INLAND WATER TRANSPORT

INLAND WATER TRANSPORT

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Inland Water Transport

1.1 General

In Pakistan, a number of studies, analyses and proposals concerning the development of inland waterways have been made in the past. Most of these reports have pointed out that the most advantageous aspect of inland waterway development is low energy consumption. If the existing waterways were developed and utilized, they could potentially provide highly cost-effective transport.

A well-developed inland water transport network throughout the country would not only bring about economic prosperity all along the routes, but would also develop communal harmony among the various regions of Pakistan.

However, prior to developing a comprehensive inland waterway transport system and formulating an investment plan, a full-scale, in depth, comprehensive feasibility study emphasizing economic and technical aspects should be carried out, as proposed in 1.3, below.

1.2 Economic Study

In this study, rough economic calculations are made based on the following assumptions.

(1) Economic feasibility is judged based on a comparison of costs and benefits based on the net present value.

(2) Two operating inland water routes are considered:

A full operating route about 2,000 km long from Port Qasim to Kalabagh and from Mithankot to Lahore as shown Fig. 1.2.1, and a partial operating route about 1,300 km long from Qasim to Kalabagh.

(3) Construction costs and oil consumption costs are quoted from the report "PROSPECTS OF INLAND NAVIGATION IN PAKISTAN" by Irrigation, Drainage and Flood Control Research Council, March 1984.

The construction costs and oil consumption costs are shown in Tables 1.2.1 and 1.2.2.

Fig. 1.2.1 Proposed Inland Waterways Operating Routes

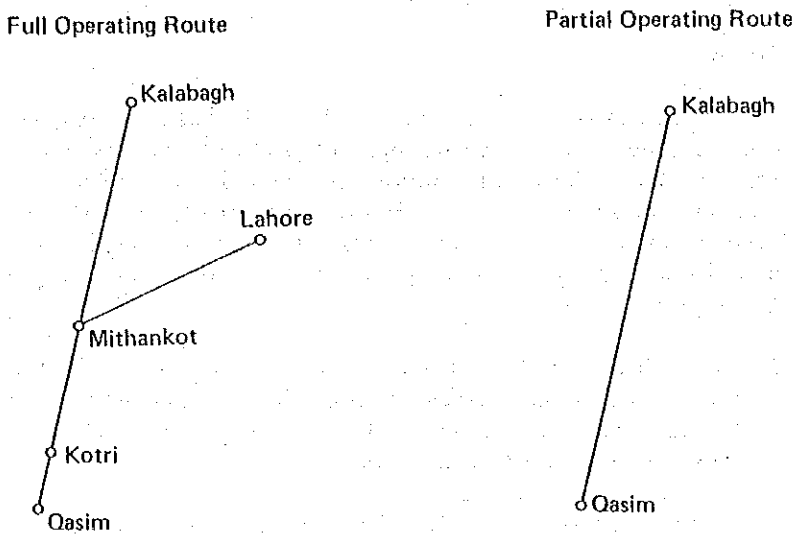


Table 1.2.1 Construction Costs

(Rs. million)

Route	Full Operating Route	Partial Operating Route
1 Qasim Port - Kotri	450	450
2 Kotri - Sukkur	650	80
3 Sukkur - Guddu - Mithankot	40	40
4 Mithankot - Taunsa Chashma - Kalabagh	70	70
5 Mithankot - Panjnad	30	-
6 Panjad - Shershah - Sidhnai	50	-
7 Sidhnai - Balloki - Lahore	80	-
8 Inlands Ports	840	150
Total	2,210	790

Table 1.2.2 Oil Consumption Costs

(Rs./ton-km)

Mode	Oil Consumption Cost
Road	0.150
Rail	0.039
Waterway	0.022

(4) Operating costs and ship costs are estimated by the study team based on data obtained from experts in Pakistan. The results of the estimation are shown in Tables 1.2.3 and 1.2.4.

Table 1.2.3 Ship Costs

Ship building cost	0.367 Rs./ton-km
Ship operating cost	0.0337 Rs./ton-km·year

Source: Study Team

Table 1.2.4 Operating Costs

(Rs. million/year)

	Full operation	Partial operation
Port Staff Wages	44	22
Maintenance Dredging	73	12
Channel Monitering	8	4
Total	125	38

Source: Study Team

(5) The calculation term is set at 30 years and the opportunity cost of capital is assumed to be 10%.

(6) The only benefit generated from the project is assumed to be the savings in oil cost between inland waterway and road or railway transport.

1.3 Evaluations

The results of the estimations are shown in Table 1.3.1. In the table the highest value is generated under Case 3, with an operating route of about 2,000 km and a traffic volume of 10 billion ton - km. Even under this case, only the benefit of inland waterway over road transport exceeds the NPV of the total cost, the B/C Ratio is 1.19.

Second is Case 5, with an operating route of 1,300 km, a traffic volume of 3 billion ton - km, and a B/C Ratio of 1.14. And the third is Case 6, with an operating route of 1,300 km, a traffic volume of 5 billion ton-km, and a B/C ratio of 1.33.

In all cases, the NPV of the benefit of inland waterway over railway transport does not exceed the NPV of the total cost.

Since the estimations in this study depend on restricted data, a more in-depth and elaborate analysis based on a detailed site survey should be executed before reaching a final decision.

However it can be said that the inland water project would only become economically feasible with lower capital investment and running costs, a larger cargo volume or an increase in oil prices.

Table 1.3.1 Summary of Rough Economic Study

	Unit	Full Operation			Partial Operation		
		Case-1	Case-2	Case-3	Case-4	Case-5	Case-6
1 Traffic Volume	Billion Ton km (km x Million Ton)	1 (2000x1)	6 (2000x3)	10 (2000x5)	1 (1000x1)	3 (1000x3)	5 (1000x5)
2 Construction Cost	Rs. Million	2,944	4,412	5,880	1,157	1,891	2,625
3 Operating Cost	Rs. Million	192	327	462	72	139	207
4 Net Present Value of Total Cost	Rs. Million	4,782	7,543	10,304	1,846	3,222	4,607
5 NPV of Benefit (Road-Waterway)	Rs. Million	2,452	7,356	12,260	1,226	3,678	6,130
6 NPV of Benefit (Rail-Waterway)	Rs. Million	325	977	1,628	163	488	814
7 B/C ratis (Road-Water way)		0.51	0.98	1.19	0.66	1.14	1.33
(Rail-Water way)		0.07	0.13	0.16	0.09	0.15	0.18

Source: Study Team

1.4 Further Necessary Studies

As noted in 1.1 and 1.2, the feasibility of inland water transport depends on lower capital investment and lower operating costs, a larger cargo volume or an increase in oil prices.

The study team would like to recommend that a full-scale, in-depth, comprehensive feasibility study should be carried out.
A basic feasibility study on Inland Water Transport should comprise the following four items:

1) Study on technical feasibility
2) Analysis on economic feasibility
3) Analysis on financial feasibility
4) Study on the implementing agency/organization

(1) The technical study should cover all physical and technical matters such as hydrographic studies, appropriate route selection, construction of new channels and river ports, remodelling of bridges, barrages and lock gates and a study of vessel dimensions and capacity. Concerning these items, a great deal of research has already been undertaken in Pakistan.

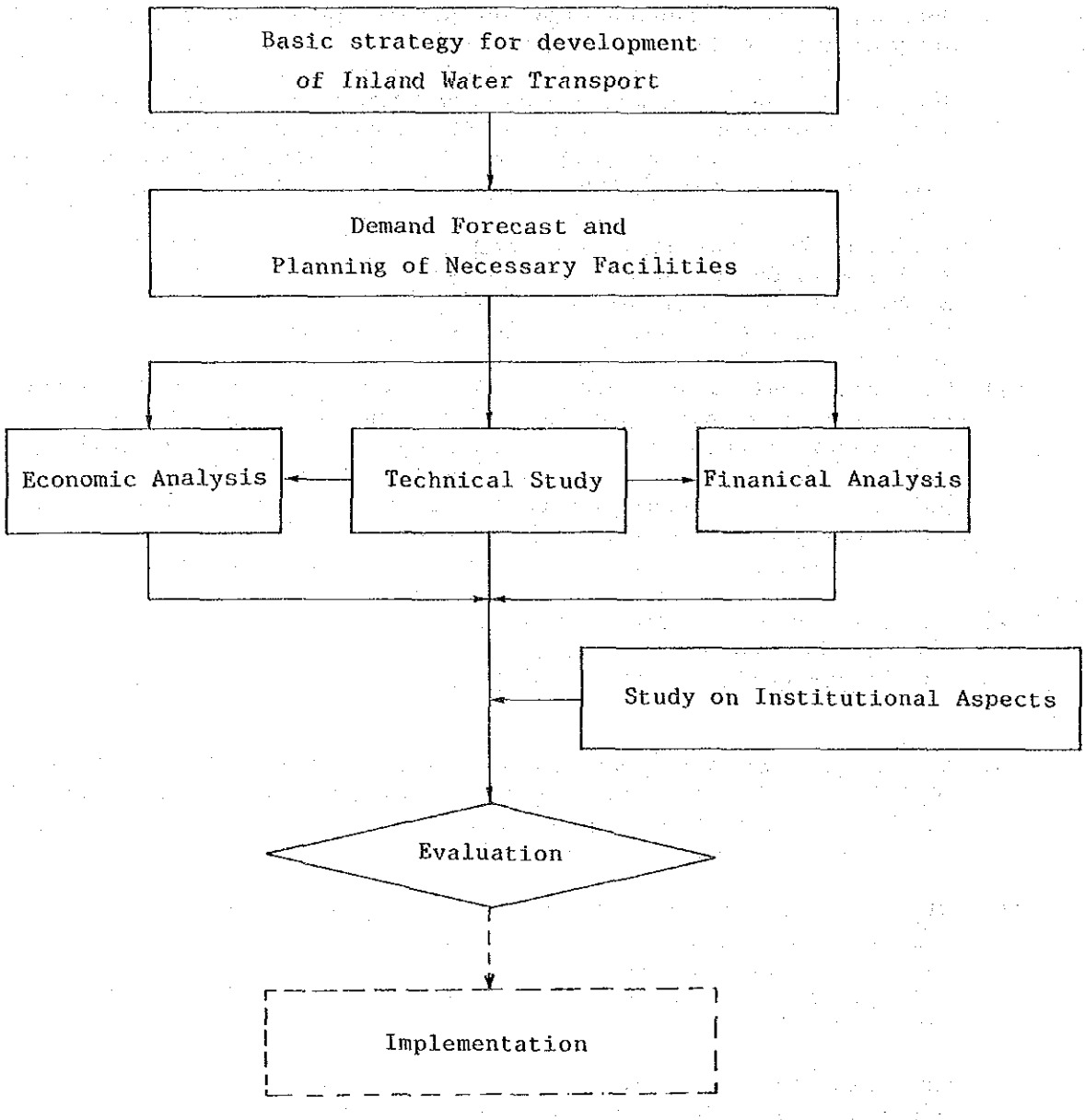
(2) The purpose of the economic analysis is to examine whether the IWT project is justifiable from the national economic point of view, usually by making a cost benefit analysis.

(3) The purpose of the financial analysis is to examine the financial viability of the implementing agency/organization and the profitability of the project itself.

(4) There is no authorized agency or organization responsible for implementing the IWT project in Pakistan so far. The IWT project will be related with many other fields, and a specific agency/organization will have to be established to successfully excute the IWT project.

An idea of the overall flow of the IWT study is shown in Fig.1.3.1, and the approximate study cost is also listed together with port projects in Chapter 3, section 5.

Fig. 1.3.1 Overall Flow Chart of IWT Study



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CHAPTER 1 PRESENT CONDITION AND PROBLEMS

1.1 General

This section describes the present performance of the Civil Aviation Authority (CAA) which administers the airports and the Pakistan International Airlines Corporation (PIA) who operates a part of the international flight service and all the domestic flights.

1.2 Present Status

1.2.1 Airports in Pakistan

(1) Airports

Table 1.2.1 summarizes the present status of airports in Pakistan as of September 1987. There are 36 airports for the public in major cities allover the country. The construction of three feeder service airports is also in progress for the purpose of the upgrading the economy of rural areas.

International airports are Karachi, Islamabad, Lahore, Peshawar Quetta and Gwadar. International flights are regularly operated between the above airports except Quetta and other countries at present.

Fig. 1.2.1 shows the location of airports in Pakistan.

(2) Administration

Most of the airports are managed and maintained by Civil Aviation Authority (CAA). Some airports such as Islamabad, Peshawar and Quetta are the joint-use airports with CAA and Pakistan Air Force (PAF). In these airports, facilities necessary for passenger and cargo handling, such as passenger aprons, terminal buildings and cargo buildings, are under the control of CAA.

CAA is also responsible for development and maintenance of airport facilities such as runways, terminal buildings and air navigational systems, provision of air traffic control services, and provision of fire fighting and rescue facilities, in order to ensure safe, efficient, and economical air transport services. Exercise of regulatory functions including licensing of aircraft and air-crew, and bilateral agreements on civil aviation matters with other countries are also included in the main functions of CAA.

Aviation Division of the Ministry of Defence (MOD) is responsible for control of CAA together with the following agencies such as Pakistan International Airlines (PIA), Airport Development

Table 1.2.1 Airports in Pakistan

(As of Sep. 1987)

Airport	Admini-[1] strative Authority	Traffic in 1985-86			Runway Length (m)	Maximum Operated Aircraft	Major Air Navigation Systems[3]						
		Passengers[2] (thousand)	Cargo (thousand tons)	Movements			ASR/ SSR	ILS	VOR/ DVOR	DME	NDB	ALS	VASIS/ PAPI
Karachi	C	D 1,786 I 2,644	28.32 103.90	48,291	3,200 2,286	B747	X	X	X	X	X	X	X
Islamabad	J	D 973 I 325	9.96 7.73	26,798	2,743	B747	X	X	X	X	X	X	X
Lahore	C	D 1,138 I 108	16.58 1.45	17,664	2,743	A300		X	X	X	X	X	X
Peshawar	J	D 279 I 33	2.00 0.69	6,069	2,743	A300			X	X	X	X	X
Gwadar	C	D 45 I 10	0.12 0.02	2,113	1,524	F27					X		
Quetta	J	D 155	0.68	2,859	3,658	A300			X	X	X		X
Bannu	C	D 9	0.01	649	1,829	F27					X		
Chitral	C	D 46	0.08	1,200	1,768	F27							
D.I. Khan	C	D 21	0.07	1,299	1,524	F27					X		
Faisalabad	C	D 103	0.40	1,691	2,743	B737		X		X	X	X	X
Gilgit	C	D 39	0.03	1,285	1,658	F27							
Hyderabad	C	D 3	0.01	776	2,133	F27					X	X	
Jiwani	C	D 6	0.01	290	1,737	F27			X	X	X		
Moenjodaro	C	D 18	0.04	1,330	1,981	F27					X		X
Multan	C	D 195	0.56	27,001	2,743	B737		X	X	X	X		X
Nawabshah	C	D 4	0.01	904	2,743	F27			X		X		
Panjgur	C	D 17	0.04	890	1,524	F27			X		X		
Pasni	C	D 19	0.10	1,402	2,743	B737					X		
Saidu Sharif	C	D 17	0.04	742	1,829	F27					X		
Skardu	C	D 27	0.01	1,104	1,981	F27							
Sui	P	D 8	0.01	474	1,524	F27					X		
Sukkur	C	D 29	0.26	1,654	2,743	B737					X		X
Turbat	C	D 73	0.23	2,776	1,829	F27					X		
Zhob	C	D 10	0.01	855	1,829	F27					X		
Bhagtanwala (Sargodha)	C	D 3	0.00	498	1,920	DHT							
Mianwali	J	D 2	0.00	452	3,048	DHT							
Bahawalpur	C	D 1	0.00	94	1,524	F27					X		
Jacobabad	J	D 2	0.00	136	1,524	F27							
Badin (Talhar)	J	D 0	0.00	182	1,524	F27							
Kohat	J	D 1	0.00	484	2,469	DHT					X		
Sibi	C	D 0	0.00	47	1,829	F27					X		
Mangla	C	-	-	-	1,524	-					X		
Khuzdar	C	-	-	-	1,829	-					X		
Parachinar	C	-	-	-	1,219	-					X		
Muzafarabad	C	-	-	-	914	-					X		
Rawalkot	C	-	-	-	914	-					X		
Dalbandin	(Under Construction)												
R.Y. Khan	(Under Construction)												
Ormara	(Under Construction)												

