actual productivity seems to be very low. The liquid bulk productivity is 496.9 tons per hour, which is almost the same as when operations began, which seems to be owing by storage capacity of the existing tanks.

The berth occupancy rate at the port of Karachi has been continued quite high; the occupancy rates of the east and west wharves and oil piers in 1992-93 reached 84.9%, 89% and 81.1% respectively. The Reconstruction of oil berth OP-V started at March 1991, therefore, the occupancy rate of oil piers increased rapidly from 46.5% in 1990-91. Concerning the east and west wharves, the high occupancy rate seems to be effected in the long berthing/operation time of the general cargo vessels and dry bulk carriers.

The berth occupancy rate at the port of Qasim was 60.5% at the multi-purpose terminal and high value 74.4% at the iron ore and coal berth in 1992-93.

Figure 7.6.3.1 and 7.6.3.2 show the berth occupancy rate at the both ports.

Figure 7.6.3.1 Berth Occupancy Rate at Port of Karachi

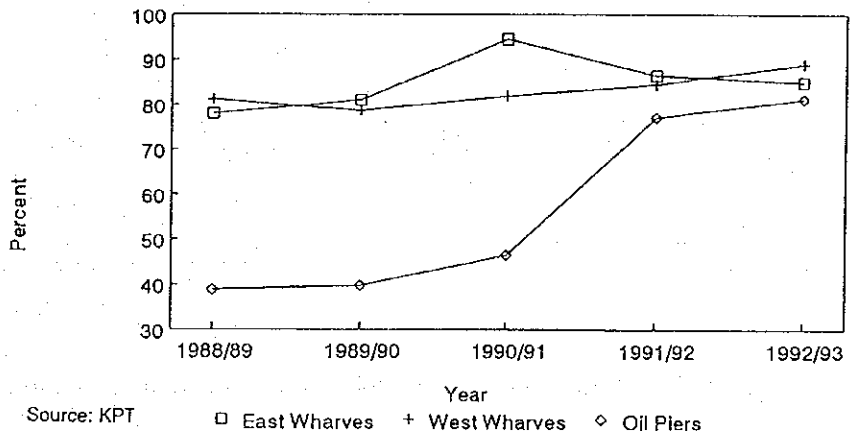
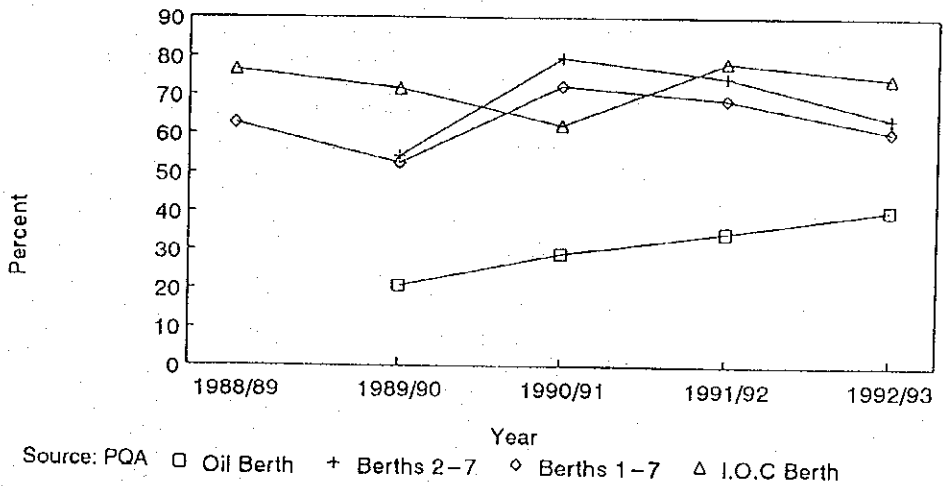


Figure 7.6.3.2 Berth Occupancy Rate at Port of Qasim



According to the table, the number of utilized berths and berth occupancy rate are calculated from the total actual operation/berthing time of each type of vessel. The number of utilized berths and berth occupancy rate considering the number of berths and completed condition are as shown in Table 7.6.3.3.

Table 7.6.3.3 Assumed Number of Utilized Berths and Berth Occupancy Rate at Karachi Port

Wharf	Berth No.	Present (1992-93)			Berth Occupancy Rate (%)	
		Total Operational Berth No.	Actual Operation /Berthing Time (hours)	Assumed Number of Utilized Berths	Present (1992-93)	After Repair and Construction
East Wharf No.	1-4		G.Cargo Vessel			
	5-7	(Nos.5,6,7,8 and	72,661	8.3		
	8	and 13 are not				
	9-17	in operation)	Container Vessel			
Sub-total	17	12	40,992	4.7		
West Wharf No.	18					
	19-21		Dry Bulk Carrier			
	22		49,057	5.6		
	23					
	24					
Sub-total	7	7				
Juna Bunder No.	25-28	4				
Total	28	23	162,710	18.6	80.8	66.3
Oil Berth No.	I					
	IV					
	V	(under construction)				
Total	3	2		1.8	90.6	90.4

Source: JICA Study Team

The number of utilized berths and berth occupancy rate at port of Qasim are assumed in following table 7.6.3.4.

Table 7.6.3.4 Assumed Number of Utilized Berths and Berth Occupancy Rate at Qasim Port

Wharf	Berth No.	Present (1992-93)		
		Actual Operation /Berthing Time (hours)	Assumed Number of Utilized Berths	Berth Occupancy Rate (%)
Multi Purpose Terminal				
	No. 1	Oil Tanker		
	(Oil Terminal I)	3,116	0.4	
	2	G. Cargo Vessel		
	3	5,807	0.7	
	4	Bulk Carrier(Wheat)		
	5	14,463	1.7	
	6	Bulk Carrier(Rice)		
	7	15,636	1.8	
Total	7	39,022	4.5	63.6
Iron and Coal Berth				
	No. 1	6,660	0.8	76.0

Source: JICA Study Team

7.7 Review of the Seventh Five Year Plan

7.7.1 Summary of the Seventh Five Year Plan

The strategy of the Seventh Plan is summarized as follows,

- Creation of a "Central Port Authority" to coordinate operation of the ports of Karachi and Qasim.
- Encouragement of private sector in cargo handling.
- Construction of container handling berths.
- Streamlining and simplification of custom procedures.
- Rationalization of port tariffs.
- Feasibility study for inland water transport, and
- Setting up of inland freight stations at strategic industrial and commercial locations.

The major projects at the ports are summarized as follows,

Port of Karachi:

- Completion of Jinnah Bridge Phase-II.
- Completion of oil products berth (OP-V).
- Completion of container terminal (2 berths).
- Harbour crafts (bucket dredger, hopper barges, marine crafts, tugs and pilot boats).
- Roads and warehouses.
- Improvement of cargo handling equipment, etc.

Port of Qasim:

- Completion of oil terminal.
- Dredger and harbour crafts (pilot boat, working boat, shipping tug, anti pollution craft).
- Deepening of channel for vessels up to 75,000 DWT bulk carriers.
- Roads and housing facilities.

The estimated cost of the public sector and semipublic sector is Rs. 2,654 million and Rs. 1,180 million respectively.

The annual growth rate of cargo traffic to be handled at the ports during the Seventh Plan period was taken to be 4.5%. However, the actual growth rate was 7.1%.

Project name, costs and plan allocation under the Seventh Five Year Plan are shown in Table 7.7.1.1.

Table 7.7.1.1 Projects and Budgetary Allocation in the Seventh Five Year Plan

(Rs. in million)

Name Status of Project	Total Cost	Foreign Ex. Component	Plan Allocation
Public Sector			
Jinnah Bridge Phase-II	1,050	271	
Port Qasim (Phase-1) (Ongoing)	4,700	1,913	
Procurement of Dredger at PQA	643	480	
Procurement of Harbour Crafts at PQA	200	120	
Oil Terminal at PQA at PQA	650	400	
Deepening of Channel at PQA	350	250	
Gwadar Fish Harbour	1,380	776	
Inland Water Transport	40	30	
Liquid Products Marine Terminal (OP-V) at KPT	530	370	
Total	9,543	4,610	2,654
Semipublic Sector			
Container Terminal at KPT	1,200	600	
Procurement of Bucket Dredger, Hopper Bardges at KPT	600		
Improvement of Cargo Handling Equipment, etc. at KPT	1,070	1,160	
Road Improvements	110	-	
Total	2,980	1,760	1,180
Grnad Total	12,523	6,370	3,834

Source: "Seventh Five Year Plan" Planning Commission, PSW, KPT, PQA

7.7.2 Execution Condition of the Seventh Five Year Plan

Among the major projects, Phase-I of the port of Qasim and Gwadur Fish Harbour have progressed to an advanced stage and is near completion. Feasibility study for Indus river navigation study was completed. A modernization project at the port of Karachi is now in progress which entails the procurement of a dredger, construction of Jinnah Bridge Phase-II and liquid products terminal OP-V. The construction of a container terminal at East Wharf by the private sector was taken in hand. The construction of a oil terminal at port of Qasim by private sector was launched. Port tariffs were revised both by KPT and PQA. However, the establishment of a "Central Port Authority" has not yet been realized.

The actual expenditures during the Seventh Five Year Plan are shown in Table 7.7.2.1.

The total expenditures in the public and semipublic sectors are Rs. 2,220.3 million and Rs. 276.9 million respectively. The achievement ratios of actual expenditures to budgeted expenditures during the Seventh Plan period are 83.7% for the public sector, 23.5% for the semipublic sector and 65.1% for the total expenditures.

Table 7.7.2.1 Actual Expenditures and Achievement Ratios

(Rs. in million)

	Public Sector	Semipublic Sector	Total
Total Budgetary Allocation during Five Years	2,654	1,180	3,834
Expenditure:			
1988/89	918.1		918.1
1989/90	58.1		58.1
1990/91	482.0	37.8	519.8
1991/92	206.1	78.3	284.4
1992/93	556.0	160.8	716.8
Total	2,220.3	276.9	2,497.2
Achievement Ratio (%)	83.7	23.5	65.1

Source: PSW, KPT, PQA

7.8 Present Problems

As mentioned above, there are some problems at the two ports, and major problems are summarized as follows:

7.8.1 Karachi Port

(1) The highest priority seems to be given to the container vessels due to the insufficient container yard and handling equipment to cope with increasing container cargo.

