CHAPTER 2. AIR TRAFFIC ANALYSIS AND DEMAND FORECAST

CHAPTER 2 AIR TRAFFIC ANALYSIS AND DEMAND FORECAST

2.1 Summary and Conclusion

The result of the forecast is shown in Table 2.1.1. The number of tourists visiting Nepal from other countries in the world has continued to grow well. The share of Indian passengers has been gradually increased as the trade between India and Nepal has been developed. These tendency will continue in future.

The drastic increase of international cargo in recent years is a noteworthy phenomenon. Although the rapid growth of air cargo is a worldwide tendency, the sharp rise of export cargo from Nepal by air is still remarkable. The labor intensive products of Nepal, such as carpets and garments, are exported more and more due to the difference of wage levels between Nepal and the developed countries. Furthermore, this phenomenon should be considered not as a transient but as a structural one.

As for domestic transportation, due to the delays in road improvement and due to the difficulty in constructing roads, many regions are compelled to rely solely upon air routes. Thus, despite the low level of per capita income and having a small area of 54,000 sq. miles, still domestic air transportation in Nepal holds an amazing high status in this country. But with the future advance of road improvement, the status of air transportation between pivotal airports may gradually decline. Air transportation between remote airports and pivotal airports still continues to hold a dominant role.

The process of forecast is shown in Figs. 2.1.1 - 2.1.2.

Table 2.1.1 Summary of Air Traffic Forecast
(Figures in parenthesis are annual growth rate in %)

		1987	1990	1995	2000	2005	2010
Inter-national	Passengers (1000 Pax, arrival and departure)	574	669	924	1234	1567	1946
			(5.3)	(6.7)	(6.0)	(4.9)	(4.4)
	Cargo (1000ton, import and export)	1) 14	24	45	69	100	138
			(23.8)	(13.4)	(8.9)	(7.7)	(6.7)
Domestic	Passengers (1000 trips)	2) 296	353	418	489	566	648
			(5.3)	(3.4)	(3.2)	(3.0)	(2.7)
	Cargo Loaded (ton) 3)	2) 2750	2930	3220	3520	3850	4210
			(1.9)	(1.9)	(1.8)	(1.8)	(1.8)

Note;