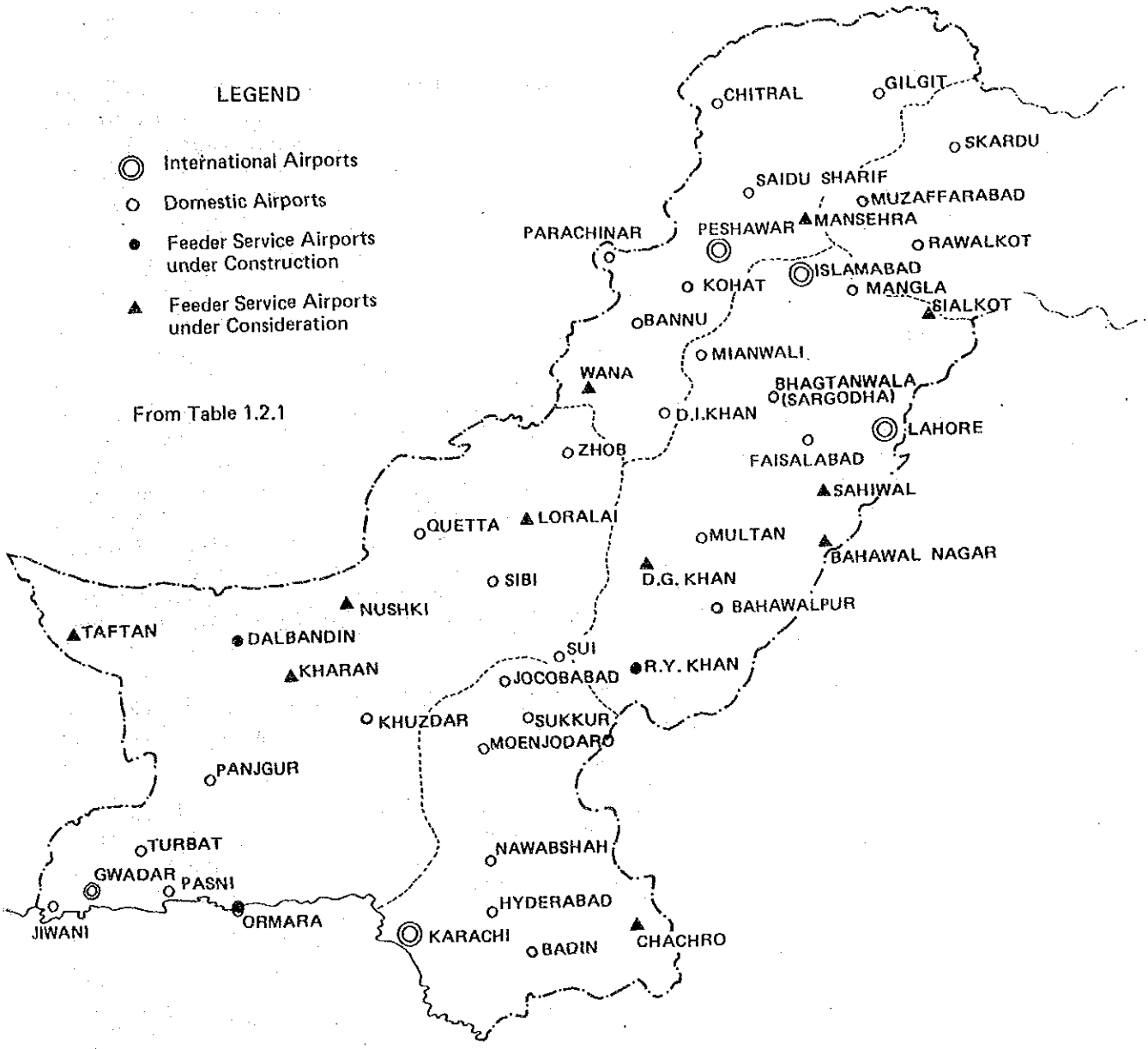
Note: 1) C : CAA
J : Joint User PAF and CAA
P : Private

2) D : Domestic
I : International

3) X : Installed System is earmarked

Source: AIP Pakistan
Civil Aviation Statistics

Fig. 1.2.1 Airports in Pakistan



Authority (ADA), Airport Security Force (ASF), and Pakistan Meteorological Department (PMD). MOD has also responsibility for the review of the development plans, the evaluation and processing of proposals, monitoring progress of the development plan, and coordination of various agencies in other ministries and government organization.

(3) Income and Expenditure

Income and Expenditure of CAA in 1984-85 is as shown in Table 1.2.2. The income was Rs. 671 million against the expenditure of Rs. 271 million, and the profit (unappropriated income carried over the next year) was Rs.671 million. Table 1.2.3 shows the balance sheet at the end of June, 1985.

1.2.2 Airlines

(1) Air Routes

Domestic air routes in Pakistan as of September 1987 are shown in Fig. 1.2.2. Air routes between Karachi and Islamabad/Lahore are trunk routes of domestic network. Between Karachi and Islamabad, six direct flights including 2 night coach services are operated by B747 or A300. Other six or eight flights by way of Lahore, Multan, etc. are operated with A300 or B737 aircraft. Between Karachi and Lahore, about 16 flights including 10 direct flights and three night coach services are operated by A300 or B737. For Peshawar and Quetta, two or four flights are operated by A300, B737 and F27.

Pakistan Iternational Airlines (PIA), national airline of Pakistan, operates all domestic routes connecting 31 cities in Pakistan.

Fig. 1.2.3 shows international air routes from/to Pakistan. The routes are operated by PIA together with foreign carriers. PIA's international air network connects 36 cities in Asia, Africa, Europe, and United States of America.

(2) Administration

PIA is under the control of Ministry of Defence (MOD). The board of directors situated on the top of the organization of PIA, consists of the members of Ministry of Defence, Planning Commission, Civil Aviation Authority, Pakistan Banking Council, Bankers Equity Limited, PIA Holdings (Pvt.) Ltd., and PIA.

(3) Income and Expenditure

The profit and loss account and balance sheet of PIA in 1985-86 are as shown in Table 1.2.4. Revenue was Rs. 10,621 million, and expenditure was Rs. 10,038 million. As a result, operating income amounted to Rs. 583 million.

Table 1.2.2 Income and Expenditure of CAA, 1984-85

(Rs. in thousand)

INCOME	
Landing and Housing	350,412
Route Navigational Fees	79,734
Embarkation Fees	157,442
Rent, Electric and Water	37,294
Other Income	46,765
	671,647
EXPENDITURE	
Salaries, Allowances and Benefits	104,951
Travelling and Conveyance	10,231
Repairs and Maintenance	63,263
Advertisement and Promotions	2,006
Telephone, Postage and Communication	10,565
Electric, Fuel and Power	38,118
Rent, Rates and Taxes	2,985
Legal and Professional Charges	962
Audit Fees	30
Printing, Stationery and Periodicals	2,772
Subscription and Donations	1,528
Insurance	3,514
Bank and Financial Expenses	257
Other Expenses	6,044
Bad Debts	3,879
	251,105
Depreciation	20,393
	271,498
EXCESS OF INCOME OVER EXPENDITURE FOR THE YEAR	400,149
Prior period adjustments	3,306
	403,455
Unappropriated Income Brought Forward	267,591
Unappropriated Income Carried to Balance Sheet	671,046

Source: CAA Annual Report and Accounts 1984-85

Table 1.2.3 Balance Sheet of CAA, 1984-85

(Rs. in thousand)

FUND AND LIABILITIES	
GOVERNMENT EQUITY	2,924,662
UNAPPROPRIATED ~~P~~ PROFIT	671,046
	3,595,708
DEFERRED INCOME	11,015
Deferred Liabilities	76,912
CURRENT LIABILITIES	
Current Maturity of Deferred Liabilities	–
Creditors and Accrued Expenses	17,499
Other Liabilities	22,616
	40,115
CONTINGENT LIABILITIES	
	3,723,750
PROPERTY AND ASSETS	
Capital Expenditure	
Fixed Assets	2,488,911
Development Payment	771,612
Deferred Receivables	50,000
Current Assets	
Current maturity of deferred receivables	52,500
Short Term Investments (At cost)	150,500
Income Receivable	82,128
Advances, Deposits, Prepayments and Other Receivables	21,912
Cash and Bank Balances	106,187
	413,227
	3,723,750

Source: CAA Annual Report and Accounts 1984-85

Fig. 1.2.2 Domestic Air Routes

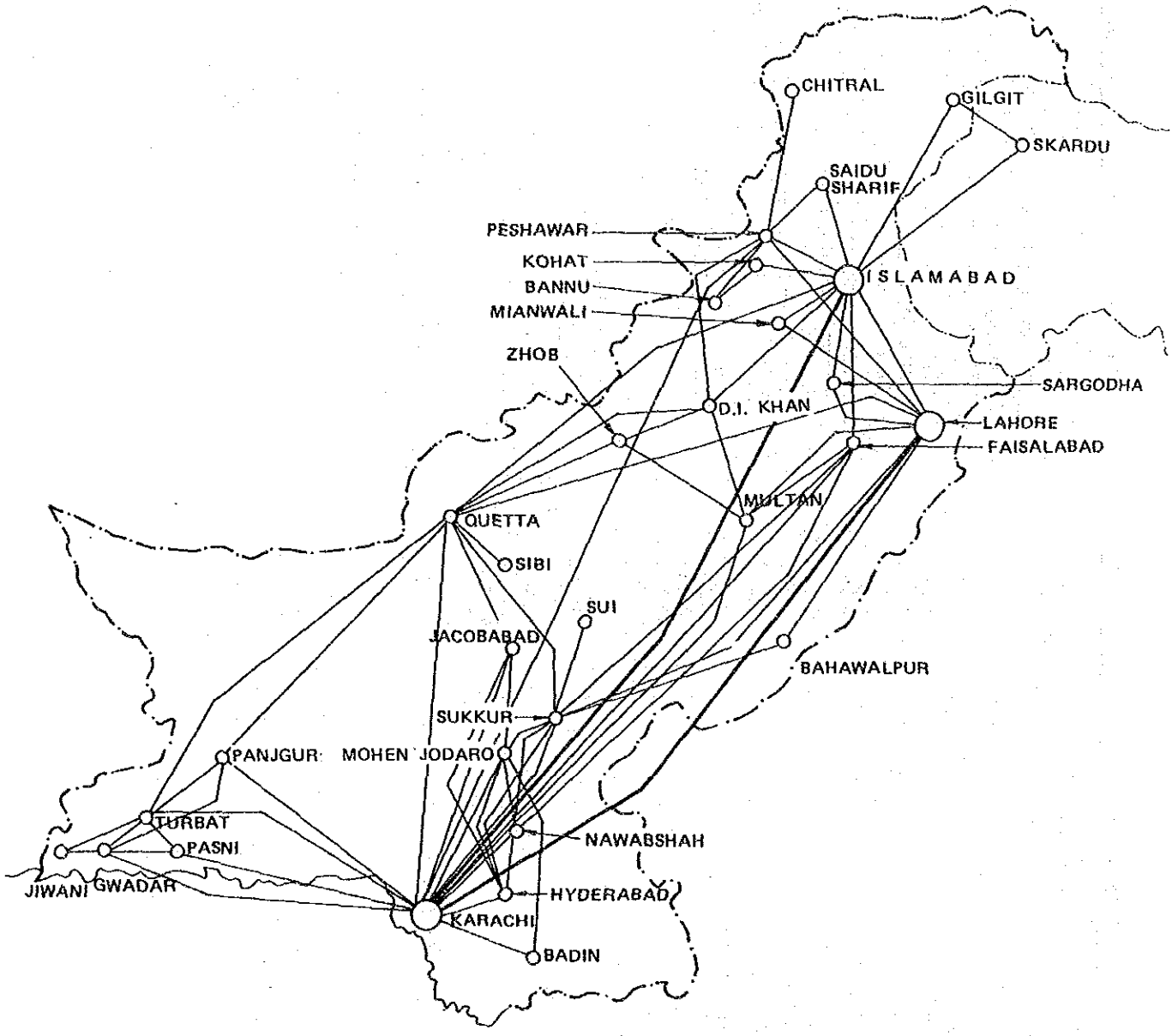


Fig. 1.2.3 International Air Routes from/to Pakistan

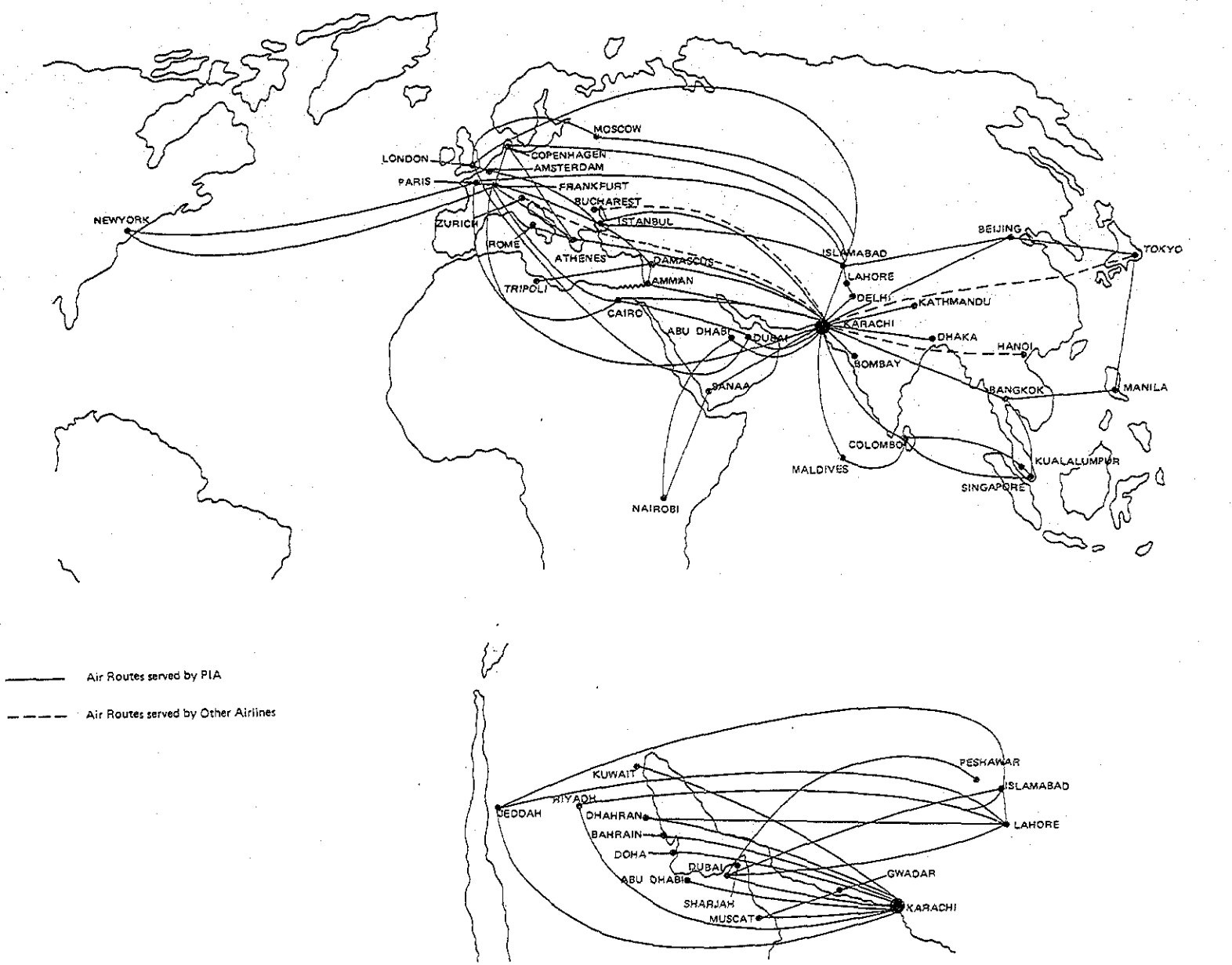


Table 1.2.4 Profit and Loss Account of PIA in 1985-86

(Unit: Rs. thousand)

REVENUE	
Traffic and maintenance	9,888,540
Other revenue	732,819
	10,621,359
EXPENDITURE	
Flying and maintenance	8,311,361
Depreciation	1,177,606
Financial charges	549,079
	10,038,046
OPERATING INCOME	583,313
Profit on disposal of fixed assets	253,128
Provision for staff bonus	(60,000)
Workers' profit participation fund	(50,467)
PROFIT FOR THE YEAR	725,974
Prior period items	117,451
NET PROFIT AFTER PRIOR PERIOD ITEMS	608,523
Profit brought forward	85,505
Profit available for appropriation	694,028
APPROPRIATION	
Revenue reserves	—
Reserve for issue of bonus shares	300,608
Proposed dividend	28,000
	328,608
UNAPPROPRIATED PROFIT CARRIED FORWARD	365,420

Source: PIA Annual Report 1986

Table 1.2.5 Balance Sheet of PIA as of June 30, 1986

(Unit: Rs. thousand)

FIXED ASSETS — tangible		SHARE CAPITAL AND RESERVES	
Operating assets	10,110,692	Share Capital	
Capital work-in-progress	268,019	Authorised	5,000,000
	10,378,711	Issued, subscribed and paid-up	1,920,046
LONG-TERM INVESTMENTS	108,583	Reserves	3,229,833
LONG-TERM ADVANCES & DEPOSITS	160,151	Unappropriated profit	365,420
DEFERRED COSTS	29,560		5,515,299
CURRENT ASSETS		SURPLUS ON REVALUATION OF FIXED ASSETS	38,290
Stores and spares	1,140,539	LONG-TERM LOANS	5,241,248
Trade debts	1,324,002	CURRENT LIABILITIES	
Advances, deposits and prepayments	339,371	Current maturity of long-term loans	1,184,703
Other receivables	107,015	Bank overdraft and short-term finances under mark-up arrangements	220,424
Cash and bank balances	1,354,255	Creditors, accrued expenses and other liabilities	1,109,652
	4,265,182	Advance against transportation	1,588,947
		Proposed dividend	28,000
			4,131,726
		LIABILITIES IN BANGLADESH AND INDIA (less: all Indian assets)	15,624
		CONTINGENT LIABILITIES AND COMMITMENTS	
	14,942,187		14,942,187

Source: PIA Annual Report 1986

(4) Fleets

Fleet possession by PIA at present is summarized in the following table.