(2) Waiting time and mooring time of dry bulk carriers for/at berths is unacceptably high which cause excessive congestion due to the lack of berthing facilities and low productivity.

(3) The existing railway yard behind the East Wharf is not utilized efficiently.

(4) The cargo-handling equipment and the floating crafts have become superannuated.

7.8.2 Qasim Port

(1) The port has been developed as a maritime industrial and commercial cargo-handling port, and several industrial companies have begun production at the industrial area, which was allotted about 2,000 acres of land to be divided among the several industrial companies. However, all of the cargoes such as the general cargo to be handled at the port from these industrial companies were not handled. There seems to be a lack of service and operation.

(2) The handling productivity at I.O.C berth is seems to be rather low, nominal capacity of unloaders is 1,200 tons per hour, however, actual handling productivity registered only about 412 tons.

(3) The maintenance dredging volume at the entrance channel reaches about 3.0 million m^3 annually, and the cost of dredging works places a great burden on the financial condition of PQA.

7.9 Master Plan

7.9.1 General

In this section, the basic concepts employed in making the Master Plan are introduced. Then, the functional allotment of port activity among the two port is analyzed. Next, the forecast of seaborne cargo volume by the year 2005-06 is formulated as a basis for planning, taking into consideration the recent rapid growth of containerization in Pakistan. An analysis is performed on the prospects of containerization and container cargo volume in the future, reflecting the past trend and the overall cargo volume forecast. Finally, the development plan of port facilities is proposed as the Master Plan.

7.9.2 Functional Allotment of Port Activity Among the Two Ports

The ports of Karachi and Qasim have the same hinterland and transportation system. The port of Karachi is in a sense a mature port, opened a century ago, and most of Pakistan's port related functions and assets have been developed and concentrated here including container handling. The port of Qasim, meanwhile, was constructed recently in order to relieve the heavy congestion at the port of Karachi and was planned to be a maritime industrial and commercial cargo handling port. However, at present, the port handles mainly industrial cargoes, especially iron ore and coal of Pakistan Steel Mill, as well as wheat and rice.

As for the transportat of valuable general cargoes such as machinery and chemicals, not only economical but also fast, safe and convenient transportation measures are essential. For that purpose, containerization has progressed remarkably in international shipping. This worldwide tendency is expected to take hold in Pakistan also. At present, container cargoes which accounted for about 5.1 million tons in 1992-93 are handled at Karachi port, only using general cargo berths without specialized container handling equipment. Container cargo traffic at Karachi port which recorded rapid increase from 0.4 million tons or 60 thousand TEUs in 1980-81 to 5.1 million tons or 507 thousand TEUs in 1992-93 despite the absence of a full scale container terminal is expected to increase further in the future. Therefore, in order to meet the forecast demand in the target year of 2005-06 of the Master Plan, full scale container terminals need to be established. At present, the ports of Karachi and Qasim are proceeding with container terminal development (Berth nos. 14 to 17 and 22 to 24 at Karachi port and Berth No. 5 to 7 at Qasim port) in line with the Government policy on the private sector participation under the Build-Operate and Transfer (BOT) basis. However, even if these investments are made, handling capacity will be insufficient to meet the forecast demand for the year of 2005-06, therefore, new berths must be constructed at both ports.

Dry bulk carriers are forced to wait and to moor for a long period of time before/after berthing at both ports; waiting time and mooring time were 136.9 hours and 366.1 hours per ship at Karachi port in 1992-93 and 221.0 hours and 212.0 hours per ship at Qasim port in 1991-92, which seems to be a consequence of the excessive congestion at both ports. One major reason for the congestion is that loading and discharging is carried out at the general cargo berths at Karachi port and the multi-purpose terminal at Qasim port without specialized berths. In order to reduce such congestion and meet the future demand, it is necessary to increase cargo-handling productivity's and improve the cargo handling system at both ports.

On the other hand, liquid bulk cargoes have the largest share of the cargoes and are increasing steadily at the port of Karachi, reaching 12.5 million tons in 1992-93. At Qasim port, the handling of liquid bulk cargoes has been increasing rapidly since 1990, reaching 1.5 million tons in 1992-93 (Liquid bulk cargoes mainly comprise crude oil, diesel oil fuel oil, molasses, chemical products and furnace oil). The average handling productivity and berth occupancy rate in 1992-93 was 790.4 tons per ship and 81.1% at Karachi port (which is heavily congested) and 469.9 tons per ship and 40.5% at Qasim port. The excessive congestion at the Karachi port will be relieved after completion of OP-V. And at present, new oil berth at Qasim port (under Built-Operation and Transfer basis) is under construction and expected to start in December 1994. Therefore, it is possible to meet the future demand.

As mentioned above, the functional allotment of port activity among the two ports is the same. Therefore, it is very important to develop the two ports to meet the forecast demand in the target year of 2005-06; in this regard, the development should be well coordinated.

7.9.3 The Basic Concept of the Port Development

In formulating the Master Plan, the following provisions have been taken into consideration: Based on the traffic forecast, which is partially based on discussion between the counterparts from the Government of Pakistan and the JICA Study Team, seaborne cargo throughput is estimated up to 2005-06. In the Master Plan, development of port facilities is planned to cope with the estimated cargo throughput. Only the ports of Karachi and Qasim are to be developed based on the nation-wide demand forecast. The other ports are discussed independently from the viewpoint of regional development.

In making the Master Plan for the two ports, the following various aspects concerning the port development are recognized:

(1) Effective Utilization of the Existing Facilities

Due to limited available space within the existing port area especially at Karachi port, the effective utilization of the existing facilities (including the possibility of conversion of wharves to meet the forecast demand at the two ports) is important. The effective utilization of existing facilities for the development at the two ports would be highly feasible from the view point of minimizing the total investment cost and to maximize its effect.

(2) Lack of Modern Terminal

In order to ensure efficient cargo-handling productivity, systematically organized modern terminals equipped with efficient cargo handling facilities and sufficient storing facilities specialized such as dry bulk cargoes and containers need to be prepared. However, the fact that two ports have no such modern terminals is one of the main reasons for the long period of waiting and mooring times.

(3) Establishment of the Container Terminal

The number of containers to be handled at both ports in 2005-06 is estimated as 1.4 million TEUs. In order to cope with the progress of containerization, the container terminal operation by the private sector using their own handling equipment has been progressing by leasing the existing facilities. However, the cargo-handling capacity of these terminals is insufficient to handle the above number of containers, therefore, full scale container terminal will be required by the year 2005-06. If the development of container terminals at the two ports is allowed to lag behind container terminal construction in other countries, the two ports will fall from their central position as foreign trade ports.

(4) Modernization of the Dry Bulk Terminal

The volume of wheat to be handled at Qasim port in 2005-06 is estimated as 3.7 million tons, about 1.3 times as much as the volume in 1992-93. At present, multi-purpose terminal berth Nos. 5-7 are handling wheat; the handling productivity is rather high, about 200 tons per hour, which seems to be a result of good management/operation of handling. However, the present cargo-handling capacity is insufficient to meet the forecasted demand, therefore, it is necessary to modernize and improve existing facilities.

At Karachi port, various kinds of dry bulk cargoes are being handled at general cargo berths such as fertilizer, rice, phosphate, scrap and etc. The dry bulk carriers are being forced to moor for a long time at the berths due to the low cargo-handling productivity which causes the high berth occupancy rate at the port. Therefore, specialized dry bulk handling facilities must be provided.

(5) Establishment of Additional Liquid Terminal

The volume of liquid bulk to be handled at both ports in 2005-06 is 25.0 million tons: 16.5 million tons at Karachi port and 8.4 million tons at Qasim port.

At Qasim port, the liquid bulk is mainly furnace oil which has been handled at the temporary oil berth which was converted from multi-purpose terminal, berth No.1, in 1990. At present, the present handling capacity is insufficient; therefore, new oil berth is under construction and expected to start in December 1994.

7.9.4 International Containerization

(1) Outline of International Container Transport

Containerization of sea transport is the second stage in the development countries, while it is nearly completed in the developed countries. In many ports of Asian and Middle East countries, container berths able to accept full container ships have been constructed or are being planned, and the volume of containers to/from these ports is increasing at a remarkable rate. Presently, Karachi port is ranked seventeenth in terms of number of containers handled among the ports in Asia and the Middle East. Table 7.9.4.1 shows the historical trend of the number of containers handled at the container ports.