1) Figure in 1987/88
2) Figure in 1986/87
3) excluding chartered flight cargo

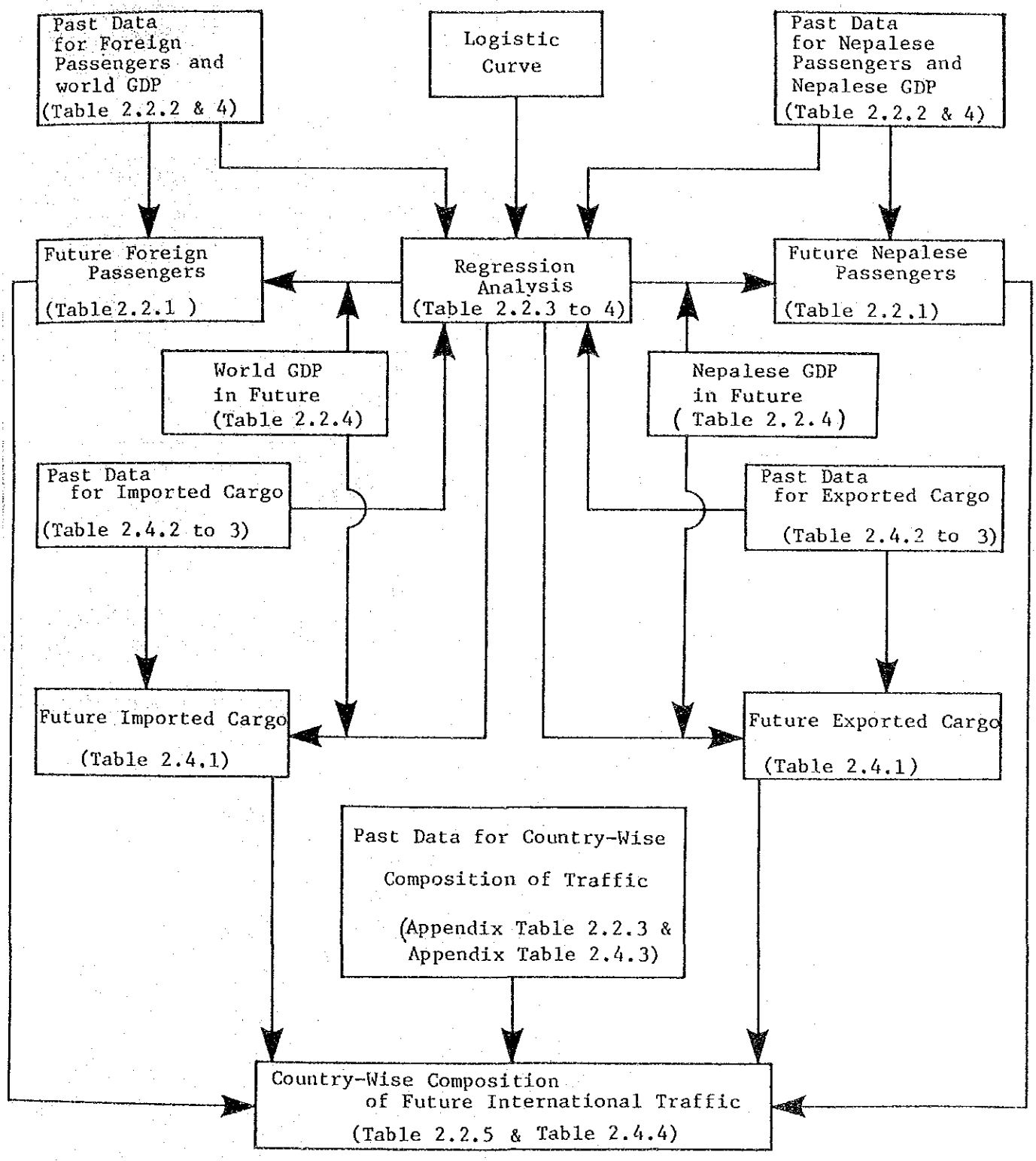


Fig.2.1.1 Forecast Process for International Passengers and Cargo

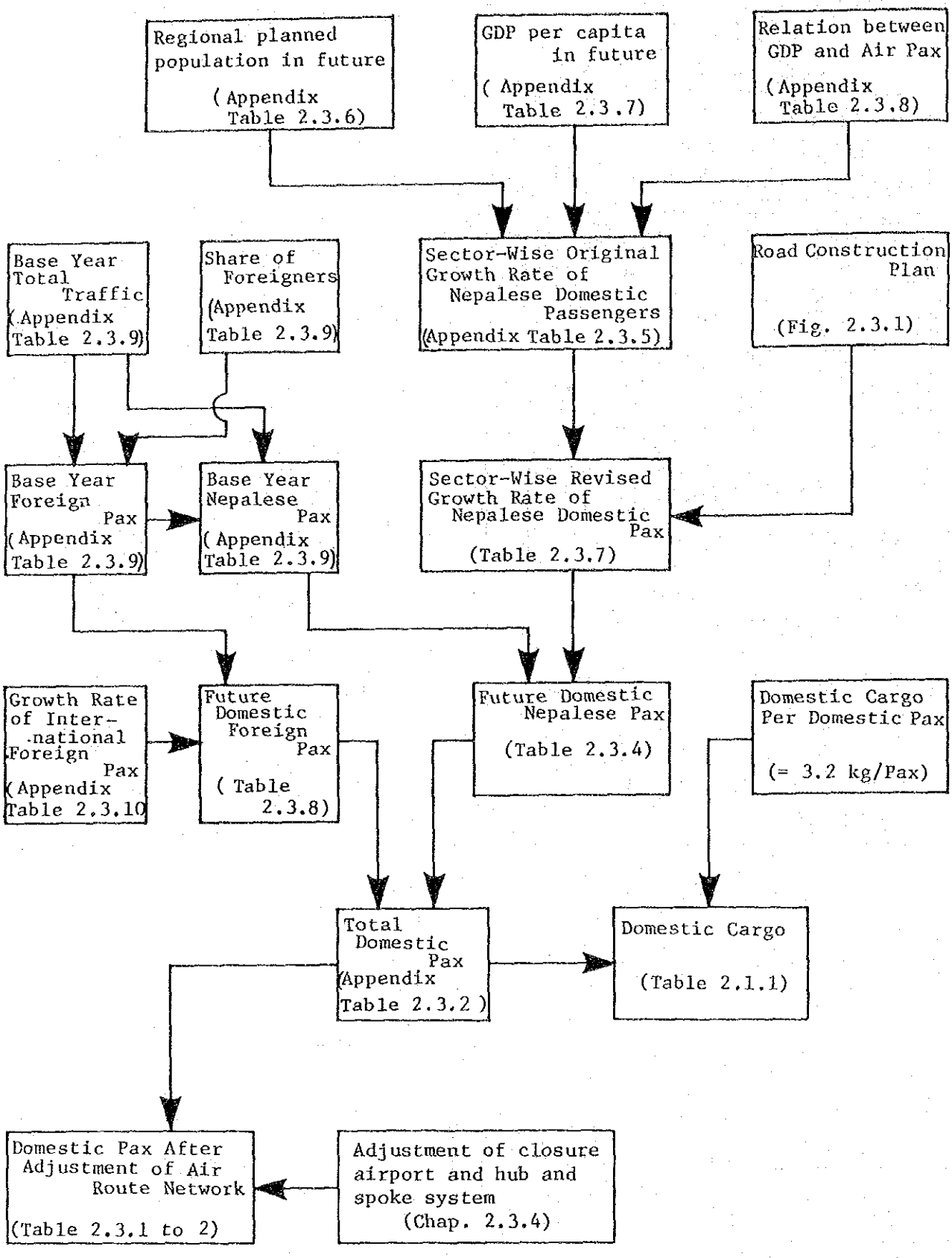


Fig. 2.1.2 Forecast Process for Domestic Passengers and Cargo

2.2 Demand Forecast for International Passenger Traffic

2.2.1 Result of Forecast

The result of the forecast is shown in Table 2.2.1. and Fig. 2.2.1. The past data are shown in Table 2.2.2. The annual growth rate of the "Total" in Table 2.2.2 amounts to, in recent years, 5 - 6% on the average.

Table 2.2.1 International Passenger Traffic Forecast (Arrival and Departure)
(1000Pax)

Year	Foreign Pax	Nepalese Pax	Total	
			Pax	Growth Rate (%)
(1987)	(411)	(163)	(574)	5.3
1990	441	228	669	6.7
1995	557	367	924	6.0
2000	695	539	1234	4.9
2005	846	721	1567	4.4
2010	981	965	1946	

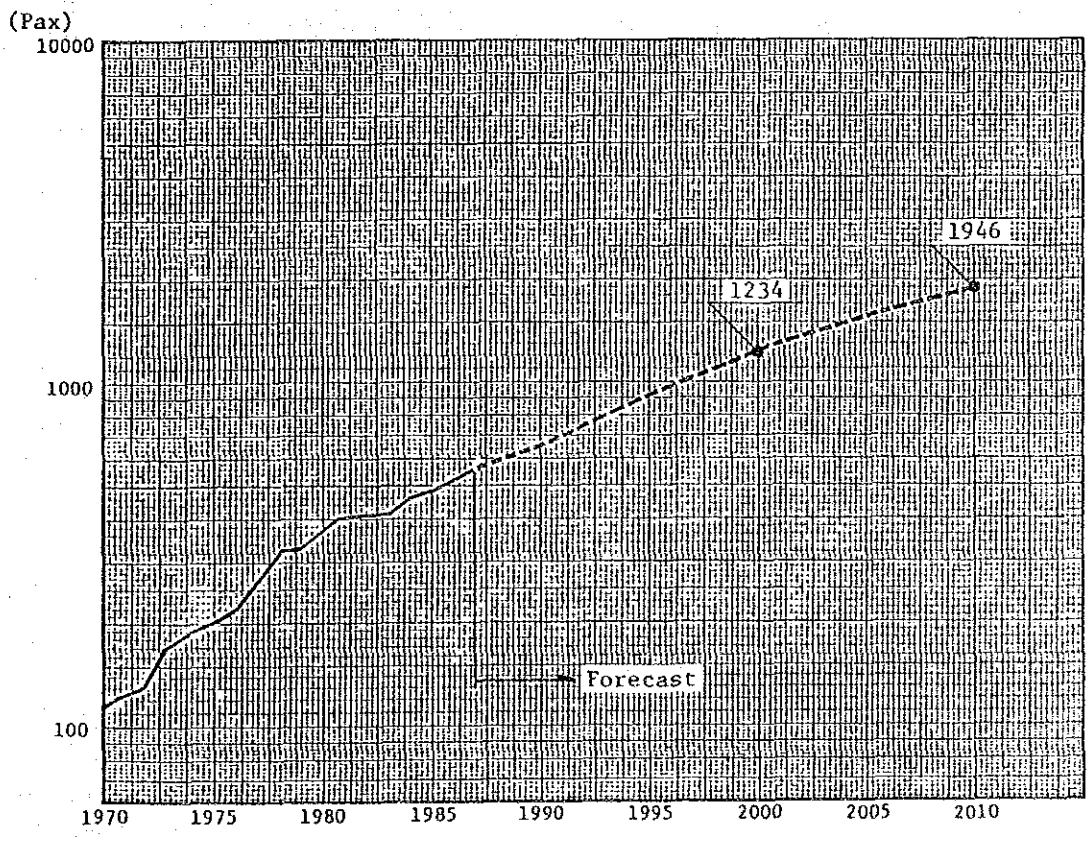


Fig. 2.2.1 International Passenger Traffic Forecast

Table 2.2.2. International Passenger Traffic of TIA

(1000 Pax)

	Foreign Pax (A)	Nepalese Pax (B)	Total (C)
69	-	-	87
70	-	-	113
71	-	-	124
72	-	-	131
73	-	-	172
74	-	-	188
75	-	-	-
76	180	38	218
77	220	44	264
78	260	65	325
79	276	56	332
80	279	90	369
81	284	117	401
82	307	101	408
83	305	110	415
84	300	165	465
85	304	179	483
86	365	158	523
87	411	163	574
88	470	158	628

Source

(A): Nepal Tourist Statistics
(Arrivals x 2)

(C): Civil Aviation Report

(B) = (C) - (A)

2.2.2 Forecast Model

In this study an econometric model was used, to which, the ICAO Manual on Air Traffic Forecasting refers. All over the world, international air traffic is at level higher than it's ever been. But someday the growth rate will be stagnant. Therefore, an air traffic demand curve shows in general gradual increase in its first stage, then turns to gradual decrease in the second stage. Such a curve may be explained only by logistic curve or Comperts curve. Such a logistic curve, as shown in the formula below, has been adopted in this study.

$$Y = \frac{K}{1 + \alpha \cdot \exp(\beta \cdot X)}$$

Y = passengers
X = independent variable
α, β, K = model parameter

The adaptability of the model is shown in Table 2.2.3 and 2.2.4. The model parameters α, β and K are obtained by the non-linear least square method.

The forecasts by the two models in Table 2.2.3 and 2.2.4 show some discrepancy each other. Therefore, it is necessary to make one final forecast by adjusting the two forecasts. Table 2.2.1 shows the result of the adjustment. For the adjustment, the following two points were considered:

(1) The demand curve should be smooth
(2) The future growth rates should be in harmony with the past growth rates.

2.2.3 Country-wise Composition of Passengers

The country-wise composition of passengers is shown in Table 2.2.5. The share of passengers to and from India grows year after year, and this trend may be deemed as a natural result in accordance with the sharp growth of Nepalese passengers in Table 2.2.1. The constant growth rates in Table 2.2.5 are obtained from Appendix Table 2.2.3.