PIA owns 16 wide bodied aircraft such as B747 and A300. DC10 were replaced by B747 and A300 for the purpose of simplification of fleet composition by 1987.

Table 1.2.6 Fleet Possession

(As of September 1987)

Aircraft Type	No. of Aircraft
B-747-200	8
A300-B4	7 + 1*
B-707	6
B-737-300	5 + 1*
F-27	9
Twin Otter	2
Cessna	5
Total	42 + 2*

Note: * shows aircraft on lease to other airlines
Source: Role and Performance of PIA

1.2.3 Air Traffic

(1) Passenger

Passenger traffic departing and arriving at each airport in Pakistan by PIA or foreign airlines are shown in the statistics published by CAA and PIA. Those figures are tabulated in App. Table 1-1 to 1-4 and shown in Fig. 1.2.4 to 1.2.7.

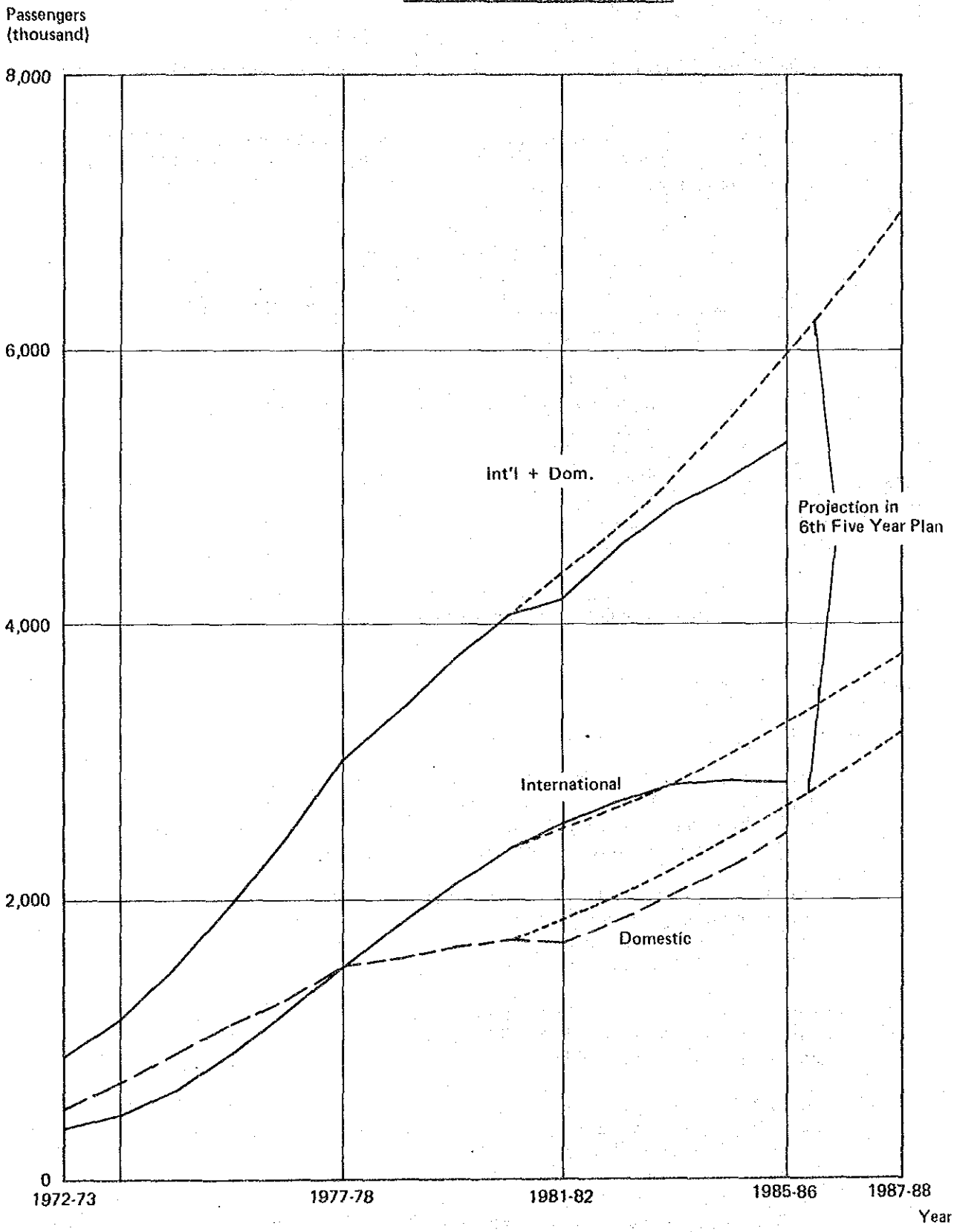
Air passengers in Pakistan have increased as shown in Fig. 1.2.4. Total passengers of domestic and international routes (including those using the foreign carriers) in 1985-86 are over five millions, which is more than twice the traffic of ten years ago.

The growth rate of total passengers have changed as follows: until 1977, it was 20 to 30% per year, about 10% in 1978 to 80, and about 5% after 1981. The growth rate has since tapered off.

Domestic passengers have shown slow growth between 1978 and 1981, but they have increased about 10% per year since 1982, and reached 2.5 million in 1985-86.

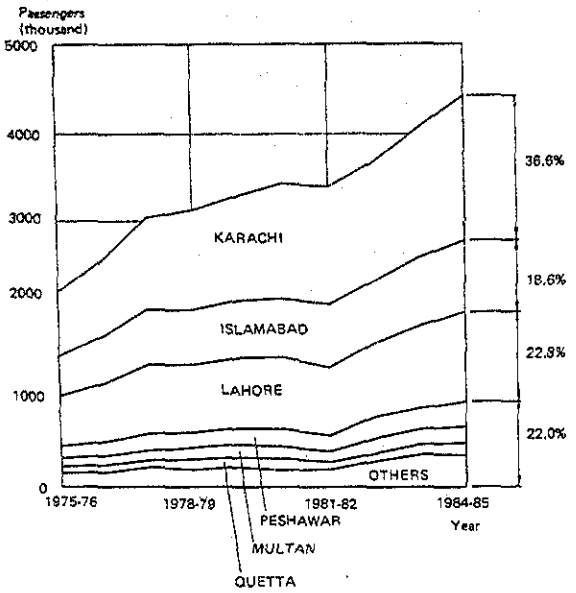
As for international passengers, it has constantly increased by 15 - 20% per year until around 1980, but the growth rate has decreased since 1980. Especially, it has been stagnant at around 2.8 million since 1983.

Fig. 1.2.4 Trend of Air Passengers



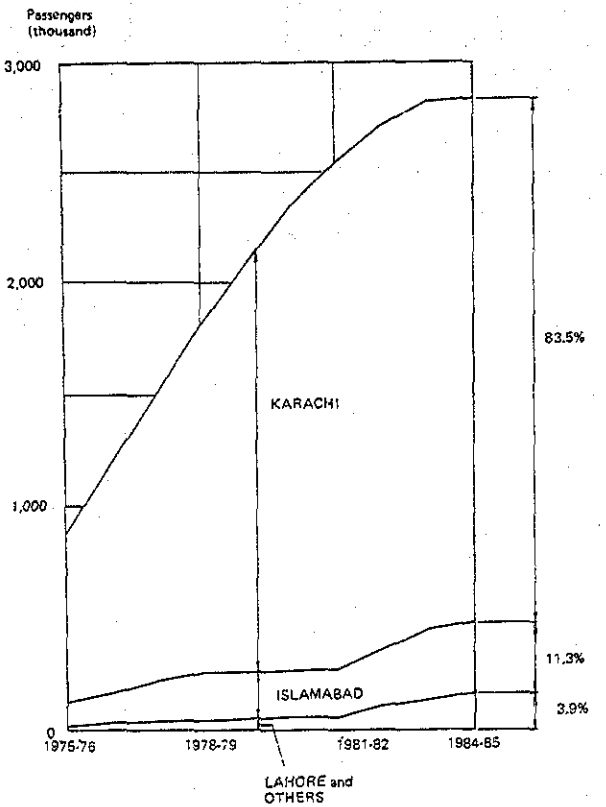
From App. Table 1-1

Fig. 1.2.5 Domestic Passengers of PIA in 1985-86



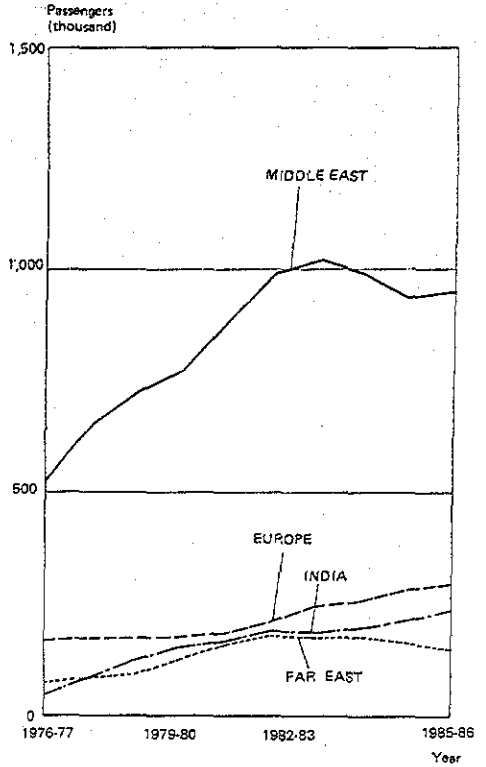
From App. Table 1–2

Fig. 1.2.6 International Passengers by Airport



From App. Table 1–3

Fig. 1.2.7 International Passengers by Route



From App. Table 1–4

Three airports of Karachi, Lahore and Islamabad shared 78% of the total domestic passengers, and is shown in App. Table 1-2 and Fig. 1.2.5. In the case of international passengers, as shown in Fig. 1.2.6, nearly 84% of passengers depart or arrive at Karachi airport, 11% at Islamabad, 4% at Lahore, and 1% at Peshawar airports in 1985-86.

As shown in App. Table 1-4 and Fig. 1.2.7, international passengers are classified by route. Passengers from/to Middle East countries, which were 62% of the total international passengers in 1985-86, showed a tendency to decrease slightly from 1982-83 to 1984-85. Since most passengers went there to find employment opportunities. The decrease is considered caused by a stagnated economy in accordance with the drop in oil revenues of the Middle East countries and prolonged Iran - Iraq war. Table 1.2.7 shows the ratio of departing and arriving international passengers by route since 1981-82. On the Europe, Far East, and India routes, those ratios are almost constant. On the Middle East route, the departing passengers were more than arriving passengers until 1982-83, but arriving passengers have gradually increased and are more than the departing passengers since 1983-84.

When the trends of international and domestic passengers are compared with the forecast for the Sixth plan period, the trends are less than the forecasted traffic in the Sixth plan. Differences are shown in Fig. 1.2.4. The slow increase would be mainly due to the low growth of the international passengers from/to Middle East as explained above.

Table 1.2.7 Ratio of Departing and Arriving Passengers by Route

(Unit: %)

Route		1981-82	1983-84	1985-86
Middle East	Departing	55.0	49.7	48.5
	Arriving	45.0	50.3	51.5
Europe	D	53.7	52.1	52.8
	A	46.2	47.9	47.2
Far East	D	46.7	46.4	49.2
	A	53.3	53.6	50.8
India	D	48.1	48.3	50.0
	A	51.9	51.7	50.0

Source: PIA Passenger Traffic Forecast

(2) Cargo

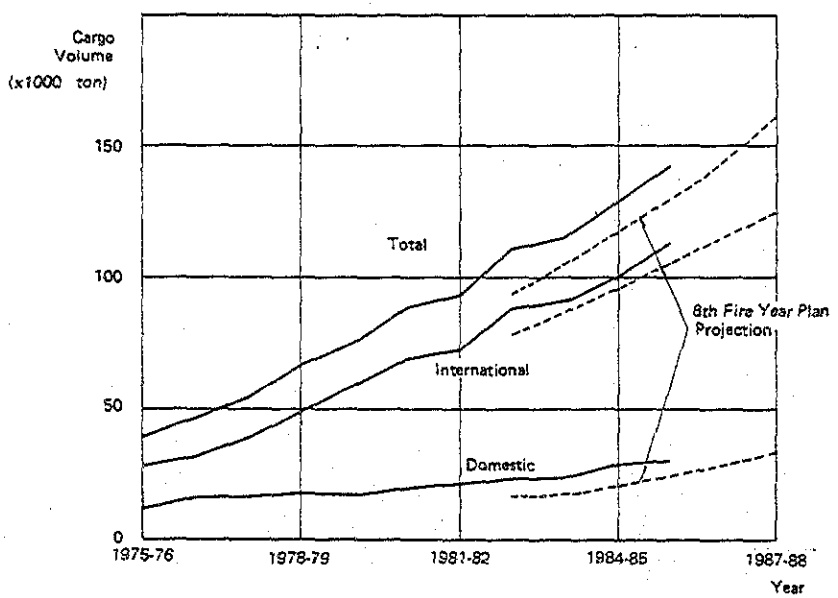
The trend of cargo volumes for these ten years is as shown in App. Table 1-5 and Fig. 1.2.8. Both domestic and international cargo have continued to increase. For the recent five years the annual growth rate of international cargo volume was about 10% and the cargo volume in 1984-85 have reached to 100 thousand tons. For domestic cargo, the growth rate was about 10%, and 30 thousand ton in 1984-85. There is not so much difference between actual trend and the Sixth Five Year Projection comparing with passenger's trend.

(3) Movements (Landing/Takeoff)

Karachi, Islamabad, Lahore and Multan are the airports which have large aircraft movements in Pakistan. As shown in App. Table 1-6 and Fig. 1.2.9, total movements including charter flights and training flights varied in these airports. But the movements of scheduled flights are generally at the same level in Islamabad, Lahore, and Multan airports, and have an increasing trend at Karach airport.