Table 7.9.4.1 Number of Containers at Major Ports in Asia and Middle East

(Unit: TEUs)

	Port	1988	1989	1990	1991	1992	Annual Increased Rate (%)
1	Hong Kong	4,033,427	4,463,709	5,100,637	6,161,912	7,972,235	18.6
2	Singapore	3,375,100	4,364,400	5,223,500	6,354,000	7,560,000	22.3
3	Kaohsiung (Taiwan)	3,082,838	3,382,512	3,494,631	3,913,108	3,960,518	6.5
4	Busan (South Korea)	2,065,462	2,158,828	2,348,475	2,694,115	2,751,006	7.4
5	Kobe (Japan)	2,263,214	2,458,964	2,595,940	2,635,425	2,608,272	3.6
6	Yokohama (Japan)	1,452,857	1,506,338	1,647,891	1,796,368	1,886,789	6.8
7	Tokyo (Japan)	1,396,026	1,438,521	1,555,138	1,783,837	1,728,548	5.5
8	Dubai (UAE)	-	-	916,363	1,255,260	1,481,807	27.2
9	Bangkok (Thailand)	791,584	924,040	1,018,290	1,170,697	1,303,308	13.3
10	Manila (Philippines)	758,199	949,787	1,038,905	1,047,900	1,157,912	11.2
11	Jeddah (Saudi Arabia)	595,031	548,698	549,934	721,192	847,252	9.2
12	Damman (Saudi Arabia)	208,278	294,059	232,456	342,612	312,000	10.6
13	Port Kelang (Malaysia)	325,661	399,348	496,526	607,626	677,588	20.1
14	Colombo (Sri Lanka)	520,940	544,197	583,811	669,489	676,041	6.7
15	Osaka (Japan)	515,924	513,658	483,036	541,267	617,184	4.6
16	Fujairah (UAE)	202,893	270,661	414,353	475,734	527,046	27.0
17	Karachi (Pakistan)	281,437	339,807	390,391	469,705	510,017	16.0
18	Khor Fallan (UAE)	124,224	125,486	162,620	268,777	358,760	30.4
19	Tanjung Priok (Indonesia)	110,111	143,225	198,135	256,140	328,012	31.4
20	Bonbay (India)	256,618	277,358	324,216	279,556	315,400	5.3
21	Penang (Malaysia)	155,120	189,734	222,441	251,849	303,367	18.3
22	Dalian (China)	74,945	100,000	131,259	172,536	220,000	30.9
23	Mina Qaboos (Oman)	147,882	165,332	167,873	155,604	153,120	0.9
24	Bandar Abbas (Iran)	-	-	-	74,687	95,151	27.4
25	Mina Sulman (Bahrain)	66,794	68,500	75,066	84,254	89,829	7.7
						(Average)	14.7

Source: Containerisation International Year Book (1993)

(2) Management and Operation of Container Terminal

There is a marked trend towards privatization of container terminals in the world, but it is very

difficult to define and evaluate so-called "privatization" because of peculiarities among individual ports and countries and because each port authority has its own jurisdiction and duties.

Privatization schemes of port facilities are considered as follows:

1) Lease and Concession

The public sector constructs a terminal and leases it to the private sector on a per contract basis. The private sector manages and operates it and turns over a percentage of the revenue. There are several types of leases used by the port authorities: flat rate, mini-max or shared revenue etc. There is no best type: it depends on the nature of port and its objectives.

2) Build-Operate and Transfer

The private sector constructs a terminal and operates it for a certain period. During that period, the private sector recovers its initial investment and transfers the terminal to the public sector.

3) Private

The private sector constructs a terminal and operates it by itself. This scheme is only adopted in the case of a special terminal, for instance, an exclusive terminal for coal, iron ore and so on.

Of the above schemes, many authorities in the world such as USA, Philippines and European countries have adopted 1) Lease and Concession scheme. The major container berths and ferry wharves in Japan are also operated by the same scheme.

7.9.5 Methods to Determine Number of Berths

One of the most important factors in determining the scale of a wharf is the number of its berths. Methods used to determine the number of berths include the following: (a) method to determine the number macroscopically by giving the standard value of handled tonnage per-meter of berth length as a postulate; (b) Method to determine the number of berths by assuming the frequency of ship entries and the cargo handling capacity; (c) Method to determine the number of berths by applying queuing theory. Here, (b) and (c) methods are used to determine the number of berths for the two ports.

7.9.6 Forecast of Seaborne Cargo Throughput

(1) Demand Forecast of Seaborne Trade

The demand forecast of seaborne cargoes is shown in Tables 7.9.6.1 and 7.9.6.2.

Table 7.9.6.1 Demand Forecast of Seaborne Trade

	1992/93	1997/98	2005/06
Dry Cargo	16,138	20,132	29,541
Wheat	2,866	2,852	3,656
Sugar	71	67	22
Cement	44	307	94
Fertilizer	1,471	1,659	1,306
Iron/Steel	399	857	1,934
Minerals (Ore)	1,701	2,168	2,952
Coal/Coak	1,044	801	618
Rock Phosphate	308	309	309
Rice	840	1,555	2,156
Cotton	367	521	1,346
Miscellaneous	7,027	9,036	15,148
Liquid Cargo	14,093	17,418	24,968
Edible Oil	1,493	1,980	1,519
Crude Oil	4,029	2,155	9,705
Petroleum Products	6,997	12,047	11,866
Molasses	1,013	1,236	1,878
Others	561	-	-
Grand Total	30,231	37,550	54,509
(Index)	(100)	(124)	(180)

Source: JICA Study Team

The rate of increase of the cargo tonnage is indicated by an index in parentheses with a base value of 100 for 1992-93. The figures are 124 for 1997-98 and 180 for 2005-06.

Table 7.9.6.2 Demand Forecast for Import/Export Cargo

('000 tons)

Commodities	1992/93	1997/98	2005/06
Import	24,756	30,033	41,307
Dry Cargo	12,226	13,851	18,217
Wheat	2,866	2,852	3,656
Sugar	71	67	22
Cement	44	307	-
Fertilizer	1,471	1,659	1,306
Iron/Steel	399	857	1,934
Minerals (Ore)	1,701	2,168	2,952
Coal/Coak	1,044	801	618
Rock Phosphate	308	309	309
Miscellaneous	4,322	4,831	7,420
Liquid Cargo	12,530	16,182	23,090
Edible Oil	1,493	1,980	1,519
Crude Oil	4,029	2,155	9,705
Petroleum Products	6,997	12,047	11,866
Others	11	-	-
Export	5,475	7,517	13,202
Dry Cargo	3,912	6,281	11,324
Rice	840	1,555	2,156
Cotton	367	521	1,346
Cement	-	-	94
Miscellaneous	2,705	4,205	7,728
Liquid Cargo	1,563	1,236	1,878
Molasses	1,013	1,236	1,878
Others	550	-	-

Source: JICA Study Team

The volume of imported cargoes, 41.3 million tons, accounting for 75.8% of the total. As for imported cargoes, the volume of liquid bulk cargo such as edible oil, crude oil and petroleum products accounted for 3.7%, 23.5% and 28.7% of the total imported cargoes, while the major commodities of dry cargo are wheat, fertilizer, iron ore, coal and others, accounted for 6.7%, 2.7%, 1.1%, and 27.8% of the total respectively.

(2) Forecast of Containerized Cargo

1) Method of Forecast

The number of containers and the volume of container cargo for export/import trade in Pakistan are forecasted using the following procedure:

a) Selection of containerizable cargo;

b) Estimation of the ratio of container cargo to containerizable cargo;

c) Estimation of the number of containers and volume of container cargo.

2) Containerizable Cargo

The main commodities of containerizable cargo are sugar; iron and steel and other dry cargoes for import; and sugar, cotton and other dry cargoes for export.

3) Ratio of Containerization

The ratio of containerized cargo volume to containerizable cargo volume is estimated using a logistic curve based on the data of Karachi port as shown in Table 7.9.6.3.

Table 7.9.6.3 Percentage of Containerization

Year	Containrizable Cargo ('000tons)			Containered Cargo ('000tons)			Ratio (%)		
	Import	Export	Total	Import	Export	Total	Import	Export	Total
87 - 88	3,156	1,890	5,046	1,445	1,318	2,763	45.8	69.7	54.8
88 - 89	3,408	2,425	5,833	1,620	1,813	3,433	47.5	74.8	58.9
89 - 90	3,290	2,232	5,522	1,801	1,620	3,421	54.7	72.6	62.0
90 - 91	3,885	2,313	6,198	2,002	1,944	3,946	51.5	84.0	63.7
91 - 92	3,805	2,866	6,671	2,218	2,444	4,662	58.3	85.3	69.9
92 - 93	4,187	2,978	7,165	2,639	2,503	5,142	63.0	84.0	71.8

Source: KPT

The basic equation for logistic curve approximation of the growth of containerization is as follows:

$$P = \frac{Pm}{1 + C^{(t - t_o)}}$$

where,

P : percentage of containerization at the year t
Pm : ultimate containerization is defined as "percentage of containerization at fully containerized stage"
C : a parameter
t : year
t_o : time lag in year

Table 7.9.6.4 shows the ratio of containerization to containerizable cargo.

Table 7.9.6.4 Ratio of Containerization

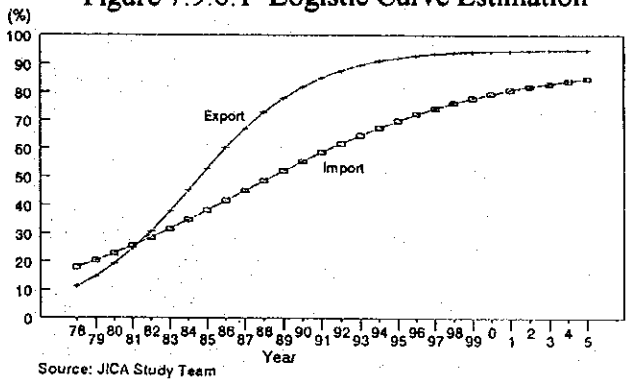
Unit: %

Year	Import		Export	
	Actual	Estimate	Actual	Estimate
1987 - 88	45.8		69.7	
1988 - 89	47.5		74.8	
1989 - 90	54.7		72.6	
1990 - 91	51.5		84.0	
1991 - 92	58.3		85.3	
1992 - 93	63.0		84.0	
1997 - 98		75.3		93.3
2005 - 6		85.4		94.9

Source: JICA Study Team
Note: Actual data is from KPT

The growing feature of containerization is shown in Figure 7.9.6.1.

Figure 7.9.6.1 Logistic Curve Estimation



Source: JICA Study Team

4) The number of Containers (TEU)

The container cargo volume per TEU is estimated using the past data at Karachi port, which is 13.8 tons/TEU and 11.7 tons/TEU for import and export respectively, and empty ratio in import and export are 50.2%, 11.4% and 60.0%,9.7% in target years of 1997-98 and 2000-06.

Table 7.9.6.5 shows the container cargo volume and the number of containers with the planning period.

