IV. TRAFFIC DEMAND FORECAST

IV. TRAFFIC DEMAND FORECAST

1. Outline

1-1 Objectives

The objectives of the traffic demand forecast are:

1) To analyze the existing traffic demand, showing the time-series trend, modal split and the existing problems.

2) To project the traffic demand in the year 1987/88 and 1999/00, showing the gaps between demand and supply, which will be adopted to project-identification in the latter chapter.

1-2 Frame work

The framework for the work is shown in Fig. 1-2-1. The work shall comprise of three steps, as here-under:

Step 1. Preliminary Study.

Step 2. Macroscopic Traffic Demand.

Step 3. Microscopic Traffic Demand.

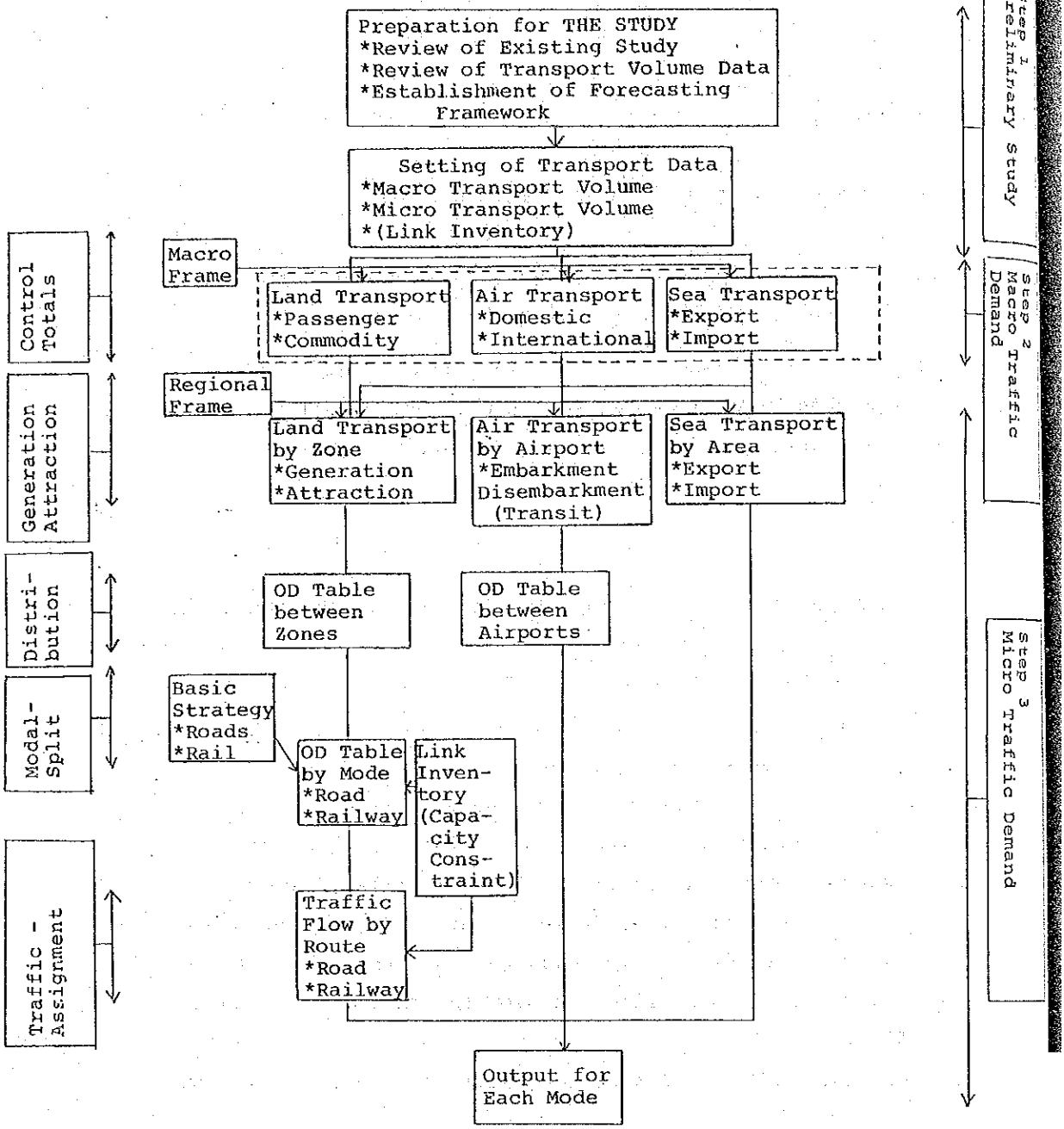
In Step 1, the review of the existing studies, field survey, data collection of the traffic volume and computer input will be included. Based on the macro-economic framework as shown in III-1, national total of traffic volume will be projected in Step 2. In Step 3, the traffic demand by origin-destination will be projected, based on the regional framework as shown in III-2, and on the data of link inventory as shown in II-3.

The characteristics of the projection frame are summarized below.

1) Road and Railway Transport are handled simultaneously as a land transport, applying the so-called four-step estimation method.

2) Air and Sea Transport are handled independently from the land transport. It should be, however, mentioned that air transport will be compared with the land transport for major routes and imports/exports will be considered as generation/attraction at Karachi zone.

Fig. 1-2-1 Framework for Traffic Demand Forecast



1-3 Scope

(1) Target Year

1987/88 and 1999/2000 were set to the target year for projection.

(2) Zoning

1) Land Traffic

Zoning was determined, mainly based on districts consisting of 46 domestic and 5 international base zones through discussion with the relevant persons. Tribal areas and close related districts were aggregated, particularly in Baluchistan and NWFP. Table 1-3-1 and Fig. 1-3-1 show the zoning together with zone centres, comprising the district centres in each zone.

Base zone is also aggregated to middle zone, consisting of 23 zones (18 domestic zones), which would be used for presentation of the desire lines.

2) Sea Traffic

Seaborne trade at KPT and PQA was projected, and distributed to 7 international areas.

3) Air Traffic

Air traffic was analyzed through 21 airports in Pakistan and 4 international areas.

(3) Types of Transport

Both passenger and freight transports were processed in traffic demand forecast.

The commodities were classified for land (road/railway) transport as shown in Table 1-3-2, in consistent with those for macro and regional frame. As for the projection of sea traffic, aggregation of commodities was done, if necessary.

The passengers were classified into two categories, as the following:

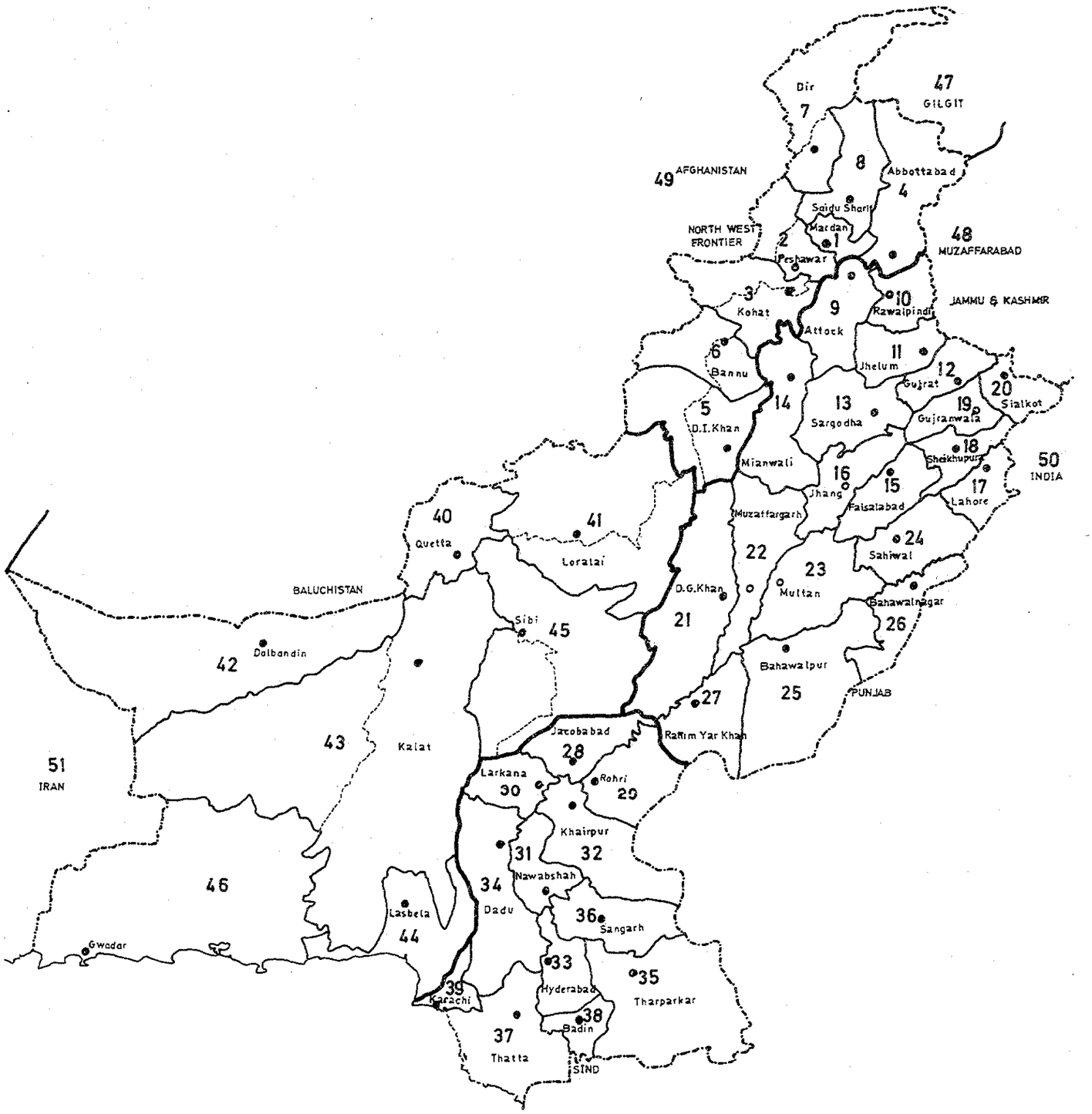
Table 1-3-1 List of Districts (as abridged for Zoning)

Zone No.	N W F P	District Code
	PESHAWAR DIVISION	
1.	Mardan	111
2.	* Peshawar	112
	Khyber Agency	712
	Bajour & Mohammad	744
3.	* Kohat	113
	Khurrum	713
	HAZARA DIVISION	
4.	* Abbottabad	121
	Mansehra	122
	Kohistan	123
	D. I. KHAN DIVISION	
5.	* D.I.Khan	131
	South Waziristan	731
6.	* Bannu	132
	North Waziristan	732
	MALAKAND DIVISION	
7.	* Dir	141
	Chitral	142
8.	* Swat(Saidu Sharif)	143
	Malakand	144
	PUNJAB	
	RAWALPINDI DIVISION	
9.	Attock	211
10.	Rawalpindi	212
11.	Jhelum	213
12.	Gujrat	214
	SARGODHA DIVISION	
13.	Sargodha	221
14.	Mianwali	222
15.	Faisalabad	223
16.	Jhang	224
	LAHORE DIVISION	
17.	* Lahore	231
	Kasur	235
18.	Sheikhupura	233
19.	Gujranwala	232
20.	Sialkot	234
	MULTAN DIVISION	
21.	D.G. Khan	241
22.	Muzaffargarh	242
23.	* Multan	243
	Vehari	245
24.	Sahiwal	244
	BAHAWALPUR DIVISION	
25.	Bahawalpur	251
26.	Bahawalnagar	252
27.	Rahim Yar Khan	253

Zone No.	S I N D	District Code.
	KHAIRPUR DIVISION	
28.	Jacobabad	311
	*Shikarpur	316
29.	Sukkur (Rohri)	312
30.	Larkana	313
31.	Nawabshah	314
32.	Kahrpur	315
	HYDERABAD DIVISION	
33.	Hyderabad	321
34.	Dadu	322
35.	Tharparkar (Umar Kot)	323
36.	Sangarh	324
37.	Thatta	325
38.	Badin	326
	KARACHI	
39.	Karachi	331
	BALUCHISTAN	
	QUETTA DIVISION	
40.	*Quetta	411
	Pishin	412
41.	*Loralai	413
	Zhob	414
42.	Chaghai	415
	KALAT DIVISION	
43.	*Kalat	421
	Kharan	422
44.	Lasbela	423
	SIBI DIVISION	
45.	Naseerabad	431
	*Sibi	432
	Kachhi	433
	Kohlu	434
	Jhuzdar	435
	MEKRAN DIVISION	
46.	Panjgur	441
	Turbat	442
	*Gwadar	443
	NORTHERN AREAS	
47.	Gilgit	501
	Skardu	502
	Diamer	503
	AZAD KASHMIR	
48.	Muzaffarabad	601
	Mirpur	602
	Rawalakot	603
	Kotli	604
	OTHER COUNTRIES	
49.	Afghanistan	
50.	India	
51.	Iran	

Note: District Centres are selected as zone centres, in principle.
"*" Shows zone centre in case of plural districts in one zone.
Source: JICA Study Team, in consultation with counterpart.

Fig. 1-3-1 Map of Zone for Pakistan Transport Study



Source: JICA Study Team, in consultation with counterpart.

Table 1-3-2 Commodity Classification

Road			Rail			
Code	Name	Old code	Code	Name	Old code	Code (year book)
1.	Wheat	110	1	Wheat	8	36
2.	Rice	120	2	Rice	5	26
3.	Cotton	160	3	Cotton	17	6
4.	Edible Oil	250,260	4	Edible Oil	34,54	21+
5.	Sugar	270	5	Sugar	13	32
6.	Cement	510	6	Cement	20	2
7.	Fertilizer	520	7	Fertilizer	26	3
8.	Iron & Steel	670,680	8	Iron & Steel	28,29,30	12,13, 14
9.	Mining	810~895	9	Mining	10,11,12, 15,56	31,1,10,23
10.	Coal & coke	910	10	Coal & coke	1	4
11.	Petroleum	930~970	11	Petroleum	2,3,18,19, 50,51	21,28, 29+
12.	Firewood	990	12	Firewood	4	7
13.	Sugarcane	150	13	Rock Phos-phate	49	-
14.	Fruits & vegetable	220,230,240, 280,290	14	Railway Materials	39,40,41,42, 43,44,45	25+
15.	Livestock	310	15	Railway Oil	59,60	5-
16.	Others		16	Others	Others	Others
17	Sum		17	Sum		

Notes: (1) Old code for road represents code for Road OD Survey (NTRC),

(2) Old code for rail represents code for Railway commodity OD (PR).

Source: JICA Study Team, in consultation with counterpart.

Category	Road	Railway
1. Lower Class	Bus	First Sitter/ 2nd Class
2. Upper Class	Mini Bus/ Wagon/Car/ Jeep/Taxi	ACC/First Sleeper

As for air transport, no detailed classification was tried in passenger or freight.

(4) Modes of Transport

Modes of Transport processed in traffic demand forecast are as the following;

1) Land: Both road and railway, considering the petroleum transport with pipeline.
2) Sea: Port and shipping
3) Air: Airport and aviation.

(5) Cases

Based on the macro and regional frame, projection was done, in principle, for one case excepting the following;

1) Modal split between road and railway: Case A (based on the past trend) and Case B (based on the strategic modal split as shown in Chapter VII).
2) Passenger traffic at major airports: Standard growth case and high growth case.

1-4 Preliminary Study

Availability of the Traffic Data

Before collection of the following data, reviews of the various important studies conducted in the past have been carefully made.

The following data were collected from the relevant organization and compiled for projection.

1) Road:
   - Road OD Survey (Round-I & Round-II),
   - Traffic Volume (Round-I & Round-II),
   - Traffic Counts (1975-80),
   - Location of Traffic Counts Stations,
   - Network Data for Trunk Routes.

2) Railway:
   - Pakistan Railways Yearbook of Information (1970/71-1980/81),
   - Commodity OD between Stations (July 1980 and January 1981),
   - Station-wise, Number of Passengers by Classes (1975/76),
   - The Number of Tickets Sold at the Major Stations (January, 1981),
   - Correspondent Tables between Stations & Districts.

3) Sea:
   - KPT Statistics (1970/71-1980/81),
   - Pakistan's Foreign Trade by Area/Country,
   - Foreign Trade Statistics (1981).

4) Air:
   - Civil Aviation Statistics Handbook (1976, 1980)
   - PIA Passenger OD (1972/73-1980/81),
   - PIA Freight OD (1972/73-1980/81),
   - ICAO Statistics (1978-1980).

From the processing of the traffic data, it was found that the following items should be improved in terms of the comprehensive transport planning.

1) The national totals of road traffic were missing for the years after 1975 and it was necessary to estimate with traffic count data. It is recommended that the regular survey on road traffic should be carried out and kept as the statistics.

2) Railway passenger OD data were missing. It was, therefore, needed to collect the data for tickets sold by destination at major stations together with station-wise number of passengers by classes. Similarly, bus passenger OD data were incomplete. It is, therefore, recommended that the periodic passenger OD surveys for railway and bus should be carried out.

3) The Road OD Survey data were very useful for this study but they could not deal with the seasonal fluctuation. Improving this point, road OD survey should be carried out by several years.

4) There are, in general, two types of OD surveys. One is called "Net Flow" and deals with passenger & commodity flows themselves. The other is called "Gross Flow" and deals with the flows in terms of transport modes. The latter was adopted for this study, and the former survey should be carried out for more precise projections.

5) There are data for seaborne trade by commodity or by area, but no data by commodity and by area, except PNSC. Such data are indispensable for planning of shipping.

6) International passenger OD data are available for PIA, but not for foreign fleets. It was, therefore, necessary to compile ICAO statistics, but they are only sample surveys and it is recommended that such surveys should be carried out.

7) Traffic demand forecast for the comprehensive transport planning needs to process vast data, and it is recommended that such data should be compiled in a computer system and maintained periodically.

2. Macroscopic Traffic Demand Forecasting

2-1 General

This section presents a set of macroscopic traffic demand projections. The projections have been done mainly using by regression model. The results of this projections will be passed on Microscopic Traffic Demand Projections to be used by control total. The reference mode, data and periods are as follows;

(1) Reference Mode and Data

1) Land Traffic
   Passenger kilometers
   Tonne kilometers

2) Port Traffic (International)
   Cargoes handled at the ports by commodity
   Passengers handled at the port

3) Air Traffic
   International passengers handled at all airports
   International cargoes handled at all airports
   Domestic passenger kilometers
   Domestic tonne kilometers

(2) Reference Periods

Reference periods for past trends are mainly from 1971-72 to 1980-81 due to the limited data and to grasp the recent traffic situation, and the target year are 1982-83, 1987-88 and 1999-2000.

2-2 Historical Traffic Trends

(1) Land Traffic

1) Passenger

The historical trend of domestic passenger traffic is shown in Table 2-2-1. During the past 10 years, total passenger traffic increased at the rate of 6.8% per annum. Over the same period, population increased at the rate of 3.1% per annum. The population elasticity of passenger traffic was 2.19.

The relative share of passenger kilometers carried by railway was almost constant about 20% as against a little under 80% in road traffic.

With regard to railway traffic, the data on number of passengers carried which are shown in Table 2-2-2 are obtained from Pakistan Railways. The number of passengers carried by railway is almost constant during the past 10 years and an average kilometers travelled by a passenger increased from 76.7 KM in 1971-72 to 132.4 KM in 1980-81.

2) Cargo

The historical trend of domestic cargo traffic is shown in Table 2-2-3. During the past 10 years, total cargo traffic increased at the rate of 5.7% per annum. Over the same period, GDP increased at the rate of 5.5% per annum. The GDP elasticity of cargo traffic was 1.04.

The relative share of cargo traffic carried by railway declined from 49.1% in 1971-72 to 30.3% in 1980-81 as against road traffic which increased from 50.9% in 1971-72 to 69.6% in 1980-81.

Tonnes carried by railway showed a peak in 1975-76 when it reached 15 million tonnes and it was dropped only 11 million tonnes in 1980-81, while no significant trends are visible in terms of Tonnes-km. As a result, average kilometers travelled by a tonne carried by railway during the past 10 years showed fluctuations. (See Table 2-2-2)

Table 2-2-4 shows relative share of selected commodities carried by railway. Increased share of commodities from 1971-72 to 1980-81 are remarkable in fertilizers, railway materials and petroleum.