Table 2.2.3 Forecast of International Passengers by Past Trend

Year	Foreigners $Y = \frac{K}{1+\alpha \exp(\beta X)}$ K=1800 α =8.07305 β= -0.0649528 R^2= 0.98			Nepalese $Y = \frac{K}{1+\alpha \exp(\beta X)}$ K=1500 α =31.8925 β= -0.116921 R^2 = 0.98		
	Foreigners (1000) (Y)		Year (1976=1)	Nepalese (1000) (Y)		Year (1976=1)
	Actual 1)	Forecast	(X)	Actual 1)	Forecast	(X)
76	180	210	1	38	51	1
77	220	223	2	44	57	2
78	260	235	3	65	64	3
79	276	249	4	56	71	4
80	279	263	5	90	80	5
81	284	278	6	117	89	6
82	307	294	7	101	100	7
83	305	310	8	110	111	8
84	300	327	9	165	124	9
85	304	345	10	179	138	10
86	365	364	11	158	153	11
87	411	383	12	163	169	12
90		445	15		230	15
95		562	20		368	20
2000		695	25		553	25
05		837	30		767	30
10		983	35		979	35

Source : 1) Table 2.2.2

Table 2.2.4 Forecast of International Passengers by GDP

Year	Foreigners: $Y = \frac{K}{1+\alpha \cdot \exp(\beta \cdot X)}$ K=1100, α = 30.8342, β = -2.0163 E-03, R^2 = 0.99			Nepalese: $Y = \frac{K}{1+\alpha \cdot \exp(\beta \cdot X)}$ K=1100, α = 74.5225, β = -0.07589, R^2 = 0.98		
	Foreigners (1000) (Y)		GDP of All the world	Nepalese (1000) (Y)		GDP of Nepal 3)
	Actual 1)	Forecast	(Bill. US$ in 1980 price) 2) (X)	Actual 1)	Forecast	(Bill. Rs in 1980 Price) (X)
1976	180	215	998	38	73	22.0
77	220	229	1037	44	77	22.9
78	260	244	1079	65	82	23.6
79	276	259	1117	56	82	23.6
80	279	269	1140	90	86	24.3
81	284	280	1167	117	95	25.8
82	307	283	1174	101	96	25.9
83	305	295	1203	110	100	26.5
84	300	317	1253	165	110	27.9
85	304	335	1291	179	117	28.8
86	365	354	1330	158	126	29.9
87	411	373	1370	163	137	31.1
90		439	1497		188	36.0
95		569	1735		317	44.9
2000		717	2012		531	55.9
05		859	2332		781	68.6
10		972	2704		978	84.3

Source:

(1) See Table 2.2.2
(2) Estimated by JICA Study Team using the data of Table 1 and 9 in UN Statistics of National Accounts : Main Aggregates, 1983/1984 and P205
(3) - Up to 1986 : from Statistical Year Book of Nepal 1987
- After 1987 : with JICA Study Team projection

Table 2.2.5 Country-Wise Composition of International Passengers (Origin or destination)

Region		USA	Canada	France	Germany	Italy	U.K	Other Europe	Japan	Aust – ralia	All Others	India	Total
annual growth rate (%)		3.8	4.9	0.2	3.8	6.6	6.5	6.6	5.2	3.7	8.1	7.9	6.4
1987	Pax (1000)	57	11	35	36	23	41	69	35	24	77	164	574
	share (%)	10.0	1.9	6.1	6.3	4.0	7.1	12.1	6.1	4.2	13.5	28.7	100.0
1990	Pax (1000)	63	12	34	40	27	48	82	40	26	95	202	669
	share (%)	9.4	1.8	5.1	5.9	4.0	7.2	12.3	6.0	3.9	14.3	301	100.0
1995	Pax (1000)	77	16	35	49	38	67	115	52	32	143	300	924
	share (%)	8.3	1.7	3.8	5.3	4.1	7.3	12.5	5.7	3.4	15.5	32.4	100.0
2000	Pax (1000)	91	20	35	57	51	90	155	66	37	206	427	1234
	share (%)	7.3	1.6	2.8	4.6	4.1	7.3	12.6	5.3	3.0	16.7	34.6	100.0
2005	Pax (1000)	101	23	32	64	65	113	196	78	41	280	574	1567
	share (%)	6.4	1.5	2.1	4.1	4.1	7.2	12.5	5.0	2.6	17.8	36.7	100.0
2010	Pax (1000)	109	26	29	69	80	139	242	90	44	369	750	1946
	share (%)	5.6	1.3	1.5	3.5	4.1	7.2	12.4	4.6	2.3	19.0	38.6	100.0

2.3 Demand Forecast for Domestic Passenger Traffic

2.3.1 Result of the Forecast

The result of the forecast at each airport is shown in Table 2.3.1 and the sector-wise total passengers is shown in Table 2.3.2. The Nepalese passengers and the foreign passengers before adjustment by closure airport and "hub and spoke system" are estimated separately as shown in Table 2.3.4 and 2.3.8 respectively and totaled in Appendix Table 2.3.13. The airport ranking by total traffic is shown in Table 2.3.3 and Appendix Table 2.3.1.

The growth rate at each airport is shown in the range of -5 to 15% as Appendix Table 2.3.3. This growth rate reflects the road improvement schedule as will be seen later.

Due to the Lumbini project, Bhairahawa Airport advances rapidly in the ranking in Appendix Table 2.3.1. As shown in Table 2.3.3, the total of the ten main airports shares 75% of the total traffic of all the 45 airports.

The price elasticity of the domestic air traffic demand may be very small due to the oligopolystic status of the air transportation in Nepal. Therefore, the effect of the new airfare on the forecasts may be negligible small also.

Table 2.3.1 Total Passengers per Airport after Adjustment of Air Links
(1000 Passengers)

	86/87	1990	1995	2000	2005	2010
1 KATHMANDU	203.2	227.0	280.0	332.9	388.9	443.9
2 BHAIRAHWA	12.9	17.0	34.8	41.9	50.0	58.3
3 BIRATNAGAR	52.7	63.2	62.4	72.5	83.4	95.6
4 NEPALGUNJ	58.6	110.8	115.2	135.0	156.5	180.5
5 POKHARA	46.5	55.7	66.9	79.9	94.0	107.6
6 BHARATPUR	0.1	0.0	0.0	0.0	0.0	0.0
7 DHANGADHI	14.1	20.0	20.2	21.2	24.3	27.7
8 JANAKPUR	6.0	6.7	6.0	4.9	3.6	3.3
9 RAJBIRAJ	0.4	0.0	0.0	0.0	0.0	0.0
10 SIMRA	11.5	11.7	12.9	14.0	15.0	16.1
11 SURKHET	15.0	18.9	14.9	17.5	20.1	22.9
12 TUMLINGTAR	13.1	14.9	18.0	21.1	24.5	28.3
13 BAITADI	4.8	6.1	7.6	9.1	10.7	12.6
14 BAGLUNG	10.6	14.1	13.0	12.7	12.8	13.0
15 BAJHANG	4.9	7.1	8.5	9.9	11.5	13.4
16 BAJURA	5.1	8.1	10.2	12.1	14.2	16.5
17 BHOJPUR	8.6	10.5	12.4	14.5	16.7	19.2
18 CHANDRAGADHI	0.6	0.0	0.0	0.0	0.0	0.0
19 DANG	1.4	1.0	1.3	1.5	1.8	2.1
20 DARCHULA	1.4	1.9	2.4	3.0	3.6	4.3
21 DHORPATANG	0.0	0.0	0.0	0.0	0.0	0.0
22 DOLPA	2.9	3.8	4.6	5.7	6.8	8.0
23 DOTI	10.6	13.0	10.6	11.5	13.1	14.7
24 GORKHA	0.0	0.0	0.0	0.0	0.0	0.0
25 JIRI	0.2	0.0	0.0	0.0	0.0	0.0
26 JOMSOM	7.9	9.6	11.4	13.5	15.8	17.9
27 JUMLA	9.2	10.9	12.9	14.9	17.2	19.7
28 LAMIDANDA	11.1	14.7	17.0	19.3	21.9	24.9
29 LANGTANG	0.0	0.0	0.0	0.0	0.0	0.0
30 LUKLA	14.3	15.6	19.6	24.2	29.1	33.6
31 MAHENDRANAGAR	8.6	11.3	13.9	16.5	19.8	23.6
32 MANANG	0.6	0.8	0.9	1.0	1.1	1.2
33 MEGHAULI	10.8	11.8	14.9	18.6	22.5	26.1
34 PHAPLU	0.8	1.1	1.2	1.4	1.6	1.7
35 RAMECHAP	3.3	4.7	5.3	5.4	3.5	2.7
36 ROLPA	0.2	0.4	0.4	0.0	0.0	0.0
37 RUKUMKOT	10.0	12.3	15.5	18.7	22.3	26.2
38 RUMJATAR	6.8	7.8	9.2	10.4	11.9	13.6
39 SANFEBAGAR	14.8	20.2	24.9	27.2	30.6	35.0
40 SIMIKOT	2.9	3.9	4.5	5.1	5.9	6.6
41 SYANGBOCHE	0.0	0.0	6.7	8.3	10.1	11.6
42 TAPLEJUNG	2.6	3.5	4.1	4.7	5.4	6.1
43 TIKAPUR	1.8	1.6	2.0	2.4	1.8	1.4
44 MUGU	0.0	0.0	2.7	3.3	3.9	4.5
45 BARDIYA	0.0	0.0	0.0	0.0	0.0	0.0
46 MOUNTAIN	36.8	40.1	50.8	63.2	76.7	88.8
47 FOREIGN	0.0	0.0	0.0	0.0	0.0	0.0
	591.4	705.2	836.0	977.6	1132.2	1295.7