Table 7.9.6.5 Container Cargo Volume and Number of Containers

Import	1992/93	1997/98	2005/06	Export	1992/93	1997/98	2005/06	Total	1992/93	1997/98	2005/06
1 Total Dry Cargo	12,226	13,851	18,217	1 Total Dry Cargo	3,912	6,281	11,324	1 Total Dry Cargo	16,138	20,132	29,541
Wheat	2,866	2,852	3,656	Rice	840	1,555	2,156				
Sugar	71	67	22	Cotton	367	521	1,346				
Cement	44	307	-	Cement	-	-	94				
Fertilizer	1,471	1,659	1,306	Miscellaneous	2,705	4,205	7,728				
Iron/Steel	399	857	1,934								
Minerals (Ore)	1,701	2,168	2,952								
Coal/Coak	1,044	801	618								
Rock Phosphate	308	309	309								
Miscellaneous	4,322	4,831	7,420								
2 Total Containerizable Cargo	4,187	4,898	7,442	2 Total Containerizable Cargo	2,978	4,283	7,836	2 Total Containerizable Cargo	7,165	9,181	15,278
Sugar	71	67	22	Rice	-	78	108				
Iron/Steel	200	857	1,934	Cotton	273	521	1,346				
Miscellaneous	3,917	3,974	5,486	Miscellaneous	2,705	3,684	6,382				
3 Total Containerized Cargo	2,638	3,688	6,355	3 Total Containerized Cargo	2,504	3,996	7,436	3 Total Containerized Cargo	5,142	7,684	13,792
Containerized Ratio (%)	63.0	75.3	85.4	Containerized Ratio (%)	84.1	93.3	94.9	Containerized Ratio (%)	71.8	83.7	90.3
4 Total TEU ('000)	255	398	731	4 Total TEU ('000)	252	381	698	4 Total TEU ('000)	507	779	1,429
Loaded Container	191	265	457	Loaded Container	210	342	636	Loaded Container	401	607	1,093
Empty Container	64	133	274	Empty Container	42	39	62	Empty Container	106	172	336

Source: JICA Study Team

(3) Cargo Throughput at the Two Ports

The projected cargoes in 2005-06 are classified into general cargo, bulk cargo, iron and coal and liquid bulk cargo, and then allocated to the ports of Karachi and Qasim. The results of the cargo classification and allocation of cargo at each port are shown in Table 7.9.6.6.

Table 7.9.6.6 Cargo Classification and Allocation at Each Port

Commodities	'000 tons	Karachi Port (Berth)	'000 tons	Qasim Port (Berth)	'000 tons
Dry Cargo					
Wheat	3,656	General Cargo Berth	1,512	Dry Bulk Cargo Berth	2,435
Sugar	22	Dry Bulk Cargo Berth	4,059	Wheat Berth	3,656
Cement	94	Container Berth	11,109	Container Berth	3,200
Fertilizer	1,306	(1,110,000 TEU)		(320,000 TEU)	
Iron/Steel	1,934			Iron Ore & Coal Berth	3,570
Minerals (Ore)	2,952				
Coal/Coak	618				
Rock Phosphate	309				
Rice	2,156				
Cotton	1,346				
Miscellaneous	15,148				
Sub-total	29,541	Sub-total	16,680	Sub-total	12,861
Liquid Cargo					
Edible Oil	1,519	Oil Berth	16,520	Oil Berth	6,750
Crude Oil	9,705			Liquid Berth	1,699
Petroleum Products	11,866				
Molasses	1,878				
Sub-total	24,968	Sub-total	16,520	Sub-total	8,449
Grand Total	54,509	Total	33,200	Total	21,310

Source: JICA Study Team

7.9.7 Required Scale of Port, Under the Master Plan

The required scale under the Master Plan must be in accordance with the volume of cargoes handled. The port facilities necessary to handle these cargoes are determined by referring to the past performance at the two ports.

(1) Karachi Port

Berth requirement for each type of cargo at Karachi port is examined in the following four sections to cope with projected demand.

1) Conventional Berths (General Cargo)

The required number of general cargo berths is calculated based on the procedures as shown in Table 7.9.7.1.

Table 7.9.7.1 Calculation of Required Number of General Cargo Berths

	Item		Unit	Calculation	General Cargo
a.	Cargo Volume Handled		'000 tons		1,512
b.	Average Cargo-Volume Handled		tons/vessel		5,000
c.	Number of Vessel Calls		calls/year	a/b	302.4
d.	Cargo-Handling Productivity		tons/hour		30
e.	Total Berthing Hours		hours/year	b/d x c	50,400
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	10			72.7
		11			66.1
		12			60.6
h.	Average Berth Wating Time		hours/vessel	(11 berths)	4.1

Source: JICA Study Team

Eleven (11) berths are required, which is deemed reasonable judging from the berth occupancy rate of 66.1% shown in the table above.

2) Conventional Berths (Dry Bulk Cargo)

The required number of dry cargo berths is calculated based on the procedures as shown in Table 7.9.7.2.

Table 7.9.7.2 Calculation of Required Number of Dry Cargo Berths

	Item		Unit	Calculation	Dry Bulk Cargo
a.	Cargo Volume Handled		'000 tons		4,059
b.	Average Cargo-Volume Handled		tons/vessel		18,000
c.	Number of Vessel Calls		calls/year	a/b	225.5
d.	Cargo-handling Productivity		tons/hour		384
e.	Total Berthing Hours		hours/year	b/d x c	10,570
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	2			86.5
		3			57.7
		4			43.3
h.	Average Berth Wating Time		hours/vessel	(3 berths)	7.1

Source: JICA Study Team

Three (3) berths are required, judging from the berth occupancy rate of 50.8% shown in the table.

3) Container Cargo Berths

The required number of container cargo berths is computed accordingly as in Table 7.9.7.3.

Table 7.9.7.3 Calculation of Required Number of Container Cargo Berths

	Item		Unit	Calculation	Container Cargo
a.	Cargo Volume Handled		'000 tons		11,109
a'.	Number of Containers		'000 TEUs		1110
b.	Average Cargo-Volume Handled		TEUs/vessel		700
c.	Number of Vessel Calls		calls/year	a'/b	1585.7
d.	Cargo-Handling Productivity		TEUs/hour		38
e.	Total Berthing Hours		hours/year	b/d x c	29,211
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	6			70.3
		7			60.2
		8			52.7
h.	Average Berth Wating Time		hours/vessel	(7 berths)	4.8

Source: JICA Study Team

Seven (7) berths are required, based on the berth occupancy rate of 60.2% shown above.

Container ships (presently the maximum multi-purpose vessel has a container capacity of 770 TEUs--23,490 DWT) have been called at Karachi port. Since, a worldwide trend is for larger container vessels, the maximum vessel capacity of 2,500 TEUs (40,000 DWT, 250 m long 12 m draft) would be appropriate for Karachi port. A quay length of 300 m and a water depth of 12 m would be sufficient, for container vessels are not fully loaded.

Concerning the conversion of existing wharves to container berths, it is important to utilize the existing wharves efficiently from the view point of minimizing the total investment cost and to maximizing its effect. A previous JICA study team roughly examined the situation upon the request of the Government and recommended to carry out a feasibility study, however, such a study has not yet been carried out. Karachi port has a total of 28 conventional berths, some of which (berth Nos. 6 to 17 at East Wharf and berth Nos. 18 to 24 at West Wharf) have suitable areas immediately behind berths. However, before the conversion of wharves commences, a further detailed feasibility study is necessary.

4) Liquid Bulk Cargo Berths

The required number of oil berths is calculated based on the procedures as shown in Table 7.9.7.4.

Table 7.9.7.4 Calculation of Required Number of Liquid Bulk Cargo Berths

	Item		Unit	Calculation	Liquid Bulk Cargo
a.	Cargo Volume Handled		'000 tons		16,520
b.	Average Cargo Volume Handled		tons/vessel		32,000
c.	Number of Vessel Calls		calls/year	a/b	516.3
d.	Cargo-handling Productivity		tons/hour		1,250
e.	Total Berthing Hours		hours/year	b/d x c	13,216
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	2			95.4
		3			63.6
		4			47.7
h.	Average Berth Wating Time		hours/vessel	(3 berths)	9.7

Source: JICA Study Team

Based on the above computation and using berth occupancy rate of 63.6%, three (3) berths are found to be required.

5) Other Port Facilities

As mentioned previously, the present condition of cargo handling equipment and floating crafts is not sufficient, therefore, KPT has planned to purchase a new bucket dredger with hopper barges and improve and modernize cargo handling equipment, roads and warehouses using World Bank's funding.

(2) Qasim Port

The berth requirement for each type of cargo at Qasim port is examined in the following sections in order for the port to cope with the forecasted demand.

1) Multi-Purpose Berth (Dry Bulk Cargo)

The required number of dry bulk cargo berths is calculated as shown below:

Table 7.9.7.5 Calculation of Required Number of Dry Bulk Cargo Berths

	Item		Calculation	Dry Bulk Cargo
a.	Cargo Volume Handled			2,435
b.	Average Cargo-Volume Handled			14,000
c.	Number of Vessel Calls		a/b	173.9
d.	Cargo-handling Productivity			384
e.	Total Berthing Hours		b/d x c	6,341
f.	Available Hours for Using Berths		21 hr. x 330 days	6,930
g.	Berth Occupancy		e/(f x B)	
	B (Number of Berths):	1		91.5
		2		45.8
		3		30.5
h.	Average Berth Wating Time		(2 berths)	10.8

Source: JICA Study Team

Two (2) multi-purpose berths for dry bulk cargo are required; the berth occupancy rate is 45.8%.

2) Multi-Purpose Berth (Wheat)

The required number of wheat-handling berths is calculated according to the procedures as shown in Table 7.9.7.6.

Table 7.9.7.6 Calculation of Required Number of Wheat-handling Berths

	Item		Unit	Calculation	Wheat
a.	Cargo Volume Handled		'000 tons		3,656
b.	Average Cargo-Volume Handled		tons/vessel		25,000
c.	Number of Vessel Calls		calls/year	a/b	146.2
d.	Cargo-handling Productivity		tons/hour		512
e.	Total Berthing Hours		hours/year	b/d x c	8,252
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	1			103.0
		2			51.5
		3			34.3
h.	Average Berth Wating Time		hours/vessel	(2 berths)	17.6

Source: JICA Study Team

Two (2) multi-purpose berths are required; a reasonable number judging from the berth occupancy rate of 51.5% shown in the table.

3) Multi-Purpose Berth (Container Cargo Berths)

The required number of container cargo berths is calculated as shown in Table 7.7.9.7.