Table 2-2-1 Trends of Domestic Passenger Traffic

Year	Volume (Million KM)				Share (%)			
	Railway	Road	Air	Total	Railway	Road	Air	Total
1971-72	9515	36520	300	46335	20.5	78.8	0.6	100.0
1972-73	11069	40577	325	51971	21.3	78.1	0.6	100.0
1973-74	11694	45973	449	58116	20.1	79.1	0.8	100.0
1974-75	12354	49860	559	62773	19.7	79.4	0.9	100.0
1975-76	12957	49285	692	62934	20.6	78.3	1.1	100.0
1976-77	13199	51765	849	65813	20.1	78.7	1.3	100.0
1977-78	15375	54665	1026	71068	21.6	76.9	1.4	100.0
1978-79	16713	57219	1093	75025	22.3	76.3	1.5	100.0
1979-80	17316	61035	1142	79493	21.8	76.8	1.4	100.0
1980-81	16311	65991	1205	83507	19.5	79.0	1.4	100.0
Annual growth rate(%)								
1972-81	6.2	6.8	16.7	6.8				

Source: for railway; Pakistan Railways Year Book of Information
for road; The Fifth Plan 1978-83
NTRC and JICA Study Team Estimate
for air; PIA

Table 2-2-2 Trends of Railways Traffic

Year	Passengers Carried (1000)	Passengers -KM (1000)	Per Capita: Carried (Person)	Per Capita: Passengers -KM	Average No. of kilometers travelled by a passenger
1971-72	124048	9514710	1.95	149.9	76.7
1972-73	136009	11068762	2.08	169.5	81.4
1973-74	140889	11693801	2.09	173.5	83.0
1974-75	143277	12354205	2.06	177.7	86.2
1975-76	147317	12956673	2.05	180.6	88.0
1976-77	142561	13198799	1.91	176.7	92.6
1977-78	149000	15375132	1.95	201.4	103.2
1978-79	145998	16712790	1.85	212.3	114.5
1979-80	143674	17316452	1.77	213.2	120.5
1980-81	123202	16311129	1.47	194.7	132.4

	Tonnes Carried (1000)	Tonnes-km (1000)	Per Capita: Carried (Tonne)	Per Capita: Tonnes-km	Average kilometers travelled by a tonne
1971-72	12862	7756412	0.203	122.2	605.8
1972-73	12520	8362625	0.192	128.0	671.9
1973-74	11501	7376918	0.171	109.5	644.7
1974-75	14148	8543648	0.203	122.9	608.1
1975-76	15313	9096751	0.213	126.8	602.5
1976-77	14368	7856662	0.192	105.2	552.8
1977-78	13344	8557171	0.175	112.1	646.5
1978-79	11958	9374700	0.152	119.1	791.7
1979-80	11853	8598473	0.146	105.9	733.1
1980-81	11371	7917738	0.136	94.5	704.9

Source: Pakistan Railways Year Book of Information

Table 2-2-3 Trends of Domestic Cargo Traffic

Year	Volume (Million KM)				Share (%)			
	Railway	Road	Air	Total	Railway	Road	Air	Total
1971-72	7756	8047	5.00	15808	49.1	50.9	0.0	100.0
1972-73	8363	8940	5.80	17303	48.3	51.7	0.0	100.0
1973-74	7370	10129	10.15	17499	42.1	57.9	0.1	100.0
1974-75	8544	11001	10.90	19545	43.7	56.3	0.1	100.0
1975-76	9097	10327	11.39	19435	46.8	53.1	0.1	100.0
1976-77	7857	11438	14.80	19310	40.7	59.2	0.1	100.0
1977-78	8557	12319	13.80	20890	41.0	59.0	0.1	100.0
1978-79	9375	14904	15.30	24294	38.6	61.3	0.1	100.0
1979-80	8598	17085	14.59	25698	33.5	66.5	0.1	100.0
1980-81	7918	18207	15.73	26141	30.3	69.6	0.1	100.0
Annual growth rate(%)								
1972-81	0.2	9.5	13.6	5.7				

Source: for railway; Pakistan Railways Year Book of Information
for road; The Fifth Plan 1978-83
NTRC and JICA Study Team Estimate
for air; PIA

Table 2-2-4 Share of Selected Commodities Carried by Railways

Commodity	Carried (1000tonnes)			Share (%)		
	1971-72	1975-76	1980-81	1971-72	1975-76	1980-81
Total	12659	15313	11371	100.00	100.00	100.00
Cement	1219	1073	784	9.63	7.01	6.89
Fertilizers	571	581	1081	4.51	3.79	9.51
Coal and coke	1336	1306	1243	10.55	8.53	10.93
Fire wood	640	363	352	5.06	2.37	3.10
Railways materials	1082	4437	2159	8.55	28.97	18.99
Paddy and rice	843	809	539	6.66	5.28	4.74
Petroleum	1069	1572	1527	8.44	10.27	13.42
Salt	240	270	272	1.90	1.76	2.39
Sugar	137	173	154	1.08	1.13	1.35
Wheat	1536	1722	809	12.13	11.25	7.11
Others	3986	3007	2451	31.49	19.64	21.55

Source: Pakistan Railways Year Book of Informetion

Note: (1) Selected commodities are over 1% of total carried in 1980-81
(2) Petroleum- Including other hydro carbon oils, non-dangerous

(2) Port Traffic

1) Passenger (International)

The historical trend of passenger traffic at Karachi Port is shown in Table 2-2-5. Pilgrims traffic by sea showed a peak in 1972-73 when it reached 114 thousand persons. In 1980-81, however, it was dropped only 15 thousand persons. As for other passengers, the small changes are due to year to year fluctuations and no significant trends are visible. During the past 10 years, the average of other passenger traffic is about 32 thousand persons.

2) Cargo (International)

The historical trend of cargo traffic handled at ports is shown in Table 2-2-6. During the past 10 years, total cargo traffic handled at ports increased at a rate of 5.7% per annum. In absolute terms, the volume of dry cargo increased from 4.6 million tons in 1971-72 to 7.5 million tons in 1980-81. The liquid cargo increased from 4.4 million tons in 1971-72 to 7.5 million tons in 1980-81.

Major commodities handled at ports are wheat, rice, cotton, sugar, edible oil, cement, fertilizers, iron & steel, phosphate rock/sulpher, coal, iron ore, crude oil, petroleum products and molasses. Table 2-2-7 shows relative share of major commodities handled at ports.

(3) Air Traffic

1) International

The historical trend of international air traffic handled at all airports in Pakistan is shown in Table 2-2-8. Both of international passenger and cargo traffic by air showed high growth rate. During the past 9 years, the increase in passenger was 26.0% per annum and the increase in cargo was 22.8% per annum. It should be noted that direction-wise passenger traffic carried by PIA increased by various growth rate. Over the same period, PIA total, Middle East & Africa, Europe, Far East and India increased at the rate of 28.8%, 35.1%, 11.7%, 21.6% and 61.5% per annum respectively. As a result, the relative share of passenger traffic carried by PIA between 1972-73 and 1980-81 has been changed as follows;

	1972-73	1980-81
PIA Total	100.0%	100.0%
Middle East & Africa	46.5%	68.2%
Europe	36.0%	11.6%
Far East	15.8%	10.0%
India	1.7%	10.2%

2) Domestic

The historical trend of domestic air traffic is shown in Table 2-2-9. During the past 10 years, the increase in terms of passenger kilometers and tonne kilometers were 16.7% and 13.6% per annum respectively. However, recently 3 or 4 years, the growth rate in both passenger and cargo traffic has been dropped.

Table 2-2-5 Trends of Port Passenger Traffic

(Persons)

Year	Pilgrims	Other Passenger	Total
1971-72	24858	31852	56710
1972-73	114038	31256	145294
1973-74	76699	33322	110021
1974-75	81136	19175	100311
1975-76	36205	26066	62271
1976-77	28192	47506	75698
1977-78	28264	51490	79754
1978-79	29611	34712	64323
1979-80	29630	21457	51087
1980-81	15456	21408	36864

Source: KPT

Table 2-2-6 Trends of Seaborne Trade

(1000Tonnes)

Year	Imports			Exports			Imports + Exports		
	Dry Cargo	Liquid Cargo	Total Cargo	Dry Cargo	Liquid Cargo	Total Cargo	Dry Cargo	Liquid Cargo	Total Cargo
1971-72	2437	3588	6025	2198	813	3011	4635	4401	9036
1972-73	3357	3652	7009	2354	804	3158	5711	4456	10167
1973-74	3213	4109	7322	2278	768	3046	5491	4877	10368
1974-75	3443	4207	7650	1850	417	2267	5293	4624	9917
1975-76	3529	3962	7491	1853	502	2355	5382	4464	9846
1976-77	2987	4111	7098	1700	675	2375	4687	4786	9473
1977-78	3738	4987	8725	1625	1215	2840	5363	6202	11565
1978-79	6316	5448	11764	1741	1297	3038	8057	6745	14802
1979-80	5113	6046	11159	2096	1303	3399	7209	7349	14558
1980-81	5117	6206	11323	2359	1259	3618	7476	7465	14941
Annual growth rate(%)									
1972-81	8.6	6.3	7.3	0.8	5.0	2.1	5.5	6.0	5.7

Source: KPT
Foreign Trade Statistics of Pakistan

Table 2-2-7 Share of Major Commodities Handled at Ports

Commodity	Handled (1000tonnes)			Share (%)		
	1971 -72	1975 -76	1980 -81	1971 -72	1975 -76	1980 -81
Imports	6025	7491	11323	100.0	100.0	100.0
Dry cargo	2437	3529	5117	40.4	47.1	45.2
Wheat	715	1422	308	11.9	19.0	2.7
Sugar	62	29	74	1.0	0.4	0.7
Cement	-	-	444	-	-	3.9
Fertilizers	195	318	1294	3.2	4.2	11.4
Iron & steel	383	395	442	6.4	5.3	3.9
Phosphate rock/sulpher	19	34	191	0.3	0.5	1.7
Coal	-	-	161	-	-	1.4
Iron ore	-	-	244	-	-	2.2
Other dry cargo	1063	1331	1959	17.6	17.8	17.3
Liquid cargo	3588	3962	6206	59.6	52.9	54.8
Crude oil	3511	3694	5598	58.3	49.3	49.4
Edible oil & tallow	77	268	608	1.3	3.6	5.4
Exports	3011	2355	3618	100.0	100.0	100.0
Dry cargo	2198	1852	2359	73.0	78.6	65.2
Rice	414	783	1257	13.7	33.2	34.7
Cotton	281	121	315	9.3	5.1	8.7
Cement	540	98	-	17.9	4.2	-
Other dry cargo	963	850	787	32.0	36.1	21.8
Liquid cargo	813	503	1259	27.0	21.4	34.8
Petroleum products	623	376	994	20.9	16.0	27.5
Molasses	185	127	265	6.1	5.4	7.3

Source : KPT
Foreign Trade Statistics of Pakistan

Note: Crude Oil- including petroleum products

Table 2-2-8 Trends of International Air Traffic

Year	Passenger (Persons)						Cargo (Tonnes)
	Total	PIA					
		Total	Middle EAST	Europe	Far EAST	India	
1972-73	368694	188213	87478	67796	29794	3145	12366
1973-74	464558	245025	131975	74534	34064	4452	17152
1974-75	631764	371676	222956	100783	43142	4795	23199
1975-76	880581	513590	323017	131129	52395	7049	28043
1976-77	1191579	777398	535916	140437	62265	38780	31133
1977-78	1504678	968372	678457	149308	69141	71466	38558
1978-79	1814029	1098723	721747	152837	79711	108428	49081
1979-80	2091167	1215428	806489	156409	115633	136897	57477
1980-81	2343775	1422096	969949	164067	142600	145480	63763
Annual growth rate (%)							
1973-81	26.0	28.8	35.1	11.7	21.6	61.5	22.8

Source: ICAO, PIA

Notes: (1) for passenger; embarked & disembarked
for cargo; loaded & unloaded

(2) Middle East- Including for Africa

Table 2-2-9 Trends of Domestic Air Traffic

Year	Passengers-KM		Tonne-KM	
	Volume (Million)	growth rate (%)	Volume (Million)	growth rate (%)
1971-72	300	-	5.00	-
1972-73	325	8.3	5.80	16.0
1973-74	449	38.2	10.15	75.0
1974-75	559	24.5	10.90	7.4
1975-76	692	23.8	11.39	4.5
1976-77	849	22.7	14.80	29.9
1977-78	1026	20.8	13.80	-6.8
1978-79	1093	6.5	15.30	10.9
1979-80	1142	4.5	14.59	-4.6
1980-81	1205	5.5	15.73	7.8

Source: PIA

2-3 Projection of Traffic Demand

(1) Land Traffic

1) Methodology

The projection of land traffic have been done by three phases as follows;

Phase I: Projection of overall traffic including air

It is projected using by regression model as follows;

$$PK = -89799 + 1.03004\ POP + 29686\ GDP/POP \qquad r=0.9964$$
$$(5.97) \qquad (4.10)$$

$$TK = -2528 + 0.11648\ GDP \qquad r=0.9759$$

where

PK: passenger kilometers
TK: tonne kilometers
POP: population
GDP: GDP at 1980-81 constant prices

Phase II: Projection of air traffic

It is explained in air traffic projection.

Phase III: Projection of land traffic, and allocation of railway and road.

The land traffic is defined as the difference between overall and air traffic. As for allocation, it is explained in Microscopic Traffic Demand Forecasting.

2) Results

The results of domestic traffic projections are shown in Table 2-3-1. Overall passenger kilometers will increase at the rate of 6.5% per annum the Sixth Five Year Plan and 5.0% per annum thereafter.

Similarly, overall tonne kilomenters will increase at the rate of 7.7% and 6.8% per annum respective period. On the other hand, population and GDP are expected to increase at the rate of 2.8% and 7.2% per annum during the Sixth Five Year Plan, 2.4% and 6.5% per annum thereafter, respectively.

Table 2-3-1 Projection of Domestic Traffic Demand

Passenger

Year	Passenger-KM (Million)			Share (%)		
	Land	Air	Total	Land	Air	Total
1971-72	46035	300	46335	99.35	0.65	100.00
1980-81	82302	1205	83507	98.56	1.44	100.00
1982-83	93734	1484	95218	98.44	1.56	100.00
1987-88	128226	2162	130388	98.34	1.66	100.00
1999-2000	230920	3851	234771	98.36	1.64	100.00
Annual growth rate (%)						
1972-81	6.7	16.7	6.8			
1981-83	6.7	11.0	6.8			
1983-88	6.5	7.8	6.5			
1988-2000	5.0	4.9	5.0			

Cargo

Year	Tonne-KM (Million)			Share (%)		
	Land	Air	Total	Land	Air	Total
1971-72	15803	5.00	15808	99.97	0.03	100.00
1980-81	26125	15.73	26141	99.94	0.06	100.00
1982-83	30048	19.27	30067	99.94	0.06	100.00
1987-88	43548	26.35	43574	99.94	0.06	100.00
1999-2000	95836	44.00	95880	99.95	0.05	100.00
Annual growth rate (%)						
1972-81	5.7	13.6	5.7			
1981-83	7.2	10.7	7.2			
1983-88	7.7	6.5	7.7			
1988-2000	6.8	4.4	6.8			

Thus, the expected demand elasticities are as follows;

	1972 -81	1981 -83	1983 -88	1999 -2000
Passenger-KM/ Population	2.27	2.34	2.32	2.08
Passenger-KM/ GDP	1.24	1.13	0.90	0.77
Tonne-KM/ GDP	1.04	1.20	1.07	1.05

(2) Port Traffic

1) Passenger

a) Methodology

Port passenger traffic was classified by two groups, namely pilgrims and other passengers. Projection of both pilgrims and other passengers has been done in two phases as follows;

Phase I: For each group, total of sea and air traffic has been projected using the following model;

$$PIL = -50164 + 1.59346\ POP \qquad r=0.9335$$

$$OTH = -1921268 + 30.71669\ POP + 9.87576\ NIA \qquad r=0.9927$$
$$(4.25) \qquad (2.29)$$

where,

PIL: Pilgrims

OTH: Other passengers for Middle East & Africa

POP: Population

NIA: Net factor income from abroad

Phase II: The share of sea and air traffic for each group has been projected by following the logistic function. The maximum share of air was assumed to be 90% for pilgrims, 99% for other passenger based on the past trend as shown in Table 2-3-2.

Table 2-3-2 Trends of Pilgrims and Other Passengers Handled at Port and Airports

Pilgrims

	Volume (Persons)			Share (%)		
	Port	Airports	Total	Port	Airports	Total
1972-73	114038	16000	130038	87.7	12.3	100.0
1973-74	76699	11000	87699	87.5	12.5	100.0
1974-75	81136	34000	115136	70.5	29.5	100.0
1975-76	36205	27000	63205	57.3	42.7	100.0
1976-77	28192	44000	72192	39.1	60.9	100.0
1977-78	28264	41000	69264	40.8	59.2	100.0
1978-79	29611	47000	76611	38.7	61.3	100.0
1979-80	29630	46000	75630	39.2	60.8	100.0
1980-81	15456	70000	85456	18.1	81.9	100.0

Other passengers

	Volume (Persons)			Share (%)		
	Port	Airports	Total	Port	Airports	Total
1972-73	31256	71478	102734	30.4	69.6	100.0
1973-74	33322	120975	154297	21.6	78.4	100.0
1974-75	19175	188956	208131	9.2	90.8	100.0
1975-76	26066	296017	322083	8.1	91.9	100.0
1976-77	47506	491916	539422	8.8	91.2	100.0
1977-78	51490	637457	688947	7.5	92.5	100.0
1978-79	34712	674747	709459	4.9	95.1	100.0
1979-80	21457	760489	781946	2.7	97.3	100.0
1980-81	21408	899949	921357	2.3	97.7	100.0

Total

	Volume (Persons)			Share (%)		
	Port	Airports	Total	Port	Airports	Total
1972-73	145294	87472	232766	62.4	37.6	100.0
1973-74	110021	131975	241996	45.5	54.5	100.0
1974-75	100311	222956	323267	31.0	69.0	100.0
1975-76	62271	323017	385288	16.2	83.8	100.0
1976-77	75698	535916	611614	12.4	87.6	100.0
1977-78	79754	678457	758211	10.5	89.5	100.0
1978-79	64323	721747	786070	8.2	91.8	100.0
1979-80	51087	806489	857576	6.0	94.0	100.0
1980-81	36864	969949	1006813	3.7	96.3	100.0

Source: for port ; KPT
for airport;CAD and ICAO report
Note: for airport; Passengers for Middle East & Africa

$$SHRPIL = \frac{90}{1+e^{1.75860 - 0.34771\ t}} \qquad r=-0.8232$$

$$SHROTH = \frac{99}{1+e^{-0.28505 - 0.39394\ t}} \qquad r=-0.9619$$

where

SHRPIL: Air traffic share in pilgrims

SHROTH: Air traffic share in other passenger

t: Time trend

(1970-1971=1, ,1980-81=10)

b) Results

Table 2-3-3 shows the projected traffic of pilgrims and other passengers. Total pilgrims traffic will increase from 85,000 persons in 1980-81 to 113,000 persons in 1987-88 and 166,000 persons in 1999-2000.

Similarly, other passengers traffic will increase from 921,000 persons in 1980-81 to 1,503,000 persons in 1987-88 and 2,566,000 persons in 1999-2000. Both pilgrims and other passenger, air traffic share will increase and reach to maximum in 1999-2000.

As a result, both declining pilgrims and other passengers traffic by sea will remain upto the year 1987-88 and after that sea traffic will turn to increase due to the limited capacity of traffic by air as shown in Table 2-3-4.

2) Cargo

a) Methodology

The projection of cargo volumes handled at ports has been done by commodity-wise. The approach to projection is mainly used by the balance of the production and consumption. As for projection of production, it has been obtained from macro-economic targets. Main task in this part is therefore projecting of

Table 2-3-3 Projection of Pilgrims and Other Passengers Traffic by Sea and Air

	Pilgrims			Other passengers		
	Volume (Persons)	Share (%) Sea	Air	Volume (Persons)	Share (%) Sea	Air
1972-73	130038	87.7	12.3	102734	30.4	69.6
1980-81	85456	18.1	81.9	921357	2.3	97.7
1982-83	92175	17.4	82.6	1093286	1.7	98.3
1987-88	113381	11.4	88.6	1502706	1.1	98.9
1999-2000	166158	10.0	90.0	2566400	1.0	99.0

Note : for air; passengers for Middle East & Africa are selected

Table 2-3-4 Projection of Port Passenger Traffic

(Persons)

Year	Pilgrims	Other passengers	Total
1971-72	24858	31852	56710
1980-81	15456	21408	36864
1982-83	16038	18586	34624
1987-88	12925	16530	29455
1999-2000	16616	25664	42280
Annual growth rate (%)			
1972-81	-5.1	-4.3	-4.7
1980-83	1.9	-6.8	-3.1
1987-88	-4.2	-2.3	-3.2
1999-2000	2.1	3.7	3.1

consumption by commodity. Fig. 2-3-1 shows the method of projection of consumption. The projection of consumption is mainly used by regression model.

b) Results

Based upon the results of the regression models applied for the forecasting of the major commodities, and the various cross-examinations and comparisons on per capita consumptions and the analysis of deficit and surplus, followings are the summary of the result of volume of seaborne cargo movements.

The overall annual growth rate for the seaborne trade will be 8.2% per annum during the Sixth Five Year Plan and 5.1% per annum thereafter as shown in Table 2-3-5. In absolute terms the total volume will increase from 15 million tons in 1980-81 to 25 million tons in 1987-88 and 45 million tons in 1999-2000. At present, the volume of dry cargo and liquid cargo is almost balanced but it will be some changed in future. To summarise in terms of growth rate, it is anticipated that the growth rate of dry cargo will be about 10.1% upto the year 1987-88 and 3.9% thereafter as against a constant rate of 6.3% for liquid cargo over the same period. As for the export-import ratio, it will certainly improve 1:3.1 in 1980-81 to 1:2.3 in 1987-88 and 1:1.9 in 1999-2000. The resulting seaborne trade by commodity are summarised in Table 2-3-6. It is indicated that component of export-import commodity will change because some import commodity like wheat, sugar, cement and iron & steel is expected to be exported.