Table 2.3.2 Total Passengers by Sector after Adjustment of Air Links
(1000 Passengers, to and from, scheduled and non-scheduled,
Nepalese and Foreigners)

			86/87	1990	1995	2000	2005	2010
1	CHANDRAGADHI	KATHMANDU	0.6	0.0	0.0	0.0	0.0	0.0
2	BIRATNAGAR	KATHMANDU	27.6	31.3	24.3	27.8	31.3	35.2
3	BIRATNAGAR	LAMIDANDA	8.0	10.9	12.7	14.6	16.8	19.3
4	BIRATNAGAR	TUMLINGTAR	7.1	8.4	10.3	12.3	14.5	17.0
5	BIRATNAGAR	BHOJPUR	5.6	7.1	8.5	10.1	11.8	13.7
6	BIRATNAGAR	RUMJATAR	2.3	2.8	3.4	4.0	4.7	5.5
7	BIRATNAGAR	TAPLEJUNG	2.0	2.7	3.2	3.7	4.3	4.9
8	TUMLINGTAR	KATHMANDU	6.0	6.5	7.7	8.8	10.0	11.3
9	LAMIDANDA	KATHMANDU	3.1	3.8	4.3	4.7	5.1	5.6
10	BHOJPUR	KATHMANDU	2.9	3.4	3.9	4.4	4.9	5.5
11	RAJBIRAJ	KATHMANDU	0.4	0.0	0.0	0.0	0.0	0.0
12	TAPLEJUNG	KATHMANDU	0.6	0.8	0.9	1.0	1.1	1.2
13	LUKLA	KATHMANDU	14.3	15.6	19.6	24.2	29.1	33.6
14	RUMJATAR	KATHMANDU	3.7	4.1	4.7	5.2	5.8	6.5
15	RUMJATAR	JANAKPUR	0.8	0.9	1.1	1.2	1.4	1.6
16	PHAPLU	KATHMANDU	0.8	1.1	1.2	1.4	1.6	1.7
17	KATHMANDU	MOUNTAIN	36.8	40.1	50.8	63.2	76.7	88.8
18	KATHMANDU	SIMRA	11.5	11.7	12.9	14.0	15.0	16.1
19	KATHMANDU	JANAKPUR	4.5	4.8	3.8	2.9	2.2	1.7
20	KATHMANDU	BHARATPUR	0.1	0.0	0.0	0.0	0.0	0.0
21	KATHMANDU	MEGHAULI	10.8	11.8	14.9	18.6	22.5	26.1
22	KATHMANDU	JIRI	0.2	0.0	0.0	0.0	0.0	0.0
23	KATHMANDU	RAMECHAP	2.7	3.7	4.2	4.6	3.5	2.7
24	KATHMANDU	POKHARA	33.1	37.9	47.6	58.3	69.8	80.8
25	KATHMANDU	BHAIRAHWA	10.1	12.8	30.5	37.6	45.3	53.1
26	KATHMANDU	BAGLUNG	2.8	3.6	3.1	2.8	2.6	2.4
27	KATHMANDU	JOMSOM	1.2	1.4	1.6	1.8	2.1	2.3
28	KATHMANDU	NEPALGUNJ	10.3	29.7	31.3	36.3	42.2	48.6
29	KATHMANDU	SURKHET	3.0	0.0	0.0	0.0	0.0	0.0
30	KATHMANDU	DANG	0.5	0.0	0.0	0.0	0.0	0.0
31	KATHMANDU	RUKUMKOT	1.8	0.0	0.0	0.0	0.0	0.0
32	KATHMANDU	JUMLA	2.5	2.9	3.3	3.7	4.1	4.6
33	KATHMANDU	TIKAPUR	0.4	0.0	0.0	0.0	0.0	0.0
34	KATHMANDU	DHANGADHI	4.3	0.0	0.0	0.0	0.0	0.0
35	KATHMANDU	DOTI	2.6	0.0	0.0	0.0	0.0	0.0
36	KATHMANDU	SANFEBAGAR	1.0	0.0	0.0	0.0	0.0	0.0
37	KATHMANDU	BAITADI	0.6	0.0	0.0	0.0	0.0	0.0
38	KATHMANDU	BAJHANG	0.7	0.0	0.0	0.0	0.0	0.0
39	KATHMANDU	MAHENDRANAGAR	0.5	0.0	0.0	0.0	0.0	0.0
40	KATHMANDU	BAJURA	0.4	0.0	0.0	0.0	0.0	0.0
41	KATHMANDU	MANANG	0.6	0.0	0.0	0.0	0.0	0.0
42	JANAKPUR	RAMECHAP	0.7	1.0	1.1	0.8	0.0	0.0

			86/87	1990	1995	2000	2005	2010
43	POKHARA	BAGLUNG	6.7	8.8	8.6	8.9	9.4	10.0
44	POKHARA	JOMSOM	6.7	8.2	9.8	11.7	13.7	15.6
45	BHAIRAHWA	NEPALGUNJ	0.3	0.5	0.6	0.8	0.9	1.1
46	BHAIRAHWA	BAGLUNG	1.1	1.7	1.3	1.0	0.8	0.6
47	BHAIRAHWA	RUKUMKOT	0.4	0.6	0.8	1.0	1.2	1.4
48	BHAIRAHWA	DOLPA	0.7	1.0	1.2	1.5	1.8	2.1
49	BHAIRAHWA	ROLPA	0.2	0.4	0.4	0.0	0.0	0.0
50	NEPALGUNJ	SURKHET	11.6	18.4	14.3	16.8	19.2	21.9
51	NEPALGUNJ	RUKUMKOT	6.9	10.7	13.4	16.2	19.3	22.7
52	NEPALGUNJ	JUMLA	6.1	7.5	9.0	10.5	12.2	14.1
53	NEPALGUNJ	SIMIKOT	2.6	3.9	4.5	5.1	5.9	6.6
54	NEPALGUNJ	DOLPA	2.2	2.8	3.4	4.2	5.0	5.9
55	NEPALGUNJ	TIKAPUR	0.0	0.0	0.0	0.0	0.0	0.0
56	NEPALGUNJ	DHANGADHI	0.1	5.6	4.2	4.9	5.5	6.2
57	NEPALGUNJ	DOTI	4.1	7.9	6.1	6.8	7.7	8.6
58	NEPALGUNJ	SANFEBAGAR	6.7	10.3	12.5	14.8	17.2	20.1
59	NEPALGUNJ	BAITADI	1.8	2.9	3.5	4.1	4.7	5.4
60	NEPALGUNJ	BAJHANG	1.9	3.6	4.2	4.8	5.4	6.3
61	NEPALGUNJ	MAHENDRANAGAR	0.6	1.3	1.1	1.3	1.5	1.7
62	NEPALGUNJ	BAJURA	2.8	4.9	6.1	7.2	8.4	9.7
63	NEPALGUNJ	DARCHULA	0.6	0.8	1.0	1.2	1.4	1.6
64	RUKUMKOT	DANG	0.9	1.0	1.3	1.5	1.8	2.1
65	JUMLA	SIMIKOT	0.3	0.0	0.0	0.0	0.0	0.0
66	JUMLA	SURKHET	0.4	0.5	0.6	0.7	0.9	1.0
67	NEPALGUNJ	DANG	0.0	0.0	0.0	0.0	0.0	0.0
68	TIKAPUR	DHANGADHI	0.0	0.0	0.0	0.0	0.0	0.0
69	TIKAPUR	SANFEBAGAR	1.3	1.6	2.0	2.4	1.8	1.4
70	DHANGADHI	BAJURA	1.9	3.2	4.1	4.9	5.8	6.8
71	DHANGADHI	SANFEBAGAR	3.5	5.2	6.4	5.0	5.6	6.3
72	DHANGADHI	BAJHANG	1.2	1.9	2.3	2.7	3.2	3.7
73	DHANGADHI	DOTI	3.1	4.1	3.2	3.7	4.2	4.7
74	DHANGADHI	MAHENDRANAGAR	0.0	0.0	0.0	0.0	0.0	0.0
75	DOTI	MAHENDRANAGAR	0.8	1.0	1.3	1.0	1.2	1.4
76	SANFEBAGAR	MAHENDRANAGAR	2.3	3.1	4.0	5.0	6.0	7.2
77	BAJHANG	MAHENDRANAGAR	1.1	1.6	2.0	2.4	2.9	3.4
78	MAHENDRANAGAR	BAITADI	2.4	3.2	4.1	5.0	6.0	7.2
79	MAHENDRANAGAR	DARCHULA	0.8	1.1	1.4	1.8	2.2	2.7
80	KATHMANDU	SYANGBOCHE	0.0	0.0	6.7	8.3	10.1	11.6
81	KATHMANDU	MUGU	0.0	0.0	2.7	3.3	3.9	4.5
82	KATHMANDU	BARDIYA	0.0	0.0	0.0	0.0	0.0	0.0
83	POKHARA	MANANG	0.0	0.8	0.9	1.0	1.1	1.2