Table 7.9.7.7 Calculation of Required Number of Container Cargo Berths

	Item		Unit	Calculation	Container Cargo
a.	Cargo Volume Handled		'000 tons		3,200
a'.	Number of Containers		'000 TEUs		320
b.	Average Cargo-Volume Handled		TEUs/vessel		700
c.	Number of Vessel Calls		calls/year	a'/b	457.1
d.	Cargo-Handling Productivity		TEUs/hour		38
e.	Total Berthing Hours		hours/year	b/d x c	8,421
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	1			121.5
		2			60.8
		3			40.5
h.	Average Berth Wating Time		hours/vessel	(2 berths)	8.7

Source: JICA Study Team

Two (2) berths are required, which is deemed reasonable judging from the berth occupancy rate of 60.8% shown in the Table.

4) Petroleum Products Berth

The required number of petroleum products berth is calculated according to the procedures as shown in Table 7.9.7.8.

Table 7.9.7.8 Calculation of Required Number of Berth for Petroleum Products

	Item		Unit	Calculation	Petroleum Products
a.	Cargo Volume Handled		'000 tons		6,750
b.	Average Cargo-Volume Handled		tons/vessel		32,000
c.	Number of Vessel Calls		calls/year	a/b	210.9
d.	Cargo-Handling Productivity		tons/hour		1,500
e.	Total Berthing Hours		hours/year	b/d x c	4,500
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	1			64.9
		2			32.5
		3			21.6
h.	Average Berth Wating Time		hours/vessel	(1 berth)	5.6

Source: JICA Study Team

One (1) berth for petroleum products is required, based on the berth occupancy rate of 64.9%.

5) Edible Oil Berth

The required number of berth dedicated to edible oil is computed as shown in Table 7.9.7.9.

Table 7.9.7.9 Calculation of Required Number of Berth for Edible Oil

	Item		Unit	Calculation	Edible Oil
a.	Cargo Volume Handled		'000 tons		1,699
b.	Average Cargo-Volume Handled		tons/vessel		23,000
c.	Number of Vessel Calls		calls/year	a/b	73.9
d.	Cargo-Handling Productivity		tons/hour		400
e.	Total Berthing Hours		hours/year	b/d x c	4,248
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	1			61.3
		2			30.6
		3			20.4
h.	Average Berth Wating Time		hours/vessel	(1 berth)	15.2

Source: JICA Study Team

One (1) berth for edible oilis required, using the berth occupancy rate of 61.3% shown in the Table.

6) Iron Ore and Coal Berth

The required number of iron ore and coal berths is computed, as shown in Table 7.9.7.10.

Table 7.9.7.10 Calculation of Required Number of Iron Ore and Coal Berth

	Item		Unit	Calculation	Iron Ore & Coal
a.	Cargo Volume Handled		'000 tons		3,570
b.	Average Cargo-Volume Handled		tons/vessel		45,000
c.	Number of Vessel Calls		calls/year	a/b	79.3
d.	Cargo-Handling Productivity		tons/hour		768
e.	Total Berthing Hours		hours/year	b/d x c	4,648
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	1			67.1
		2			33.5
		3			22.4
h.	Average Berth Wating Time		hours/vessel	(1 berth)	107.5

Source: JICA Study Team

One (1) berth for iron ore and coal is required, using the berth occupancy rate of 67.1% shown in the table.

7) Other Port Facilities

As previously mentioned, the maintenance dredging of the entrance channel was contracted out to foreign firms. The total of dredging work amounts to about 3.0 million m^3. The dredging accounts a large share of the total annual expenditure because, unlike KPT, PQA does not own a dredger. PQA should conduct dredging work by itself. It must first procure a new dredger as soon as possible.

The results of the calculations of berth requirements at the two ports are shown in Table 7.9.7.11.

The layout plan of converted wharf at the two ports in the Master Plan are shown in Figures 7.9.7.1 and 7.9.7.2.

(3) Other Ports

The present development condition of the ports of Gwadar, Keti Bunder and Ormara is as

follows;

1) Gwadar deep sea port

The Cabinet of Pakistan made its decision in March 1991 to construct a deep water sea port at Gwadar by the end of 1995. According to the Government' decision, a feasibility study "Gwadar Deep Water Port" under MOC was carried out and the study report was submitted in January 1993. At present, MOC plans to readvertise tenders of the implementation of Gwadar project under the Build-Operate and Transfer (BOT) scheme upon completion of the study.

2) Keti Bunder port

Keti Bunder is located in Turshian/Hajamano creeks of Indus delta, a distance of 160 km from Karachi. It is a small fishermen settlement in the Indus deltaic creek with a population of about 10,000. In addition, there are about 15 smaller settlements near Keti Bunder; the entire population in this coastal town depends on fishing. In Dececember 1993, MOC invited local consulting firms to submit proposals on the feasibility study for "the Development of Fish Harbour-Cum-Mini Port" at Keti Bunder, and a consulting firm was selected in Feb. 1994. The study was completed and the final report was submitted in April 1994. At present, MOC plans to construct the port by foreign loan.

3) Ormara port

Ormara is situated about 270 km west of Karachi, almost at the centre of the Mekran Coastline. The Government decided to develop Ormara port as an intermediate port together with the above mentioned two ports. A berth of 600 m (depth; -14 m) and a breakwater are planned as part of the port development (the breakwater is currently under construction).

The hinterland of the ports have remained economically stagnant because they lack the necessary industries. Therefore, development of the these ports, which will help spearhead regional development as well as support industrial development, is given the highest priority by the Government of Pakistan. However, in the development of these ports, it is necessary to consider the following items:

- Port plans exist for the these ports, however, the basic direction of development, management and operation of these ports is not prepared. Therefore, the plans should be revised in the scope of the basic directions.
- It is indispensable to foster port related industries in the hinterland to increase the feasibility of the project. Accordingly, it is necessary to precisely ascertain the port utilization schedule through examining the progress of port related industrial growth in the these areas.
- Considering the above mentioned, a new organization at each port needs to be established to administrate and operate port facilities that are to be newly constructed, and allocation of personnel should be restricted to the minimum level to secure economic operation.

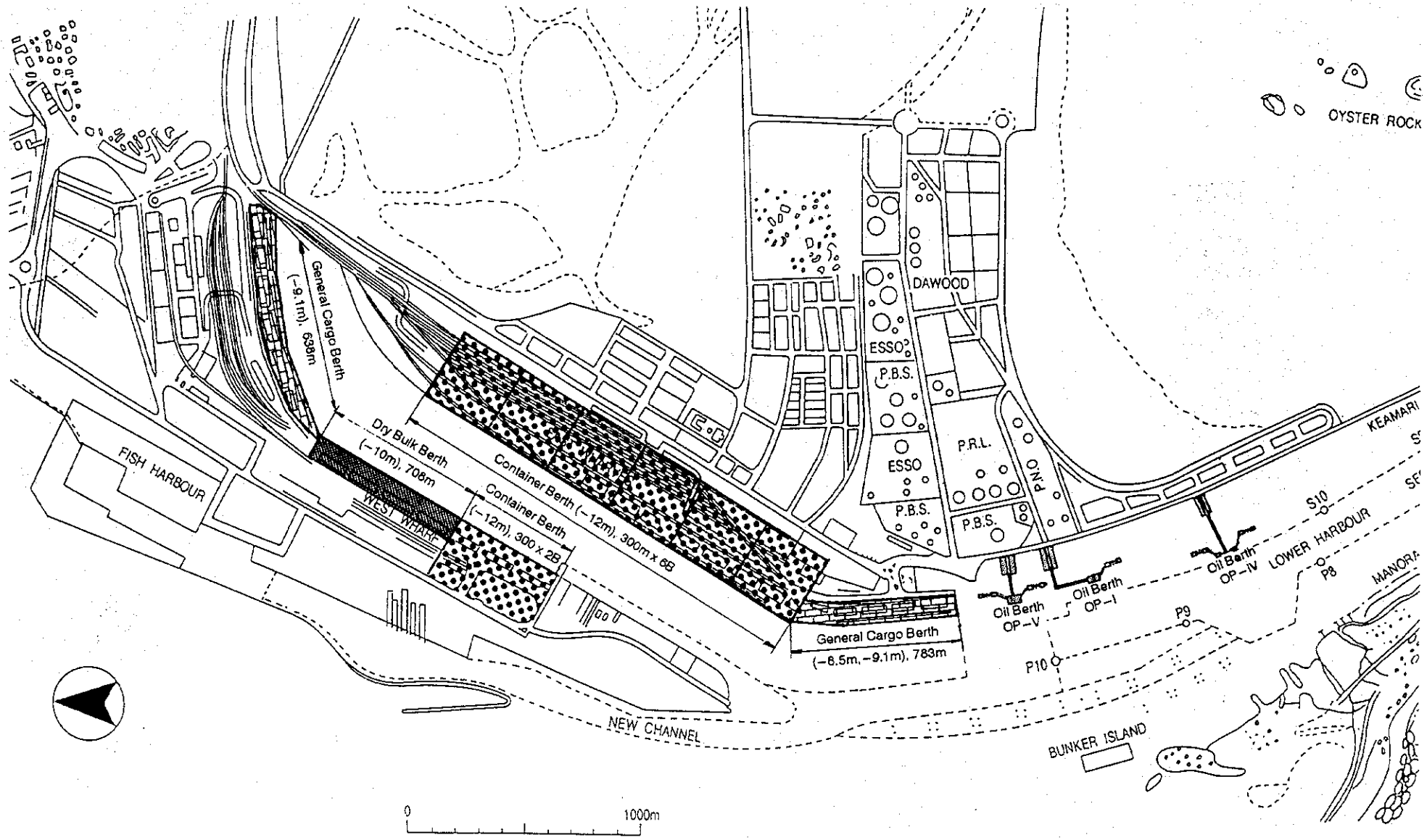
The overall projects for the Master Plan of the port sector are proposed as shown in Table 7.9.7.12.

It should be noted that costs for each project are assumed based on the past study reports and are quoted from the Government' report of the working group.