Table 2-3-7 shows the comparison of seaborne trade with other studies. As for the growth rate during the period 1980-81 to 1999-2000, four projections are very close to be five percent-plus level. In absolute terms, JICA projection is situated in the middle of four projections. These projections have been done by the different GDP growth rate. It is useful to compare in terms of GDP elasticity, and both elasticities by JICA

Fig. 2-3-1 Chart Showing the Method of Trade Projection

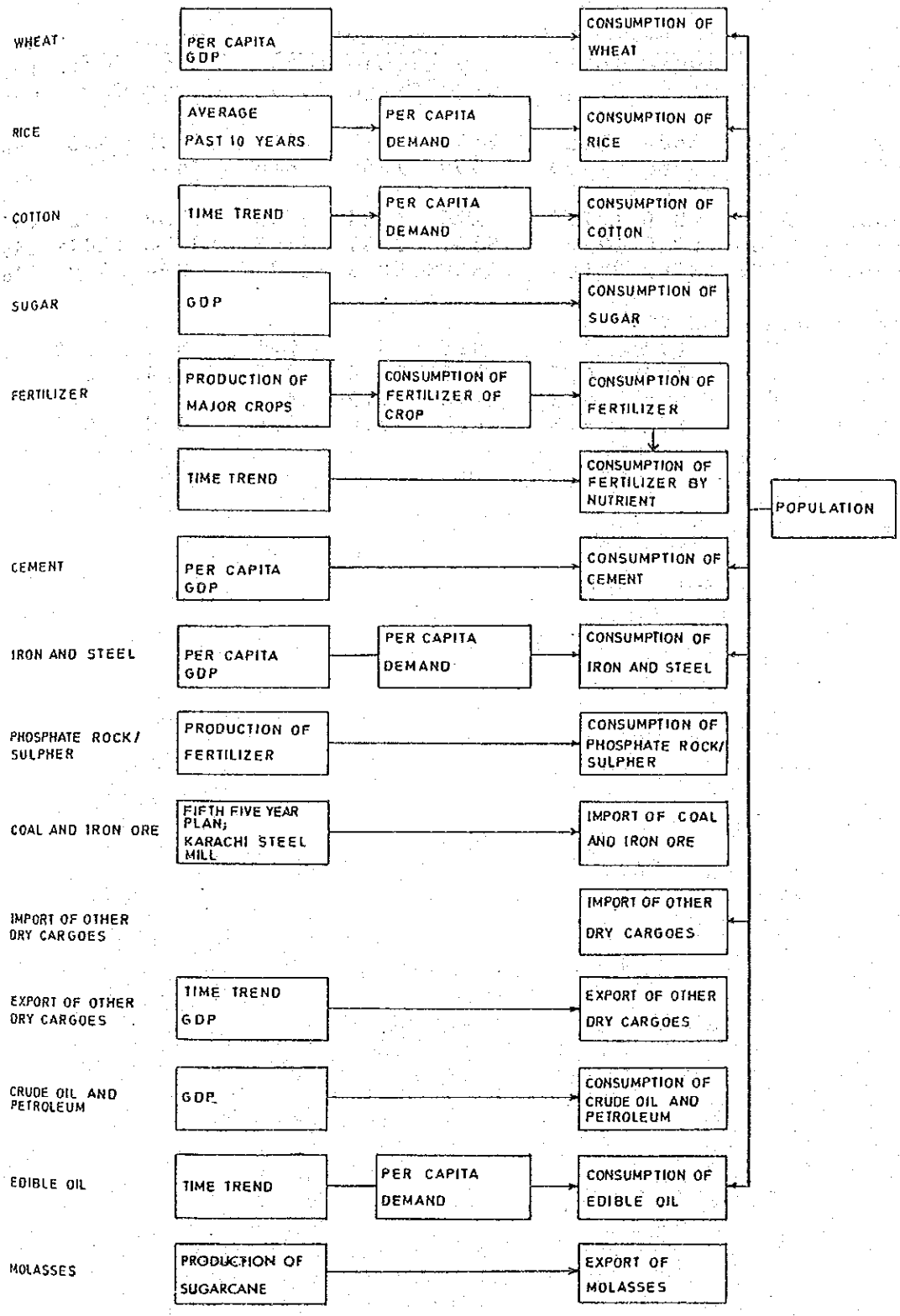


Table 2-3-5 Summary Projection of Seaborne Trade

(1000Tonnes)

Year	Imports			Exports			Imports + Exports		
	DRY Cargo	Liquid Cargo	Total Cargo	Dry Cargo	Liquid Cargo	Total Cargo	Dry Cargo	Liquid Cargo	Total Cargo
1971-72	2437	3588	6025	2198	813	3011	4635	4401	9036
1980-81	5117	6206	11323	2359	1259	3618	7476	7465	14941
1982-83	5877	6896	12773	2275	1524	3799	8152	8420	16572
1987-88	8009	9218	17227	5167	2231	7398	13176	11449	24625
1999-2000	10386	18782	29168	10508	5013	15521	20894	23795	44689
Annual growth rate (%)									
1972-81	8.6	6.3	7.3	0.8	5.0	2.1	5.5	6.0	5.7
1981-83	7.2	5.4	6.2	-1.8	10.0	2.5	4.4	6.2	5.3
1983-88	6.4	6.0	6.2	17.8	7.9	14.3	10.1	6.3	8.2
1988-2000	2.2	6.1	4.5	6.1	7.0	6.4	3.9	6.3	5.1

Table 2-3-6 Projection of Seaborne Trade by Commodity

(1000Tonnes)

	1980-81	1982-83	1987-88	1999-2000
Imoprts	11323	12773	17227	29168
Dry cargo	5117	5877	8009	10386
Wheat	308	347	527	-
Sugar	74	63	-	-
Cement	444	142	-	-
Fertilizers	1294	1228	1193	2059
Iron & steel	442	536	-	-
Coal	161	504	1360	1360
Iron ore	244	754	2030	2030
Phosphate rock/sulpher	191	299	278	779
Other dry cargo	1959	2004	2621	4158
Liquid cargo	6206	6896	9218	18782
Crude oil & petroleum	5598	6264	8533	18146
Edible oil & tallow	608	632	685	636
Exports	3618	3799	7398	15521
Dry cargo	2359	2275	5167	10508
Wheat	-	-	-	643
Rice	1257	1259	1593	2998
Cotton	315	185	334	492
Sugar	-	-	94	266
Cement	-	-	1467	2208
Fertilizers	21	-	-	282
Iron & steel	-	-	630	1735
Other dry cargo	766	831	1049	1884
Liquid cargo	1259	1524	2231	5013
Petroleum products	994	1222	1825	4436
Molasses	265	302	406	577

Table 2-3-7 Comparison of Seaborne Trade Projections

	Total cargo Volume (Million) 1980-81	1999-2000	annual growth rate(%)	GDP annual growth rate(%)	GDP elasticity
JICA	14.94	44.69	5.9	6.6	0.89
SWAN WOOSTER	11.53	30.56	5.3	6.3	0.84
ADB	19.30	54.37	5.6	-	-
NESPACK	20.69	52.88	5.1	-	-

Source: Swan Wooster- Bulk Terminal Feasibility Study Final Report (1976/77)
ADB- Asian Developmemt Bank Report (Base year 1974/75)
NESPACK- NESPACK Supplementary Report (Base year 1977/78)

Note: for other three reports; it is excluding any trade in iron ore and coal for Karachi Steel Mill.

and SWAN WOOSTER are very close but in the case of ADB and NESPACK they are not known.

Fig. 2-3-2 shows the correlation between per capita income and international seaborne trade in the ESCAP region, and it is indicated that income elasticity is about 1.25. An attempt has been made to project the seaborne trade using by above elasticity as follows;

	1980-81	1987-88	1999-2000
Per capita income (Thousand Rs.)	2.972	3.856	6.223
Per capita trade (Ton)	0.178	0.247	0.449
Population (Million)	83.78	102.64	135.76
Seaborne trade (Million)			
Projection by income elasticity	14.94	25.34	60.97
Projection by commodity-wise approach	14.94	24.63	44.69

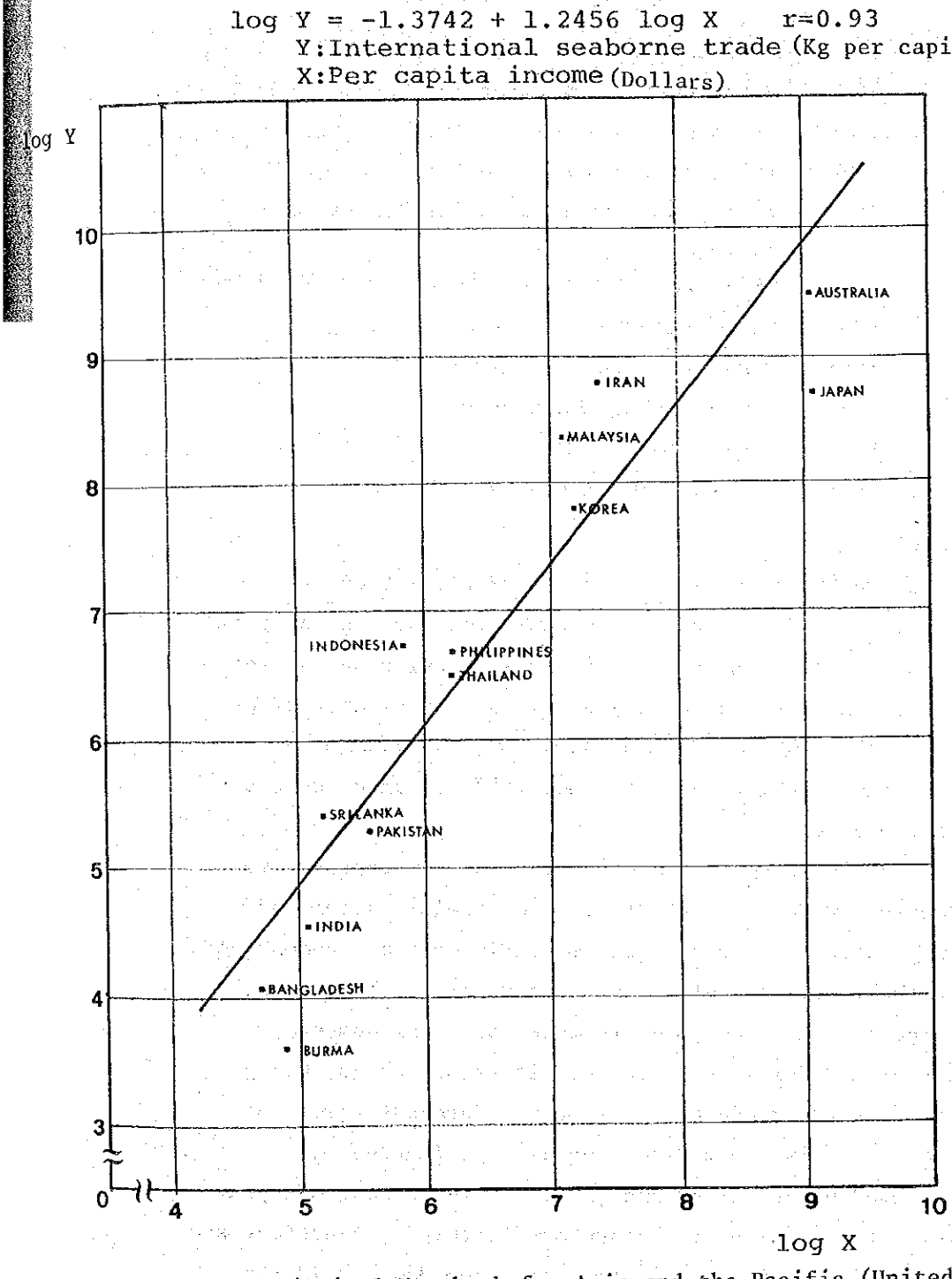
(3) Air Traffic

1) International

a) Methodology

For the international air traffic projections, passenger traffic was classified by four directions like Middle East & Africa, Europe, Far East and India. As for Middle East & Africa, it was already projected in the port traffic projections. With regard to cargo traffic, total traffic has been projected due to the limited data. Both passenger and cargo handled at all airports in Pakistan have been projected using the following regression model.

Fig. 2-3-2 Comparison between per Capita Income and International Seaborne Trade in ESCAP Region (1978)



Source: Statistical Yearbook for Asia and the Pacific (United Nations)

EURO = -275586 + 5.4097 POP r=0.9421

EAST = -354445 + 5.7105 POP r=0.9545

INDIA = -608347 + 8.9658 POP r=0.9535

PIA = MIDL + EURO + EAST + INDIA

IED = 37737 + 1.6096 PIA r=0.9965

ILU = -46203 + 0.011904 IED + 0.329528 GDP

(2.96) (3.22) r=0.9967

where,

EURO: embarked & disembarked for Europe by PIA

EAST: embarked & disembarked for East by PIA

INDIA: embarked & disembarked for India by PIA

MIDL: embarked & disembarked for Middle East & Africa by PIA
(See IV. 2-3 (2) Port Traffic Projection.)

PIA: total embarked & disembarked by PIA

IED: total embarked & disembarked

ILU: total loaded & unloaded

POP: population

GDP: GDP at 1980-81 constant prices

b) Results

Table 2-3-8 shows the results of projection of international air traffic demand. The increase of total passenger traffic is expected at 7.1% per annum during the Sixth Five Year Plan and 4.7% per annum thereafter upto the year 2000. Similarly, cargo traffic will increase at a rate of 10.6% and 7.5% per annum over the same periods.

Fig. 2-3-3 shows the comparison of air traffic projections with other studies. The absolute volume of projections prepared by other studies are not comparable as their data are different or not known. Therefore, comparison has been made in terms of index numbers, set at 100 for 1981. Both passenger and cargo, PIA's traffics are projected to remain as present level for the Sixth Five Year Plan, and JICA projection is situated between ICAO and IATA. In the comparable year 1995, the range of index numbers in three projections are from 170 to 270 for passenger and from 300 to 370 for cargo.

Table 2-3-8 Projection of International Air Traffic

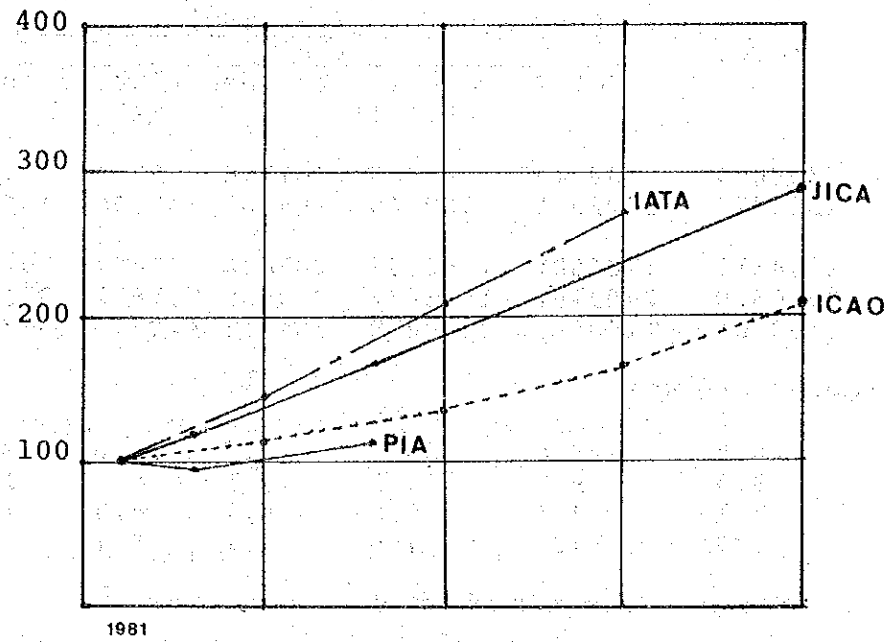
Year	Passenger (Persons)						Cargo (Tonnes)
	Total	PIA					
		Total	Middle EAST 1)	Europe	Far EAST	India	
1972-73	368694	188213	87478	67796	29794	3145	12366
1980-81	2343775	1422096	969949	164067	142600	145480	63763
1982-83	2784811	1706681	1150837	207646	155657	192541	79160
1987-88	3916520	2409781	1586632	279639	231652	311858	130845
1999-2000	6763764	4178695	2690278	458813	420790	608814	312715
Annual growth rate (%)							
1973-81	26.0	28.8	35.1	11.7	21.6	61.5	22.8
1981-83	9.0	9.5	8.9	12.5	4.5	15.0	11.4
1983-88	7.1	7.1	6.6	6.1	8.3	10.1	10.6
1988-2000	4.7	4.7	4.5	4.2	5.1	5.7	7.5

Note: Including passengers for Africa

Fig. 2-3-3 Comparison of International Air Traffic Projection

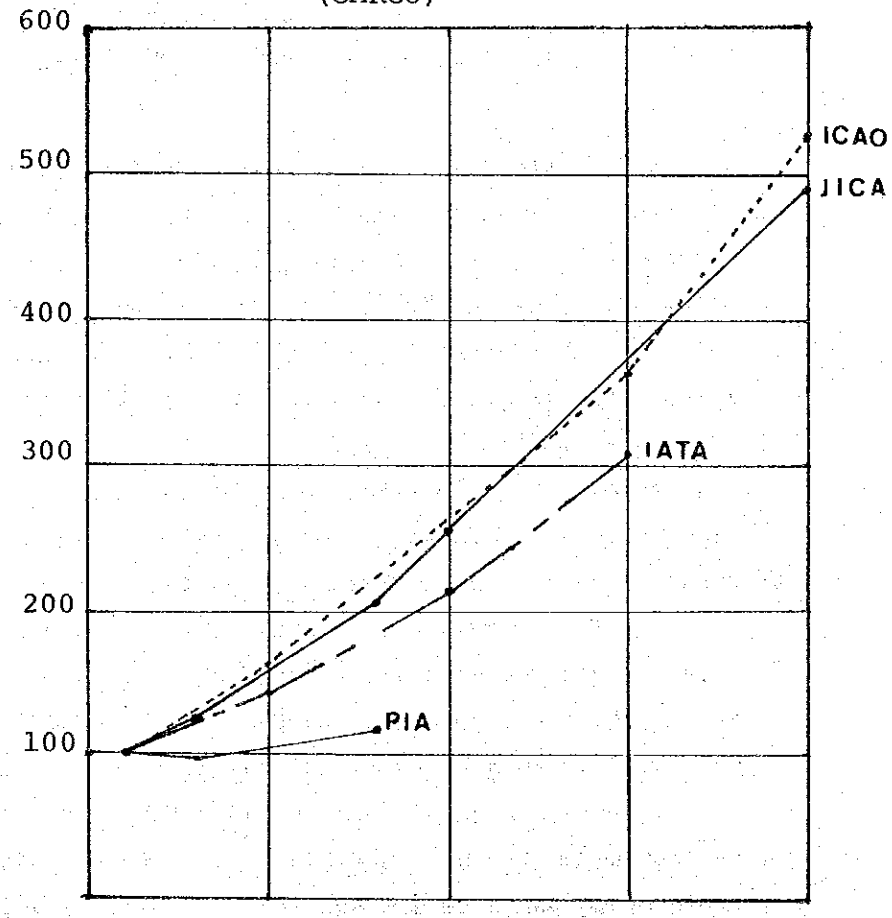
(1981=100)

(PASSENGER)



Note: for IATA; projection for Karachi

(CARGO)



Note: for IATA; projection for Karachi
including domestic traffic

Table 2-3-8 Projection of International Air Traffic

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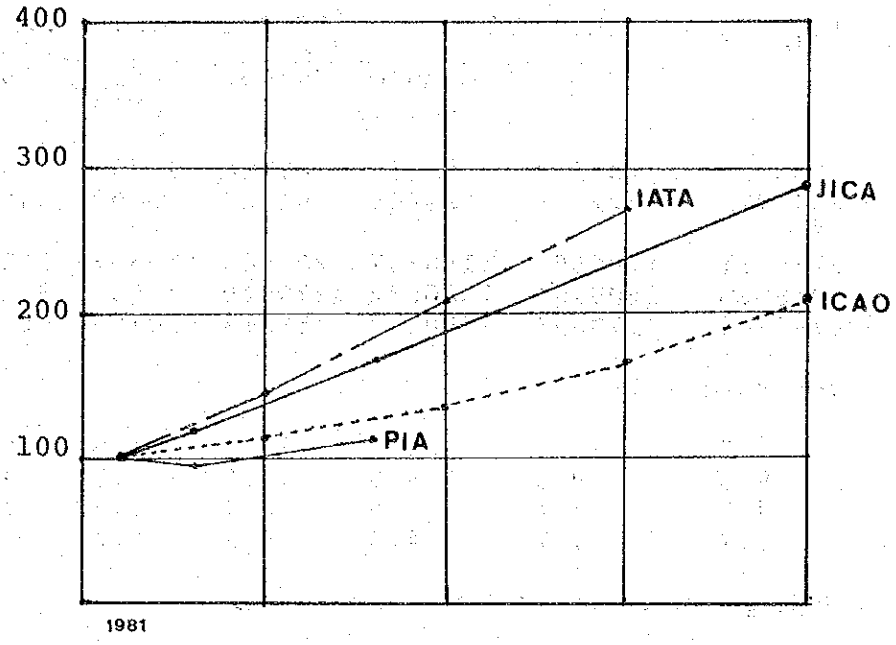
1999-2000	6763764	4178695	2690278	458813	420790	608814	312715
Annual growth rate (%)							
1973-81	26.0	28.8	35.1	11.7	21.6	61.5	22.8
1981-83	9.0	9.5	8.9	12.5	4.5	15.0	11.4
1983-88	7.1	7.1	6.6	6.1	8.3	10.1	10.6
1988-2000	4.7	4.7	4.5	4.2	5.1	5.7	7.5

Note: Including passengers for Africa

Fig. 2-3-3 Comparison of International Air Traffic Projection

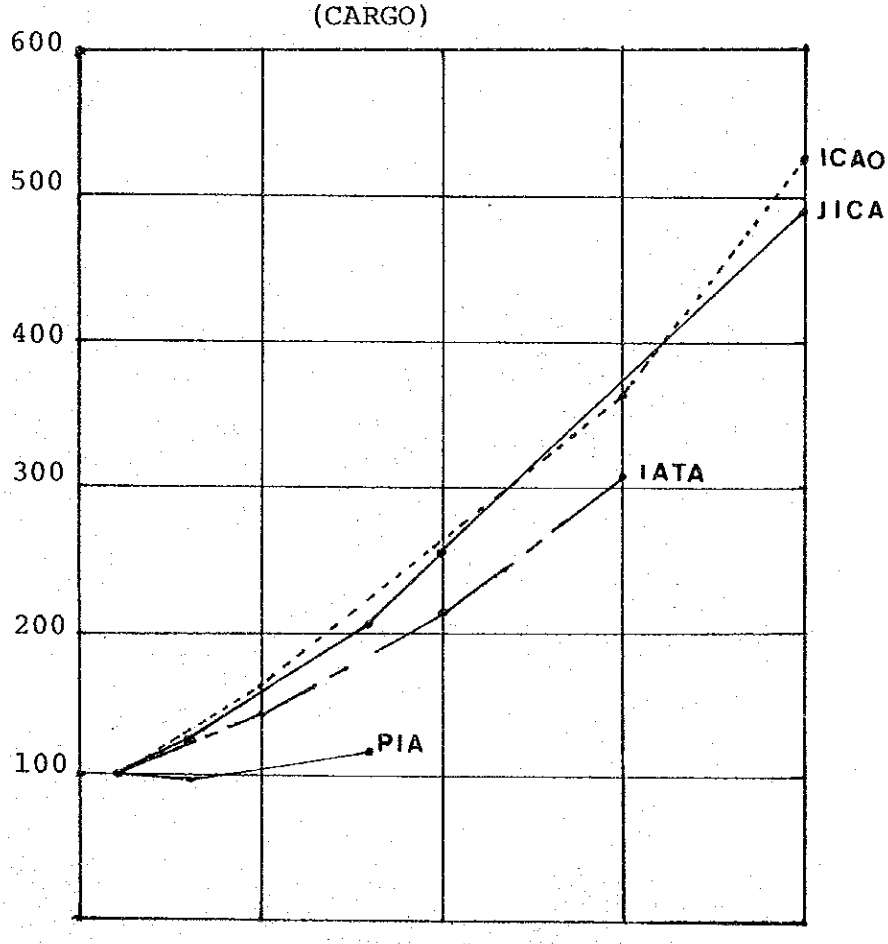
(1981=100)