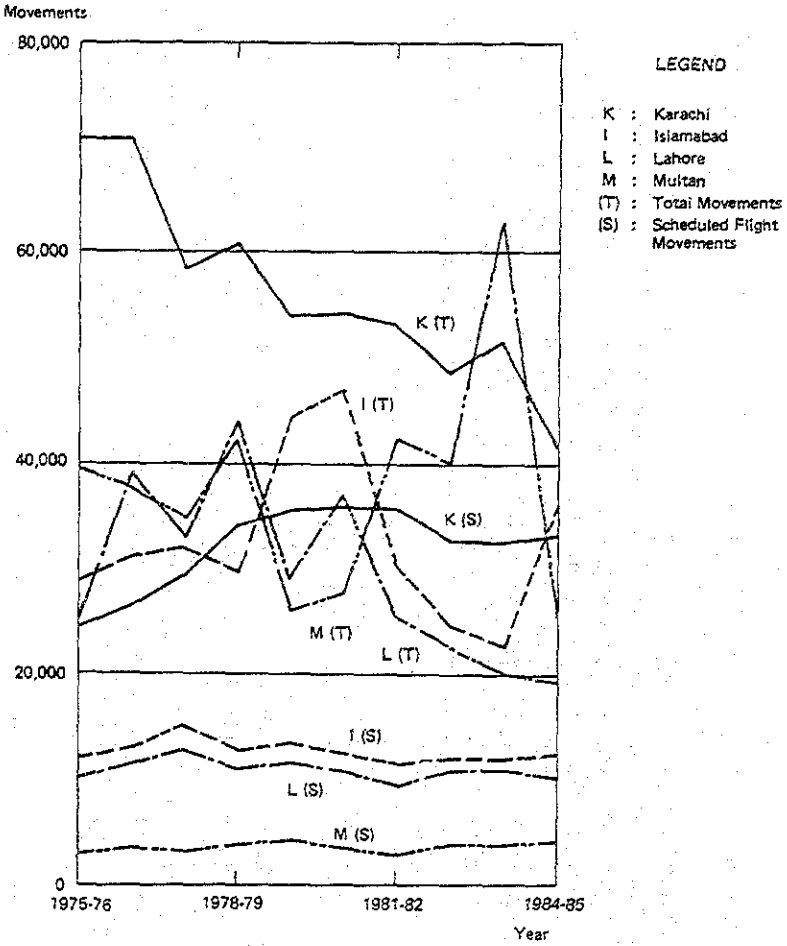
Scheduled aircraft movements in Karachi were about 32,000 in 1984-85, which is about one and a half times of that of 1975-76. The movements in 1984-85 in Islamabad, Multan and Lahore, were respectively 36,000, 25,000 and 19,000, which are nearly the same as in 1975-76.

Fig. 1.2.8 Trend of Air Cargo



From App. Table 1–5

Fig. 1.2.9 Aircraft Movements



From App. Table 1–6

1.3 Review of the Sixth Five Year Plan

1.3.1 Civil Aviation Authority

The proposed projects for CAA in the Sixth Five Year Plan consist of the development of terminals and facilities in the airport, the improvement of air navigation systems, and the construction of feeder service airports.

Budget allocation and utilization in the Sixth Five Year Plan for CAA is as shown in Table 1.3.1. Actual allocation upto 1985-86 was Rs. 378 million in the public sector and Rs. 1,533 million in the semi-public sector. The total of the plan period including the expected expenditure in 1986-87 and 1987-88 is Rs. 558 million and Rs. 2,233 million, respectively.

Table 1.3.2 summarizes the major projects in the Sixth Five Year Plan for civil aviation, showing the budget allocation and utilization for the projects.

Table 1.3.1 Budget Allocation and Utilization for CAA

(Unit: Rs. Million)

	Public Sector	Semi Public Sector	Total
6th Plan Allocation	1,000 (875)*	3,000	4,000
Utilization until 1985-86	378	1,533	1,911
1986 to 88 (Estimate)	180	700	880
Total Utilization	558	2,233	2,791(70%)

Note: * Revised in Mid-Plan Review

Source: Mid-Plan Review of the 6th Five Year Plan and Draft of Seventh Five Year Plan (PDD)

As shown in this table, minor improvements on the existing airports are almost completed. Construction of feeder service airports such as Bhagtanwala, Mianwali, and Kohat, are partly completed. But, as for the construction of new terminal buildings and facilities of Karachi and Lahore airports, they will begin during the current five year plan period, and will continue to the next five year plan.

For the augmentation and improvement of air navigational aids and communication systems, actual expenditure upto 1985-86 was Rs. 83 million against the total allocation of Rs. 416 million in the 6th Plan period.

Table 1.3.2 Major Projects of CAA in the Sixth Five Year Plan

(Unit: Rs. Million)

Airport	Project	Total Cost	Financial Allocation and Utilization (top: Sixth Five-Year Plan Allocation; bottom: Actual Expenditure (83-86) / ADP Allocation (86-88))							Remarks
			Upto 82-83	83-84	84-85	85-86	86-87	87-88	Sub Total	
(A. Semi Public Sector)										
1. Karachi	New Terminal building and facilities	1,000 2,547	- -	50 -	200 4	250 72	250 291	250 920	1,000 1,287	Final design completed. Work expected to commence in March 1988.
2. Islamabad	New Terminal building and facilities	500 1,456	- -	25 -	100 2	125 1	125 80	125 18	500 101	
3. -do-	Extension of Runway	43 32	- -	- -	- -	- -	- 1	13 15	13 16	Improvement of existing airport
4. -do-	Renovation of Airport	- 68	- -	- -	- -	- -	- 1	- 30	- 31	-do-
5. Lahore	New Terminal building and facilities	500 1,060	- -	25 -	100 12	125 0	125 37	125 378	500 427	Master plan and Preliminary design completed. Final Design in progress.
(B. Public Sector)										
6. Karachi	Reconstruction of Terminal-II	39 59	7 -	32 -	- -	- -	- -	- 59	39 59	
7. -do-	Improvement of terminal building	22 22	18 18	4 4	- -	- -	- -	- -	22 22	Completed
8. Islamabad	Improvement of terminal building	20 20	19 19	1 1	- -	- -	- -	- -	20 20	Completed
9. Lahore	Construction of new runway and new apron	124 174	20 -	19 -	86 62	- 46	- 23	- 44	124 174	To be completed within 6th Five Year Plan period
10. Quetta	Strengthening of runway for airbus operation	31 31	28 28	3 3	- -	- -	- -	- -	31 31	Completed
11. Feeder Airport	Construction of feeder airports	110 100	- -	10 -	10 -	10 8	5 18	5 -	40 26	
12. Air Navigational Aids	Augmentation and improvement of air navigational aids and communication system	416 122	65 65	30 18	60 -	80 -	100 -	80 -	416 83	

Source: Sixth Five Year Plan, Federal Government Public Sector Development Programme

1.3.2 PIA

Passenger traffic of PIA is 7,063 MPKS (million passenger kilometers) in 1985-86, which is slightly below the estimation, 7,333 MPKS, projected in Sixth Five Year Plan. According to the latest forecast by PIA, growth rate of passenger traffic upto 1987-88 will be 2.8%, as against 7.3% of forecast in Sixth Five Year Plan. (See Fig. 1.3.1).

In the Sixth Five Year Plan, Passenger traffic in 1987-88 was estimated as 8,437 MPKS. But the capacity of PIA was estimated as 6,965 MPKS in 1987-88, and the remaining 1,472 MPKS was suggested to be fulfilled by the second airline in the private sector. However, it is said this idea to establish the second airline company has been shelved on account of uncertainty on economic effectiveness.

Financial allocation and utilization is as shown in the following table. A large expenditure of PIA until 1985-86 was caused by the budget originally allocated to the second airline which was invested to PIA.

Table 1.3.3 Budget Allocation and Utilization for Airlines

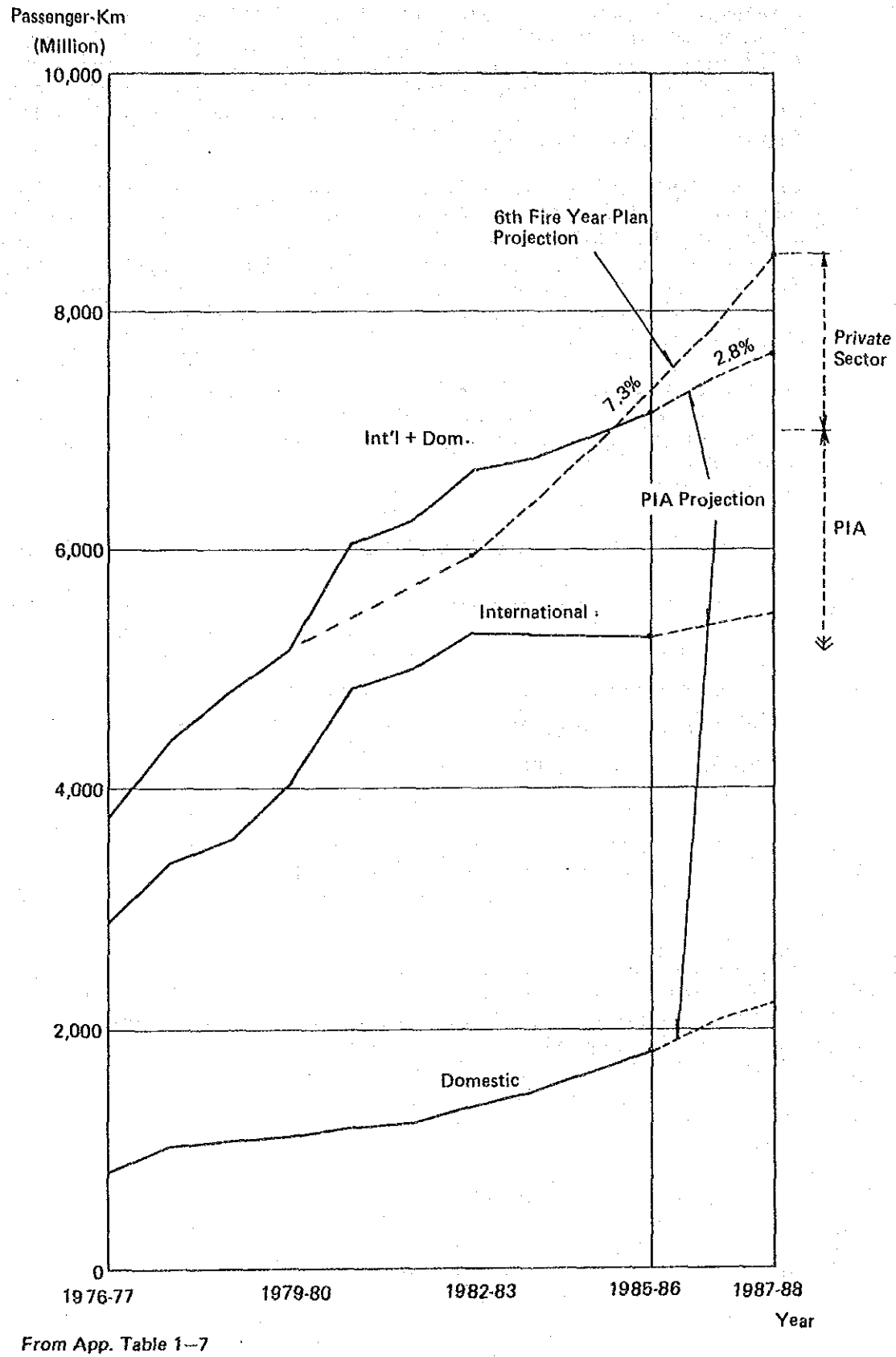
(Unit: Rs. Million)

	PIA	The Second Airline
6th Plan Allocation	2,720	2,721
Utilization until 85-86	6,906	-
Estimate 1986 to 88	1,857	-
Total	8,763	-

Source: Sixth Five Year Plan (PDD) & Review of PIA 6th Plan and Targets & Projection of the 7th Plan (PIA)

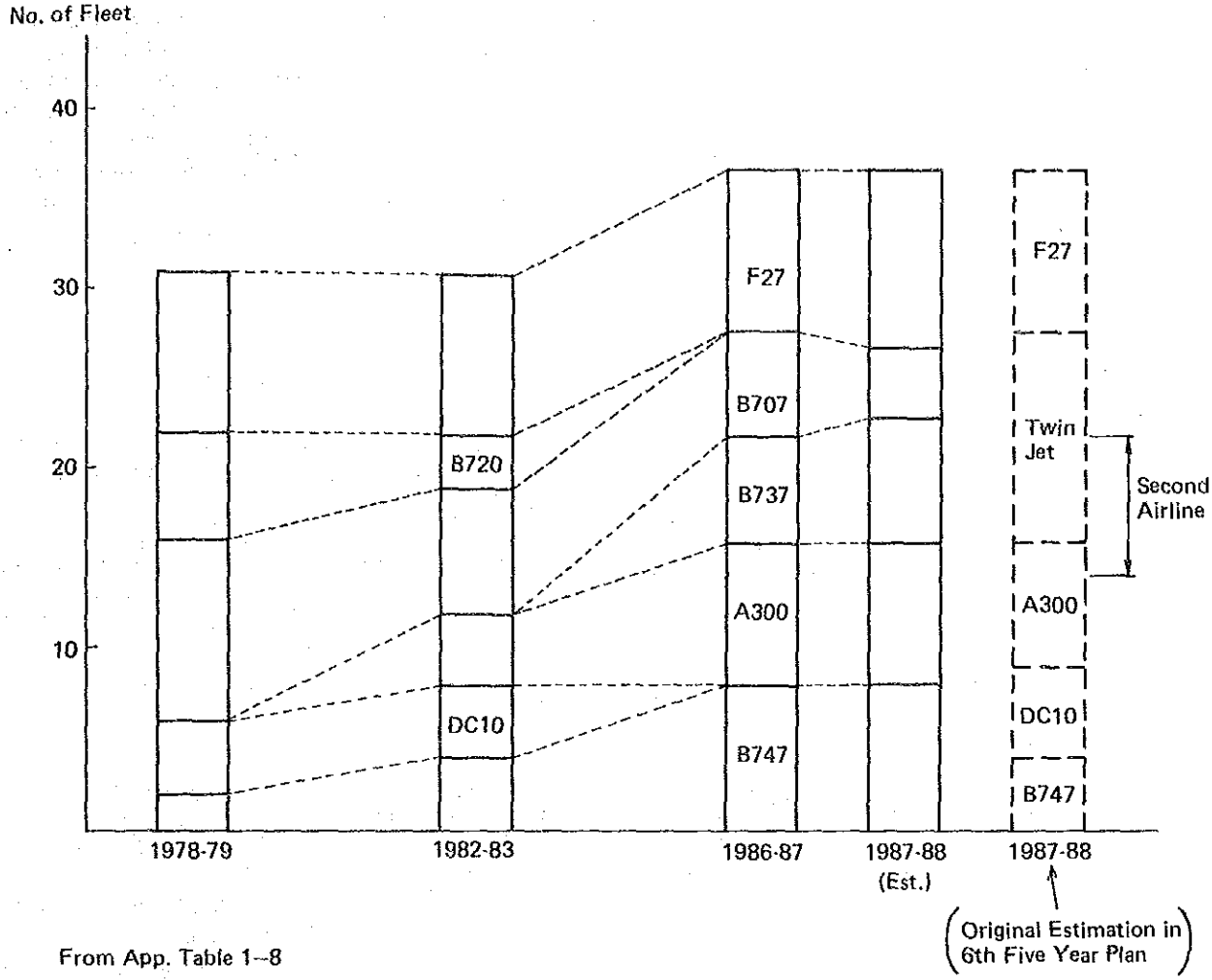
In response to such financial utilization, fleet posession of PIA has changed as shown in App. Table 1-8 and Fig. 1.3.2 which shows PIA will acquire the fleets including the allocation for the second airline company in the original Sixth Five Year Plan.

Fig. 1.3.1 Trend of Passenger Traffic (PIA)



From App. Table 1-7

Fig. 1.3.2 Transition of Fleet Possession



From App. Table 1-8

1.4 Capacity Analysis

Studies on the airports of the whole country as stated in the above subsections indicate that the three airports of Karachi, Islamabad, and Lahore are the key airports from both airline-networks; domestic and international. Capacity of these airports is studied from the aspect of runway use, runway length, apron and terminal buildings. Other airports including small airfields are not examined here. Since landing frequency and passenger volume are relatively small, existing facilities can serve them for a certain period. The service may be not satisfactory, but in the tolerable range. They can be improved by stage in response to a demand increase in the future.