Table 7.9.7.11 Berth Requirements at the Two Ports (Master Plan)

Port	Cargoes		Existing Berths			Required Berths						
	Commodities	Volume '000 tons	Name of Berth	No. of Berths	Length (m)	Name of Berth	Exist -ing	New/ Convert	Total	Length (m)	Quay Depth(m)	Ave.Ship Size(DWT)
Karachi												
	General Cargo	1,512	Nos. 1- 5	5	773.88	General Cargo	11	0	11	1,430.00	- 8.5 - -9.1	5,000
			Nos. 6-17	12	1,870.66							
	Dry Bulk	4,059	Nos.18-24	7	1,257.30	Dry Bulk	3	0	3	570.00	- 9.8 - - 10.4	18,000
			Nos.25-28	4	638.86							
	Container	11,109				Container	-	7	7	2,100.00	-12.0	23,000
			Subtotal	28	4,540.70	Subtotal	14	7	21	4,100.00		
	Mineral/ Vegetable Oil	16,520	Nos. I- V	3		Mineral/ Vegetable Oil	3	0	3		-13.4	32,000
	Total	33,200		31		Total			24			
Qasim			(Multi-purpose Terminal)			(Multi-purpose Terminal)						
	Container	3,200	Nos. 1- 4	4	800.00	Container	-	2	2	600.00	-12.0	23,000
	Dry Bulk	2,435	Nos. 5- 7	3	600.00	Dry Bulk	2	0	2	400.00	-10.0	14,000
	Wheat	3,656				Wheat	2	0	2	400.00	-10.0	25,000
			Subtotal	7	1,400.00	Subtotal	4	2	6	1,400.00		
	Mineral Oil	6,750				Mineral Oil	0	1	1		-12.0	32,000
	Vegetable Oil	1699				Vegetable Oil	0	1	1		-10.0	23,000
						Subtotal	0	2	2			
	Iron Ore & Coal	3,570	Iron Ore & Coal	1		Iron Ore & Coal	1	0	1		-12.0	45,000
	Total	21,310	Total	8		Total	5	4	9			

Figure 7.9.7.1 Layout Plan at Karachi Port (Master Plan)



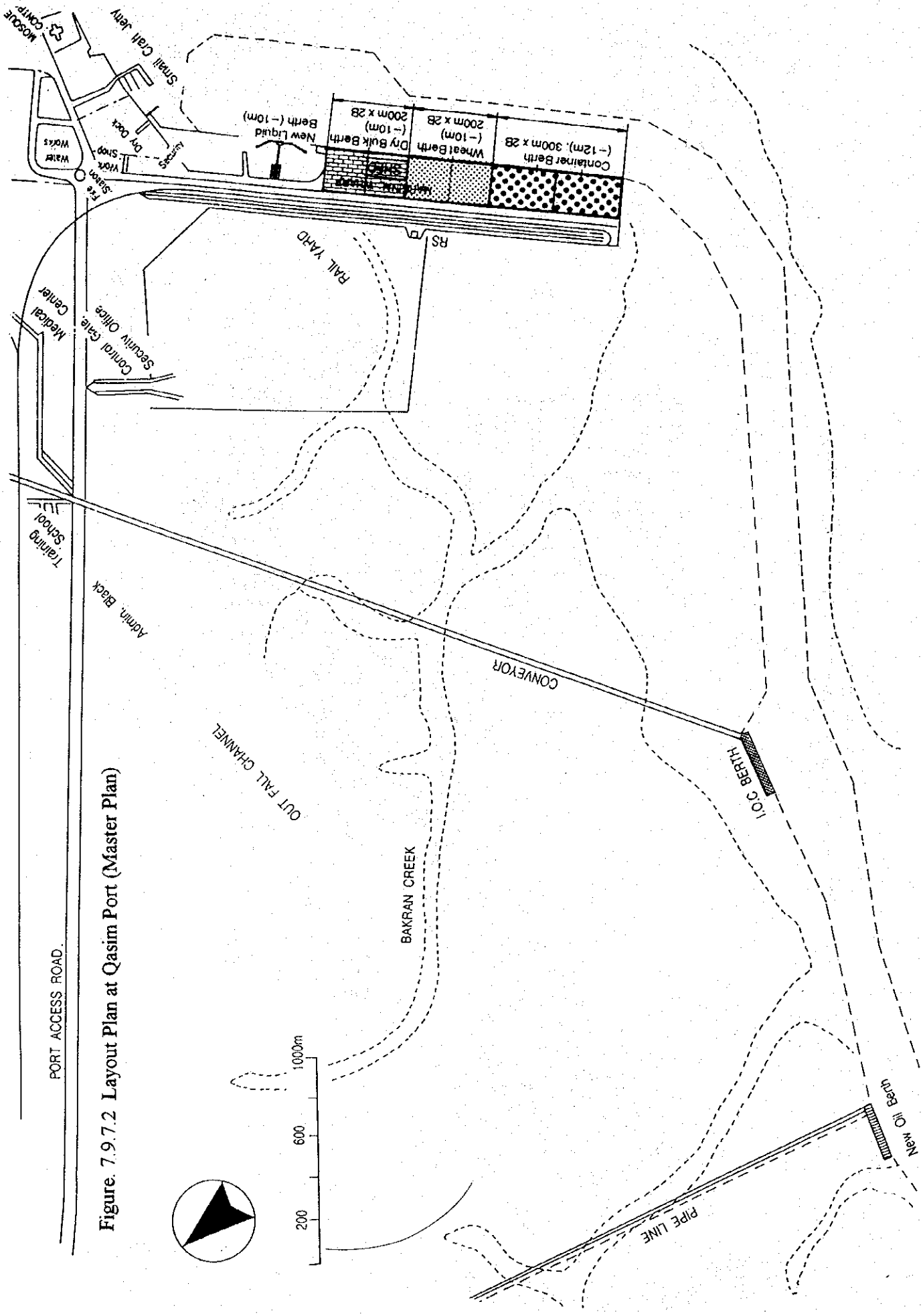


Figure. 7.9.7.2 Layout Plan at Qasim Port (Master Plan)

Table 7.9.7.12 List of Port Projects (Master Plan)

(Rs. in million)

Name of Project (No. of Berths)	Project Cost	Remarks
Karachi Port		
Jinnah Bridge Phase-II *	796	
Bucket Dredger & Ancillary Craft	552	
Reconstruction of Berths No.5-8	1,800	
Container Terminal (7)	7,840	Private Sector
Reconstruction of Oil Berth (OP-I)	530	
Feasiblity Study on Container Terminal	33	
Dry Bulk Cargo-Handling Equipment	170	Private Sector
Modern Warehousing Complex	160	Private Sector
VSP Tugs, Pilot Boats and Storage Area	200	Private Sector
Computerization	15	
Sub total	12,096	
Qasim Port		
Phase-I *	324	
Triling Suction Hopper Dredger	650	Private Sector
Deepening of Navigation Channel for 75000 DWT ships	765	
Oil Terminal*	2,500	Private Sector
Wheat Terminal (Unloaders, Silo and etc.)	1,118	Private Sector
Container Terminal (2)	1,568	Private Sector
Dry Bulk Cargo-Handling Equipment	68	Private Sector
Feasiblity Study on Container and Wheat Terminal	38	
Harbor Craft and Cargo-Handling Equipment	6	Private Sector
Construction of Second Carriage Way	153	Private Sector
Bulk Water Supply to Industrial Area	390	
New Required Berth	200	Private Sector
Computerization	10	
Sub total	7,790	
Others		
Other Projects	25	
Sub total	25	
Gand Total	19,911	

Source: JICA Study Team

Note: * is ongoing project

7.10 Eighth Five Year Plan

7.10.1 General

In this chapter, the basic policies and strategies are drawn for the port sector under the Eighth Five Year Plan. Then, the cargo forecast and berth requirement by the year 1997-1998 is executed, and evaluation of the candidate projects is made. Finally, the projects for the Eighth Five Year Plan are identified.

7.10.2 Basic Policies and Strategies

In formulating the Eighth Five Year Plan of the port sector, the following basic policies and strategies are recognized:

(1) Port facilities required by the demand forecast in conform with the schedule of the Master Plan.

(2) Establishment of the full scale container terminal. At present, the ports of Karachi and Qasim are proceeding with container terminal development (Berth No's. 14 to 17 and 22 to 24 at Karachi port and Berth No's 5 to 7 at Qasim port) in line with the Government policy on the private sector participation under the Build-Operate and Transfer (BOT) scheme. However, the handling capacity of these berths is insufficient to meet the forecasted container volume, therefore, full scale container terminal is required by the year 1997-98.

(3) Effective utilization of existing facilities for the development at the two ports.

(4) Each port will play its respective role and should function to complement each other. In principle, Karachi port will mainly deal with general cargo and bulk cargoes, while Qasim port will mainly handle bulk cargo and cargoes associated with the local industries. However, exceptional assignment of several cargoes such as oil and container cargoes could take place as long as item (3) mentioned above is satisfied as discussed in detail in section 7.9.

(5) Encouragement of private sector participation in the port development and operation.

7.10.3 Proposed Projects

(1) Cargo Forecast

According to the forecast of seaborne cargo throughput in Section 7.9.6, the projected cargoes in 1997-98 are classified into general cargo, bulk cargo, iron ore and coal, and liquid bulk cargo, and then allocated to the ports of Karachi and Qasim. The results of cargo classification and allocation of cargo at each port are shown in Table 7.10.3.1.

Table 7.10.3.1 Cargo Classification and Allocation at Each Port in 1997-98

Commodities		Karachi Port		Qasim Port	
	'000 tons	(Berth)	'000 tons	(Berth)	'000 tons
Dry Cargo					
Wheat	2,852	General Cargo Berth	1,492	Dry Bulk Cargo Berth	1,880
Sugar	67	Dry Bulk Cargo Berth	3,134	Wheat Berth	2,852
Cement	307	Container Berth	6,304	Container Berth	1,500
Fertilizer	1,659	(630,000 TEU)		(150,000 TEU)	
Iron/Steel	857			Iron Ore & Coal Berth	2,969
Minerals (Ore)	2,168				
Coal/Coak	801				
Rock Phosphate	309				
Rice	1,555				
Cotton	521				
Miscellaneous	9,036				
Sub-total	20,132	Sub-total	10,930	Sub-total	9,201
Liquid Cargo					
Edible Oil	1,980	Oil Berth	11,632	Oil Berth	4,500
Crude Oil	2,155			Liquid Berth	1,286
Petroleum Products	12,047				
Molasses	1,236				
Sub-total	17,418	Sub-total	11,632	Sub-total	5,786
Grand Total	37,550	Total	22,562	Total	14,987

Source: JICA Study Team

(2) Berth Requirement

The required scale under the Eighth Five Year Plan must be in accordance with the volume of cargoes to be handled. Thus the number of necessary berths is calculated using the same method explained in Section 7.9 of the Master Plan.