(PASSENGER)



Note: for IATA; projection for Karachi

(CARGO)



Note: for IATA; projection for Karachi
including domestic traffic

2) Domestic

a) Methodology

Domestic air traffic in terms of passenger kilometers and tonne kilometers has been projected by using the following model;

$$DPK = -2609 + 0.042871\ POP + 0.000094638\ IED \qquad r=0.9919$$
$$\qquad\qquad\qquad (2.38) \qquad\quad (0.57)$$
$$DTK = 3.76 + 0.010448\ DPK \qquad r=0.9348$$

where

DPK: domestic air passenger kilometers (million)
DTK: domestic air tonne kilometers (million)
POP: population (thousand)
IED: international embarked & disembarked handled at all airports in Pakistan (person)

As for passenger kilometers, another regression analysis has been done as follows;

$$\text{I}\quad DPK/POP = -0.009545 + 0.008175\ GDP/POP \qquad r=0.9137$$
$$\text{II}\quad DPK = -2382 + 0.060389\ POP - 472.8\ GDP/POP \qquad r=0.9905$$
$$\qquad\qquad\qquad\qquad (7.37) \qquad (-1.38)$$

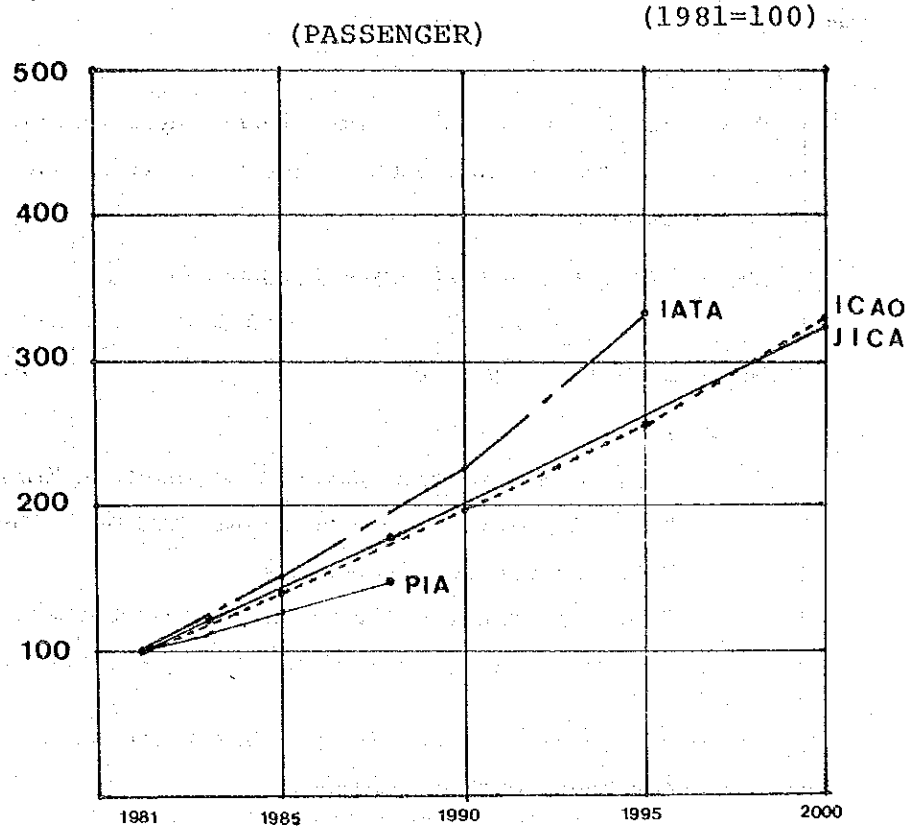
These two formula are not adopted because of low value of correlation coefficient of formula I and the minus sign on GDP/POP (per capita GDP) in formula II.

b) Results

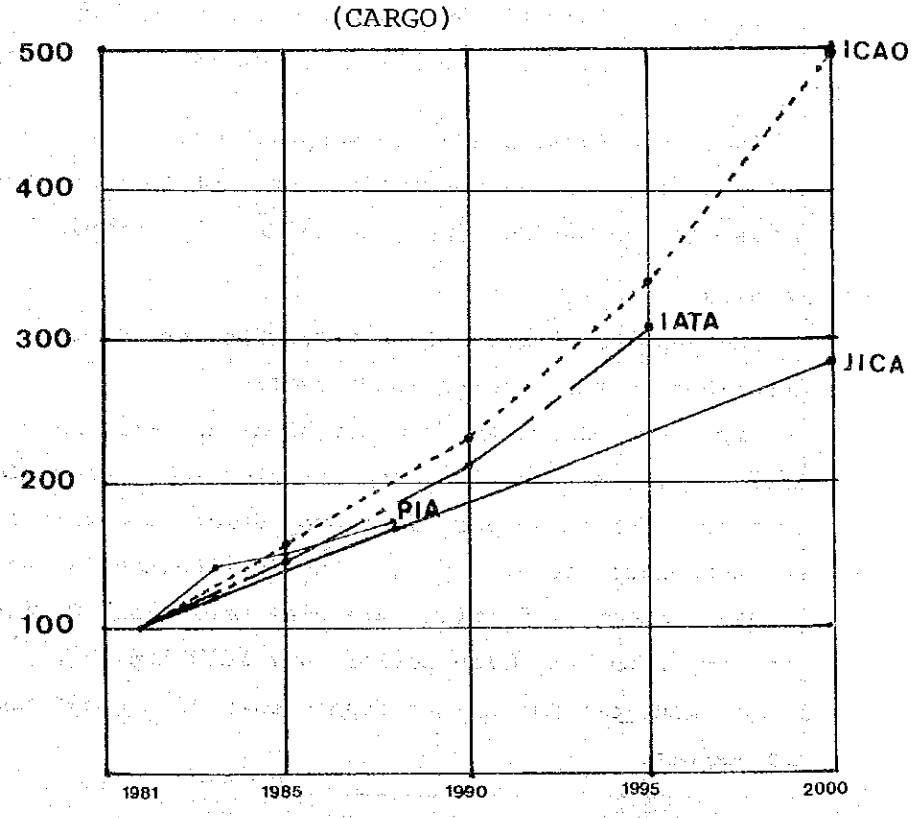
The results of domestic air traffic was already described in relation to land traffic.

Fig. 2-3-4 shows the comparison of domestic air traffic projections with other studies like international traffic. For passenger, four projections are very close to each other and JICA projection is situated in the middle. Cargo projections are also very close during the next Five Year Plan period, but ICAO and IATA projections are increasing higher than JICA projection thereafter.

Fig. 2-3-4 Comparison of Domestic Air Traffic Projection



Note: for IATA; projection of Karachi



Note: for IATA; projection for Karachi
including international traffic

3. Microscopic Traffic Demand Forecasting

3-1 Land Traffic

(1) Methodology

1) General Flow

The flow of land traffic projection is shown in Fig. 3-1-1. The following data are the input to the projection system.

1. Macro-scopic traffic demand forecast
2. Macro-economic and regional frame
3. Policy/strategy for modal split
4. Present OD tables (Passenger, Commodity, Vehicle)
5. Link Inventory

The output of the projection system is as follows.

1. Future OD tables by mode (Passenger, Commodity, Vehicle)
2. Traffic volume by road link

The system applies the so-called four-step estimation method, which comprises of generation/attraction, distribution, modal split and traffic assignment.

2) Generation and Attraction

a) Commodity

Generation and attraction traffics are generally correlated with surplus and deficit, respectively, as follows.

$$S_i^k = Y_i^k + \delta \cdot M^k$$

$$D_i^k = C_i^k + \delta \cdot E^k$$

$$C_i^k = \bar{C}^k \cdot P_i$$

$$\bar{C}^k = (\Sigma_i Y_i^k + M^k - E^k)/\Sigma_i P_i$$

$$\text{Surplus/Deficit} = S_i^k - D_i^k$$

where

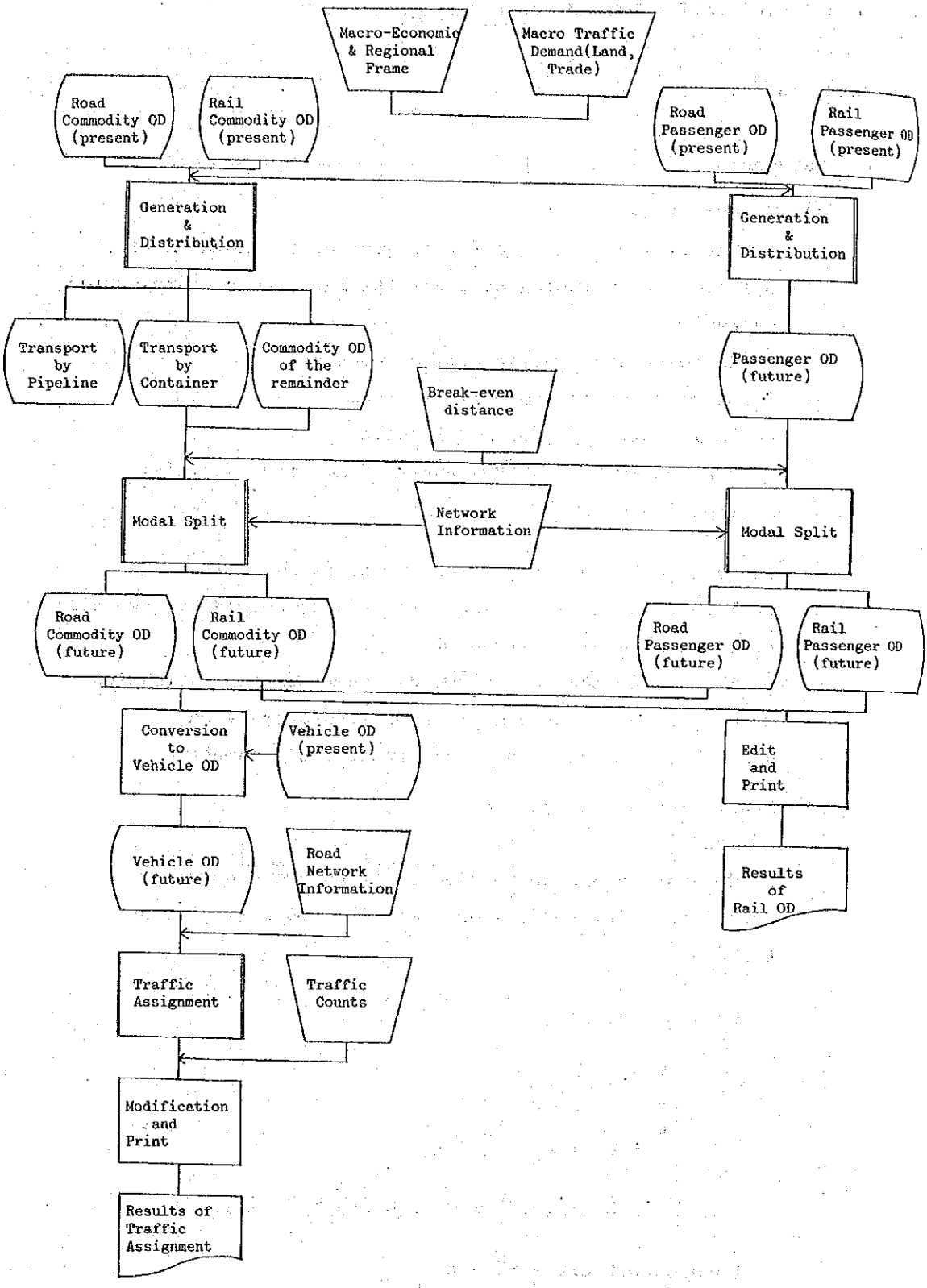


Fig. 3-1-1 General Flow of Land Traffic Projection

i: index for zone

k: index for commodity

S: supply

D: demand

Y: production

C: consumption

M: import

E: export

δ: 1 for Karachi zone, 0 for other zones

P: population

Import/Export and production by zone are projected in macro and regional frame for the future, and this formula was adopted for the projection of the generation and attraction. It should be, however, noted that supply and demand themselves were used, if necessary, because the actual commodity flow is much complicated by reason of the size of zones, the feeder transport, the stockyard and so on.

b) Passenger

Generation and attraction traffics are correlated with the socio-economic variables (population, income, production etc). The available data by zone are population, and the following equations were estimated by the regression analysis, after the trial of several type equations.

$$\ln G = \underset{(1.83)}{1.39} + \underset{(10.8)}{1.04} \ln P + \underset{(6.14)}{0.450} \ln R \quad (r=0.92)$$: Lower-class

$$\ln G = \underset{(3.56)}{4.61} + \underset{(2.27)}{0.370} \ln P + \underset{(5.31)}{0.661} \ln R \quad (r=0.73)$$: Upper-class

where

G: generation traffics (=attracion traffics)

P: population

R: urbanization (= P(urban)/P)

It should be noted that the passenger OD matrix is symmetric, and so the generation traffic is equal to the attraction traffic.

The totals of generation traffics were controlled by the result of macroscopic demand forecast, both for commodity and passenger.

3) Distribution

Distribution traffics were projected with Fratar method, based on the present pattern. Generation traffics of the zones, where no traffics are observed at present, were distributed to the zones of the deficit.

Petroleum and railway oil from Karachi to Punjab or NWFP were assumed to be transported by the pipeline up to Multan to be distributed.

The transport by container was projected by the distribution of the containerizable cargos from/to Karachi, which was controled by the total container cargos of port planning.

4) Modal Split

Modal split between road and railway was projected for 2 cases (see V), as follows.

Case A: present pattern

Case B: strategic modal aplit

In Case A, the relative service levels of road and railway were assumed to be unchanged, which means that the modal split by OD is same as present.

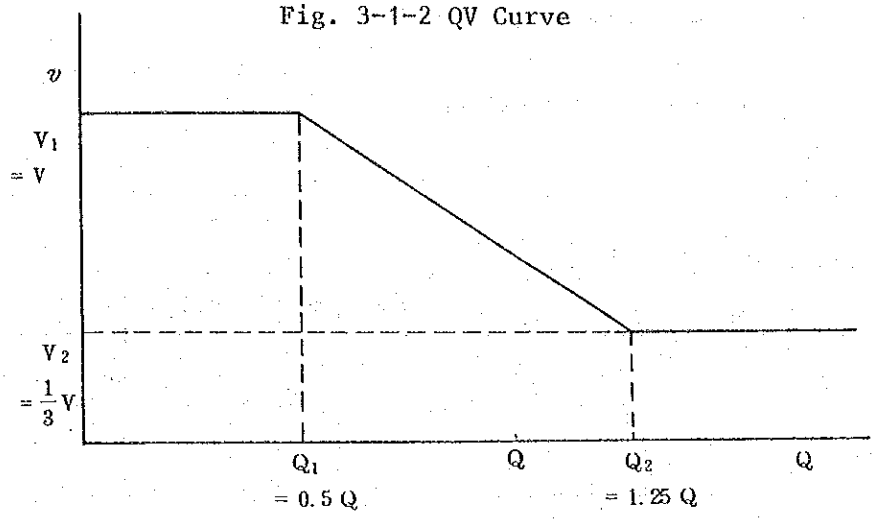
In Case B, the longer distant traffics were converted from road to railway, and the shorter distant traffics from railway to road, based on the idea of the break-even distance by commodity for freight and by class for passenger. As for railway freight transport, stations were aggregated to 15 base stations, and the feeder service was assumed to be carried by trucks.

The container cargoes were assumed to be carried by railway from/to Karachi to/from Lahore, for the northern area, and the remainder by trucks.

5) Traffic Assignment for Road

Passenger OD and commodity OD were converted to vehicle OD, assuming that the load factor would be same as present. Vehicle OD was assigned to each link by the method of the traffic equilibrium assignment with QV curves (see Fig. 3-1-2, Table 3-1-1).

Fig. 3-1-2 QV Curve



Link information was prepared by the road planner. QV curves were determined, mainly based on Highway Master Plan and the results of the traffic assignment were cross checked with the actual traffic count data. The unit of vehicle OD is PCU, and the capacity in the mixed traffic was doubled, considering the mixture of trucks.

(2) Results

1) Summary

The results of land traffic demand forecasting are summarized in Table 3-1-2. The difference between Case A and Case B is small for passenger and large for commodity. This is due to the modal split structure by distance as shown in the latter section.

The share of railway commodity decreases rapidly in Case A, mainly because of the opening of pipelines.

Table 3-1-3 and Table 3-1-4 show the projection results of passenger and commodity, which do not include the intrazonal traffics. These are the bases of the analysis hereafter. The average trip lengths for railway passenger are 315 km and 386 km in Case A and Case B, respectively in 1999/00. As for railway commodity, 675 km and 961 km in Case A and Case B, respectively. These indicate that the strategy for modal split is working well in Case B.

Table 3-1-1 QV Curve

(1) Design Speed (V max)

Type of Terrain	Type of Road Surface	width (0.1 m)				
		≦36	36< ≦60	60< ≦72	72< ≦108	73x2
Flat	Metalled Good	80	90	95	100	110
	Metalled Poor	60	70	70	75	80
	Un-Metalled	40	45	-	-	-
Rolling	Metalled Good	65	80	80	90	100
	Metalled Poor	50	60	60	70	75
	Un-Metalled	30	40	-	-	-
Mountanious	Metalled Good	40	50	60	70	80
	Metalled Poor	30	35	45	50	60
	Un-Metalled	20	25	-	-	-

(2) Capacity (Q max)

* Mixed Traffic

Type of Terrain	width (0.1 m)				
	≦36	36< ≦60	60< ≦72	72< ≦108	73x2
Flat	500	1,500	4,000	8,000	48,000
Rolling (0.9xFlat)	450	1,350	3,600	7,200	43,000
Mountanious(0.7xFlat)	350	1,000	2,800	5,600	34,000

Source: JICA Study Team estimation, based on Highway Masterplan.

The transport volume by commodity is summarized in Table 3-1-5. In 1999/00, cement, iron & steel, mining, coal & coke, rock phosphate and others become 4-5 times more than present.

2) Distribution and Modal Split

The modal split by distance is shown in Fig. 3-1-3. It is clearly seen that the shorter distance traffics are converted from railway to road, and the longer distance traffics from road to railway in Case B.

Table 3-1-6 and Table 3-1-7 show the comparison between Case A and Case B of the modal split for freight by commodity and for passenger by class. Almost all of the commodities increases the railway share in Case B, particularly in the unit of ton-km.

As for the desire lines for passenger OD, commodity OD and vehicle OD, it is clear that the longer distance traffics decrease in Case B for road.

3) Traffic Assignment for Road

The results of the traffic assignment was compared with the actual traffic count data as shown in Fig. 3-1-4. The simulation reproduces the actual observations very well, particularly for the major routes. This shows the justification of the simulation methodology. It should be, however, noted that the reproduction is not so well for the minor routes, particularly for passenger cars. This is mainly because the intra-zonal traffics were neglected in the simulation. It may be, therefore, necessary to add the intra-zonal traffics in the stage of the road planning.

Fig. 3-1-5 show the comparison of the simulation results between present network and future network in Case A in 1999/2000. In the case of the present network, the major routes are saturated and the conversion to the minor routes is seen evidently. In the case of the future network, the traffic flows become smooth because of the reduction of the congestion. The situation is seen similarly in Case B as shown in Fig. 3-1-6.

Table 3-1-2 Traffic Volume

			1980/1981	1982/1983	1987/1988	1999/00
Passenger-km (million)	Case A	SUM	82,302 (100.0)	93,734 (100.0)	128,226 (100.0)	230,920 (100.0)
		ROAD	65,991 (80.2)	74,945 (80.0)	101,784 (79.4)	182,052 (78.8)
		RAIL	16,311 (19.8)	18,789 (27.0)	26,442 (20.6)	48,868 (21.2)
	Case B	SUM			128,226 (100.0)	230,920 (100.0)
		ROAD	——— do ———	—— do ——	101,897 (79.5)	181,338 (78.5)
		RAIL			26,329 (20.5)	49,582 (21.5)
Ton-km (million)	Case A	SUM	26,125 (100.0)	30,048 (100.0)	43,548 (100.0)	95,837 (100.0)
		ROAD	18,207 (69.7)	20,403 (67.9)	31,401 (72.1)	70,039 (73.1)
		RAIL	7,918 (30.3)	8,019 (26.7)	9,581 (22.0)	20,188 (21.1)
		PIPELINE	0 (0.0)	1,626 (5.4)	2,566 (5.9)	5,610 (5.8)
	Case B	SUM			44,027 (100.0)	97,048 (100.0)
		ROAD			27,745 (63.0)	55,081 (56.7)
		RAIL	——— do ———	—— do ——	13,716 (31.2)	36,357 (37.5)
		PIPELINE			2,566 (5.8)	5,610 (5.8)

Note: Including intra-zonal traffic.

Source: JICA Study Team estimation.