1.4.1 Runways

Runway numbers and length at the existing airports are compared with criteria often used in airport studies: the criteria published by Federal Aviation Administration, U.S.A.

Annual aircraft movements at these three airports are shown in Table 1.4.1, which are much below the runway capacity. Peak hour movements are also presumed to be below the capacity.

Table 1.4.1 Aircraft Movements

Airport	Movements in 1984-85	Runway Capacity[1]		Remarks
		Annual	Hourly	
Karachi	41,345	280,000	54	Close Parallel Runways
Islamabad	35,821	170,000	42	Single runway
Lahore	19,099	170,000	42	do

1) From Federal Aviation Administration, the U.S.A.

The existing runway length of the three airports are shown in Table 1.4.2. Karachi airport has enough runway length for the operation of all aircrafts. For Islamabad airport, the existing runway length is sufficient for the current B747 operation in domestic routes, but not sufficient for the B747 international flights departing from Islamabad. Therefore, international flights are operated with takeoff weight restriction at the present time.

Lahore airport also has enough runway length for the current operations with A300 aircraft in domestic and international lines. Runway length is adequate for B747 operation, but B747 is currently not operated due to the apron capacity.

Table 1.4.2 Runway Length and Operating Aircraft

Airport	Runway Length (m)	Maximum Aircraft Operated		Required Runway Length	
Karachi	3,200	B747 (Int'l)	3,000	(Karachi-London)	1)
Islamabad	2,750	B747	3,500	(Islamabad-London)	2)
Lahore	2,750	A300	2,700	(Lahore-Jehdda)	1)

Source: 1) Long Range Perspective Plan for Civil Aviation in Pakistan
(Aviation Planning Service, 1980)

2) "Existing runway at Islambad" (PIA)

1.4.2 Apron

Required number of aircraft stands is calculated by the following formula:

$$S = Ni \times Ti/60 \times 1.2 + E$$

Where: S : Required number of aircraft stands
Ni: Number of arriving aircraft during the peak hour
Ti: Gate occupancy time in minutes
E: One extra stand for the largest aircraft (1 extra for every 10 stands)

Required number of aircraft stands under the present condition in comparison with the existing facilities are summarized as shown in Table 1.4.3.

Total number of the existing aircraft stands is nearly equal to the required number. Aircraft movements at these airports have been at the same level for the past several years. The introduction of new routes has not been permitted. This means the capacity of the existing facilities are already below the traffic demand.

Table 1.4.3 Number of Aircraft Stands

Airport	Required Number		Existing Number	
Karachi	L	7	L	9
	M	9	M	13
	S	3		
	F	2		
	Total	21	Total	22
Islamabad	L	2	L	2
	M	3	M	2
	S	1		
	F	2	F	4
	Total	8	Total	8
Lahore	M	5	M	2 + (2)*
	S	2	S	1
	F	1	F	4
	Total	8	Total	7 + (2)*

Note L: B747 class, M: A300 class, S: B737 class
F: F27 class
* shows 2 stands under construction.

1.4.3 Passenger Terminal Building

Terminal building space requirements are calculated by multiplying the number of peak hour passengers by the unit floor area per peak hour passenger.

FAA stipulates the unit floor area is 14 sq.m per peak hour passengers for estimating gross terminal building space for domestic use. (FAA, Advisor Circular AC150/5360-7)

In the case of terminal planning in Japan, unit floor area of 15 sq.m and 35 sq.m is adopted for rough estimate of area requirement of domestic and international terminals, respectively. In detail planning, however, domestic terminal building is generally designed with the unit floor area of nearly 10 to 15 sq.m. Similarly, for international terminal buildings, it is appropriate to designed with the unit floor area of 20 to 35 sq. m taking into consideration the number of greeters and the space of offices and concessions in each case.

In the new terminal project of Karachi Airport, the unit floor area of the terminal building is nearly 14 sq.m and 25 sq.m for domestic and international terminals, respectively. Therefore, capacity analysis of existing terminal buildings is carried out as shown below using the above figures.

Table 1.4.4 The Floor Area of The Terminal Building

Items	Karachi		Islamabad		Lahore	
	Dom	Int'l	Dom	Int'l	Dom	Int'l
(1) Actual Floor Area (m^2)	32,909		10,961		7,748	
(2) Peak Hour Passengers	920	1,349	530	250	620	100
(3) Required Unit Floor Area per One Passenger (sq.m)	14	25	14	25	14	25
(4) Required Floor Area (sq.m)	12,900	33,700	7,400	6,300	8,700	2,500
	46,600		13,700		11,200	
(1) - (4)	-13,700		-2,700		-3,500	

1.4.4 Car Parking

The following formula is used to calculate the required car parking spaces.

$$A = P \times C \times L$$

Where, A: Required car parking spaces (sq.m)
P: Number of peak hour passengers
C: Number of parking spaces per peak hour passenger (0.8 by Japanese and FAA standard)
L: Unit space for one lot (25 sq.m including incident space by general planning value)

Required car parking space and existing car parking space are summarized as follows in Table 1.4.5.

Table 1.4.5 Car Parking Area

	Karachi	Islamabad	Lahore
Peak Hour Passengers	2,269	780	720
Number of Parking Spaces	1,815	624	576
Required Area (m^2)	45,380	15,600	14,400
Actual Area (m^2)	7,500	19,000	3,200

The existing car parking area at Karachi and Lahore are considerably small in comparison with the standard area applicable in the planning.

1.4.5 Conclusion

At these three airorts, the runway capacity is adequate for the present operations. But the existing lengths of the runway are not enough at Islamabad and Lahore airports. Apron capacity is already below the traffic demand in these three airports. The capacity of terminal buildings and car parking at each airport are already below the traffic demand. Some congestion in the terminal area is caused for this reason.

1.5 Problems

Air traffic demand in Pakistan is concentrated at the three airports of Karachi, Islamabad and Lahore. The facilities of these airports have been gradually improved in order to handle the increasing demand.

But those facilities which have been improved gradually will not be able to provide the same service level against an increasing future demand. Some facilities are not efficient for handling passengers, cargo and aircrafts, causing complaints from the passengers.

Although the long-term master plan for the above three airports have been prepared, development works have not been commenced yet. A Program for the completion of the development plan should be authorized based on the prospect of demand-capacity relationship.

Augmentation and improvement of air navigational aids and air communication systems have partly progressed, but installation of air traffic control radar has not been completed.

Budget utilization for the air navigational aids is behind schedule in the Sixth Five Year Plan, as shown in Table 1.3.2.

Construction of feeder service airports are in progress. Feeder airports are planned for development in remote areas such as Baluchistan, Jammu and Kashmir, and the southern part of Punjab. But benefits due to the airport construction would not be large enough to justify the viability in economic and financial aspects since traffic demand will be rather low. As a means to consolidate the national unity, they need to be constructed. However, the construction should be at a modest pace, not to cause a burden to Pakistan over the aviation development plan.

CHAPTER 2 MASTER PLAN

2.1 General

In this chapter, the Master Plan for airport/aviation is formulated.

The demand forecast, which is shown in Part II as OD tables, is broken down to the traffic demand by airport. Taking into these future demand, facilities and fleet plan required in the target year are calculated, and projects and cost for the Master Plan are summarized.

2.2 Future Traffic Demand for Planning

2.2.1 Forecast of Air Traffic

Annual passenger traffic and aircraft movements by route in 1992-93 and 2005-06 are summarized as shown in App. Table 2.2 and 2.3.

Based on the interzonal OD tables which are shown in Part II, the future OD tables between the airports have been created as follows:

i) In the zone where there is only one airport, the demand of the zone is equal to the demand of that airport.

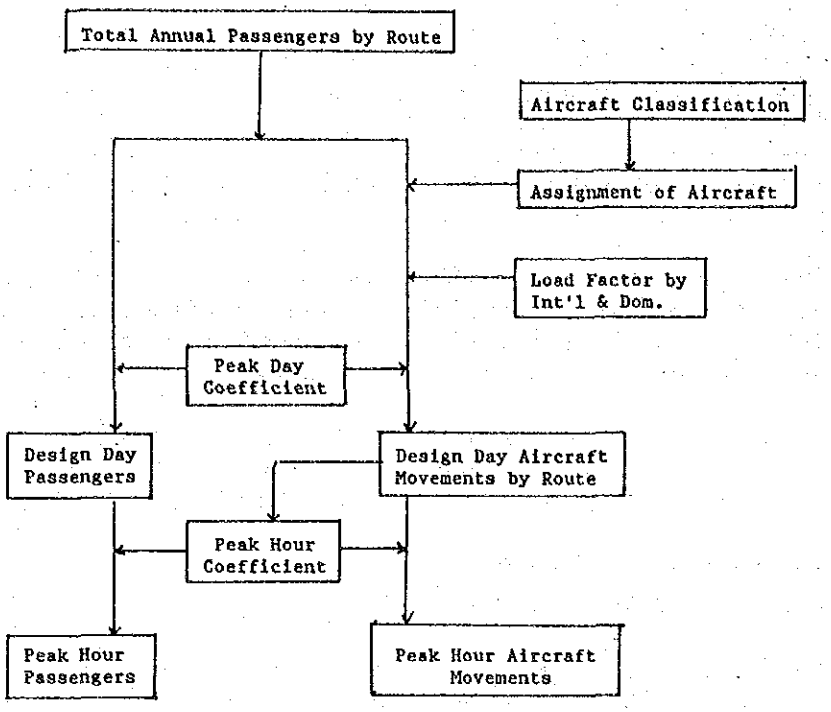
ii) In the zone where there are two or more airports, the demand of that zone is distributed to each airport according to the share of the past traffic demand. If a new airport is located in the zone which has no air traffic in the past, the total demand of that zone is distributed to each airport in the light of the ratio of the PIA passenger traffic forecast.

For the airport facility planning, the traffic demand on the design day was calculated taking the actual condition in Pakistan into account based on the ICAO (International Civil Aviation Organization), FAA (Federal Aviation Administration) standards and recommendation and, if necessary, JCAB (Civil Aviation Bureau of Japan).

In this section, the annual traffic demand was broken down into daily and hourly bases in order to establish facility requirements as shown in Fig. 2.2.1

Parameters/coefficients used in this analysis are assumed as follows:

Fig. 2.2.1 Flow Chart for Breakdown of Air Traffic Volume



(a) Aircraft Classification

The aircraft expected to be operated in Pakistan in 1992-93 and 2005-06 are classified by type and size as follows, taking into account the present aircraft types owned by PIA and future fleet plan.

Table 2.2.1 Aircraft Classification

Class	Seating Capacity		Aircraft Type
	1992-93	2005-06	
B747 Class	400	450	B747-200, 300
Wide I	270	300	B74M, A300, A330
Wide II	-	200	B767, A310
Narrow Body Jet Class	135	150	B737, B707
F27 Class*	40	40	F27
DHC-6 Class*	18	18	DHC-6

* Only for domestic route

Source: JICA Study Team

(b) Assignment of Operating Aircraft

i) Operating Aircraft for Domestic Routes

The selection of aircraft types to be operated by route has been mode mainly based on the above aircraft classification and the economical considerations.

The criteria on aircraft assignment for domestic routes are assumed as shown below by annual passenger volume by route.

In this table, Wide II aircraft will not be introduced in the Seventh Five Year Plan period, so Wide I aircraft is adopted from 150,000 to 600,000 of annual passengers in one way.

Table 2.2.2 Operating Aircraft Assignment for Domestic Flight Operation

Annual Passengers in One Way	Aircraft	Seating Capacity	
		1992-93	2005-06
650 to 1,500	DHC-6 Class	18	18
1,500 to 80,000	F27 Class	40	40
80,000 to 150,000	Narrow Body Jet Class	135	150
150,000 to 400,000	Wide II	-	200
400,000 to 600,000	Wide I	270	300
Above 600,000	B747 Class	400	450

Source: JICA Study Team

ii) Operating Aircraft for International Routes

The assumption of aircraft mix for international flights in 2005-06 was made as shown in Table 2.2.4 based on the present pattern at Karachi airport and the fleet requirements upto year 2006 by PIA. In the future, size of aircraft will tend to become large, particularly for Europe and Far East routes, it is assumed that Wide II aircraft will be introduced instead of Narrow Body Jet.

Besides, aircraft mix in 1992-93 made by the present pattern at Karachi Airport is shown in Table 2.2.3.

Table 2.2.3 Aircraft Mix for International Flights in 1992-93

Route	B747 Class	Wide I	Wide II	Narrow Body Jet Class
Middle East and Africa	20%	45%	5%	30%
Europe	30	50	-	20
Far East	15	60	-	25
Regional	10	35	-	55

Source: JICA Study Team

Table 2.2.4 Aircraft Mix for International Flight in 2005-06

Route	B747 Class	Wide I	Wide II	Narrow Body Jet Class
Middle East and Africa	25%	45%	10%	20%
Europe	40	50	10	-
Far East	25	60	15	-
Regional	15	35	10	40

Source: JICA Study Team

(c) Design Day Coefficient

Design day coefficient is established as shown in the following Table 2.2.5. This value is set up by the ratio of the actual air traffic passengers on the average day in the second peak month to the annual air traffic passengers in Pakistan.

Table 2.2.5 Design Day Coefficient

	Domestic	International
Design Day Coefficient	1/313	1/313

Source: JICA Study Team

(d) Peak Hour Coefficient

Peak hour coefficient for planning is designated in ICAO and FAA standards as follows:

FAA: The graph is shown which relates peak hour coefficient to annual enplaned passengers. (Advisory Circular AC 150/5360-7, FAA)

ICAO: Typical peak hour is defined as the 30th or 40th busy hour for the year. (Airport Planning Manual, Part 1)

The formula designated in the JCAB standard is of a type similar to the formula in FAA standard, using the peak day aircraft movements instead of annual passengers.

The coefficient of the formula has used the constant value based on the past traffic in Japan.

For this study, peak hour coefficient is calculated based on the actual flight schedule in Pakistan, and summarized as follows:

Domestic : $P = 1.6372/A + 0.1257$
International : $P = 0.4908/A + 0.1538$

Where, P: Peak hour coefficient
A: Peak day aircraft movements by airport.

(e) Load Factor on Design Day

Load factor on design day is assumed as shown in Table 2.2.6, considering general standard values used for the airport planning and present situation in Pakistan.

Table 2.2.6 Load Factor

	Domestic	International
Load Factor	80%	70%

Source: JICA Study Team

(f) Design Day Aircraft Movements by Route

Design day aircraft movements by route is calculated by using the following formula:

Design day aircraft movements by route

$$= \frac{\text{Annual passengers by route} \times \text{Design day coefficient}}{\text{Aircraft seating capacity} \times \text{Design load factor}}$$

(g) Peak Hour Aircraft Movements and Passengers

Peak hour aircraft movements and passengers are calculated by the following formulae:

Peak hour aircraft movements

= Design day aircraft movements x Peak hour coefficient

Peak hour passengers

= Annual passengers x Peak day coefficient
x Peak hour coefficient

2.2.2 Summary of the Forecast

The passenger and cargo traffic volume and aircraft movements necessary to formulate facility requirements are calculated.

Table 2.2.7 and 2.2.8 show the annual domestic and international passengers at major airports and all airports. Table 2.2.9 shows annual domestic and international cargo. Air traffic volume of each airport is shown in App. Table 2-6 to 2-9.

Table 2.2.7 Annual Domestic Passengers

		1985-86	1992-93	2005-06
Passenger-kms (million)	Total	1,794 (6.6%)	2,813 (6.2%)	6,158
Passengers (thousand)	All airports	4,601 (6.4%)	7,088 (6.9%)	16,835
	Karachi	1,633 (7.5%)	2,711 (6.7%)	6,264
	Islamabad	870 (3.5%)	1,104 (5.4%)	2,181
	Lahore	1,053 (4.7%)	1,448 (7.0%)	3,474

Note: ( ) indicates annual growth rate
Source: JICA Study Team

Table 2.2.8 Annual International Passengers

	1985-86	1992-93	2005-06
All Airports	3,120 (1.6%)	3,481 (3.1%)	5,204
Karachi	2,644 (0.8%)	2,795 (3.1%)	4,170
Islamabad	325 (4.1%)	431 (3.3%)	656
Lahore	108 (10.2%)	213 (3.3%)	323

Note: ( ) indicates annual growth rate
Source: JICA Study Team

Table 2.2.9 Annual Cargo

		1985-86	1992-93	2005-06
Domestic	(Million ton-kms)	24.13 (6.1%)	36.42 (5.9%)	76.70
	(Thousand ton)	49 (5.7%)	72 (6.4%)	161
International	(Thousand ton)	115 (6.0%)	173 (4.8%)	320

Note: ( ) indicates annual growth rate
Source: JICA Study Team

2.3 Basic Concept for Master Plan

In order to formulate the Master plan, basic concept is proposed. Air transport has recently become an important sector for the political and economic activities in the country and for the strengthening of the relations with foreign countries. In order to secure the safe and rapid transportation for the development of the country, the Master Plan for the air transport sector is proposed based on the following basic concepts:

(i) Development of the facilities of major airports and improvement of existing airports in order to expand capacity of air transport.