Table 2.3.3 Domestic Passenger Traffic of Main Airports and Airport Ranking before Adjustment of Air Links (1000 Pax/year, Foreigners+ Nepalese)

	Rank in 1986/87	86/87			1990			1995			2000			2005			2010		
		Traffic	%	Rank	Traffic	%	Rank	Traffic	%	Rank	Traffic	%	Rank	Traffic	%	Rank	Traffic	%	Rank
Kathmandu	1.	203.2	34.4	1.	229.1	32.4	1.	281.9	33.7	1	334.6	34.2	1.	390.1	34.4	1	443.9	34.3	1
Nepalgunj	2.	58.6	9.9	2.	73.4	10.4	2.	81.3	9.7	2	96.7	9.9	2.	113.0	10.0	2	131.5	10.1	2
Biratnagar	3.	52.7	8.9	3.	63.3	9.0	3.	62.4	7.4	4	72.5	7.4	4.	83.3	7.3	4	95.6	7.4	4
Pokhara	4.	46.5	7.9	4.	54.0	7.6	4.	65.1	7.8	3	77.8	7.9	3.	91.8	8.1	3	105.2	8.1	3
Surkhet	5.	15.0	2.5	5.	18.9	2.7	7.	14.9	1.8	13	17.5	1.8	13	20.1	1.8	13	23.0	1.8	14
Sanfebagar	6.	14.8	2.5	6.	20.2	2.9	5.	25.0	3.0	6	27.1	2.8	6.	30.7	2.7	6	35.0	2.7	6
Lukla	7.	14.3	2.4	7.	15.6	2.2	9.	19.6	2.3	8	24.2	2.5	7	29.1	2.6	7	33.6	2.6	7
Dhangadhi	8.	14.1	2.4	8.	19.9	2.8	6.	20.2	2.4	7	21.1	2.2	8	24.3	2.1	9	27.8	2.1	9
Tumlingtar	9.	13.1	2.2	9.	14.9	2.1	10.	18.0	2.1	9	21.1	2.2	9	24.4	2.2	8	28.2	2.2	8
Bhairahawa	10.	12.9	2.2	10.	16.9	2.4	8.	34.9	4.2	5	42.2	4.3	5	50.3	4.4	5	58.7	4.5	5
Sub-Total	-	445.2	75.3	-	526.2	74.4	-	623.3	74.4	-	734.8	75.0	-	857.1	75.6	-	983.6	75.8	-
Total of 45 Airports	-	591.4	100	-	707.0	100	-	837.7	100	-	979.6	100	-	1134.4	100	-	1297.6	100	-

2.3.2 Forecast of Nepalese Passengers

(1) Influence of Road Improvement

The total number of Nepalese passengers in Table 2.3.4 is the sector-wise figures before adjustment of closure airport and hub and spoke system, which was prepared by using the base year traffic (Appendix Table 2.3.9) and also by considering the road improvement schedule in Fig. 2.3.1.

The influence of road improvement is estimated using the response pattern of each sector in Table 2.3.5 and Table 2.3.6. The response pattern for road improvement is classified basically into the three categories as follows:

Pattern A: Despite the road improvement, the inherent growth potential of the sector does not decline at all, or the potential recovers shortly after a decline. Therefore, the sector can neglect the influence of any road improvement at all.

Pattern B: Sector traffic declines initially due to road improvement but gradually recovers its inherent potential.

Pattern C: Air traffic drops after road improvements and does not recover and traffic continues to decline indefinitely.

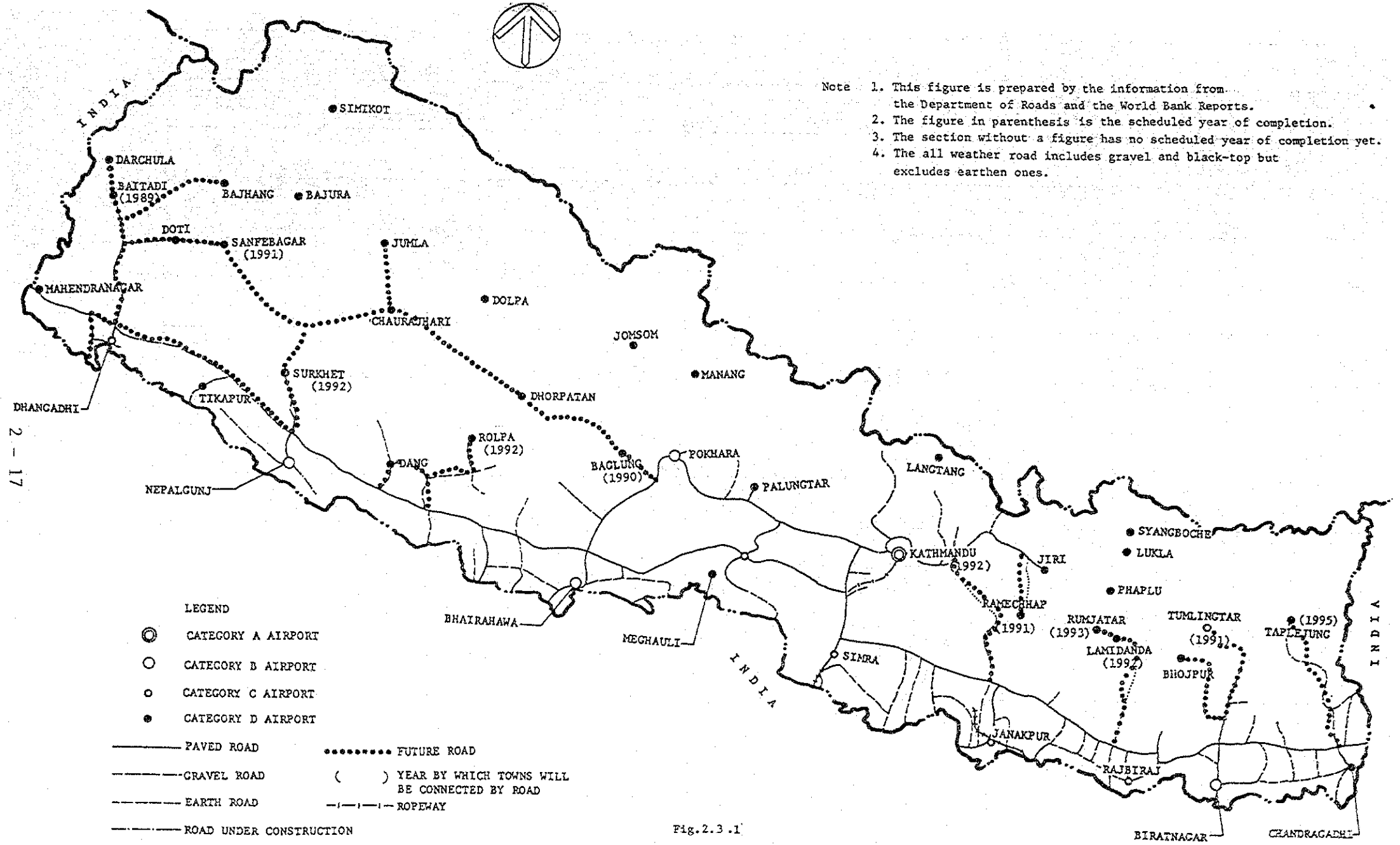
The 12 patterns in Table 2.3.5 are nothing but the variations of the basic three patterns described above. The process for deciding the response pattern is shown in Fig. 2.3.3.