1) Karachi Por

Berth requirement for each type of cargo at Karachi port is examined in the following four sections to cope with the demand forecasted.

a. Conventional Berths (General Cargo)

The required number of general cargo berths is calculated based on the procedures shown in Table 7.10.3.2.

Table 7.10.3.2 Calculation of Required Number of General Cargo Berths

	Item		Unit	Calculation	General Cargo
a.	Cargo Volume Handled		'000 tons		1,492
b.	Average Cargo-Volume Handled		tons/vessel		5,000
c.	Number of Vessel Calls		calls/year	a/b	298.4
d.	Cargo-Handling Productivity		tons/hour		30
e.	Total Berthing Hours		hours/year	b/d x c	49,733
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	10			71.8
		11			65.2
		12			59.8
h.	Average Berth Wating Time		hours/vessel	(11 berths)	7.5

Source: JICA Study Team

Eleven (11) berths are required, which is deemed reasonable judging from the berth occupancy rate of 65.2% shown in the Table.

b. Conventional Berths (Dry Bulk Cargo)

The required number of dry cargo berths is calculated according to the procedures as shown in Table 7.10.3.3.

Table 7.10.3.3 Calculation of Required Number of Dry Cargo Berths

	Item		Unit	Calculation	Dry Bulk Cargo
a.	Cargo Volume Handled		'000 tons		3,134
b.	Average Cargo-Volume Handled		tons/vessel		18,000
c.	Number of Vessel Calls		calls/year	a/b	174.1
d.	Cargo-Handling Productivity		tons/hour		256
e.	Total Berthing Hours		hours/year	b/d x c	12,242
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	2			88.3
		3			58.9
		4			44.2
h.	Average Berth Wating Time		hours/vessel	(3 berths)	16.4

Source: JICA Study Team

Three (3) berths are required, which is deemed reasonable judging from the berth occupancy rate of 58.9% shown in the Table.

c. Container Cargo Berths

The required number of container cargo berths is calculated according to the procedures as shown in Table 7.10.3.4.

Table 7.10.3.4 Calculation of Required Number of Container Cargo Berths

	Item		Unit	Calculation	Container Cargo
a.	Cargo Volume Handled		'000 tons		6,304
a'.	Number of Containers		'000 TEUs		630
b.	Average Cargo-Volume Handled		TEUs/vessel		700
c.	Number of Vessel Calls		calls/year	a'/b	900.0
d.	Cargo-handling Productivity		TEUs/hour		31
e.	Total Berthing Hours		hours/year	b/d x c	20,323
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	4			73.3
		5			58.7
		6			48.9
h.	Average Berth Wating Time		hours/vessel	(5 berths)	5.9

Source: JICA Study Team

Five (5) berths are required, which is deemed reasonable judging from the berth occupancy rate of 58.7% shown in the Table.

d. Liquid Bulk Cargo Berths

The required number of Liquid bulk cargo berths is calculated according to the procedures as shown in Table 7.10.3.5.

Table 7.10.3.5 Calculation of Required Number of Liquid Cargo Berths

	Item		Unit	Calculation	Liquid Bulk Cargo
a.	Volume Cargo Handled		'000 tons		11,632
b.	Average Cargo-Handled Volume		tons/vessel		32,000
c.	Number of Vessel Calls		calls/year	a/b	363.5
d.	Cargo-handling Productivity		tons/hour		1250
e.	Total Berthing Hours		hours/year	b/d x c	9,306
f.	Aveailable Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	3			44.8
h.	Average Berth Wating Time		hours/vessel	(3 berths)	3.1

Source: JICA Study Team

Three (3) liquid cargo berths are required, based on the berth occupancy rate of 44.8%.

2) Qasim Port

Berth requirement for each type of cargo at Qasim port is examined in the following six sections for the port to cope with the demand forecasted.

a. Multi-Purpose Berth (Dry Bulk Cargo)

The required number of dry bulk cargo berths is calculated based on the procedures outlined in Table 7.10.3.6.

Table 7.10.3.6 Calculation of Required Number of Dry Bulk Cargo Berths

	Item		Unit	Calculation	Dry Bulk Cargo
a.	Cargo Volume Handled		'000 tons		1,880
b.	Average Cargo-Volume Handled		tons/vessel		14,000
c.	Number of Vessel Calls		calls/year	a/b	134.3
d.	Cargo-Handling Productivity		tons/hour		256
e.	Total Berthing Hours		hours/year	b/d x c	7,344
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	1			106.0
		2			53.0
		3			35.3
h.	Average Berth Wating Time		hours/vessel	(2 berths)	22.0

Source: JICA Study Team

Two (2) berths are required, which is deemed reasonable judging from the berth occupancy rate of 53.0% shown in the Table.

b. Multi-Purpose Berth (Wheat)

The required number of wheat-handling berths is calculated according to the procedures as shown in Table 7.10.3.7.

Table 7.10.3.7 Calculation of Required Number of Wheat-handling Berths

	Item		Unit	Calculation	Wheat
a.	Cargo Volume Handled		'000 tons		2,852
b.	Average Cargo-Volume Handled		tons/vessel		25,000
c.	Number of Vessel Calls		calls/year	a/b	114.1
d.	Cargo-handling Productivity		tons/hour		400
e.	Total Berthing Hours		hours/year	b/d x c	7,130
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	1			102.9
		2			51.4
		3			34.3
h.	Average Berth Wating Time		hours/vessel	(2 berths)	19.5

Source: JICA Study Team

Two (2) wheat handling berths are required, based on the berth occupancy rate of 51.4% shown in the table.

c. Container Cargo Berths

The required number of container cargo berths is calculated according to the procedures outlined in Table 7.10.3.8.

Table 7.10.3.8 Calculation of Required Number of Container Cargo Berths

	Item		Unit	Calculation	Container Cargo
a.	Cargo Volume Handled		'000 tons		1,500
a'.	Number of Containers		'000 TEUs		150
b.	Average Cargo-Volume Handled		TEUs/vessel		700
c.	Number of Vessel Calls		calls/year	a'/b	214.3
d.	Cargo-Handling Productivity		TEUs/hour		19
e.	Total Berthing Hours		hours/year	b/d x c	7,895
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	1			113.9
		2			57.0
		3			38.0
h.	Average Berth Wating Time		hours/vessel	(2 berths)	19.7

Source: JICA Study Team

Two (2) container cargo berths are required, using the berth occupancy rate of 57.0%.

d. Petroleum Products Berth

The required number of petroleum products berth is calculated based on the procedures in Table 7.10.3.9.

Table 7.10.3.9 Calculation of Required Number of Petroleum Products Berth

	Item		Unit	Calculation	Petroleum Products
a.	Cargo Volume Handled		'000 tons		4,500
b.	Average Cargo-Volume Handled		tons/vessel		32,000
c.	Number of Vessel Calls		calls/year	a/b	140.6
d.	Cargo-Handling Productivity		tons/hour		1000
e.	Total Berthing Hours		hours/year	b/d x c	4,500
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	1			64.9
		2			32.5
		3			21.6
h.	Average Berth Wating Time		hours/vessel	(1 berth)	49.4

Source: JICA Study Team

One (1) berth is required to handle petroleum products, based on the berth occupancy rate of 64.9% shown in the Table.

e. Edible Oil Berth

The required number of berth for edible oil is computed according to the procedures outlined in Table 7.10.3.10.

Table 7.10.3.10 Calculation of Required Number of Berth for Edible Oil

	Item		Unit	Calculation	Edible Oil
a.	Cargo Volume Handled		'000 tons		1,286
b.	Average Cargo-Volume Handled		tons/vessel		23,000
c.	Number of Vessel Calls		calls/year	a/b	55.9
d.	Cargo-Handling Productivity		tons/hour		400
e.	Total Berthing Hours		hours/year	b/d x c	3,215
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	1			46.4
		2			23.2
		3			15.5
h.	Average Berth Wating Time		hours/vessel	(1 berth)	38.9

Source: JICA Study Team

One (1) berth for edible oild using the assumption of the berth occupancy rate of 46.4%.

f. Iron Ore and Coal Berth

The required number of iron ore and coal berths is calculated according to the procedures as shown in Table 7.10.3.11.

Table 7.10.3.11 Calculation of Required Number of Berth for Iron Ore and Coal

	Item		Unit	Calculation	Iron Ore & Coal
a.	Cargo Volume Handled		'000 tons		2,969
b.	Average Cargo-Volume Handled		tons/vessel		45,000
c.	Number of Vessel Calls		calls/year	a/b	66.0
d.	Cargo-Handling Productivity		tons/hour		768
e.	Total Berthing Hours		hours/year	b/d x c	3,866
f.	Available Hours for Using Berths		hours/year	21 hr. x 330 days	6,930
g.	Berth Occupancy		%	e/(f x B)	
	B (Number of Berths):	1			55.8
		2			27.9
		3			18.6
h.	Average Berth Wating Time		hours/vessel	(1 berth)	68.0

Source: JICA Study Team

One (1) berth for iron ore and coal is required, using the berth occupancy rate of 55.8%.

Calculation results are summarized in Table 7.10.3.12.