Table 3-1-3 Passenger Traffic Volume

			1980/1981	1982/1983	1987/1988	1999/00
Passenger ('000')	Case A	SUM	281,251 (100.0)	316,367 (100.0)	424,556 (100.0)	745,897 (100.0)
		ROAD	227,737 (81.0)	255,813 (80.9)	342,086 (80.6)	597,981 (80.2)
		RAIL	53,514 (19.0)	60,554 (19.1)	82,470 (19.4)	147,915 (19.8)
	Case B	SUM			424,556 (100.0)	745,897 (100.0)
		ROAD	——— do ———	— do —	349,780 (82.4)	623,215 (83.6)
		RAIL			74,776 (17.6)	122,681 (16.4)
Passenger - km (million)	Case A	SUM	51,539 (100.0)	58,497 (100.0)	80,282 (100.0)	144,573 (100.0)
		ROAD	36,590 (71.0)	41,224 (70.5)	55,513 (69.1)	97,910 (67.7)
		RAIL	14,950 (29.0)	17,273 (29.5)	24,768 (30.9)	46,662 (32.3)
	Case B	SUM			80,278 (100.0)	144,549 (100.0)
		ROAD	——— do ———	— do —	55,623 (69.3)	97,172 (67.2)
		RAIL			24,655 (30.7)	47,377 (32.8)

Note: Excluding intra-zonal traffic.

Source: JICA Study Team estimation

Table 3-1-4 Commodity Traffic Volume

			1980/1981	1982/1983	1987/1988	1999/00
Ton ('000')	Case A	SUM	53,986 (100.0)	61,735 (100.0)	89,246 (100.0)	189,707 (100.0)
		ROAD	43,583 (80.7)	50,981 (87.6)	75,164 (84.2)	159,817 (84.2)
		RAIL	10,403 (19.3)	10,754 (17.4)	14,083 (15.8)	29,891 (15.8)
	Case B	SUM	——— do ———	—— do ——	96,745 (100.0)	209,215 (100.0)
		ROAD			82,199 (85.0)	171,372 (81.9)
		RAIL			14,546 (15.0)	37,842 (18.1)
Ton-km (million)	Case A	SUM	24,561 (100.0)	27,700 (100.0)	39,533 (100.0)	86,707 (100.0)
		ROAD	16,514 (67.2)	19,681 (71.1)	29,952 (75.8)	66,519 (76.7)
		RAIL	8,047 (32.8)	8,019 (28.9)	9,581 (24.2)	20,188 (23.3)
	Case B	SUM	——— do ———	—— do ——	40,012 (100.0)	87,918 (100.0)
		ROAD			26,296 (65.7)	51,561 (58.6)
		RAIL			13,716 (34.3)	36,357 (41.4)

Note: Excluding intra-zonal traffic.

Source: JICA Study Team estimation.

Table 3-1-5 Transport Volume by Commodity (Case A)

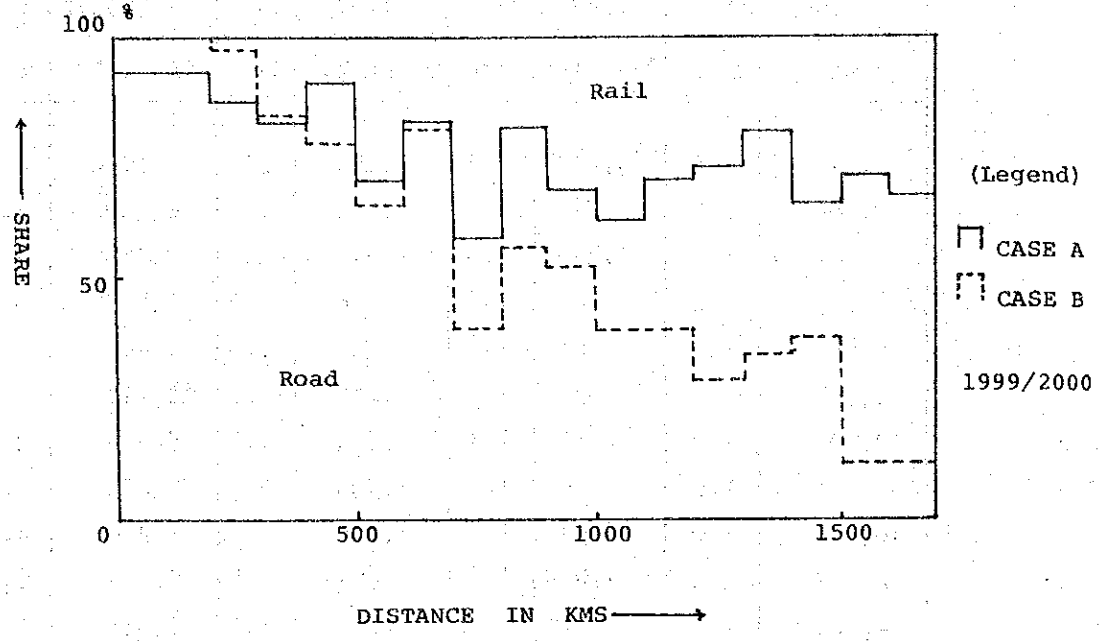
'000'Tons

	1980/1981		1982/1983		1987/1988		1999/2000	
	Quantity	Rate	Quantity	Rate	Quantity	Rate	Quantity	Rate
Wheat	2,014	1.0	2,217	1.1	2,861	1.4	4,702	2.3
Rice	2,684	1.0	3,013	1.1	4,084	1.5	6,780	2.5
Cotton	1,749	1.0	1,864	1.1	2,217	1.3	3,076	1.8
Edible Oil	617	1.0	695	1.1	948	1.5	1,857	3.0
Sugar	450	1.0	487	1.1	601	1.3	1,440	3.2
Cement	2,585	1.0	3,292	1.3	6,118	2.4	10,917	4.2
Fertilizer	2,702	1.0	2,971	1.1	3,824	1.4	8,138	3.0
Iron & Steel	781	1.0	944	1.2	1,538	2.0	4,000	5.1
Mining	10,851	1.0	12,635	1.2	18,755	1.7	43,280	4.0
Coal & Coke	2,872	1.0	3,830	1.3	7,981	2.8	18,154	6.3
Petroleum	4,608	1.0	4,634	1.0	4,771	1.0	7,936	1.7
Firewood	1,013	1.0	1,140	1.1	1,557	1.5	3,233	3.2
Sugar Cane	805	1.0	815	1.0	853	1.1	1,078	1.3
Fruits & Vegetable	3,635	1.0	3,987	1.1	5,100	1.4	10,484	2.9
Livestock	624	1.0	682	1.1	863	1.4	1,906	3.1
Rock Phosphate	148	1.0	168	1.1	234	1.6	710	4.8
Railway Material	1,415	1.0	1,597	1.1	2,193	1.6	4,954	3.5
Railway Oil	654	1.0	720	1.1	930	1.4	2,101	3.2
Others	13,779	1.0	16,044	1.2	23,817	1.7	54,961	4.0
Total	53,986	1.0	61,735	1.1	89,246	1.7	189,707	3.5

Source: JICA Study Team estimation

Fig. 3-1-3 Modal Split by Distance

(1) Commodity Share between Road and Railway by Distance



% (2) Passenger Share between Road and Railway by Distance

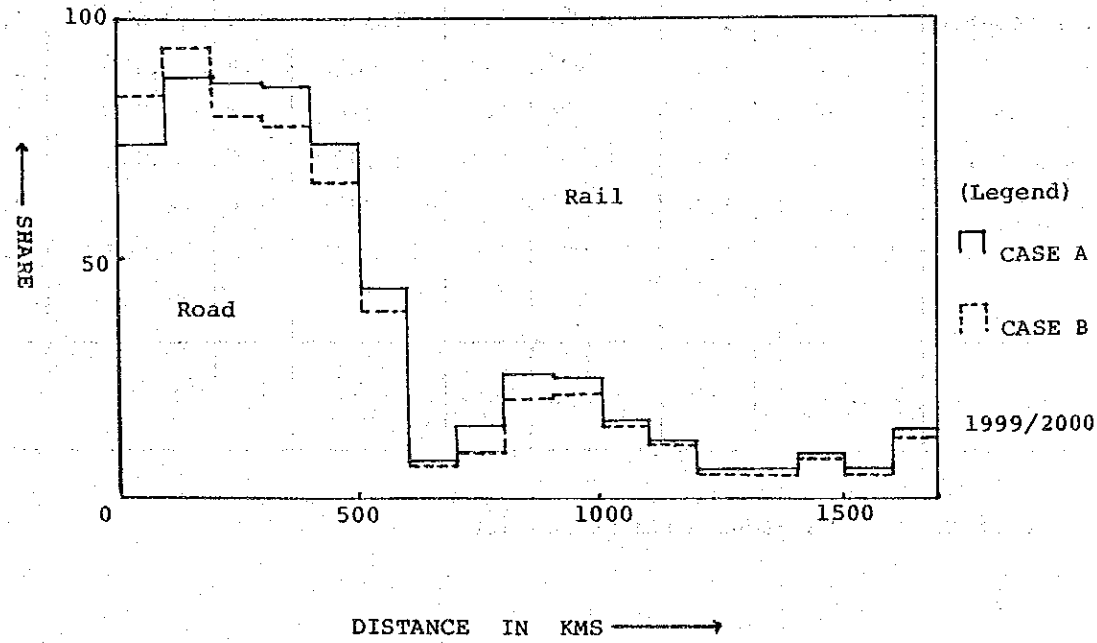


Table 3-1-6 Modal Split by Commodity

(1999/2000)

Commodity		Ton ('000')		Ton・km(Million)	
		Case A	Case B	Case A	Case B
1 Wheat	Road	2,760 (58.7)	3,731 (71.0)	746 (39.6)	888 (47.2)
	Rail	1,942 (41.3)	1,523 (29.0)	1,138 (60.4)	991 (52.8)
2 Rice	Road	5,506 (81.2)	6,913 (77.7)	3,187 (71.9)	2,367(52.2)
	Rail	1,274 (18.8)	1,989 (22.3)	1,245 (28.1)	2,170(47.8)
3 Cotton	Road	2,900 (94.3)	2,942 (91.8)	1,101 (88.5)	998(78.2)
	Rail	175 (5.7)	264 (8.2)	143 (11.5)	278(21.8)
4 Edible Oil	Road	1,571 (84.6)	1,392 (74.2)	620 (67.4)	412(45.0)
	Rail	286 (15.4)	484 (25.8)	300 (32.6)	505(55.0)
5 Sugar	Road	1,336 (92.8)	1,415 (92.1)	460 (86.4)	411(75.8)
	Rail	104 (7.2)	121 (7.9)	73 (13.6)	131(24.2)
6 Cement	Road	9,086 (83.2)	9,328 (81.5)	3,242 (70.4)	2,106(45.6)
	Rail	1,831 (16.8)	2,116 (18.5)	1,365 (29.6)	2,510(54.4)
7 Fertilizer	Road	5,351 (65.7)	5,885 (61.4)	2,388 (53.2)	1,396(30.4)
	Rail	2,788 (34.3)	3,695 (38.6)	2,103 (46.8)	3,197(69.6)
8 Iron & Steel	Road	3,875 (96.9)	2,876 (67.4)	2,062 (92.6)	662(29.6)
	Rail	125 (3.1)	1,392 (32.6)	164 (7.4)	1,572(70.4)
9 Mining	Road	41,889(96.8)	42,380 (95.8)	8,536 (93.5)	7,471(81.6)
	Rail	1,391(3.2)	1,842 (4.2)	594 (6.5)	1,681(18.4)
10 Coal & Coke	Road	15,803(87.0)	16,753 (71.3)	11,360(82.1)	7,442(52.9)
	Rail	2,351(13.0)	6,753 (28.7)	2,481(17.9)	6,636(47.1)
11 Petroleum	Road	6,808(85.8)	6,850 (82.0)	1,961(76.7)	1,615(62.8)
	Rail	1,128(14.2)	1,508 (18.0)	596(23.3)	958(37.2)
19 Other Dry Cargo	Road	47,318(86.1)	48,164 (80.9)	23,578(77.5)	17,625(57.4)
	Rail	7,644(13.9)	11,364 (19.1)	6,829(22.5)	13,086(42.6)

Source: JICA Study Team estimation

Table 3-1-7 Passenger Modal Split by Class

(1999/2000)

Class		Passenger ('000')		Passenger-km (Million)	
		Case A	Case B	Case A	Case B
Lower	Road	508,587 (77.7)	533,636 (81.5)	84,281 (65.0)	83,630 (64.5)
	Rail	146,195 (22.3)	121,146 (18.5)	45,310 (35.0)	45,937 (35.5)
Upper	Road	89,394 (98.1)	89,580 (98.3)	13,630 (91.0)	13,542 (90.4)
	Rail	1,721 (1.9)	1,535 (1.7)	1,352 (9.0)	1,440 (9.6)
Sum	Road	597,981 (80.2)	623,215 (83.6)	97,910 (67.7)	97,172 (67.2)
	Rail	147,915 (19.8)	122,681 (16.4)	46,663 (32.3)	47,377 (32.8)

Source: JICA Study Team estimation

Fig. 3-1-4(1) Comparison between Traffic Count and Simulation

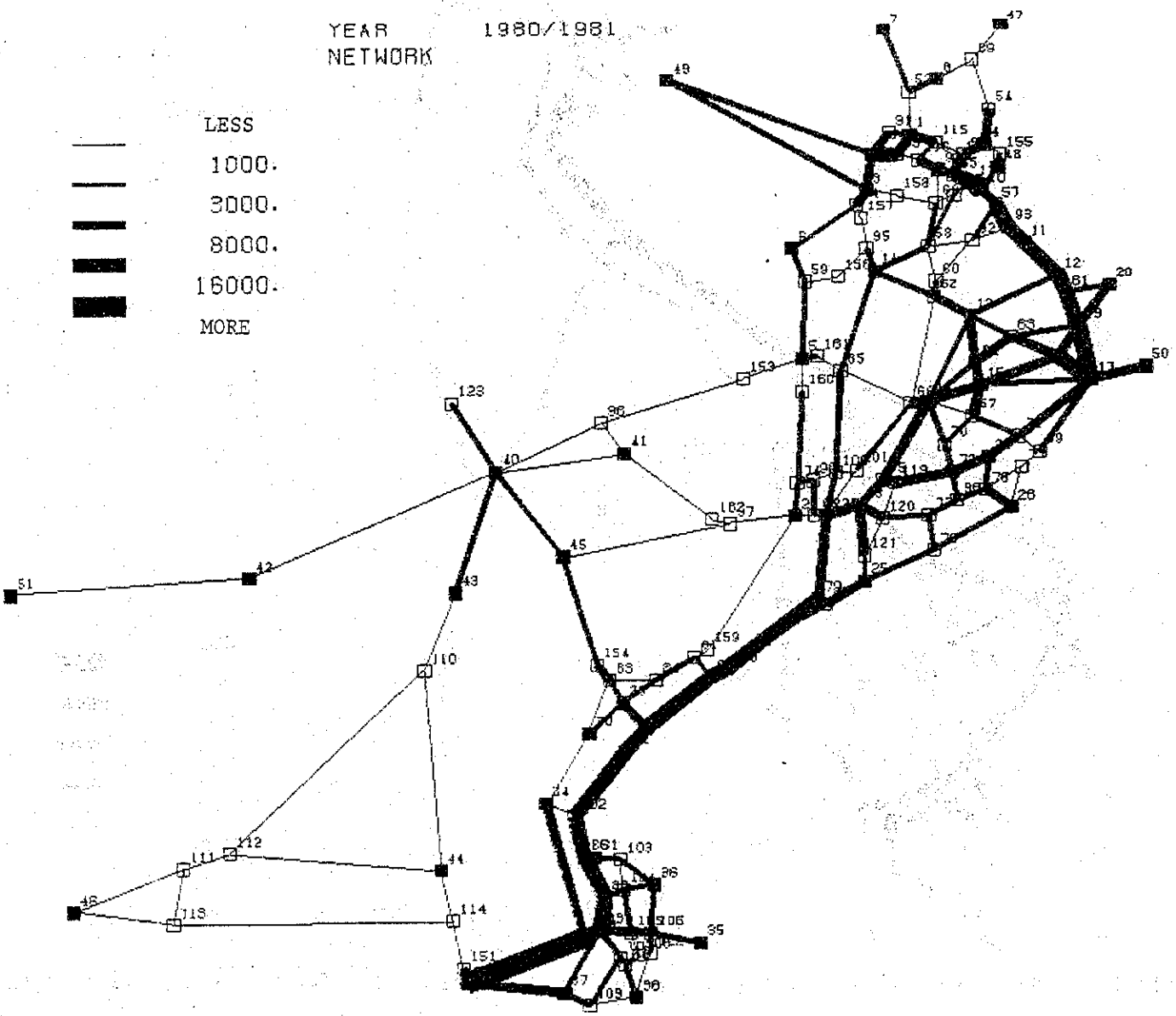
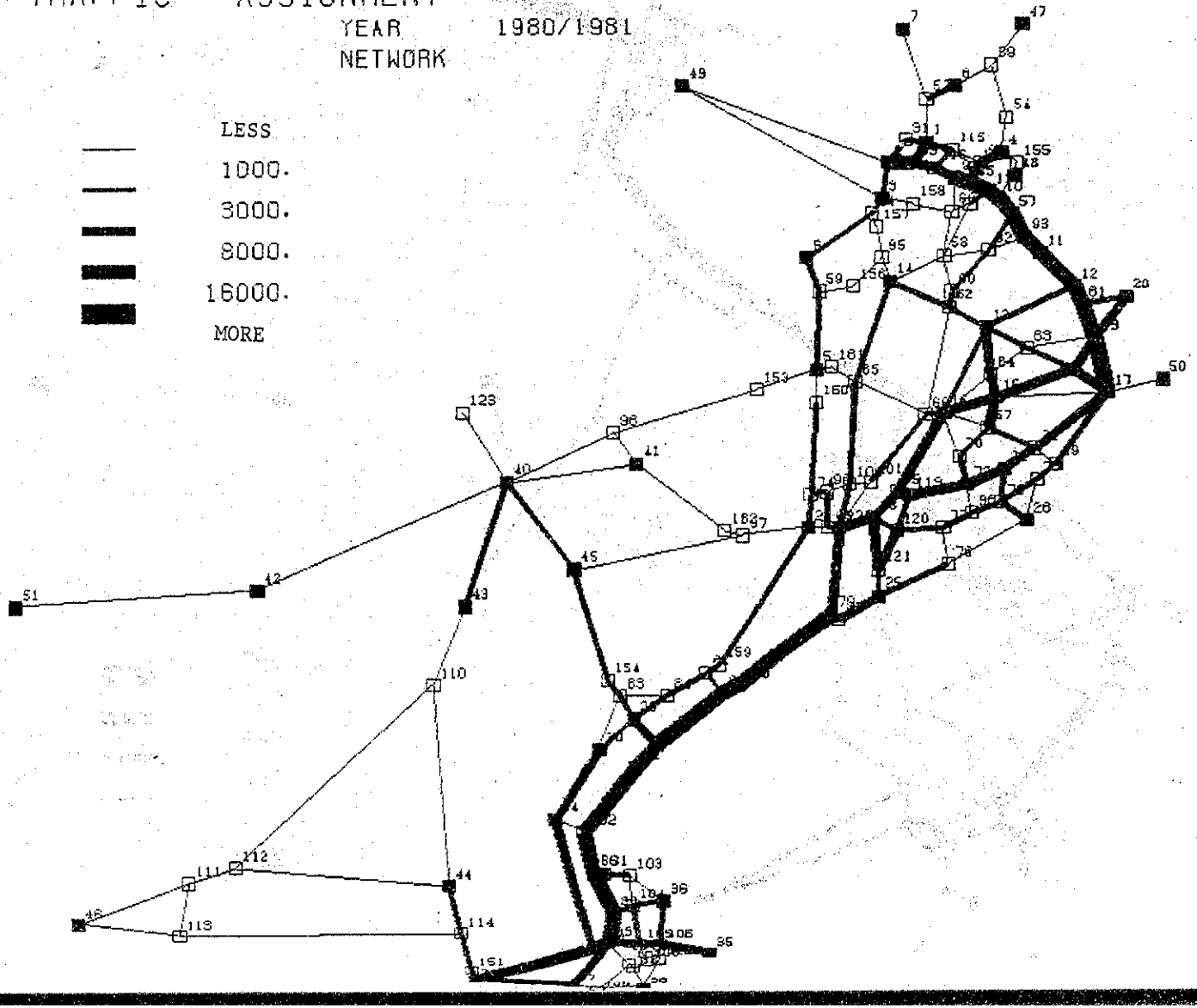