The Kathmandu - Tumlingtar sector in Fig. 2.3.2 (1) may be described as a typical example of pattern A. The sector's traffic declined temporarily due to improvement of Muglin - Narayangath Road and Dharan - Dhankuta Road, but soon afterward it restored its own growth potential. According to an interview survey at the bus terminal, there are normally 10 to 20 daily bus passengers.

Table 2.3.4 Nepalese Passengers by Sector before Adjustment of Closure Airport and "Hub and Spoke System" (1000 Pax, to and from, scheduled and non-scheduled)

			86/87	1990	1995	2000	2005	2010
1	CHANDRAGADHI	KATHMANDU	0.6	0.5	0.4	0.3	0.2	0.2
2	BIRATNAGAR	KATHMANDU	27.6	31.3	24.3	27.8	31.3	35.2
3	BIRATNAGAR	LAMIDANDA	8.0	10.9	12.7	14.6	16.8	19.3
4	BIRATNAGAR	TUMLINGTAR	7.1	8.4	10.3	12.3	14.5	17.0
5	BIRATNAGAR	BHOJPUR	5.6	7.1	8.5	10.1	11.8	13.7
6	BIRATNAGAR	RUMJATAR	2.3	2.8	3.4	4.0	4.7	5.5
7	BIRATNAGAR	TAPLEJUNG	2.0	2.7	3.2	3.7	4.3	4.9
8	TUMLINGTAR	KATHMANDU	5.4	5.9	6.9	7.8	8.7	9.8
9	LAMIDANDA	KATHMANDU	3.1	3.8	4.3	4.7	5.1	5.6
10	BHOJPUR	KATHMANDU	2.9	3.4	3.9	4.4	4.9	5.5
11	RAJBIRAJ	KATHMANDU	0.4	0.3	0.2	0.2	0.1	0.1
12	TAPLEJUNG	KATHMANDU	0.6	0.8	0.9	1.0	1.1	1.2
13	LUKLA	KATHMANDU	1.4	1.6	1.9	2.1	2.3	2.6
14	RUMJATAR	KATHMANDU	3.7	4.1	4.7	5.2	5.8	6.5
15	RUMJATAR	JANAKPUR	0.8	0.9	1.1	1.2	1.4	1.6
16	PHAPLU	KATHMANDU	0.7	0.9	1.1	1.2	1.3	1.4
17	KATHMANDU	MOUNTAIN	0.7	0.8	1.0	1.1	1.2	1.4
18	KATHMANDU	SIMRA	11.5	11.7	12.9	14.0	15.0	16.1
19	KATHMANDU	JANAKPUR	4.5	4.8	3.8	2.9	2.2	1.7
20	KATHMANDU	BHARATPUR	0.1	0.1	0.1	0.0	0.0	0.0
21	KATHMANDU	MEGHAULI	0.2	0.3	0.3	0.4	0.5	0.5
22	KATHMANDU	JIRI	0.1	0.1	0.1	0.1	0.1	0.0
23	KATHMANDU	RAMECHAP	2.7	3.7	4.2	4.6	3.5	2.7
24	KATHMANDU	POKHARA	10.6	12.5	15.6	18.5	21.6	25.1
25	KATHMANDU	BHAIRAHWA	10.1	12.8	16.6	20.2	24.1	28.5
26	KATHMANDU	BAGLUNG	2.2	3.0	2.3	1.8	1.4	1.1
27	KATHMANDU	JOMSOM	0.9	1.2	1.3	1.4	1.6	1.7
28	KATHMANDU	NEPALGUNJ	10.3	11.3	14.5	17.5	20.7	24.4
29	KATHMANDU	SURKHET	3.0	3.7	2.9	3.3	3.7	4.2
30	KATHMANDU	DANG	0.5	0.4	0.3	0.3	0.2	0.2
31	KATHMANDU	RUKUMKOT	1.8	2.2	2.7	3.1	3.6	4.1
32	KATHMANDU	JUMLA	2.5	2.9	3.3	3.7	4.1	4.6
33	KATHMANDU	TIKAPUR	0.4	0.4	0.6	0.7	0.5	0.4
34	KATHMANDU	DHANGADHI	4.3	5.3	4.1	4.8	5.4	6.1
35	KATHMANDU	DOTI	2.6	3.0	2.3	2.5	2.8	3.1
36	KATHMANDU	SANFEBAGAR	1.0	1.3	1.6	1.8	2.0	2.3
37	KATHMANDU	BAITADI	0.6	0.7	0.8	0.9	1.0	1.1
38	KATHMANDU	BAJHANG	0.7	1.0	1.1	1.2	1.3	1.5
39	KATHMANDU	MAHENDRANAGAR	0.5	0.6	0.5	0.6	0.7	0.8
40	KATHMANDU	BAJURA	0.4	0.6	0.8	0.9	1.0	1.1
41	KATHMANDU	MANANG	0.6	0.8	0.9	1.0	1.1	1.2

			86/87	1990	1995	2000	2005	2010
42	JANAKPUR	RAMECHAP	0.7	1.0	1.1	0.8	0.6	0.5
43	POKHARA	BAGLUNG	3.4	5.1	3.9	3.1	2.4	1.8
44	POKHARA	JOMSOM	3.3	4.6	5.2	6.0	6.7	7.6
45	BHAIRAHWA	NEPALGUNJ	0.3	0.5	0.6	0.8	0.9	1.1
46	BHAIRAHWA	BAGLUNG	1.1	1.7	1.3	1.0	0.8	0.6
47	BHAIRAHWA	RUKUMKOT	0.4	0.6	0.8	1.0	1.2	1.4
48	BHAIRAHWA	DOLPA	0.7	1.0	1.2	1.5	1.8	2.1
49	BHAIRAHWA	ROLPA	0.2	0.4	0.4	0.3	0.4	0.4
50	NEPALGUNJ	SURKHET	11.6	14.7	11.4	13.5	15.5	17.7
51	NEPALGUNJ	RUKUMKOT	6.9	8.5	10.7	13.1	15.7	18.6
52	NEPALGUNJ	JUMLA	6.1	7.2	8.7	10.2	11.9	13.8
53	NEPALGUNJ	SIMIKOT	2.6	3.8	4.4	5.0	5.7	6.4
54	NEPALGUNJ	DOLPA	2.2	2.8	3.4	4.2	5.0	5.9
55	NEPALGUNJ	TIKAPUR	0.0	0.0	0.0	0.1	0.0	0.0
56	NEPALGUNJ	DHANGADHI	0.1	0.1	0.1	0.1	0.1	0.1
57	NEPALGUNJ	DOTI	4.1	4.9	3.8	4.3	4.9	5.5
58	NEPALGUNJ	SANFEBAGAR	6.7	9.0	10.9	13.0	15.2	17.8
59	NEPALGUNJ	BAITADI	1.8	2.2	2.7	3.2	3.7	4.3
60	NEPALGUNJ	BAJHANG	1.9	2.6	3.1	3.6	4.1	4.8
61	NEPALGUNJ	MAHENDRANAGAR	0.6	0.7	0.6	0.7	0.8	0.9
62	NEPALGUNJ	BAJURA	2.8	4.3	5.3	6.3	7.4	8.6
63	NEPALGUNJ	DARCHULA	0.6	0.8	1.0	1.2	1.4	1.6
64	RUKUMKOT	DANG	0.9	1.0	1.3	1.5	1.8	2.1
65	JUMLA	SIMIKOT	0.3	0.4	0.4	0.4	0.5	0.5
66	JUMLA	SURKHET	0.4	0.5	0.6	0.7	0.9	1.0
67	NEPALGUNJ	DANG	0.0	0.0	0.0	0.0	0.0	0.0
68	TIKAPUR	DHANGADHI	0.0	0.0	0.0	0.0	0.0	0.0
69	TIKAPUR	SANFEBAGAR	1.3	1.6	2.0	2.4	1.8	1.4
70	DHANGADHI	BAJURA	1.9	3.2	4.1	4.9	5.8	6.8
71	DHANGADHI	SANFEBAGAR	3.5	5.2	6.4	5.0	5.6	6.3
72	DHANGADHI	BAJHANG	1.2	1.9	2.3	2.7	3.2	3.7
73	DHANGADHI	DOTI	3.1	4.1	3.2	3.7	4.2	4.7
74	DHANGADHI	MAHENDRANAGAR	0.0	0.0	0.0	0.0	0.0	0.0
75	DOTI	MAHENDRANAGAR	0.8	1.0	1.3	1.0	1.2	1.4
76	SANFEBAGAR	MAHENDRANAGAR	2.3	3.1	4.0	5.0	6.0	7.2
77	BAJHANG	MAHENDRANAGAR	1.1	1.6	2.0	2.4	2.9	3.4
78	MAHENDRANAGAR	BAITADI	2.4	3.2	4.1	5.0	6.0	7.2
79	MAHENDRANAGAR	DARCHULA	0.8	1.1	1.4	1.8	2.2	2.7
80	KATHMANDU	SYANGBOCHE	0.0	0.0	0.3	0.4	0.4	0.5
81	KATHMANDU	MUGU	0.0	0.0	0.6	0.7	0.7	0.8
82	KATHMANDU	BARDIYA	0.0	0.0	0.0	0.0	0.0	0.0