Table 7.10.3.12 Required Berthing Facilities (Eighth Five Year Plan)

Port	Cargoes		Existing Berths			Required Berths						
	Commodities	Volume '000 tons	Name of Berth	No. of Berths	Length (m)	Name of Berth	Exist -ing	New/ Convert	Total	Length (m)	Quay Depth(m)	Ave.Ship Size(DWT)
Karachi												
	General Cargo	1,492	Nos. 1- 5	5	773.88	General Cargo	11	0	11	1,430.00	- 8.5 - -9.1	5,000
			Nos. 6-17	12	1,870.66							
	Dry Bulk	3,134	Nos.18-24	7	1,257.30	Dry Bulk	3	0	3	570.00	- 9.8 - - 10.4	18,000
			Nos.25-28	4	638.86							
	Container	6,304				Container	-	5	5	1,500.00	-12.0	23,000
			Subtotal	28	4,540.70	Subtotal	14	5	19	3,500.00		
	Mineral/ Vegetable Oil	11,632	Nos. I- V	3		Mineral/ Vegetable Oil	3	0	3		-13.4	32,000
	Total	22,562		31		Total			22			
Qasim			(Multi-purpose Terminal)			(Multi-purpose Terminal)						
	Container	1,500	Nos. 1- 4	4	800.00	Container	-	2	2	600.00	-12.0	23,000
	Dry Bulk	1,880	Nos. 5- 7	3	600.00	Dry Bulk	2	0	2	400.00	-10.0	14,000
	Wheat	2,852				Wheat	2	0	2	400.00	-10.0	25,000
			Subtotal	7	1,400.00	Subtotal	4	2	6	1,400.00		
	Mineral Oil	4,500				Mineral Oil	0	1	1		-12.0	32,000
	Vegetable Oil	1286				Vegetable Oil	0	1	1		-10.0	23,000
						Subtotal	0	2	2			
	Iron Ore & Coal	2,969	Iron Ore & Coal	1		Iron Ore & Coal	1	0	1		-12.0	45,000
	Total	14,987	Total	8		Total	5	4	9			

(3) Evaluation of Candidate Projects

1) Container Terminal at the Ports of Karachi and Qasim

As mentioned above, a total of seven berths (five berths at Karachi port and two berths at Qasim port) are required. At present, both ports have been proceeding with container terminal development (four berths at Karachi port and two berths at Qasim port) through private sector participation under the Build-Operate and Transfer scheme. Therefore, the remaining one berth at Karachi port should be constructed during the Eighth Five Year Plan to ensure that the port becomes a full-scale container terminal.

2) Feasibility Study on Modernization of Karachi Port

Karachi port is proceeding with the conversion of existing wharves to container berths, despite the fact that a feasibility study was not never carried out. Therefore, it is necessary to conduct the feasibility study in the early stage.

3) Oil Berth at the Two Ports of Karachi and Qasim

Oil Pier No. V at Karachi port has been completed and oil handling has commenced, while new oil berth at Qasim port is still under construction and expected to start in December 1994. In addition, at present, Qasim port is planned to have a new liquid berth for edible oil through private sector participation, while additional storage tanks are under construction immediately behind the berths. Therefore the new berth planning will be reviewed including actual tonnage and operation of the terminal before the construction period.

4) Deepening of Navigation Channel for 75,000 DWT ships

In view of the forthcoming oil terminal project and the feasibility study "Project of Deepening and Widening of the Navigation Channel for Passage of 75,000 DWT Ships" has been initiated. This will be followed by appointment of consultants for detailed design and preparation of tender. PQA places a high priority in completing the projects.

5)Reconstruction of Berth No's.5 to 8 at East Wharves

Berth No's.5 to 8 had serious settlement problems due to inherent design defect; quay wall of Berth No.5 collapsed in January 1993. Project should be completed in the early stage of the Eighth Five Year Plan period.

6) Bulk Water Supply to Industrial Area at Qasim Port

This project is under implementation (ongoing) and is scheduled to be completed by the end of December 1994.

7) Computerization at the Two Ports of Karachi and Qasim

In order to establish a central on-line computerized data bank with interlinks to port users and associated organizations, project should be completed in the early stage of the Eighth Five Year Plan period.

The results of the above preliminary evaluation of the candidate projects and cost are summarized in Table 7.10.3.13, and the costs for each project are assumed based on the past studies and are quoted from the report of the Government working group which is the same as in the Master Plan.

An investment schedule for the selected projects is proposed as shown in Table 7.10.3.14. The priority of each project is based on the judgment of the Study Team.

Table 7.10.3.13 List of Port Projects for Eighth Five Year Plan

(Rs. in million)

	Name of Project (No. of Berths)	Project Cost	Remarks
Karachi Port			
	Jinnah Bridge Phase-II *	796	
	Bucket Dredger & Ancillary Craft*	552	
	Oil Terminal OP-V*	530	
	Reconstruction of Berths No.5-8	1,800	
	Container Terminal (5 berths)	4,704	Private Sector
	Feasiblity Study on Container Terminal	33	
	Modern Warehousing Complex	160	Private Sector
	VSP Tugs, Pilot Boats and Storage Area	200	Private Sector
	Computerization	15	
	Sub total	8,790	
Qasim Port			
	Phase-I *	324	
	Deepening of Navigation Channel for 75000 DWT ships	765	
	Oil Terminal *	2,500	Private Sector
	Container Terminal (2 berths)	1,568	Private Sector
	Bulk Water Supply to Industrial Area	390	
	New Liquid Berth	200	Private Sector
	Computerization	10	
	Sub total	5,757	
Others			
	Other Projects	25	
	Sub total	25	
	Gand Total	14,572	

Source: JICA Study Team

Note: * is ongoing project

Table 7.10.3.14 Investment Schedule for Eighth Five Year Plan

(Rs. in million)

Name of Projects	Toal Estimated Cost	Yearly Allocation					Ranking
		1993/94	1994/95	1995/96	1996/97	1997/98	
Jinah Bridg Phase-II*	796	200	200	200	196		A
Bucket Dredger & Ancillary Craft*	552	492	60				A
Phase-I*	324		81	81	81	81	A
Oil Terminal OP-V (KPT)*	530	265	265				A
Oil Terminal (PQA)*	2,500	800	800				A
Conainer Terinal (KPT)	4,704			568	2,136	2,000	A
Conainer Terinal (PQA)	1,568				568	1,000	A
Reconstrucion of Berth No.5-8	1,800		300	500	500	500	A
Deepening of Navigation Channel	765				380	385	B
Feasiblity Study on Container Terminal	33		20	13			A
New Liquid Berth	200				100	100	A
VSP Tug, Pilot Boats and Storage Area	200		50	50	50	50	B
Modern Warehousing Complex	160		40	40	40	40	B
Bulk Water Supply to Industrial Area	390		90	100	100	100	A
Computerization (KPT)	15		5	10			A
Computerization (PQA)	10		3	7			A
Total	14,547	1,757	1,914	1,569	4,151	4,256	

Source: JICA Study Team
Note: * is ongoing project

(4) Economic Assessment

In order to confirm the viability of the major proposed projects for the Eighth Five Year Plan, a rough cost-benefit analysis is conducted from the national economic point of view. The scope of the project for economic analysis consist of the following.

- Container terminals (five berths at Karachi port and two berths at Qasim port) are constructed.
- A liquid (edible oil) berth is constructed at Qasim port.

The period of analysis is 1993-94 to 2005-06.

1) "With" and "Without" Cases

A cost-benefit analysis is conducted on the difference between the "With" and "Without" investment cases in order to clearly identify the incremental benefits and costs of the project.

In case of the container terminals, the "With" case assumes that the conversion of Multi-purpose berth at Qasim port will be completed by 1997-98 and the container terminals at Karachi port will be constructed by 1997-1998. The "Without" case assumes that neither project will be realized by 1997-98 and, just after that time, some measures to cope with the increase in number of containers will be undertaken. As for the "With" case the liquid berth, a new berth will be built at Qasim port by 1997-98. The "Without" project case assumptions are the same as those for the "with container project."

Future cargo volumes under all cases are assumed to equal to those forecast in Section 7.9 of the Master Plan. After 1997-98, the volumes under the "With" and "Without" cases are assumed to remain constant at 1997-98 level.

2) Benefits

The following items are counted as benefits of the investment.

a. Savings in waiting time of container ships and edible oil carriers; this is calculated by means of queuing theory.

b. Savings in cargo handling time and cost; this benefit assumes that improvement in cargo handling efficiency is related to the reduction in ship berthing time, and the savings in the

cargo handling cost is counted by its unit savings per ton for a container berth.

In addition, no residual values of the facilities and equipment are assumed under the "With" project case at the end of the final year of calculation, i.e. 2005-06, and no rehabilitation cost of berths for the "Without" case are taken into consideration.

3) Cost

The following cost items are taken into consideration;

a. Construction costs for the "With" project case; the construction costs for newly developed container terminals and liquid berth at ports of Karachi and Qasim are counted based on the cost estimates made in Section 7.10.3.

b. Maintenance and Operation costs of the "With" project case; The maintenance and operation costs for projects are assumed based on the data obtained from the ports.

4) Economic Internal Rates of Return

The result of the cost-benefit analysis expressed in terms of the economic internal rate of return (EIRR) is summarized in Table 7.10.3.15.

The benefit/cost ratio was calculated at 1.21 based on a discount rate of 12% per year. The EIRR is 18.0% for the overall project, which is far higher than the opportunity cost of about 12%. Thus, the project is considered to be economically feasible.

Table 7.10.3.15 Economic Evaluation of Port Projects

Year		Cost	Benefit	Cost	Benefit
1993 /	1994	0	0	0	0
1994 /	1995	0	0	0	0
1995 /	1996	506	0	506	0
1996 /	1997	2,498	167	2,117	141
1997 /	1998	3,003	1,363	2,156	979
1998 /	1999	201	1,363	122	829
1999 /	2000	201	1,363	103	703
2000 /	2001	201	1,363	88	596
2001 /	2002	201	1,363	74	505
2002 /	2003	201	1,363	63	428
2003 /	2004	201	1,363	53	362
2004 /	2005	201	1,363	45	307
2005 /	2006	-1,140	1,363	-217	260
Total		6,272	12,436	5,110	5,110

Net Present Value: 908 (million Rs)
B/C Ratio at a Discount Rate of 12 % / year: 1.21
Internal Rate of Return: 18.0 % / year