Fig. 3-1-4(2) Comparison between Traffic Count and Simulation



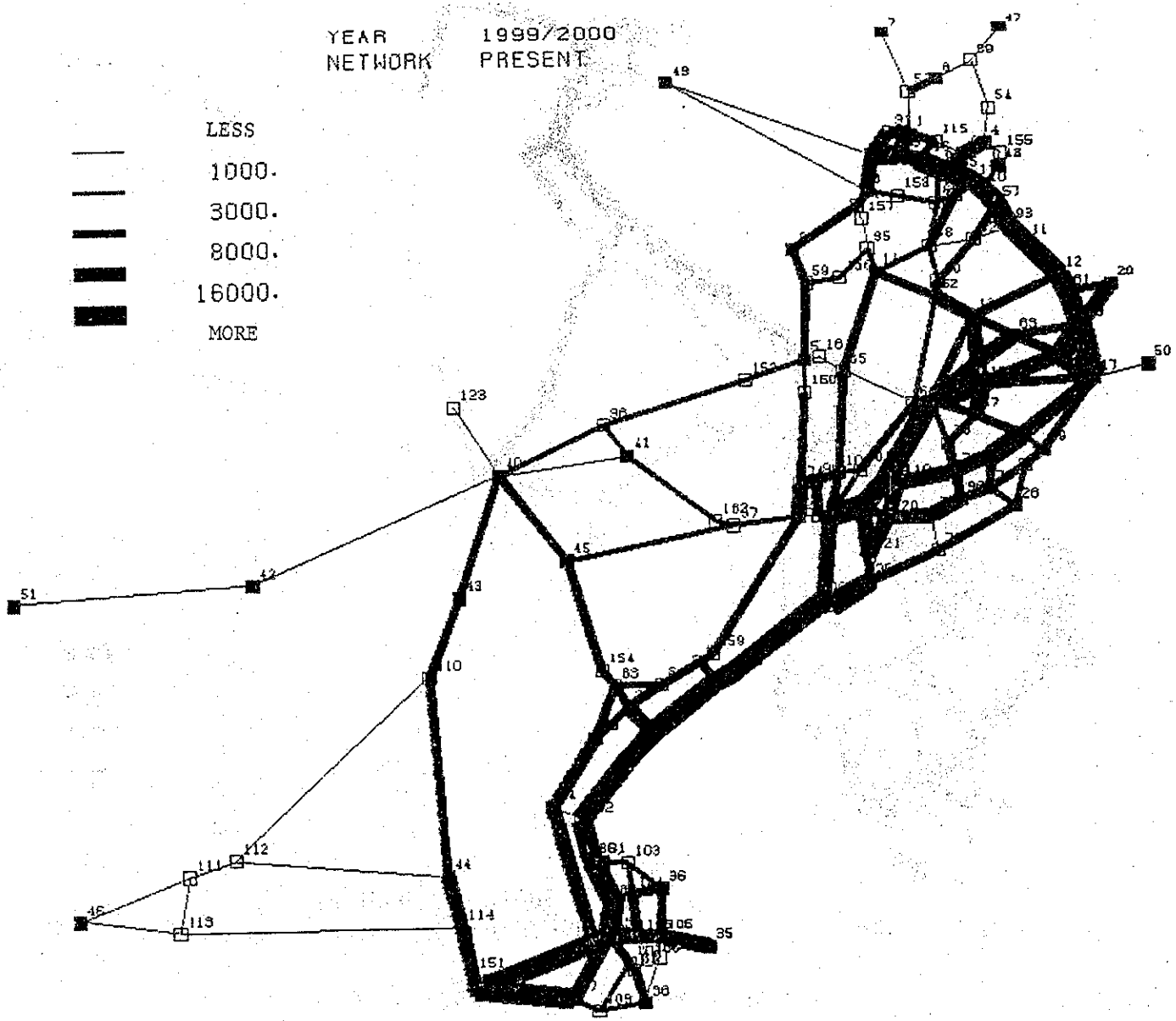
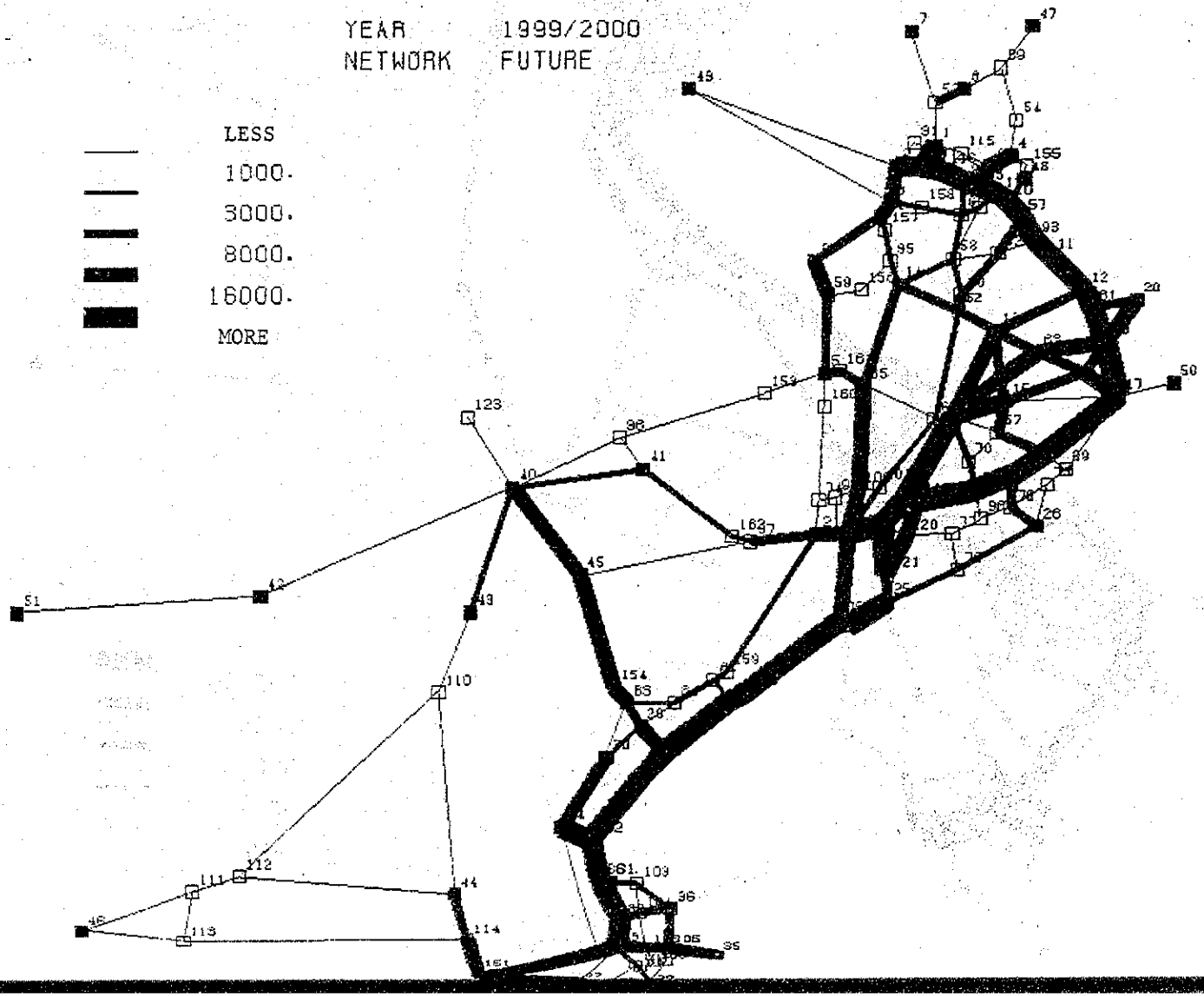

YEAR 1999/2000
NETWORK PRESENT
LESS
1000.
3000.
8000.
16000.
MORE

Fig. 3-1-5(2) Traffic Assignment (Case A)



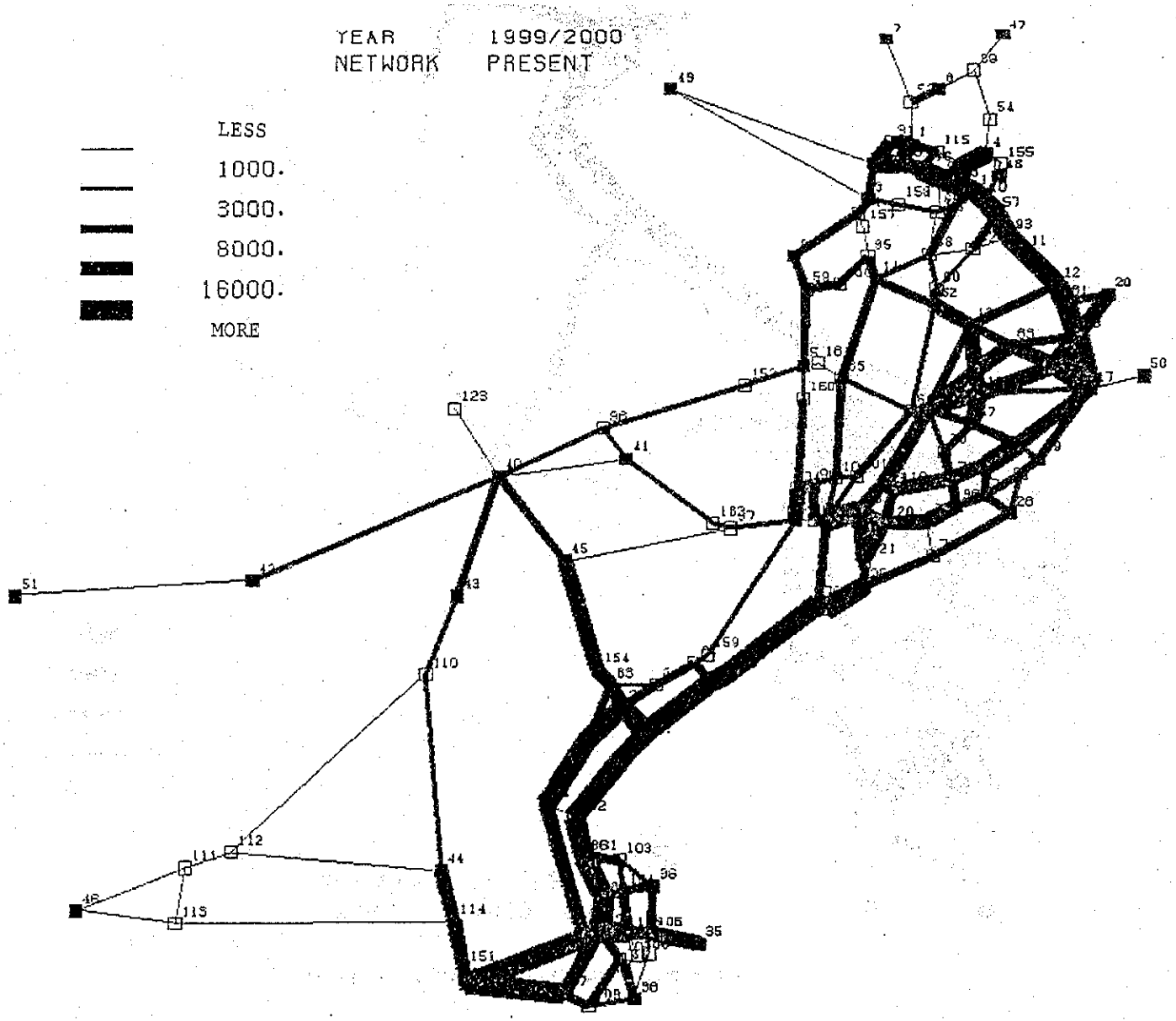
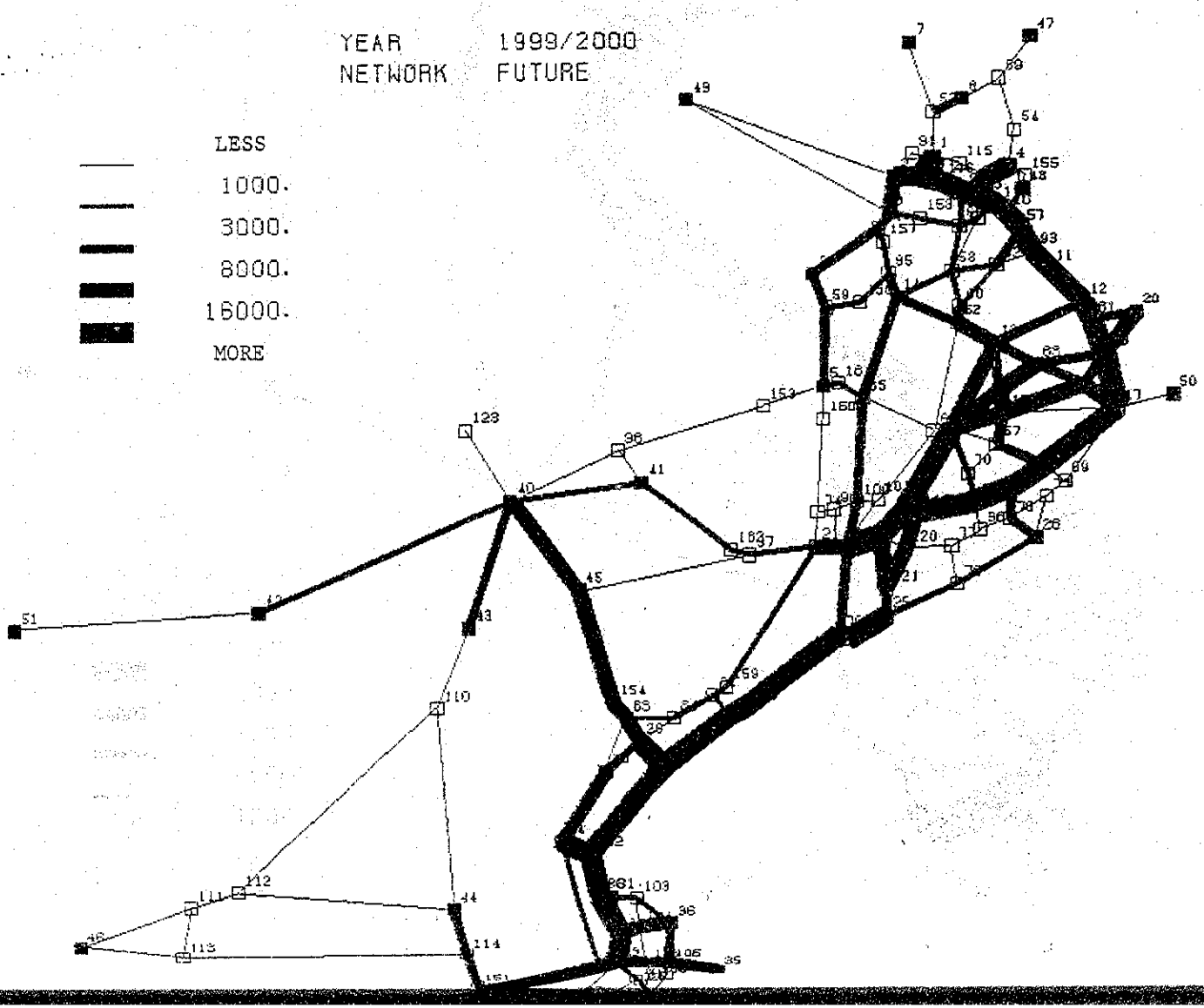

YEAR 1999/2000
NETWORK PRESENT
LESS
1000.
3000.
8000.
16000.
MORE

Fig. 3-1-6(2) Traffic Assignment (Case B)



3-2 Sea Traffic

(1) Methodology

Present trade matrix was projected to the target year with the result of trade projection, assuming that distribution by area might not change for each commodity.

It is noted that the following aggregation was done for commodity classification.

(Trade Matrix)	(Trade Projection)
Fertilizers;	Fertilizers, Phosphate Rock/Sulpher
Coal & Ores;	Coal, Iron Ore
Others;	Sugar, Iron & Steel, Other Dry Cargo

(2) Results

Tables 3-2-1, 3-2-2 show the estimation results of trade matrix at the target years.

3-3 Air Traffic

(1) Methodology

1) Passenger

The projection flow of air passenger traffic is shown in Fig. 3-3-1. The characteristics of projection system are the top down method, based on the macro-economic framework. The outputs are (1) domestic passenger OD, (2) international passenger OD and (3) passengers by new airports.

As for domestic passengers, embarked/disembarked passengers by airports were projected with time trend, as shown in previous section. After adjustment to the macroscopic traffic demand forecasting, distribution was projected with Fratar method, based on the present pattern.

Similar method was applied to the international passengers, considering the transit passengers at Karachi Airport.

New airports are expected to function mostly as feeder airports, and the passenger traffic was projected with the analogy to similar airports, based on the basic unit of passengers per population.

2) Freight

The projection flow of air freight traffic is shown in Fig. 3-3-2. The outputs are (1) domestic traffic by airport and (2) international traffic by airport or by area.

As the ratio of freight by passenger is stable as shown in previous section, domestic traffic was projected with this basic unit, applying the results of passenger projection. The international traffic was projected with the similar method as the passenger traffic.

(2) Results

1) Passenger

The projection results of domestic passenger traffic are summarized in Table 3-3-1. The total passengers grow about 3 times more than present. Among the major airports, Peshawar and Multan have comparatively high growth rate. The growth rate of D.I. Khan, Saidu Sharif and Moenjodaro is high among the others. Oppositely, Hyderabad, Nawabshah, Jiwani and Sui have low growth rate.

Fig. 3-3-3 shows the desire lines for domestic passengers. The trunk routes are found to have the heavy duties.

The projection results of international passenger traffic are summarized in Table 3-3-2. Middle East & Africa has the largest share, and India-subcontinent has comparatively high growth rate.

Transit passengers at Karachi Airport were projected with the following regression equation.

$$\ln T = \underset{(7.0)}{6.13} + \underset{(7.4)}{0.473} \cdot \ln P \qquad (r = 0.941)$$

where, T: Number of Transit Passengers
P: Number of Embarked and Disembarked Passengers for International
Period: 1972/73-1980/81

Table 3-2-1 Pakistan's Cargo Movement by Area and Type of Cargo

-- EXPORT --
1987 / 1988

Unit:1,000M/T

	1 EUROPE	2 ASIA	3 MIDDLE EAST	4 AFRICA	5 SOUTH AMERICA	6 NORTH AMERICA	7 OCEANIA	(TOTAL)
1. WHEAT	0.	0.	0.	0.	0.	0.	0.	0.
2. CEMENT	1155.	298.	12.	1.	0.	1.	0.	1467.
3. FERTILIZERS	0.	0.	0.	0.	0.	0.	0.	0.
4. RICE	31.	131.	543.	690.	197.	1.	0.	1593.
5. COAL & ORES	0.	0.	0.	0.	0.	0.	0.	0.
6. PETROLS	0.	876.	822.	0.	34.	0.	93.	1825.
7. MOLASSES	400.	5.	1.	0.	0.	0.	0.	406.
8. EDIBLE & TALLOW	0.	0.	0.	0.	0.	0.	0.	0.
9. COTTON	10.	322.	1.	0.	1.	0.	0.	334.
10. OTHERS	588.	121.	688.	0.	1.	375.	0.	1773.
(TOTAL)	2184.	1753.	2066.	691.	233.	378.	93.	7398.

-- IMPORT --
1987 / 1988

	1 EUROPE	2 ASIA	3 MIDDLE EAST	4 AFRICA	5 SOUTH AMERICA	6 NORTH AMERICA	7 OCEANIA	(TOTAL)
WHEAT	141.	0.	0.	0.	0.	328.	58.	527.
CEMENT	0.	0.	0.	0.	0.	0.	0.	0.
FERTILIZERS	595.	8.	366.	0.	0.	501.	0.	1471.
RICE	0.	0.	0.	0.	0.	0.	0.	0.
COAL & ORES	728.	408.	645.	206.	199.	735.	470.	3390.
PETROLS	87.	67.	8375.	0.	0.	3.	0.	8533.
MOLASSES	0.	0.	0.	0.	0.	0.	0.	0.
EDIBLE & TALLOW	38.	288.	2.	0.	96.	261.	0.	685.
COTTON	0.	0.	0.	0.	0.	0.	0.	0.
OTHERS	913.	1470.	15.	61.	47.	12.	103.	2621.
(TOTAL)	2501.	2241.	9402.	267.	342.	1840.	632.	17227.

Table 3-2-2 Pakistan's Cargo Movement by Area and Type of Cargo

-- EXPORT --
1999 / 2000

Unit:1,000M/T

		1 EUROPE	2 ASIA	3 MIDDLE EAST	4 AFRICA	5 SOUTH AMERICA	6 NORTH AMERICA	7 OCEANIA	(TOTAL)
1.	WHEAT	172.	0.	0.	0.	0.	400.	71.	643.
2.	CEMENT	1739.	448.	18.	1.	0.	2.	0.	2208.
3.	FERTILIZERS	116.	66.	100.	0.	0.	0.	0.	282.
4.	RICE	58.	246.	1021.	1299.	370.	2.	1.	2998.
5.	COAL & ORES	0.	0.	0.	0.	0.	0.	0.	0.
6.	PETROLS	0.	2130.	1997.	0.	83.	0.	225.	4436.
7.	MOLASSES	568.	7.	2.	0.	0.	0.	0.	577.
8.	EDIBLE & TALLOW	0.	0.	0.	0.	0.	0.	0.	0.
9.	COTTON	15.	475.	1.	0.	1.	0.	0.	492.
10.	OTHERS	1288.	265.	1508.	0.	3.	821.	0.	3885.
	(TOTAL)	3957.	3638.	4645.	1301.	457.	1225.	297.	15521.

-- IMPORT --
1999 / 2000

		1 EUROPE	2 ASIA	3 MIDDLE EAST	4 AFRICA	5 SOUTH AMERICA	6 NORTH AMERICA	7 OCEANIA	(TOTAL)
1.	WHEAT	0.	0.	0.	0.	0.	0.	0.	0.
2.	CEMENT	0.	0.	0.	0.	0.	0.	0.	0.
3.	FERTILIZERS	1148.	16.	706.	0.	0.	967.	1.	2838.
4.	RICE	0.	0.	0.	0.	0.	0.	0.	0.
5.	COAL & ORES	728.	408.	645.	206.	199.	735.	470.	3390.
6.	PETROLS	184.	142.	17810.	0.	0.	7.	0.	18146.
7.	MOLASSES	0.	0.	0.	0.	0.	0.	0.	0.
8.	EDIBLE & TALLOW	35.	267.	2.	0.	89.	242.	0.	636.
9.	COTTON	0.	0.	0.	0.	0.	0.	0.	0.
10.	OTHERS	1448.	2332.	23.	97.	75.	19.	164.	4158.
	(TOTAL)	3543.	3165.	19185.	303.	363.	1971.	634.	29168.