Note
1. This figure is prepared by the information from the Department of Roads and the World Bank Reports.
2. The figure in parenthesis is the scheduled year of completion.
3. The section without a figure has no scheduled year of completion yet.
4. The all weather road includes gravel and black-top but excludes earthen ones.

Fig.2.3.1

Construction Schedule of All-Weather Roads Linking Airports

Table.2.3.5 Response pattern of Air Passenger Transportation for Road Improvement

Response Pattern	Response to Road Improvement
A	The sector of this pattern is not influenced by road improvement at all or recovers its original growth rate within 5 years after road improvement.
B 1990	5% annual decrease up to 1990,after that it recovers its original growth.
B 1995	original growth up to 1990,5% decrease up to 1995,after that it recovers its original growth again.
B 2000	original growth up to 1995,5% decrease up to 2000,after 2001 original growth rate again.
B 2005	original growth rate up to 2000, 5% decrease up to 2005, after 2006 original growth rate again.
C 2005	original growth rate up to 2005, after 2006 5% decrease infinitely
C 1987	5% decrease up to 2010
C 1990	original growth rate up to 1990, after 1991 5% decrease
C 1995	original growth rate up to 1995, after 1996 5% decrease
C 2000	original growth rate up to 2000, after 2001 5%decrease
C 2005	original growth rate up to 2005, after 2006 5% decrease
C 7	original growth rate multiplied by 0.7

Table 2.3.6 Response Pattern of Each Sector

SECTOR		PATTERN
CHANDRAGADHI	KATHMANDU	C1987
BIRATNAGAR	KATHMANDU	B1990
BIRATNAGAR	LAMIDANDA	A
BIRATNAGAR	TUMLINGTAR	A
BIRATNAGAR	BHOJPUR	A
BIRATNAGAR	RUMJATAR	A
BIRATNAGAR	TAPLEJUNG	A
TUMLINGTAR	KATHMANDU	A
LAMIDANDA	KATHMANDU	A
BHOJPUR	KATHMANDU	A
RAJBIRAJ	KATHMANDU	6
TAPLEJUNG	KATHMANDU	A
LUKLA	KATHMANDU	A
RUMJATAR	KATHMANDU	A
RUMJATAR	JANAKPUR	A
PHAPLU	KATHMANDU	A
KATHMANDU	MOUNTAIN	A
KATHMANDU	SIMRA	C7
KATHMANDU	JANAKPUR	C1990
KATHMANDU	BHARATPUR	C1987
KATHMANDU	MEGHAULI	A
KATHMANDU	JIRI	C1987
KATHMANDU	RAMECHAP	C2000
KATHMANDU	POKHARA	A
KATHMANDU	BHAIRAHWA	A
KATHMANDU	BAGLUNG	C1990
KATHMANDU	JOMSOM	A
KATHMANDU	NEPALGUNJ	A
KATHMANDU	SURKHET	B1995
KATHMANDU	DANG	C1987
KATHMANDU	RUKUMKOT	A
KATHMANDU	JUMLA	A
KATHMANDU	TIKAPUR	C2000
KATHMANDU	DHANGADHI	B1990
KATHMANDU	DOTI	B1990
KATHMANDU	SANFEBAGAR	A
KATHMANDU	BAITADI	A
KATHMANDU	BAJHANG	A
KATHMANDU	MAHENDRANAGAR	B1990
KATHMANDU	BAJURA	A
KATHMANDU	MANANG	A
JANAKPUR	RAMECHAP	C1995
POKHARA	BAGLUNG	C1990
POKHARA	JOMSOM	A
BHAIRAHWA	NEPALGUNJ	A
BHAIRAHWA	BAGLUNG	C1990
BHAIRAHWA	RUKUMKOT	A
BHAIRAHWA	DOLPA	A
BHAIRAHWA	ROLPA	B2000
NEPALGUNJ	SURKHET	B1990
NEPALGUNJ	RUKUMKOT	A
NEPALGUNJ	JUMLA	A
NEPALGUNJ	SIMIKOT	A
NEPALGUNJ	DOLPA	A
NEPALGUNJ	TIKAPUR	C2000
NEPALGUNJ	DHANGADHI	B1990
NEPALGUNJ	DOTI	B1990

SECTOR		PATTERN
NEPALGUNJ	SANFEBAGAR	A
NEPALGUNJ	BAITADI	A
NEPALGUNJ	BAJHANG	A
NEPALGUNJ	MAHENDRANAGAR	B1990
NEPALGUNJ	BAJURA	A
NEPALGUNJ	DARCHULA	A
RUKUMKOT	DANG	A
JUMLA	SIMIKOT	A
JUMLA	SURKHET	A
NEPALGUNJ	DANG	C1987
TIKAPUR	DHANGADHI	C2000
TIKAPUR	SANFEBAGAR	C2000
DHANGADHI	BAJURA	A
DHANGADHI	SANFEBAGAR	B2000
DHANGADHI	BAJHANG	A
DHANGADHI	DOTI	B1990
DHANGADHI	MAHENDRANAGAR	B2000
DOTI	MAHENDRANAGAR	B2000
SANFEBAGAR	MAHENDRANAGAR	A
BAJHANG	MAHENDRANAGAR	A
MAHENDRANAGAR	BAITADI	A
MAHENDRANAGAR	DARCHULA	A
KATHMANDU	SYANGBOCHE	A
KATHMANDU	MUGU	A
KATHMANDU	BARDIYA	A

The phenomenon of Pattern A may be traced to the following causes:

a) Passengers are sometimes diverted temporarily from air to road soon return to air because road transportation takes too much time.

b) Road improvement of course may have an adverse effect on air transportation due to the substitution effect, but sometimes it compliments air traffic by developing regional industry. Thus the relation between road improvement and air transportation is not always competitive.

The Pattern B sector "Biratnagar - Kathmandu" in Fig. 2.3.2 (2), after the continuous reduction for a period, recovers its own growth and never declines again. In contrast to this, the Pattern C sector "Jiri - Kathmandu" in Fig. 2.3.2 (3) continues to decline indefinitely.

The application of the pattern to each sector in Table 2.3.6 is founded on the road improvement schedule shown in Fig. 2.3.1.