(ii) Development of the air navigation systems in order to improve air traffic safety.

(iii) Development of feeder service airports in order to upgrade the rural areas.

(iv) Expansion of the route network and increment of the traffic capacity of airlines.

2.4 Project Selection

2.4.1 Development of Airport in Response to Increasing Demand

(1) Karachi Terminal Project

As mentioned in Chapter 1, Karachi airport has been improved to cope with the increasing traffic demand. But it will be difficult for existing facilities to provide the same service level in future. Especially, overall improvement of terminal facilities will be necessary.

Development project of the terminal was already planned to be started in the Sixth Five Year Plan, but construction works has not been commenced yet. Most part of the project will be carried out in the next Five Year Plan period. In the Seventh Five Year Plan, it is recommended to construct the facilities, floor area of which is about 44,000 sq.m and construction cost is about 1.7 Rs. billion as described in detail in "2.7 Development Planning". Construction of other facilities is planned in the Eighth Plan period. Total construction cost will add up to 2.1 Rs. billion.

In our study, future traffic demand is reviewed based on the recent trend of the passenger traffic. The forecasted traffic demand in the target year of 1995 is 8.22 million as described in PC-I. However, due to the slow growth of passengers in recent years, the forecasted demand in 1992/93 is 5.51 million passengers in our study, which is about 70% of the CAA forecast for 1995.

Therefore, construction of the terminal of 44,000 sq.m which is about 70% of the total floor area of 66,000 sq.m is considered to be appropriate.

(2) Jet Operation to Local Airports

Operation of jet aircraft to some airports where the F27 aircraft is currently operated and traffic demand is expected to increase should be promoted for the expansion of capacity and for the improvement of service levels. In the Seventh Five Year Plan, Gilgit, Chitral and Turbat is recommended to be developped in order to introduce B737 operation.

(3) Other Airports

Other existing airports are recommended to be developed based on the future traffic demand.

2.4.2 Establishment of Safe and Efficient Transportation

(1) Development of Air Navigation Systems

Air navigation systems will generally include radio navigational aids, air traffic control, aeronautical telecommunications, meteorological and aeronautical lighting systems.

Air navigation systems have been planned in this study for air routes and airports in compliance with the international standards, i.e., Standards and Recommended Practice of ICAO. However, detailed planning practices which are not included in those of ICAO Standards have been supplemented by the standards of JCAB. The basic planning criteria of major navigation equipment are as follows:

i) Radar Approach Control

Radar approach control unit will be justified when annual aircraft operations will exceed 10,000 movements under instrument flight rules (IFR). Equipment necessary for the unit will include a terminal ASR/SSR[1/] and associated control consoles.

ii) ILS Category-I/Lighting Category-I

Installation of navigational aids and lighting equipment which will allow Category-I operation will be justified for an airport where turbo jet aircraft operate as scheduled civil transport.

1/ ASR: Airport Surveillance Radar, SSR: Secondary Surveillance Radar

Equipment necessary for Cat.-I operations will be as follows:

ILS Category-I
Approach Lighting System Category-I
Visual Approach Slope Indicator System
Runway Edge Lights
Runway Threshold Lights
Runway End Lights
Taxiway Edge Lights, etc.

Terminal DME allocated with ILS will be applicable where outer marker could not be justified for geographical and/or economical reasons.

iii) ILS Cateogry-II/Lighting Category-II

Installation of Category-II equipment will be justified for the highly congested international airports provided that such installation could result in, to a great extent, the economic benefits and contribution to aircraft operations safety. Those equipment will include the following:

ILS Category-II
Approach Lighting System Category-II
Visual Approach Slope Indicator System
Runway Edge Lights
Runway Threshold Lights
Runway End Lights
Runway Center Line Lights
Touch Down Zone Lights
Taxiway Edge Lights
Taxiway Center Line Lights, etc.

iv) VOR/DME

Installation of VOR/DME will be justified for airport where scheduled civil aircraft will be operated. NDB will also be applicable instead of the VOR/DME under conditions that the annual aircraft movements would not exceed 3,000 operations and interception to the airport of destination could be safely made by an adjacent VOR/DME or VORTAC located within 40 NM radius from the airport.

(2) Development of Alternate Airport to Karachi

a) Background

Karachi airport is an important airport as a gateway for international air traffic. The alternate airport to Karachi airport is, therefore, essential for aircraft operation in case of the runway closure due to adverse weather at Karachi. As an alternate airport to Karachi, Nawabshah airport has been designated as indicated in "AIP Pakistan" (RAC4). But, it has been rarely utilized for diversion, and Lahore and Islamabad airports have been often used instead of Nawabshah.

Nawabshah is an airport situated 200 km northeast from Karachi with a runway length of 2,743 m. The runway length is sufficient for large type aircraft operation, but there are neither parallel taxiway nor turning pads. Furthermore, there is no apron, and a part of an abandoned runway is used for parking area. Therefore, Nawabshah airport has been utilized as an alternate airport for only F27 type of aircraft actual.

Taking into account the above situation, the development direction of an alternate airport to Karachi is studied as follows.

b) General Condition for Alternate Airport

Basic condition for an alternate airport is summarized as shown below:

- the alternate airport should have sufficient facilities for diverted aircrafts and passengers.
- local weather conditions around the alternate airport should be different from that of the airport of intended landing.
- the alternate airport should not be far from the airport of originally intended landing.
- ground service by airlines should be available at the alternate airport.

c) Candidate Alternate Airports

The development project of an alternate airport to Karachi has been discussed for long years by the various agencies concerned. The major opinion regarding the alternate airport to Karachi are as follows:

- CAA proposes Sukkur airport as an alternate airport.
- PIA proposes Nawabshah airport instead of Sukkur airport.
- MOD considers three candidates of Nawabshah, Sukkur and Hyderabad, but has not decided yet.
- Sub-working group on Civil Aviation for the Seventh Plan proposes Hyderabad airport as an alternate airport.

To sum up the above, there are three candidate airports of Nawabshah, Sukkur and Hyderabad as an alternate airport to Karachi.

d) Comparison of Candidate Airports

Table 2.4.1 shows the comparison of the above three candidate airports.

As shown in Table 2.4.1, the three candidate airports each have merits and demerits, and some development works will be required to utilize the airport as an alternate airport.

The required runway length for the alternate airport is 2,000[2/] m which is enough for landing for maximum landing weight and take-off for Karachi Airport of B747 aircraft.

2/ Source: Long Range Perspective Development Plan for Civil Aviation in Pakistan, Aviation Planning Sirvice

Table 2.4.1 Candidate Alternate Airport

Airport	Nawabshah	Sukkur	Hyderabad
Air Route Distance from Karachi (km)	190	360	130
Existing Facilities			
a) Runway Length and Width (m)	2,743 x 46	2,743 x 31	2,133 x 31
b) Parallel Taxiway	Nil	Available	Nil
c) Apron	Nil Aircraft parking area on abandoned runway (46 x 300 m)	46 x 46 (m) (F27 x 1)	232 x 114 (m) (F27 x 4)
d) Radio Navigation Aids	VOR NDB	NDB	NDB (ILS and VOR/DME for training)
e) Lighting Aids	RWL THR VASIS Apron flood light	RWL THR PAPI TWL Apron flood light	SALS RWL THR TWL Apron flood light
Weather Condition	Fog which has often caused runway closing at Karachi airport in the morning hours appears near the sea, and does not affect inland areas.		
Construction Cost (mil.Rs.)	80	98	79
Annual Cost of excess burn-off fuel in 1992-93 (mil.Rs.)	9.8	13.1	8.9
Merit	Sufficient runway length and width	Sufficient runway length	Not so far from Karachi compared with other two airports
Demerit	New apron and taxiway required	Far from Karachi Runway width not sufficient for large aircraft operation	Runway width not sufficient for large aircraft operation

Each candidate airport has sufficient runway length.

Sukkur airport has enough runway length, but widening will be required. Existing apron is also necessary to be expanded. Therefore, development cost is the highest among the three candidates. Sukkur airport is more than 300 kms north from Krach. Due to the long distance from Karachi in comparison with the other two candidate airports, more fuel for the farther alternate airport will be required. Therefore, take-off weight will increase and more burn-off fuel will be also required. It will be disadvantagerous for airlines.

For Nawabshah airport, the length and width of runway is sufficient, but apron will have to be constructed because there is no apron at the moment.

In Hyderabad airport, apron expansion and runway extension are necessary. However, Hyderabad is not so far from Karachi and road transport on the super highway is also available. Climate candition is different because it is located in the inland area far from the sea.

Concerning the construction cost, Sukkur is the highest due to the large pavement area, and Nawabshah and Hyderabad are nearly the same. Annual cost of fuel is the highest at Sukkur due to the long distance from Karachi, and Nawabshah is second, and Hyderabad is the lowest.

e) Recommendation

Judging from the above various situations, Hyderabad is recommended to be developed as an alternate airport among the three candidate airports. Further study wil be necessary for detailed planning.

2.4.3 Feeder Airport Project

(1) General

Feeder Service Airports were planned to connect remote areas of the country with the air links for the purpose of development in those areas. Twelve feeder airports have already been completed and three airports are under construction. Furthermore, eleven other airports have been under consideration in the CAA Feeder Airports Project.

There are many airports in major cities all over the country. Careful consideration should be given to invest for the construction of new feeder airports. Following examination was therefore carried out for the preliminary study on the feasibility of new airport projects for the Master Plan taking into account the existing situation and future development of all transport modes including railways and roads.

(2) Demand Forecast

Future traffic demand of candidate airports has been estimated as follows:

i) In case that a candidate airport is planned in the zone where another airport is already existing, the future traffic demand of that zone, which is shown in Part II, will be devided into those two airports. The ratio of the demand of each airport is set in the light of the PIA passenger traffic forecast.

ii) In case that a candidate airport is planned in the zone where no airport is existing at present, that zone is considered to be included in the influence area of the airport located in the neighbouring zone. When a new airport is completed, an influence area will be divided into two areas of an existing airport and a new airport. Therefore, the demand of the influence area where a new airport is located will be the demand for the new airport.

(3) Method of Evaluation

Regarding the eleven candidate airports which are under consideration at present, the traffic demand, construction cost and alternate transport mode were studied.

Following conditions were taken into consideration for the alternative transport mode.

1) Alternative transport mode was assumed on the route on which the largest traffic demand would be expected from the airport.

2) Aircraft was considered as an alternate mode provided another airport would be available which has daily operation with the destination. In other cases, existing railway and/or road were considered as an alternate mode.

3) Travelling time by railway was based on the current timetable. Travelling time by road shows the time required by a flying coach. On the route the flying coach is not operated at present, necessary time was calculated using the general average speed of the flying coach. Travelling time by air includes one hour for waiting time at the airport.

Evaluation was made according to the following conditions.

- The airport is to be eliminated which would not be so far from an existing airport.

- The airport is to be eliminated where much traffic demand could not be expected.

- The airport is to be eliminated where the air route distance to the destination would not be far, and where an alternate transport mode such as railway and highway could be available.

- The airport is to be constructed where some traffic demand could be expected. Where alternate transport mode would not be developed, and which would be located far from the existing airport.

Economic evaluation was also carried out, which is explained in "3.4 Preliminary Evaluation".

(4) Result of Evaluation

Table 2.4.2 shows the comparison of eleven candidate airports.

Benefit/Cost ratio of all airports are less than 1.0. As a result of comparative study, each airport was evaluated and classified into three ranks of "A", "B" and "C".

Development of airports in rank "A" are considered appropriate comparing with other airports for upgrading of rural areas. Development of airports in rank "B" are to be carefully reexamined because the benefit of a new airport does not seems to be distinct. Development of airports in rank "C" are considered to be of little benefit for the area.

Taftan airport is evaluated as rank "A". Taftan is located at the west end of Baluchistan Province. Although it is connected with Quetta by railway, only four trains are operated in a week. Travel time by rail and road from Quetta is very long due to the long distance of 700 km. However, some traffic demand is expected. Five airports are evaluated as rank "B". Among these five airports, Loralai and Kharan are omitted due to the very low B/C ratio. Among the other three airports of Mansehra, Sialkot and Bahawalnagar, Mansehra will have the largest traffic demand. Therefore, Mansehra is also included in the Master Plan projects.

As a result, Taftan is recommended to be included in the Master Plan at first, and secondly, Mansehra is recommended. But both are not recommended to be included in the Seventh Plan due to the low priority compared with the other projects.

2.4.4 On-Going Projects

On-going projects brought forward from the Sixth Five Year Plan are desirable to be completed during the Seventh Five Year Plan period.

Table 2.4.2 Feeder Airport Projects

Airport	Traffic Demand in 2005-06 (thousand)	Construction Cost (Rs. Million)	Alternative Transport Mode: Destination	Distance (km)	Transport Mode	Time	Remarks	Evaluation	Benefit/ Cost Ratio
1. Mansehra	311	73	Peshawar	150	Road	2h 30m	Not so far from Islamabad Airport (140 km)	B	0.23
2. Wana	3	48	Peshawar	280	Road (Wana - D.I. Khan) Air (D.I. Khan - Peshawar)	4h 40m	Very small traffic demand Not so far from D.I. Khan Airport (150 km)	C	0.03
3. Sialkot	132	68	Islamabad	220	Rail	5h 20m	Not so far from Lahore Airport (130 km)	B	0.32
					Road	4h 30m			
4. D.G. Khan	58	66	Karachi	850	Road (D.G. Khan - Multan) Air (Multan - Karachi)	5h 50m	Not so far from Multan Airport (90 km)	C	0.21
5. Sahiwal	310	73	Lahore	150	Rail	2h 30m	Not so far from Faisalabad and Multan Airports. (100 - 170 km)	C	0.31
					Road	2h 30m			
6. Bahawalnagar	44	63	Lahore	230	Road	4h 00m	Not so far from Lahore Airport (230 km)	B	0.34
7. Chachro	45	65	Karachi	330	Road	5h 30m	Railway and Highway not available	B	0.07
8. Loralai	12	63	Multan	310	Road	5h 00m	Very small traffic demand	C	0.10
9. Taftan	69	67	Quetta	680	Rail	19h 30m	Very far from Quetta (Travel time is long) Some traffic demand expected	A	0.84
					Road	11h 30m			
10. Nushki	22	63	Quetta	120	Rail	6h 00m	Very small traffic demand Not so far from Quetta Airport (120 km)	C	0.13
					Road	2h 00m			
11. Kharan	70	65	Quetta	250	Road	4h 00m	Some traffic demand expected Railway not available.	B	0.09

2.5 Facility Requirements

This section sets forth the airport facility requirements which are estimated based on the estimated air traffic volume and also in compliance with the relevant standards, recommended practices and/or recommendations of ICAO, FAA and JCAB. Facility requirements for each airport in 1992-93 and 2005-06 are summarized in App. Table 2-10 to 2-13.

(1) Runway

Runway length at each airport is estimated according to the requirement by maximum operating aircraft.

i) The major airports which will handle B-747 and Airbus in the future were checked for the possibility of take-off and landing under the conditions of maximum pay load, airport altitude and temperature, utilizing the ICAO standard.

ii) The airport where B737 will be operated will require a runway length of 2,000 m. Therefore, the runway will be extended in the airports, where the existing runway length is less than 2,000 m.

iii) The local airports where F-27 class aircraft will be introduced in the future, will require a runway of 2,000 m (6500FT) according to the FAA. However, some airports now in service have shorter runway length than 2,000 m. In this case, existing runway is considered to be enough.