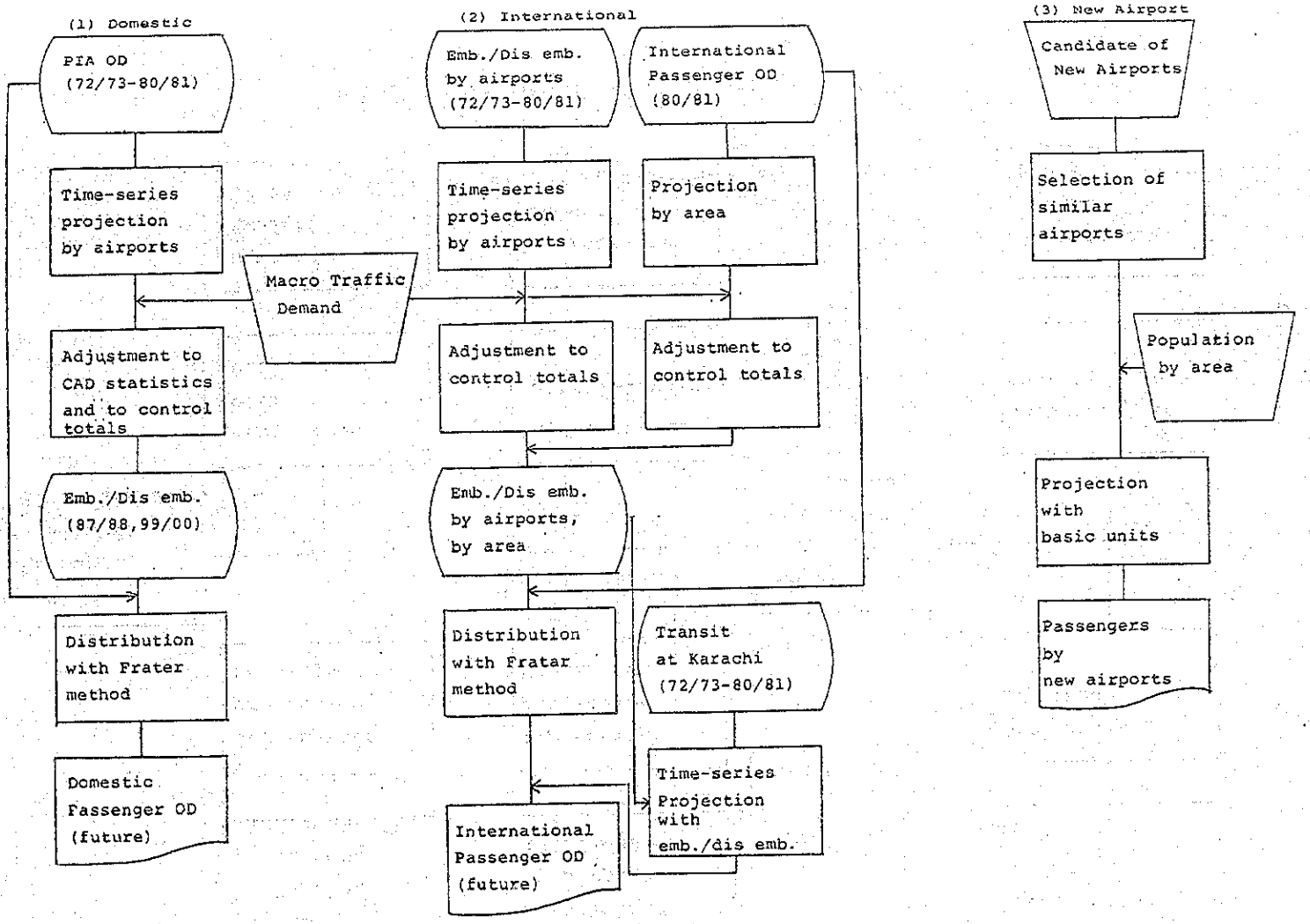


Fig. 3-3-1 Projection Flow of Air Passenger Traffic

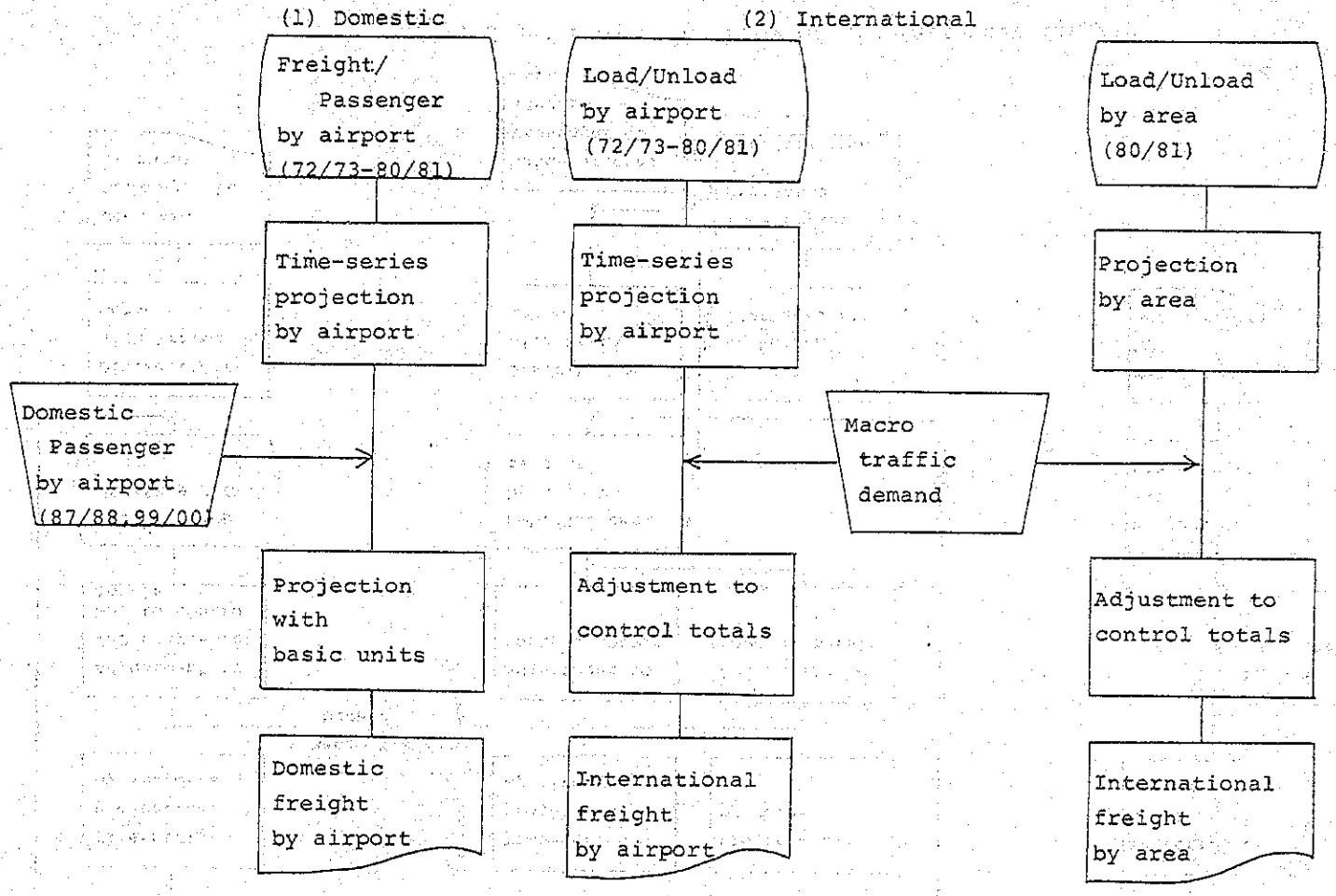


Fig. 3-3-2 Projection Flow of Air Freight Traffic

Table 3-3-1 Projection of Domestic Passenger Traffic

(Passenger)

CODE	AIRPORT	1980-81			1987-88			1999-2000			Ratio
		Embarked	Disembarked	TOTAL	Embarked	Disembarked	TOTAL	Embarked	Disembarked	TOTAL	1999/1980
	N W F P										
1	PESHAWAR	90,564	80,797	171,361	184,688	164,772	349,460	304,304	271,437	575,741	3.36
2	D.I. KHAN	9,175	8,818	17,993	23,018	22,132	45,150	41,344	39,744	81,088	4.51
3	SAIDU SHARIF	7,490	5,582	13,072	16,587	12,363	28,950	27,905	20,796	48,701	3.73
4	CHITRAL	9,352	9,420	18,772	17,815	17,942	35,757	28,595	28,791	57,386	3.06
	PUNJAB										
7	ISLAMABAD	330,870	334,092	664,962	601,783	608,130	1,209,913	975,004	985,092	1,960,096	2.95
8	LAHORE	403,990	391,349	795,339	751,092	727,715	1,478,807	1,224,445	1,186,105	2,410,550	3.03
9	FAISALABAD	27,687	27,253	54,940	53,537	52,736	106,273	88,968	87,621	176,589	3.21
10	MULTAN	55,357	56,863	112,220	119,315	122,570	241,885	200,976	206,420	407,396	3.63
	SIND										
11	KARACHI	633,253	659,395	1,292,648	1,162,268	1,210,829	2,373,097	1,969,260	2,051,137	4,020,397	3.11
12	HYDERABAD	789	967	1,756	831	1,019	1,850	841	1,031	1,872	1.07
13	NAWABSHAH	3,228	3,057	2,631	1,870	2,148	4,018	3,110	3,570	6,680	2.54
14	MOENJODARO	7,193	6,259	13,452	16,381	14,251	30,632	27,400	23,832	51,232	3.81
15	SUKKUR	7,475	7,301	14,776	15,075	14,724	29,799	25,977	25,370	51,347	3.48
	BALUCHISTAN										
16	QUETTA	60,951	58,796	119,747	117,342	113,198	230,540	202,758	195,561	398,319	3.33
17	PANJGUR	5,545	4,772	10,317	11,410	9,816	21,226	19,659	16,909	36,568	3.54
18	TURBAT	14,174	13,028	27,202	29,154	26,809	55,963	52,400	48,178	100,578	3.70
19	PASNI	6,277	6,259	12,536	14,357	14,309	28,666	22,314	22,234	44,548	3.55
20	GWADAR	13,368	11,066	24,434	26,400	21,842	48,242	43,565	36,035	79,600	3.26
22	JIWANI	2,272	2,049	4,321	4,047	3,652	7,699	6,486	5,851	12,337	2.86
23	SUI	3,228	3,057	6,285	5,335	5,055	10,390	8,351	7,912	16,263	2.59
	TOTAL	1,708,145	1,708,672	3,413,163	3,211,416	3,211,416	6,422,832	5,335,273	5,335,273	10,670,546	3.13

Source: JICA Study Team estimation

Note: Total includes the airports of Gilgit and Skardu

Fig. 3-3-3 Desire Lines for Air Passenger

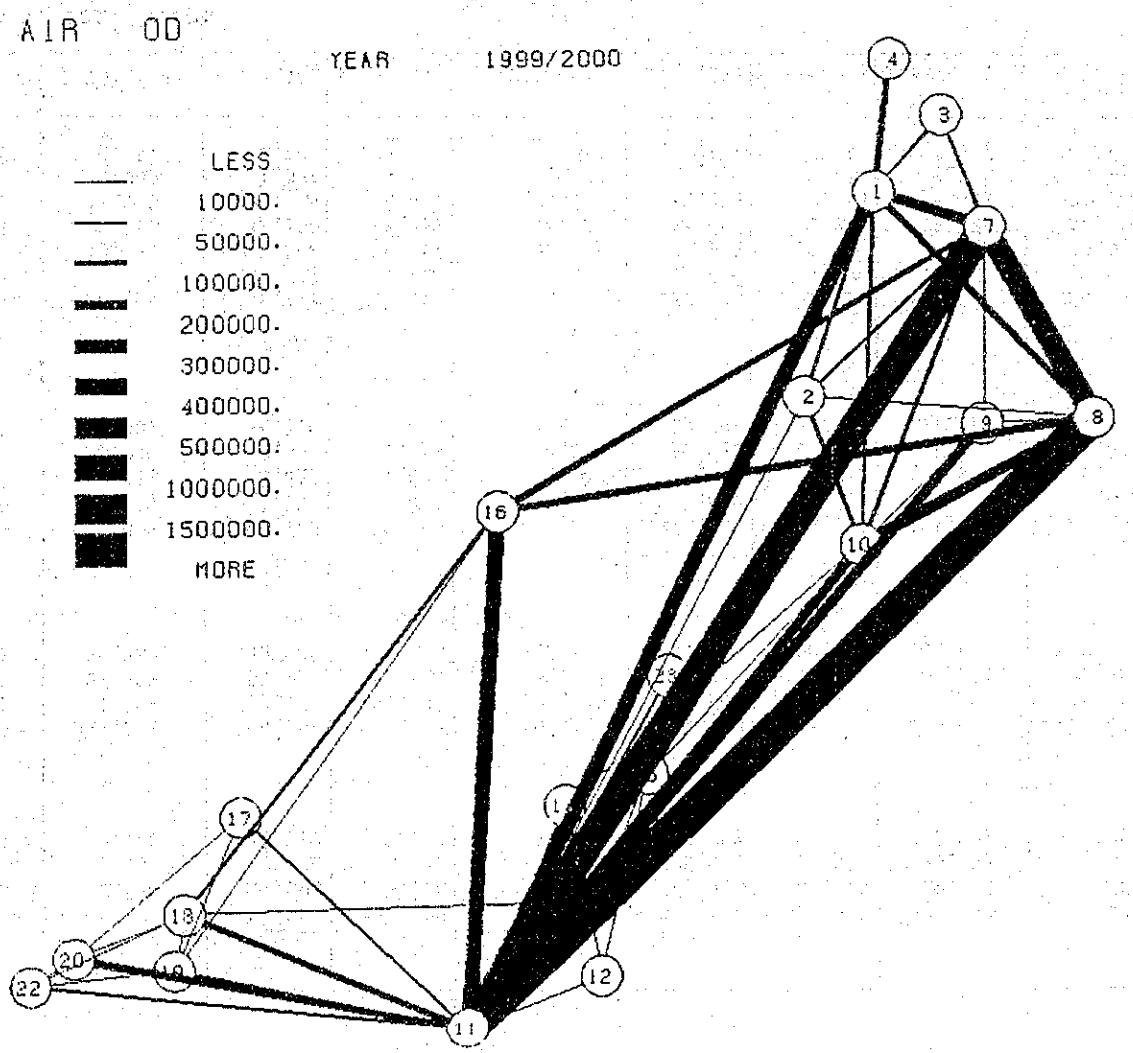


Table 3-3-2 Projection of International Passenger Traffic

(1) 1980-81 (Passenger)

AIRPORT	MIDDLE EAST & AFRICA	EUROPE	FAR EAST	INDIA	TOTAL
PESHAWAR	6,579	0	0	0	6,579
ISLAMABAD	97,967	99,142	6,553	0	203,662
LAHORE	29,664	0	0	19,974	49,638
KARACHI	1,116,699	337,810	303,248	323,249	2,081,006
GWADAR	2,890	0	0	0	2,890
TOTAL	1,253,799	436,952	309,801	343,223	2,343,775

(2) 1987-88

AIRPORT	MIDDLE EAST & AFRICA	EUROPE	FAR EAST	INDIA	TOTAL
PESHAWAR	15,317	0	0	0	15,317
ISLAMABAD	176,707	183,187	11,908	0	371,803
LAHORE	52,663	0	0	46,928	99,591
KARACHI	1,741,888	539,744	476,616	667,267	3,425,517
GWADAR	4,292	0	0	0	4,292
TOTAL	1,990,867	722,932	488,525	714,196	3,916,520

(3) 1999-2000

AIRPORT	MIDDLE EAST & AFRICA	EUROPE	FAR EAST	INDIA	TOTAL
PESHAWAR	29,791	0	0	0	29,791
ISLAMABAD	302,777	303,044	21,947	0	627,769
LAHORE	91,601	0	0	94,164	185,765
KARACHI	2,905,292	869,274	855,107	1,283,856	5,913,534
GWADAR	6,905	0	0	0	6,905
TOTAL	3,336,369	1,172,319	877,055	1,378,021	6,763,764

Source: JICA Study Team estimation

Transit passengers were found to have strong correlation with the international passengers. Table 3-3-3 shows the projection results.

Table 3-3-3 Transit Passenger at Karachi Airport (passenger)

Year	Emb. & Disemb.	Transit
1980/81	2,081,006	451,250
1987/88	3,425,517	564,898
1999/00	5,913,534	731,242

Source: JICA Study Team estimation

The projection results of passenger traffic at new airports are summarized in Table 3-3-4 , together with the basic unit of passengers per urban population, which was estimated from the similar airports. It is found that the traffic demand is not so large as the existing airports.

2) Freight

Table 3-3-5 and Table 3-3-6 show the projection results of domestic and international freight traffic, respectively. International traffic has higher growth rate than domestic, and the share of Karachi Airport in international traffic is about 80%.

(3) Cross Check of the Projection Results

1) Domestic Passenger and Population

The projection result of domestic passenger was cross checked with the growth rate of the urban population, as follows.

$$a = \left\{(T_{80} - T_{72})/T_{72}\right\} / \left\{(P_{80} - P_{72})/P_{72}\right\}$$

$$T_i = T_{72}\left\{1 + a\cdot(P_i - P_{72})/P_{72}\right\}$$

where

T_i: Emb./disemb. passengers in i-th year

P_i: Urban population in i-th year

The result is summarized in Table 3-3-7, where the estimates with the above formula are compared with the projection results. The difference between the two method is less than 20% for almost all airports. These results indicate the justification of the projection methodology.

2) High Growth Case for Major Airports

Recent years, the growth of domestic passenger traffic at major airports becomes less steep. This is thought to be mainly because of price elasticity and capacity constraint. Therefore, time-series projection was tried, removing the data of recent 3 years. These results are considered to be the upper limit of domestic passenger traffic, and summarized in Table 3-3-8 .

The projection results show 10 - 30% more than the traffic demand of the standard case.

3) Modal Split between Air and Land Transport

Table 3-3-9 shows the modal split between air and land transport for the major origin-destination pairs. Though the projection of air and land traffic was done independently, the modal split seems to be stable.

Table 3-3-4 Projection of Passenger Traffic at New Airports

(Passenger)

Code	AIRPORT	TERRAIN	1980-81	1987-88	1999-00	Similar Airport	Assumed Destination
1	BANNU	Mountainainous	2,582 (41.65)	5,116 (66.45)	7,587 (83.38)	SAIDU SHARIFF CHITRAL	PESHAWAR
2	SARGODHA	Flat	12,961 (19.91)	33,306 (36.56)	66,078 (52.61)	D.I.KHAN	ISLAMABAD
3	D.G. KHAN	Flat	2,953 (15.97)	5,722 (22.62)	8,844 (26.09)	SUI MULTAN	KARACHI
4	BAHAWALPUR	Flat	5,236	10,179	15,862	SUI MULTAN	KARACHI
5	RAHIMYAR KHAN	Flat	4,773	10,201	17,402	SUI MULTAN	KARACHI
6	ZHOB	Mountainainous	1,392 (42.21)	2,285 (55.75)	3,469 (68.02)	TURBAT	QUETTA
7	SIBI	Flat	374 (13.36)	770 (16.75)	1,302 (18.09)	SUI	KARACHI
8	KHUZDAR	Mountainainous	6,653 (214.62)	13,980 (303.92)	25,138 (386.75)	TURBAT	KARACHI
9	ORMARA (GWADAR)	Flat	3,741 (89.08)	7,739 (124.83)	12,260 (137.76)	JIWANI PASNI	KARACHI

Note: The figures in the brackets show the basic unit of passengers per urban population.

Source: JICA Study Team estimation

Table 3-3-5 Projection of Domestic Freight Traffic

(tons)

AIRPORT	1980-81	1987-88	1999-00
PESHAWAR	433.0	1151.9	1896.4
D.I. KHAN	13.9	40.9	73.3
SAIDU SHARIF	7.3	17.4	29.1
CHITRAL	43.4	112.1	179.7
ISLAMABAD	6717.6	12237.2	19811.0
LAHORE	7808.4	18537.6	30196.7
FAISALABAD	111.0	362.5	602.0
MULTAN	317.3	875.4	1473.3
KARACHI	14956.6	34033.9	57619.1
HYDERABAD	6.8	8.9	9.0
NAWABSHAH	2.3	7.7	12.7
MOENJODARO	50.7	106.2	177.4
SUKKUR	17.3	39.9	68.7
QUETTA	462.2	989.4	1708.2
PANJGUR	2.5	10.3	17.6
TURBAT	56.0	115.6	207.4
PASNI	84.5	117.5	182.5
GWADAR	98.5	196.4	323.8
JIWANI	11.0	14.4	23.0
SUI	13.2	32.9	51.5
TOTAL	31213.5	69008.1	114662.4

Source: JICA Study Team estimation

Table 3-3-6 Projection of International Freight Traffic

(1) Freight by Airport (tons)

AIRPORT	1980/81	1987/88	1999/2000
PESHAWAR	697	1,053	2,569
ISLAMABAD	10,097	19,730	44,472
LAHORE	2,574	6,605	17,874
KARACHI	50,395	103,457	247,800
T O T A L	63,763	130,845	312,715

(2) Freight by Area (tons)

YEAR	MIDDLE EAST	EUROPE	FAR EAST	INDIA	TOTAL
1980/81	9,770	34,439	17,032	2,522	63,763
1987/88	20,048	70,672	34,951	5,174	130,845
1999/2000	47,913	168,903	83,532	12,367	312,715

Source: JICA Study Team estimation

Table 3-3-7 Cross Check of Domestic Passengers with Urban Population

CODE	AIRPORT	URBAN POPULATION('000')		PASSENGER		1987 - 88			1999 - 2000		
		1972 - 73	1980-81	1972-73	1980-81	T_{87}	X_{87}	X_{87}/T_{87}	T_{99}	X_{99}	X_{99}/T_{99}
N W F P											
1	PESHAWAR	562	836	59,076	171,361	317,693	349,460	1.10	516,882	575,741	1.11
2	D.I.KHAN	100	116	1,797	17,993	46,336	45,150	0.97	76,704	81,088	1.06
3	SAIDU SHARIF	66	88	0	13,072	--	28,950	--	--	48,701	--
4	CHITRAL	159	208	6,036	18,772	27,607	35,757	1.30	46,579	57,386	1.23
PUNJAB											
7	ISLAMABAD	898	1,361	237,341	664,962	1,215,288	1,209,913	1.00	1,970,680	1,960,096	0.99
8	LAHORE	1,987	2,958	265,570	795,339	1,484,384	1,478,807	1.00	2,420,590	2,410,550	1.00
9	FAISALABAD	1,028	1,420	18,390	54,940	104,728	106,273	1.01	169,715	176,589	1.04
10	MULTAN	639	1,098	33,697	112,220	208,701	241,885	1.16	346,582	407,396	1.18
SIND											
11	KARACHI	3,507	5,103	328,252	1,292,648	2,563,468	2,373,097	0.93	4,274,777	4,020,397	0.94
12	HYDERABAD	828	955	2,994	1,756	x	1,850	x	x	1,872	x
13	NAWABSHAH	186	266	1,148	2,631	4,595	4,018	0.87	7,246	6,680	0.92
14	MOENJODAR	179	255	3,300	13,452	27,075	30,632	1.13	45,106	51,232	1.14
15	SUKKUR	256	338	4,502	14,776	29,437	29,799	1.01	47,856	51,347	1.07
BALUCHISTAN											
16	QUETTA	190	285	22,428	119,747	238,570	230,540	0.97	397,347	398,319	1.00
17	PANJGUR	5	10	1,101	10,317	19,533	21,226	1.09	36,122	36,568	1.01
18	TURBAT	32	52	0	27,202	--	55,963	--	--	100,578	--
19	PANSI	25	42	4,043	12,536	22,526	28,666	1.27	36,014	44,548	1.24
20	GWADAR	25	42	3,574	24,434	45,443	48,242	1.06	73,808	79,600	1.08
22	JIWANI	25	42	1,202	4,321	7,991	7,699	0.96	12,944	12,337	0.95
23	SUI	113	178	3,107	6,285	8,973	10,390	1.16	14,351	16,263	1.13

Note: T (Estimation with urban population). X (Estimation with projection system).
Source: JICA Study Team estimation

Table 3-3-8 Domestic Passenger Traffic at Major Airports (High Growth Case)

(Passenger)

CODE	AIRPORT	1980-81	1987-88	1999-00
1	PESHAWAR	171,361	440,755	750,176
7	ISLAMABAD	664,962	1,463,552	2,474,451
8	LAHORE	795,339	1,656,866	2,799,568
11	KARACHI	1,292,648	2,528,303	4,300,720
16	QUETTA	119,747	279,906	492,287
20	GWADAR	24,434	72,687	126,220

Source: JICA Study Team estimation.