(2) Taxiway

At Karachi, Islamabad and Lahore airports, instrument approach will exceed four flights during the peak hour, and the operation of wide bodied jet aircraft will become frequent. Therefore, a complete parallel taxiway with perpendicular exits will be necessary.

(3) Aprons

i) Calculation Method for Required Number of Aircraft Stands

The following formula is used to obtain the required number of aircraft stands for the target year.

$$S = Ti/60 \times Ni \times 1.2 + A$$

Where, S: Required number of aircraft stands,
Ti: Gate occupancy time in minutes,
Ni: Number of arriving aircrafts during the peak hour,
A: One extra stand for the largest aircraft of the target year for unexpected peaking occasion. (1 extra for every 10 stands)

ii) Gate Occupancy Time

The gate occupancy time for each category is assumed as tabulated in Table 2.5.1, with a margin for delay considering the current condition.

Table 2.5.1 Gate Occupancy Time

(Unit: minutes)

		Occupancy Time	
		L Jet	Others
Domestic	Primary airports	80	55
	Others	70	45
Int'l	PIA	130	70
	Foreign carrier	70	

Notes: 1) Primary airports; Karachi, Islamabad, Lahore, Peshawar, and Quetta
2) L Jet; B747 and Wide I class

iii) Apron Space

Apron space is established according to the aircraft classification, and added required width of B747, Wide I, Wide II under self-maneuvering.

Table 2.5.2 Parking Space Requirement

	Width (m)	
	Nose-in/Push-out (Karachi, Islamabad and Lahore)	Self-Maneuvering (Others)
B747 Class, Wide I	70	105
Wide II	60	95
Narrow Body Jet Class	45	60
F27 Class, DHC-6 Class	-	50

Note: Each figure includes the clearance between aircraft.

(4) Passenger Terminal Building

As described in "1.4 Capacity Analysis", the unit floor area per peak hour passenger is generally 10 to 15 sq.m for domestic and 20 to 35 sq.m for international passenger. In the new terminal project of Karachi, unit floor area is 14 sq.m and 25 sq.m for domestic and international terminal, respectively.

For estimation of facility requirements, unit floor area per peak hour passenger for domestic terminals is, therefore, set at 15 sq.m and 10 sq.m for major airports and other small airports, respectively. And unit floor area for international terminals is set at 25 sq.m.

In addition to the above space requirements, a space of 10 sq.m per peak hour international transit passengers is required in Karachi airport considering the number of transit passengers.

(5) Cargo Terminal Building

Required cargo handling space is calculated by multiplying annual cargo handling volume per unit floor area by the forecasted cargo volume.

In the cargo terminal planning in Karachi airport, handling volume per unit floor area of 5 ton/sq.m is adopted, which is the sum of domestic and international cargo. Actual ratio of domestic and international cargo volume is 20:80 at Karachi airport. Required floor area for handling of unit volume of international cargo is generally about 2.5 times of domestic cargo. Therefore, handling capacity per unit floor area is proved to be 11.0 ton/sq.m (0.09 sq.m/ton) for domestic and 4.4 ton/sq.m (0.23 sq.m/ton) for international cargo. Furthermore, handling capacity in 2005-06 is assumed to be improved as shown in Table 2.5.3, considering the development of mechanization in the future.

Table 2.5.3 Cargo Handling Capacities

(Unit: sq.m/ton)

	1992/93	2005/06
Domestic	0.09	0.08
International	0.23	0.19

(6) Car Parking

The following formula is used to calculate the required car parking spaces.

$$A = P \times C \times L$$

Where, A: Required car parking spaces
P: Number of peak hour passengers
C: Number of parking lots per peak hour passenger (0.8 by Japanese and FAA standard)
L: Unit space for one lot ($25\ m^2$ for parking lot and circulation road only)

(7) Air Navigation Systems

Air navigation systems will be installed to meet the aircraft operation requirements in correspondence with the traffic demand forecast. Existing facilities which are neither fully operational nor reliable for air safety will also be replaced or upgraded preferentially.

Facility requirements for air navigation system are shown in App. Table 2-14.

2.6 Fleet Plan

The future fleet plan of PIA is estimated based on the forecasted aircraft movements by route in the target year.

The aircraft category and the typical aircraft types of each category are summarized as follows:

B747 Class	(B747-200, 300, 400 etc)
Wide Body I Class	(A300, A330, MD-II etc)
Wide Body II Class	(B767, A310, A340 etc)
Narrow Body Jet Class	(B737, B707 etc)
F27 Class	(F27 etc)
DHC6 Class	(DHC6 etc)

The total number of aircraft to be purchased is estimated as shown in the following table.

Table 2.6.1 Fleet Plan

	Aircraft	Required in 2005-06 (1)	Existing (2)	Replaced by 2005-06 (3)	Total Aircraft to be purchased (1)-(2)+(3)
1.	B747 Class	15	8	8	15
2.	Wide Body I Class	17	7	7	17
3.	Wide Body II Class	5	-	-	5
4.	Narrow Body Jet Class	11	10	10	11
5.	F27 Class	24	9	9	24
6.	DHC 6 Class	9	2	2	9

Source: JICA Study Team

2.7 Development Plan

2.7.1 General

Based on the future traffic demand and some detailed studies as described in 2.4, candidate projects for the Master Plan are selected. Total project cost is approximately 7.7 Rs. billion for airport projects and 80.6 Rs. billion for aviation.

2.7.2 Projects and Cost Estimation

(1) Projects and Cost

Candidate projects and cost are summarized in Table 2.7.1.

(2) Project Cost for Karachi Airport

Details of the project cost for Karachi terminal project is as shown in Table 2.7.2

Table 2.7.1 Projects and Cost Estimation for Master Plan

Project Name	Outline	Cost (Rs. Million)
A. Airport		
1. Karachi Airport Project	- Extension of secondary runway and taxiway	139
	- Construction of new terminal facilities	2,456
2. Islamabad Airport Project	- Extension of existing terminal facilities	50
	- Construction of airport at new site	1,167
3. Lahore Airport Project	- Construction of terminal facilities	630
4. Improvement of Existing Facilities	- Improvement and expansion of runway, taxiway, and terminal facilities at other airports	890
5. Alternate Airport Projects	- Construction of taxiway and terminal facilities	103
6. Feeder Airport Projects	- Construction of feeder service airports	140

(Cont'd)

Project Name	Outline	Cost (Rs. Million)
7. Aeronautical Communication and Control System	- Installation of radar equipment at Lahore, Islamabad and Quetta. Remotely controlled VHF A/G communication facilities and upgrade of AFTN network.	531
8. ARSR/SSR En Route Rader Network	- 3 sets of ARSR/SSR	532
9. Air Navigation System for Karachi Airport	- ILS Cat-II, DVOR/DME, RWL for main runway, ILS Cat-I, ALS Cat-I, VASIS, RWL for subrunway, etc.	113
10. Air Navigation System for Islamabad Airport	- ILS Cat-II, DVOR/DME, NDB, Lighting Cat-II etc.	323
11. Air Navigation system for Lahore Airport	- ILS Cat-II Lighting Cat-II, RVR, TWL, etc.	69
12. Air Navigation system for Other Airports	- Development of air navigation system in minor airports	318
13. Air Navigation system for Feeder Airports	- Developmet of air navigation system in feeder airports	9
14. Other On-going Projects		238
Total (Airport)		7,708
B. Aviation		
1. Purchase of Aircraft	- B747 Class : 15 - Wide Body Class : 22 - Narrow Body Class : 11 - F27 Class : 24 - DHC-6 Class : 9	70,310
2. Hangar, Workshop and Equipment		10,310
Total (Aviation)		80,620

Source: JICA Study Team

Table 2.7.2 Comparison of Costs

(Unit: Rs. Million)

Item	Master Plan (2005/06)	Seventh and Eighth Plan	Seventh Plan
A. Apron			
1. Pavement	109	74	74
2. Drainage and Earthwork	194	145	145
3. Preliminaries	15	11	11
4. Consulting Fee	30	22	22
5. Contingency	35	25	25
Sub Total	383	277	277
B. Terminal Building			
1. Terminal Building	780	459	392
2. Other Building	10	10	10
3. Car Park and Access Road	10	130	128
4. Utilities	700	770	539
5. Boarding Bridge	159	102	102
6. Security Fence	1	1	1
7. Preliminaries	75	68	53
8. Consulting Fee	150	137	107
9. Contingency	188	168	133
Sub Total	2,073	1,845	1,465
Total (A + B)	2,456	2,122	1,742

CHAPTER 3 THE SEVENTH FIVE YEAR PLAN

3.1 Basic Policies/Strategies for the Seventh Five Year Plan

On the basis of the Master Plan concept mentioned in Chapter 2, policies and strategies for the successful execution of the Seventh Five Year Plan are proposed as follows:

(1) Policies

i) Major airports of Karachi, Islamabad and Lahore should be developed in accordance with the change of traffic demand, while the existing facilities will make the best use until the maximum capacity is reached.

ii) Other airports should be improved corresponding to the traffic demand.

Alternate airport for Karachi should be developed.

iii) Air navigation systems which are indispensable to the safety and efficiency of the air transport should be improved without any delay.

iv) Expansion of route network and increment of the traffic should be promoted according to the increasing demand.

(2) Strategies

i) Major Airports

a) Extension of secondary runway at Karachi airport.

b) Expansion of terminal facilities at Islamabad airport.

c) Construction of new terminal facilities at Karachi and Lahore airports.

ii) Other Airports

a) Improvement and expansion of facilities at other airports

b) Runway extension and strengthening for jet operation at Chitral, Gilgit and Turbat airports.

c) Development of Hyderabad airport as an alternate airport of Karachi.

iii) Air Navigation Systems

a) Installation of PSR (Primary Surveillance Radar) and SSR (Secondary Surveillance Radar) at Lahore, Islamabad and Quetta airports, and SSR at Rahim Yar Khan and Turbat airports.

b) Provision of message switching system at Karachi for AFTN.

iv) Airlines

a) Introduction of aircraft.
b) Purchase of the equipment and facilities.

3.2 Candidate Projects

3.2.1 Selection of Airport Projects

(a) Karachi International Airport

i) Runway and Taxiway

The main runway has regular pattern of cracks, and is to be overlaid in order to improve conditions. But it is difficult to overlay the runway without closing of aircraft operation because of the continuous traffic. Therefore, it is necessary to extend the secondary runway to the same length of 3,200 m as the main runway and install several new taxiways.

ii) Terminal Facilities

In order to meet the growing demands, the terminal area is necessary to be radically improved and developed. Therefore, new passenger terminal facilities (apron, terminal building, car parking, etc.) are planned to be constructed in the east side of the existing terminal area.

(b) Islamabad International Airport

For Islamabad Airport, extension of the runway to the length of 3,353 m (11,000 ft) was decided in the Sixth Five Year Plan, and runway extension will be successively carried out in the Seventh Five Year Plan. So, it is necessary to be completed in the Seventh Five Year Plan.

In addition to this project, terminal facilities are also necessary to meet the growing demands.

(c) Lahore International Airport

Upto the end of the Sixth Five Year Plan, development of runway and taxiway will be completed. So, continuously it is necessary to develop the new terminal facilities near the runway from a viewpoint of it's function and expansibility.

(d) Other Airports

i) Runway and Taxiway

Runways at Chitral, Gilgit and Turbat will be extended and upgraded in order to introduce jet aircraft operation.

In addition to above mentioned projects, for several airports it is also necessary to overlay runway and taxiways to strengthen them.

ii) Terminal Facilities

For other airports except three major airports, it is also necessary to expand the existing terminal facilities to meet future demands.

(e) Alternate Airport to Karachi

Hyderabad airport is desirable to be developed as an alternate airport for international flights to Karachi airport. So, the taxiway and terminal facilities corresponding to the diverted aircraft is required.

(f) Aeronautical Communication and Control System

Phase-I of this project, i.e., replacement of PSR/SSR at Karachi has been completed in the Sixth Plan period. Phase-II which includes following works should be completed in the Seventh Plan period.

- Installation of PSR/SSR at Lahore, Islamabad and Quetta.
- Installation of SSR at Rahim Yar Khan and Turbat.
- Provision of communication network for ATS operation.
- Installation of a message switching system for AFTN.

(g) Air Navigation System for Karachi Airport

Existing ILS Cat-I should be upgraded to Cat-II. Existing VOR should be replaced and DVOR/DME should be installed. Runway light should be upgraded to Cat-II. RVR equipment should be installed.

For the extension of the secondary runway, ILS Cat-I, ALS Cat-I, VASIS, Runway light, and taxiway lights should be installed.

(h) Air Navigation System for Lahore Airport

Existing ILS Cat-I should be upgraded to Cat-II. Existing lighting aids should be upgraded.

(i) Air Navigation System for Other Airports

Air Navigation Systems in other airports are also necessary to be replaced, upgraded or newly installed based on the requirements shown in 2.4.2(1) "Development of Air Navigation Systems".

(j) On-Going Projects

On-going projects continued from the Sixth Five Year Plan are necessary to be completed in the Seventh Five Year Plan. Such on-going projects are listed based on "Annual Development Programme (revised) 1986-87" by CAA.

3.2.2 Fleet Plan for Airlines

The fleet Plan of PIA for the Seventh Five Year Plan is estimated based on the required capacity calculated from the traffic demand.

Aircrafts to be introduced in the Seventh Plan period are as follows:

- Wide Bocy Class (A300) : 3
- Narrow Body Class(B737) : 1
- F27 Class (F27) : 2 + 2 (Replace)

Aircraft Hangar for B747 and Wide Body Jet are necessary to be constructed at Islamabad.

3.3 Project Cost Estimation

3.3.1 Airport Project

According to the selection of airport projects, airport project cost is estimated as shown in Table 3.3.1.

Table 3.3.1 Airport Project Cost for Seventh Five Year Plan

Project Name	Outline	Cost (Rs. Million)
Karachi Airport	• Extension of secondary runway	139
	• Construction of new terminal facilities	1,742
Islamabad Airport	• Expansion of terminal facilities	50
Lahore Airport	• Construction of new terminal facilities	368
Other airports		
Peshawar A/P	• Expansion of jet apron • Overlay on existing jet apron • Expansion of P.T.B. and C/P	51
D.I. Khan A/P	• Widening of runway • Overlay on taxiway and apron • Expansion of C/P	3
Chitral A/P	• Extension of runway • Overlay on runway and taxiway • Expansion of light apron, P.T.B. and C/P	34
Faisalabad A/P	• Expansion of P.T.B	1
Multan A/P	• Expansion of C/P	1
Sukkur A/P	• Overlay on taxiway and apron • Expansion of light apron, P.T.B and C/P	3
Nawabshah A/P	• Expansion of P.T.B	1
Moenjodaro A/P	• Overlay on runway and taxiway	8
Quetta A/P	• Expansion of jet apron	12
Zhob A/P	• Construction of runway and taxiway • Expansion of light apron, P.T.B and C/P	11

(Cont'd)

Project Name	Outline	Cost (Rs. Million)
Panjgur A/P	• Expansion of P.T.B and C/P	7
Turbat A/P	• Extension and overlay of runway • Expansion of light apron, P.T.B and C/P	34
Pasni A/P	• Expansion of P.T.B and C/P	9
Gwadar A/P	• Expansion of light apron, P.T.B and C/P	13
Jiwani A/P	• Construction of taxiway • Expansion of P.T.B and C/P	11
Gilgit A/P	• Extension and overlay of runway • Expansion of light apron and C/P	40
Skardu A/P	• Expansion of P.T.B and C/P	9
Bannu A/P	• Expansion of light apron, P.T.B and C/P	5
Mangla A/P	• Expansion of light apron, P.T.B and C/P	5
R.Y. Khan A/P	• Expansion of light apron, P.T.B and C/P	4
Dalbandin A/P	• Expansion of light apron, P.T.B and C/P	4
Sui A/P	• Expansion of light apron, P.T.B and C/P	4
Khuzdar A/P	• Expansion of light apron, P.T.B and C/P	6
Rawalkot A/P	• Expansion of light apron, P.T.B and C/P	12
Alternate airport to Karachi	• Construction of new taxiway and terminal facilities	79
Aeronautical Communication and Control System	• Installation of radars at Lahore, Islamabad and Quetta • Remotely controlled VHF A/G communication facilities and upgrade of AFTN network	531

(Cont'd)

Project Name	Outline	Cost (Rs. Million)
Air Navigation Systems for Karachi Airport	• ILS Cat.II, DVOR/DME, VOR, RWL and RVR for main runway. ILS Cat.I, ALS Cat.I, VASIS, RWL for secondary runway, etc.	73
Air Navigation System for Lahore Airports	• ILS Cat.II, Lighting Cat.II	62
Air Navigation System for other Airports	• Development of air navigation systems for other airports	74
Other On-going Projects	• Islamabad, Renovation of airport	37
	• Chitral, Improvement for Boeing operation	28
	• Lahore, Renovation of airport	25
	• Islamabad, Extension of runway	16
	• Skardu, Extension of runway	5
	• Quetta, Resurfacing of runway	5
	• Ormara, Construction of runway	5
	• Moenjodaro, Constructin of runway	3
	• Chitral, Extension of runway	3
	• Karachi, Improvement of engineering depot	3
	• General, Provision of UHF links	2
	• General, Acquisition of land and collection of outstanding dues	74
	•Others	32
Total (Airport)		3,639

Note: A/P : Airport
P.T.B : Passenger Terminal Building
C/P : Car Parking

Source: JICA Study Team, ADP (Revised) 1988-87, CAA

3.3.2 Aviation

Cost for aircraft purchase and other facilities are estimated as shown in Table 3.3.2.