Table 3-3-9 Modal Split between Air and Land Transport

'000' passengers (%)

Origin-Destination	Mode	1980/1981	1987/1988	1999/2000 case1	1999/2000 case 2
Karachi -- Lahore	Sum	2,984 (100)	5,665 (100)	11,125 (100)	11,324 (100)
	Air	464 (15.5)	991 (17.5)	1,661 (14.9)	1,860 (16.4)
	Land	2,520 (84.5)	4,674 (82.5)	9,464 (85.1)	9,464 (83.6)
Karachi -- Islamabad	Sum	1,042 (100)	1,988 (100)	3,773 (100)	3,971 (100)
	Air	338 (32.4)	692 (34.8)	1,163 (30.8)	1,361 (34.3)
	Land	704 (67.6)	1,296 (65.2)	2,610 (69.2)	2,610 (65.7)
Karachi --Peshawar	Sum	386 (100)	746 (100)	1,481 (100)	1,534 (100)
	Air	70 (18.1)	162 (21.7)	279 (18.8)	332 (21.6)
	Land	316 (81.9)	584 (78.3)	1,202 (81.2)	1,202 (78.4)
Karachi -- Quetta	Sum	355 (100)	637 (100)	1,194 (100)	1,233 (100)
	Air	65 (18.3)	135 (21.2)	244 (20.4)	283 (23.0)
	Land	290 (81.7)	502 (78.8)	950 (79.6)	950 (77.1)
Lahore -- Islamabad	Sum	7,160 (100)	11,880 (100)	21,951 (100)	22,042 (100)
	Air	152 (2.1)	290 (2.4)	435 (2.0)	526 (2.4)
	Land	7,008 (97.9)	11,590 (97.6)	21,516 (98.0)	21,516 (97.6)

Note: Case1(Normal growth case for air traffic), Case2(High growth case for air traffic).

Source: JICA Study Team estimation

V. BASIC CONCEPT AND POLICY/STRATEGY FOR TRANSPORT SYSTEM DEVELOPMENT

V. BASIC CONCEPT AND POLICY/STRATEGY FOR TRANSPORT SYSTEM DEVELOPMENT

1. Basic Concept for Transport Planning

The significance of transport to the normal life of a country and its development lies fundamentally in the fact that mobility and accessibility are essential to the achievement of nearly every other aspects of economic growth. Transport plays an important role in making land more productive, in marketing farm products, in exploiting minerals and forests, in developing new industries and in export and import trade. It is also a critical element in achieving social objectives, in the successful implementation of health and education programmes and in cultural exchanges.

The main objectives of transport planning is that the implementation of the plan should not only contribute to the stable, steady and safe movement of goods and persons, but also to the economic growth directly, i.e. to achieving a higher rate of increase of production and per capita income, creation and promotion of local markets, transport of agricultural commodities and to facilitating of social contacts and educational activities.

Therefore, it is necessary to make a careful determination of the share of a nation's resources that should be devoted to transport development, in order to accomplish the desired goals set forth by the transport needs projected and the policy and strategy to be taken. Since transport planning has to deal with existing resources as well as those which will become available in future, the first approach shall be the planning how available facilities can be used most efficiently, and the second is how investment in additional facilities should be made with minimum use of resources while satisfying the planned objectives.

2. Financial Framework for Transport Development

2-1 Overall Framework of ADP Budget in the Future

The Government of Pakistan has persistently made strenuous efforts to provide the people with fundamental socio-economic requirements in spite of the fact that the financial resources for national development is domestically limited.

Not a single sector of those which the government designates as the realms of importance for development efforts is allowed to be unduly favored at the expense of others because they together form an integrated whole to be developed in a balanced manner.

As is already mentioned, the share of Transport Sector in the Annual Development Programme has been on the average around sixteen percent. It means that in terms of the percentage of GNP public expenditure on the Sector has been about 1.6 percent. And in terms of the percentage of GDP it has been more or less 1.8 percent. With communications combined the ratio to GDP has been around 2.1 percent.

Hereunder, the study team will determine the overall framework of ADP budget for Transport in the future periods by way of three different approaches.

(1) International Comparison

Pakistan had in 1978 a population of 76,340 thousand and GDP amounting to 20,497 million dollars (at 1981 prices). She has a surface area of 804 thousand square km.

The study team tried to pick out the countries with a population of more than 10,000 thousand and at the same time with a surface area of more than 100 thousand square km as of 1978 to make a statistical comparison and a statistical analysis. It found that there were in all forty countries meeting the above conditions excluding the communist block, of which five were dropped on account of unavailability of financial data. Also, Sri Lanka with the surface area of less than 100 thousand square km was added to the list because of her proximity to Pakistan in geographical and other terms.

In short, thirty six countries were selected to be subjected to statistical observation. (Refer to Table 2-1-1.)

First, the study team examined whether the amount of public expenditure on T & C sector Pakistan yearly allocates is up to the international standard by a simple, arithmetical method. It divided the said expenditure by GDP, population, surface area, etc for each country using the latest statistics available.

As you see in Table 2-1-1, the public expenditure on T & C sector measured in comparison with GDP is in Pakistan 2.01 percent, while in the developing countries as a whole it is 1.95 percent, and in the Asian developing countries it is on the average 1.85 percent. It is thus clarified that Pakistan spends on the said sector a little more than an economy of the same size.

When it is viewed in relation to surface area, it is found that in Pakistan 512 dollars were spent per square km, and in the Asian developing countries 1,023 dollars were expended on the average. So, it can be said that in terms of land space public spending on T & C is in the country considerably lower than the international standard.

Again, when it is assessed in reference to the size of population, Pakistan is found to be far behind the other countries in that while in the Asian developing countries the per capita spending is on the average 18.9 dollars it is only 5.4 dollars in the country.

(2) Alternative 1 (M - 1)

In proceeding to a further research the study team chose twenty countries from among the thirty six, the balance being excluded on account of statistical unfitness.

On the basis of their data and on the assumption that the public expenditure on transport and communications sector is the function of population, surface area and GDP multiple regression analysis was performed.

The resultant equation is as shown under.

$$\text{Log TC} = 3.8632 + \underset{(5.45)}{0.160723} \times \text{Log POP} + \underset{(5.39)}{0.009415} \times \text{Log SA} + \underset{(11.00)}{0.8190} \times \text{Log GDP}$$

$$R = 0.996348$$

where TC = public expenditure on T & C sector
($ million, '81 prices)
POP = population (thousand)
SA = surface area (thousand square KM)
GDP = GDP ($ million, '81 prices)

The multiple correlation coefficient shows a strong reliability of the equation. Examination of the three regression coefficients and T values reveals that the scale of the economy is the predominant factor in determining the size of the public expenditure on T & C sector, although the influence of population and surface area cannot be neglected.

The purpose of construction of the above equation is to determine the future framework of public investment in Transport in Pakistan. By applying the value of surface area of Pakistan and those of her future GDP and population, future amount of public expenditure on T & C that ought to be borne by her if she is to be internationally on a par is calculated.

Eventually it is rendered into the expenditure on Transport by applying the ratio of 0.86 to it.

As the outcome of the above procedures it became clear that the country will need an aggregated amount of 31,751 million rupees in the Sixth Plan period (1983-84 -- 1987-88). Also, she will need an aggregated amount of 125,289 million rupees in the period 1988-89 -- 1999-2000. Throughout the two periods, therefore, the combined amount of 157,040 million rupees will be required for the development of Transport Sector.

That amount is supposed to be borne by a country with the surface area, future population and economy of Pakistan.

(3) Alternative 2 (M - 2)

Although out of the federal annual receipts only a fraction has been allotted to the development expenditure, the total framework of ADP expenditure can be said to have grown in parallel with the growth of GDP in the majority of years.

During the 21 years since 1960-61, the ADP expenditure in the

four year period from 1970-71 to 1973-74 was extremely at a low level in comparison with GDP. Also, in the three year period of 1962-63 to 1964-65 it was a little too much in relation to GDP.

By employing the statistical data for the remaining fourteen years, simple regression analysis has been performed on the assumption that ADP is the function of GDP with result shown under.

$$\underset{\text{(Rs.million)}}{ADP} = 1802.1531 + 0.101847 \times \underset{\text{(Rs.million)}}{GDP}$$

$$R = 0.967257,\ T = 13,202013$$

The allocation to transport and communications sector has closely followed the steps of ADP for these 21 years.

By using the statistical data for the entire period, simple regression analysis has been conducted on the premise that the expenditure on T & C sector is the function of ADP with the result as shown below.

$$\underset{\text{(Rs.million)}}{TC} = 229.6258 + 0.180836 \times \underset{\text{(Rs.million)}}{ADP}$$

$$R = 0.964247,\ T = 15.860224$$

where TC = ADP expenditure on T & C sector

The share of Transport in the ADP expenditure on T & C sector has for these several years been on the average 86 percent. Hence the following formula.

$$TPORT = 0.86 \times TC$$

where TPORT = ADP expenditure on Transport

By means of the above equations together with the estimated future GDP's, the ADP expenditure on Transport in the future is to be calculated.

The resultant estimation is that the aggregated amount of 29,821 million rupees will be allocated for the sixth plan period. And for the period 1988-89 to 1999-2000 the aggregated amount of 121,811 million rupees will be appropriated. In total the amount of 151,632 million rupees is expected to be spent on Transport during the seventeen years from 1983-84 to 1999-2000 if the government pursues the investment pattern of the past.

When this alternative is compared with the preceding one, it is found that the budget of the former is by 1,930 million rupees less

than that of the latter for the sixth plan period. And for the period 1988-89 to 1999-2000 the difference ammounts to 3,478 million rupees. In both periods, therefore, this estimation is by 5,408 million rupees less than the preceding one.

It means that Pakistan should spend on Transport by this amount more than she is expected to in the planned periods if she is to be on an equal footing with a country of the same conditions.

(4) Alternative 3 (M - 3)

It has been already mentioned that the past behavior of ADP expenditure is such that it has more or less followed the steps of GDP.

The average ratio of ADP to GDP for the past 21 years since 1960-61 is calculated at 11.0 percent. If the said periods with irregular behavioral patterns are excluded the ratio is recalculated at 11.4 percent. Again, when the latest 7 years with stable and regular statistical achievements are adopted for the base period, it stands at 11.1 percent.

For this reason, in this alternative the size of future ADP expenditure is assumed to be 11 percent of GDP.

The behavior of the share of T & C sector in ADP expenditure has been remarkably stable for the last 21 years, the average value being calculated at 19.6 percent. When the last 7 years are adopted for the base period, the share takes an average value of 19.2 percent.

Consequently, it is logical to assume that the future share of the same sector in ADP will be 19 percent. (Refer to Table 2-1-2.)

Also, 86 percent of the expenditure on T & C sector is assumed to be allotted to Transport.

So far the study team has invariably employed a fixed pattern in calculating the expenditure on Transport: it first determined the size of the combined expenditure of transport and communications before arriving at the expenditure on Transport only.

There is an obvious and fundamental reason for it. It is a general rule all over the world in preparing statistics to put transport and communications into one and the same sector. It means that one can generally have an easy access to the statistical data on transport and communications combined. But, when one wants and tries to have the statistics on Transport separately it is not unusual to find that it is not immediately available. In this connection the country is no exception.

However, it is worthwhile to see directly where the share of Transport stands in the total ADP expenditure by availing oneself of the accessible data. (See the table below.)

The Share of Transport in the ADP Expenditure

Unit: Rs. million

Year	Total ADP	Transport	Share of Transport
1977-78	17,150	2,712	15.8%
1978-79	20,579	3,537	17.2%
1979-80	21,968	3,509	16.0%
1980-81	26,137	4,243	16.2%

Average for Four Years (1977-1981)

1. Weighted : 16.3%
2. Simple : 16.3%

Source: Annual Plan

The above table provides a supporting evidence to the assumption in this alternative regarding the share of Transport, which is calculated at 16.34 percent by multiplying 19 percent by 86 percent.

Upon the above assumption together with the estimation of future GDP's, the ADP investments in Transport Sector in the Sixth Plan period and the succeeding period have been calculated at 31,130 million rupees and 131,723 million rupees respectively, resulting in 162,853 million rupees for the entire periods.

The estimation of this alternative is by 5,813 million rupees more than that of Alternative 1 (M-1), and by 11,221 million rupees more than that of Alternative 2 (M-2) over the entire periods.

The former difference is mainly explained by the fact that in Alternative 1 a declining growth of population in the future is taken

into consideration and reflected in the declining growth of the expenditure on Transport Sector. And the latter difference is accounted for by the fact that in Alternative 2 the regression equations possess a built-in structure where the elasticity of ADP expenditure to GDP and also that of T & C expenditure to ADP expenditure automatically decline as GDP and ADP expenditure grow.

Under Alternative 3 (M - 3), in addition to the above case which is named Case-2 two more cases are brought forth for examination.

Case-1 is based upon a conservative estimate where the ratio of ADP to GDP is assumed to be 10 percent, the share of T & C sector 18 percent and the share of Transport 84 percent. In contrast, Case-3 is based on a positive estimate with the assumption of 12, 20, 88 percents in the above order.

The resultant budgetary appropriation to Transport is in Case-1 calculated at 26,186 million rupees for the Sixth Plan period and at 110,808 million rupees for the succeeding period, adding up to 136,994 million rupees for the entire periods. In Case-3 it is calculated at 36,578 and 154,779 million rupees for the respective periods, adding up to 191,357 million rupees.

(5) Eventual Selection

The methodology employed in Alternative 1 (M - 1) is characterized by multiplicity of analytical angles and ahead of the other two in sophistication. The resultant solution of the equation expresses a value that is on a par with the international standard.

The methodology of Alternative 2 (M - 2) is characterized by a structural formulation, constituting an entity in its own way. It scientifically traces historical footsteps and builds a system of formulas upon them. The resultant estimate signifies a value that closely follows the past behavioral pattern.

The methodology of Alternative 3 (M - 3) is built on a simple and clearcut logic. However, it lacks scientific meticulousness. The estimation of M - 3, Case-2 is somewhat greater than that of M - 1. In the hope that Pakistan will not be satisfied with the standard requirement a country of the same GDP, population and surface area is supposed to meet, M - 3, Case-2 has been adopted as the final selection.

The selection of this alternative means that the future share

of Transport Sector in the ADP expenditure is assumed to be 16.34 percent (= 0.19 x 0.86). It is an established theory that Transport as a crucial infrastructure holds the key of the economic development of a country.

As it is already shown, the public expenditure on transport and communications sector in Pakistan is in relation to population and surface area very small although it is big enough in comparison with GDP. The implication is that the country is economically undersized. In a further hope that she may achieve an economic growth greater than heretofore the study team adopted one more alternative in which the size of the public investment in Transport is by 25 percent greater than M - 3, Case-2. Hence the following table.

Overall Framework of ADP Expenditure on Transport Sector

(Rs. million)

Alternatives	1983-84 -- 1987-88	1988-89 -- 1999-00	Total
Standard: M - 3, Case-2	31,130	131,723	162,853
25% Increase: Standard x 1.25	38,913	164,654	203,567

In other words, in this alternative the future share of Transport Sector in the ADP expenditure is presumed to be 20.425 percent, which in turn signifies that the future share of T & C sector is set at 23.75 percent.

Table 2-1-1 International Comparison of Public Expenditure on Transport and Communications

Country	Year		vis-a-vis		Country	Year	vis-a-vis		
		GDP (%)	Population ($/person)	Surface Area ($/Km)			GDP (%)	Population ($/person)	Surface Area ($/Km)
Argentina	'75	1.41	31.5	289	Malaysia	'78	1.66	25.6	1,005
Australia	'78	0.92	95.9	180	Mexico	'78	1.04	18.6	631
Bangladesh	'75	0.61	1.1	588	Morocco	'78	4.81	40.8	1,727
Brazil	'78	1.68	35.6	482	Nepal	'77	2.71	4.0	370
Burma	'78	0.90	1.5	74	Nigeria	'77	5.04	52.6	3,793
Canada	'78	1.17	131.9	311	Pakistan	'78	2.01	5.4	512
Chile	'77	1.21	18.1	254	Peru	'78	0.60	5.1	67
Egypt	'77	0.65	4.3	168	Philippines	'78	2.21	14.4	2,228
Ethiopia	'75	1.88	2.8	63	Spain	'78	0.81	41.5	3,052
Erance	'78	1.17	133.9	13,044	Sri Lanka	'77	1.24	4.2	888
Germany	'78	2.18	293.2	72,880	Sudan	'75	1.74	9.1	57
Ghana	'75	1.48	10.7	440	Tanzania	'78	1.56	5.3	93
India	'77	1.15	2.5	482	Thailand	'78	1.63	10.2	892
Indonesia	'77	0.67	2.9	206	Turkey	'78	4.40	65.8	3,643
Iran	'75	2.49	61.9	1,239	U.K.	'76	1.18	68.3	15,654
Iraq	'75	2.42	45.7	1,169	U.S.A.	'78	0.78	98.0	2,283
Itany	'75	2.95	143.7	26,661	Venezuela	'78	3.41	133.2	1,916
Japan	'78	0.43	47.5	14,686	(Average 1)		1.79	46.6	4,785
Kenya	'78	2.05	9.8	250	(Average 2)		1.95	23.1	871
					(Average 3)		1.85	18.9	1,023

Notes: (1) Dollar values are expressed at 1981 prices.
(2) Average 1 = Total Average, Average 2 = Average for Developing Countries
Average 3 = Avarage for Asian Developing Countries

Sources: Government Finance Statistics Yearbook (IMF), Statistical Yearbook (UN)
Japan Statistical Yearbook (Government of Japan),JICA Estimates

Table 2-1-2 ADP Expenditure on Transport and Communications Sector

Unit: RS,Million unless otherwise specified

Items / No. / Year	GDP, current	GDP,* constant	Population (thousand)	ADP	T&C**	at 1981 prices			(7)/(6)	(8)/(7)	(8)/(6)	Remarks
						GDP	ADP	T&C**				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	
1960-61	18,349	17,649	46,200	1,830	385	82,898	8,268	1,739	10.0	21.0	2.1	
1961-62	19,139	18,710	47,530	2,366	529	87,882	10,864	2,429	12.4	22.4	2.8	
1962-63	20,489	20,056	48,900	3,707	632	94,204	17,044	2,906	18.1	17.0	3.1	
1963-64	22,945	21,356	50,310	3,316	759	100,310	14,497	3,318	14.5	22.9	3.3	
1964-65	26,202	23,360	51,760	3,707	767	109,723	15,523	3,220	14.1	20.7	2.9	
1965-66	28,969	25,126	53,260	2,970	673	118,018	12,100	2,741	10.3	22.7	2.3	
1966-67	32,622	25,901	54,790	3,705	846	121,658	13,817	3,155	11.4	22.8	2.6	
1967-68	35,542	27,659	56,370	4,515	936	129,916	16,504	3,420	12.7	20.7	2.6	
1968-69	37,985	29,454	58,000	4,975	917	138,347	18,120	3,341	13.1	18.4	2.4	
1969-70	43,345	32,336	59,700	5,429	940	151,884	19,024	3,294	12.5	17.3	2.2	
1970-71	45,702	32,434	61,490	2,948	533	152,344	9,827	1,777	6.5	18.1	1.2	
1971-72	49,169	32,812	63,340	2,681	439	154,120	8,404	1,376	5.5	16.4	0.9	
1972-73	60,795	35,179	65,240	4,455	731	165,238	12,108	1,987	7.3	16.4	1.2	
1973-74	80,441	37,901	67,200	6,506	1,285	178,023	14,398	2,844	8.1	19.8	1.6	
1974-75	104,640	39,393	69,210	10,754	2,148	185,031	19,016	3,798	10.3	20.0	2.1	
1975-76	121,423	40,699	71,290	13,558	2,690	191,166	21,345	4,235	11.2	19.8	2.2	
1976-77	135,686	41,727	73,430	16,239	3,175	195,994	23,457	4,586	12.0	19.6	2.3	
1977-78	157,171	44,805	75,630	17,150	3,158	210,452	22,964	4,229	10.9	18.4	2.0	
1978-79	178,801	46,891	77,900	20,579	4,026	220,250	25,350	4,959	11.5	19.6	2.3	
1979-80	212,471	50,157	80,230	21,968	3,898	235,590	24,358	4,322	10.3	17.7	1.8	
1980-81	249,038	53,020	82,600	26,137	5,004	249,038	26,137	5,004	10.5	19.1	2.0	

*GDP at 1960 prices

**ADP expenditure on transport and communications sector

1) average for (9)
i) 21 years :11.0
ii) 7 years :11.1

2) average for (10)
i) 21 years :19.6
ii) 7 years :19.2

Sources: Pakistan Basic Facts, Pakistan Economic Survey, JICA Estimates