Table 3.3.2 Cost of Aviation

Item	Outline		Cost (Rs. Million)
Purchase of Aircraft			2,980
	3 - Wide Body Class	2,100	
	1 - Narrow Body Class	500	
	2 - F27 Class	380	
Replace Aircraft	2 - F27 Class		380
Hangar			430
Workshop and Equipment			300
Total (Aviation)			4,090

Source: JICA Study Team

3.3.3 Investment Schedule

Investment schedule for the airport projects is shown in Table 3.3.3.

New terminal project of Karachi Airport is the project with the largest amount of the cost, and a part of the project will be completed in the Eighth Five Year Plan period in order to lighten the burden imposed on the budget in the Seventh Plan.

Construction of the new terminal of Lahore Airport is also planned during the Seventh Five Year Plan period. For Islamabad Airport, expansion of the existing terminal is planned in the Seventh Plan.

Aeronautical Communication and Control projects is one of the on-going projects from the Sixth Five Year Plan, and will be completed in the Seventh Plan period.

Investment schedule for aviation is shown in Table 3.3.4. It is planned to purchase one or two aircrafts every year in the Seventh Plan period.

Table 3.3.3 Investment Schedule for Airport Projects

(Unit: Rs. Million)

Project Name	Estimated Cost	Yearly Allocation					Total 88-93	Beyond 92-93	Ranking
		1988--89	89-90	90-91	91-92	92-93			
Karachi Airport									
Extension of Secondary R/W	139				56	83	139		A
Karachi Airport New Terminal	2,142	86	523	610	349	174	1,742	400	A
Islamabad Airport Expansion of Terminal	50			10	25	15	50		A
Lahore Airport									
New Terminal	363			73	109	181	363		A
Peshawar Airport	51	9	9	16	17		51		C
D.I. Khan Airport	3				3		3		C
Chitral Airport	34	12	11	11			34		B
Faisalabad Airport	1					1	1		B
Multan Airport	1					1	1		B
Sukkur Airport	3					3	3		B
Nawabshah Airport	1					1	1		C
Moenjodaro Airport	8					8	8		C
Quetta Airport	12					12	12		C
Zhob Airport	11				5	6	11		C
Panjgur Airport	7					7	7		C
Turbat Airport	34	13	13	8			34		B
Pasni Airport	9					9	9		C
Gwadar Airport	13				4	9	13		C
Jiwani Airport	11	6	5				11		C
Gilgit Airport	40	27	13				40		B
Skardu Airport	9				4	5	9		C
Bannu Airport	5					5	5		C
Mangla Airport	5					5	5		C
R.Y. Khan Airport	4					4	4		C
Dalbandin Airport	4					4	4		C

(Cont'd)

Project Name	Estimated Cost	Yearly Allocation					Total 88-93	Beyond 92-93	Ranking
		1988--89	89-90	90-91	91-92	92-93			
Sui Airport	4					4	4		C
Khuzdar Airport	6					6	6		C
Rawalkot Airport	12				6	6	12		C
Alternate Airport to Karachi	79			15	24	40	79		A
Aeronautical Communication and Control System	531	350	181				531		A
Air Navigation System for Karachi Airport	73			15	22	36	73		A
Air Navigation Systems for Lahore Airport	62				25	37	62		A
Air Navigation Systems for other Airports	74	15	15	15	15	14	74		B
Other On-Going Projects	238	190	48				238		A
Total	4,039	708	818	773	664	676	3,639	400	

Table 3.3.4 Investment Schedule for Aviation

(Unit: Rs. Million)

Project Name	Estimated Cost	Yearly Allocation					Total 88-93	Beyond 92-93	Ranking
		1988--89	89-90	90-91	91-92	92-93			
Purchase of Aircraft									
Wide Body Jet (3)	2,100		700		700	700	2,100		A
Narrow Body Jet (1)	500	500					500		A
F27 (2)	380			190	190		380		A
Replace of F27 (2)	380	190	190				380		A
Hangar	430			430			430		B
Workshop and Equipment	300	100		100		100	300		B
Total	4,090	790	890	720	890	800	4,090		

3.4 Preliminary Evaluation of the Projects

1) Methodology

In order to assess the economic viability of the proposed projects, a preliminary benefit/cost analysis was conducted.

The benefit attributable to the proposed projects can be calculated based on the assumption that if no investment is made in air transport to cope with the increasing air traffic demand the air passengers that would increase will shift to other means of transport incurring additional cost to the mode. For the purpose of preliminary economic evaluation, the road (upper class: car) was selected as the alternative mode and the calculated benefits are:

A. Time savings of air passengers who would have to shift to road transport.

B. Vehicle operating cost on roads incurred by air passengers who would have to shift to road transport.

C. Additional road construction cost incurred by air passengers who would have to shift to road transport.

Meanwhile, the cost of the proposed projects was summarized under the following category.

a. Investment ———— Civil Work
———— Navigational Aids
———— Aircraft

b. Maintenance and Operating Cost

The economic benefit and cost thus calculated were formed into a year-by-year data stream using interpolation techniques based on the 1985-86, 1992-93 and 2005-06 calculated values. Then a benefit/cost ratio was calculated. Because the evaluation is on numerous packages of projects on the whole, the streams of benefit and cost come closer to each other unlike that of a single project, and the economic internal rate of return tends to be calculated at unusually high values in such a case. Although IRR was calculated together with BCR the extremely high value of IRR for the Seventh Five Year Plan period should be neglected.

In addition, this evaluation focuses on the domestic air transport, not including international air transport both for benefit and cost.

2) Benefit

A. Time Savings

Time savings were calculated only for the projected increase of air passengers based on the following assumptions/ procedure:

Unit Time Value

Average Monthly income of Air Passengers
———— 5000 Rs/Month

Average Working Hours per Month
———— 160 Hours/Month

Unit Time Value ———— 5000/160 = 31.25 (Rs/hr)

For the purpose of preliminary evaluation, 100% of this unit time value was taken. This value was assumed to be constant.

Projected increase of Air Passengers and Passenger-kms as compared to 1985-86

	No. of Passengers (000)	Passenger-Kms (Million)
1992-93	1,642	1,019
2005-06	6,037	4,364

Time Savings

Assumption i) Speed Air ----- 500 Kph
Road ---- 40 Kph
ii) Terminal time of air passenger
----- 2 hrs/Pass.

(1992-93)

Road	1,019,000,000/40 =	25,475,000 (hrs)
Air	1,019,000,000/500	
	+ 1,642,000 x 2 =	5,322,000 (hrs)
Savings		20,153,000 (hrs)
		630 (Rs. million)

(2005-06)

Road	4,364,000,000/40 =	109,100,000 (hrs)
Air	4,364,000,000/500	
	+ 6,037,000 x 2 =	20,802,000 (hrs)
Savings		88,298,000 (hrs)
		2,759 (Rs. million)

B. VOC Savings

VOC savings were calculated as a difference in total VOC of the following two cases:

i) Traffic assignment of OD tables of road passengers and increased air passengers (converted to vehicles) onto the road network improved by the road projects proposed in the road planning section of this report.

ii) Traffic assignment of usual road passenger OD tables (converted to vehicles) onto the same road network as above.

In other words, the additional VOC incurred by the increased air passengers on the improved or "With" network was calculated as one of the benefits of the proposed air transport projects.

(1992-93)

Road + Air	54,855	(Rs. million)
Road	53,498	(Rs. million)
Savings	1,357	(Rs. million)

(2005-06)

Road + Air	70,877	(Rs. million)
Road	64,352	(Rs. million)
Savings	6,525	(Rs. million)

C. Savings in Road Construction Cost

This was calculated in a similar manner to VOC; the additional construction cost incurred by the increased air passengers on the improved ("With") road network was taken as the benefit of air transport projects. In the last year of evaluation, the residual values were subtracted since road construction has a project life of 20 years. During the Seventh Five Year Plan period, this was calculated at 1,869.3 million Rupees in economic prices. For the remaining Master Plan period (1993-94/2005-06), this was 807.6 million Rupees.

3) Cost

The cost of the proposed air transport projects was estimated in financial prices as shown in Table 3.4.1. The investment cost was divided into that of civil works, navigational aid and aircraft, and the amount of each year was assumed to be equal during the planning period. The project life of civil works, navigational aid and aircraft is 40 years, 25 years and 20 years, respectively. The maintenance/operating cost was estimated as a difference of "With" case and "Do-Nothing" case.

For estimating economic cost from financial cost, a conversion factor of 0.89 was used due to the following considerations:

i) For aircraft acquisition, PIA usually pays Iqra and other surcharges of about 10%.

ii) For civil works, the tax portion will be about 23% which is the same as road construction.

iii) For navigational aid and maintenance/operating cost, the tax portion can be assumed to be the same as aircraft. This is subject to future detailed studies.

Table 3.4.1 Financial Cost Stream of Proposed Air Transport Projects

(Rs. million)

Year	Investment Cost				Maintenance/Operation Cost		
	Civil Works	Navigation System	Airline	Total	Civil and Navigation	Airline	Total
1988-89	214	259	270	743	12	154	166
1989-90	374	135	330	839	24	309	333
1990-91	445	21	270	736	36	463	499
1991-92	374	41	330	745	48	618	666
1992-93	374	62	300	736	60	772	832
1993-94	165	62	1,106	1,333	66	1,460	1,526
1994-95	165	62	1,106	1,333	72	2,149	2,221
1995-96	165	62	1,106	1,333	78	2,837	2,915
1996-97	165	62	1,106	1,333	83	3,525	3,608
1997-98	165	62	1,106	1,333	89	4,214	4,303
1998-99	165	62	1,659	1,886	95	4,902	4,997
1999-00	166	62	1,659	1,887	101	5,590	5,691
2000-01	166	62	1,659	1,887	107	6,278	6,385
2001-02	166	62	1,659	1,887	113	6,967	7,080
2002-03	166	62	1,659	1,887	118	7,655	7,773
2003-04	166	63	2,765	2,994	124	8,343	8,467
2004-05	166	63	2,765	2,994	130	9,032	9,162
2005-06	166	63	2,765	2,994	136	9,720	9,856

Source: JICA Study Team

4) Benefit/Cost Analysis

Using the benefit and cost calculated above, a benefit/cost analysis was conducted.

Firstly, the master plan upto the year 2005-06 was calculated as shown in Table 3.4.2.

The calculated B/C ratio was 0.94 for the entire project package of the master plan.

Secondly, the project package proposed for the Seventh Five Year Plan Period was taken as presented in Table 3.4.3.

5) Economic Evaluation of the Proposed Projects of Constructing Feeder Airports

Out of the proposed projects, the projects for constructing feeder airports were extracted and evaluated separately. Although feeder airports are not constructed merely because of the economic feasibility, this can be one of the criteria for making a decision.

The methodology of evaluation is almost the same as above, but from the possible benefits, the savings in road construction cost was excluded considering the magnitude of the demand for the proposed feeder airports.

Table 3.4.2 Economic Evaluation of Airports/Civil Aviation projects upto the Year 2005-06

(Rs. million)

Year	Total Benefit	Discounted Benefit	Total Cost	Discounted Cost
1988-89	771	549	809	576
1989-90	1,169	743	1,043	663
1990-91	1,566	889	1,099	624
1991-92	1,964	995	1,256	636
1992-93	2,361	1,068	1,396	631
1993-94	2,299	929	2,545	1,028
1994-95	2,581	931	3,163	1,141
1995-96	2,898	933	3,781	1,217
1996-97	3,254	935	4,397	1,264
1997-98	3,656	938	5,016	1,287
1998-99	4,109	942	6,126	1,404
1999-00	4,618	945	6,744	1,380
2000-01	5,192	949	7,362	1,345
2001-02	5,838	952	7,981	1,302
2002-03	6,565	956	8,597	1,252
2003-04	7,385	960	10,200	1,326
2004-05	8,308	965	10,819	1,256
2005-06	8,314	862	-7,252	-752
Total	72,848	16,440	75,082	17,581

B/C Ratio at a Discount Rate of 12 %/year : 0.94
Internal Rate of Return: -3.39 %/year

Table 3.4.3 Economic Evaluation of Airports/Civil Aviation Projects proposed for the Seventh Five Year Plan Period

(Rs. million)

Year	Total Benefit	Discounted Benefit	Total Cost	Discounted Cost
1988-89	771	549	809	576
1989-90	1,169	743	1,043	663
1990-91	1,566	889	1,099	624
1991-92	1,964	995	1,256	636
1992-93	678	307	-1,728	-782
Total	6,148	3,482	2,479	1,717

B/C Ratio at a Discount Rate of 12 %/year: 2.03
Internal Rate of Return: Extremely Large

The B/C ratio arrived at 2.03 at a discount rate of 12% per year.

Table 3.4.4 shows the results of the preliminary economic evaluation.

Table 3.4.4 Results of Economic Evaluation of Feeder Airports Construction

Airport	Benefit (Rs. Million) Before Discount	Benefit (Rs. Million) After Discount	Cost (Rs. Million) Before Discount	Cost (Rs. Million) After Discount	Benefit/ Cost Ratio
Mansehra	481	100	1,232	444	0.23
Wana	6	1	55	30	0.03
Sialkot	292	61	545	188	0.32
D.G. Khan	202	43	621	204	0.21
Sahiwal	610	127	1,303	414	0.31
Bahawalnagar	145	30	236	89	0.34
Chachro	53	7	312	108	0.07
Loralai	33	5	113	49	0.10
Taftan	851	171	621	205	0.84
Nushki	37	7	140	58	0.13
Kharan	77	15	497	162	0.09

Note: Discount rate was set at 12% p.a.

Judging from the result shown above, the following can be pointed out:

- In general, the construction of feeder airport is hardly justified economically even after taking into account the fact that the benefit in saving road construction cost is not considered.
- Among the proposed projects, the Taftan Airport is the most feasible followed by the Bahawalnagar, Sialkot, Sahiwal, Mansehra and D.G. Khan Airport. The rest is hardly justified from the economical point of view.

6) Summary

Judging from the results of the above evaluation, the proposed projects for the Seventh Five Year Plan are considered to be very sound. On the other hand, the proposed projects upto the year 2005-06 are found economically marginal. Due to the possible increase of income levels in the future, however, the entire project package for the master plan is expected to be feasible. This aspect should be tested further in more detail.

For the projects of feeder airports construction, the Taftan Airport can be easily justified economically due to the reasons mentioned above.

Also the Bahawalnagar, Sialkot, Sahiwal, Mansehra and D.G. Khan might be justified if some strategical importance is found on the social/political aspects. The rest, however, is hardly justified economically.

3.5 Policy Option

(1) Second Airlines for Feeder Service Operation

The operation of feeder service routes is not so profittable in general. It is one of the measures to establish small-scale private airlines in order to operate feeder service routes with a minimum cost by rationalized organization.

(2) Subsidy System for Airlines

As fares for domestic routes have been kept low as a policy, cost has been exceeding revenue especially in F27 and feeder routes. It is one of the reason to impose a burden on airline's management. It is considered to be one of the effective measures to increase the subsidies for airlines.