The compound growth rate of each airport in Table 2.3.7 is obtained by adjusting the original growth rate (Appendix Table 2.3.5) by the method explained above. As will be seen later, domestic foreign passengers are generally not influenced by road improvement. The growth rate for total passengers including foreigners and that of the only for Nepalese are indicated in Appendix Table 2.3.3 and Table 2.3.7 respectively.

Fig.2.3.2.(1) Influence of Mugling - Narayangandh Road and Dharan - Dhankuta Road on Kathmandu - Tumlingtar Sector
- An Example of Pattern A -

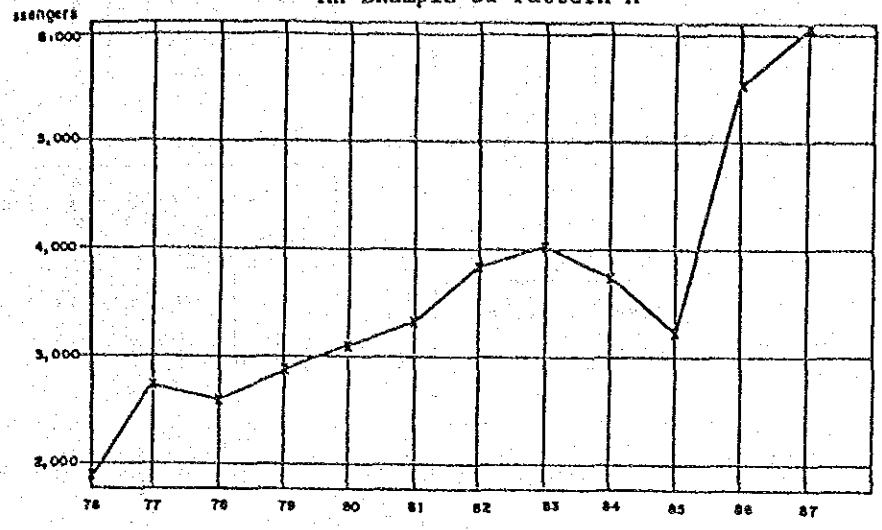


Fig.2.3.2.(2) Influence of Mugling - Narayangadh Road on Biratnagar - Kathmandu Sector
- An Example of Pattern B -

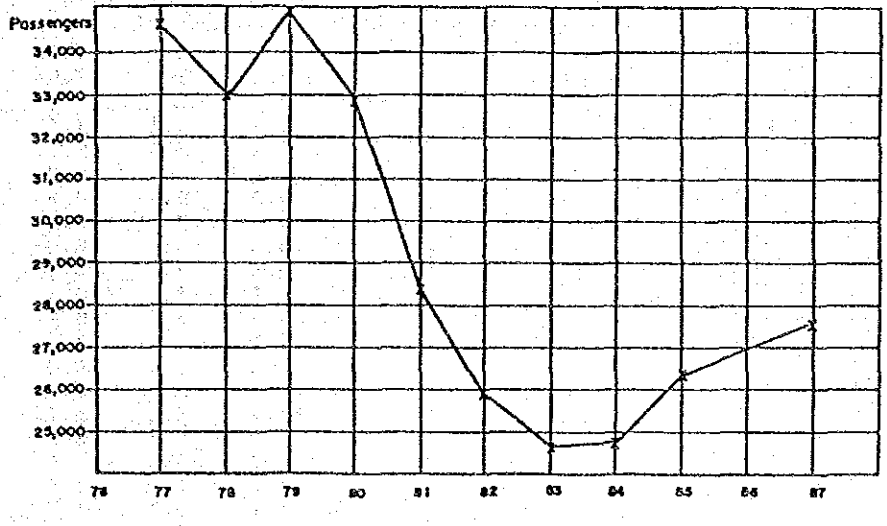
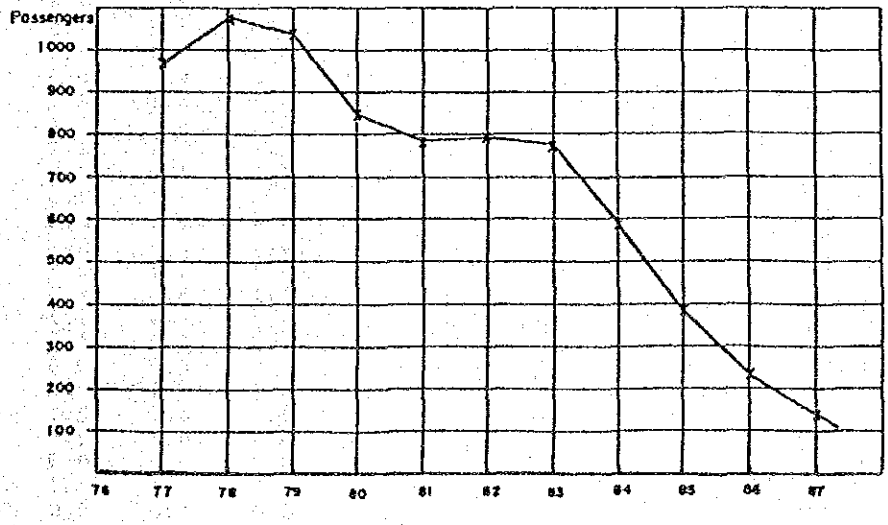


Fig. 2.3.2.(3) Influence of Lamosangn - Giri Road on Kathmandu - Jiri Sector
- An Example of Pattern C -



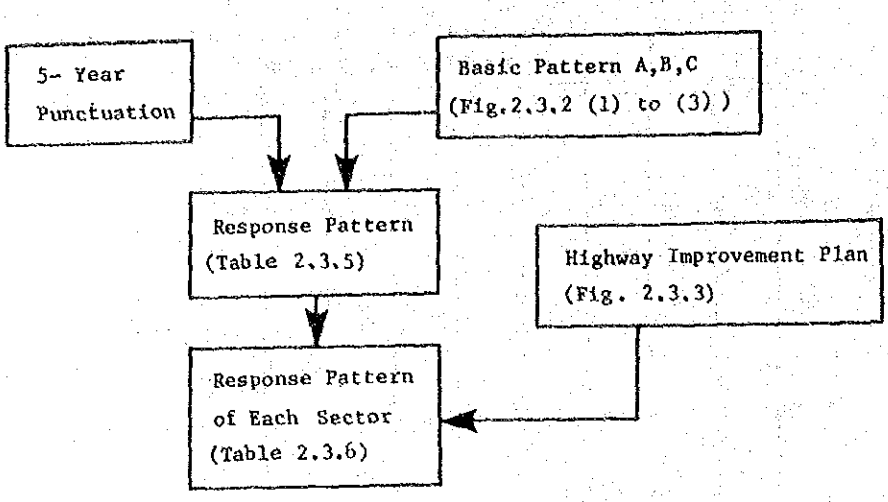


Fig. 2.3.3 The Process for Deciding Response Pattern

Table 2.3.7 Annual Growth Rate of Domestic Pax (%)

		87/90	90/95	95/00	00/05	05/10
1	KATHMANDU	4.0	0.9	2.5	2.2	2.3
2	BHAIRAHWA	8.1	4.3	3.5	3.3	3.3
3	BIRATNAGAR	5.4	-0.3	3.0	2.8	2.8
4	NEPALGUNJ	6.7	2.1	3.5	3.2	3.1
5	POKHARA	7.4	2.3	2.1	2.2	2.4
6	BHARATPUR	-5.0	-5.0	-5.0	-5.0	-5.0
7	DHANGADHI	10.3	0.3	0.9	2.8	2.7
8	JANAKPUR	3.3	-2.6	-3.4	-2.9	-2.3
9	RAJBIRAJ	-5.0	-5.0	-5.0	-5.0	-5.0
10	SIMRA	0.5	2.0	1.6	1.4	1.4
11	SURKHET	6.8	-4.7	3.3	2.8	2.7
12	TUMLINGTAR	3.9	3.8	3.1	2.9	2.9
13	BAITADI	7.3	4.4	3.6	3.4	3.3
14	BAGLUNG	11.8	-5.0	-5.0	-5.0	-5.0
15	BAJHANG	11.1	3.9	3.1	3.0	3.0
16	BAJURA	14.2	4.4	3.5	3.2	3.1
17	BHOJPUR	6.0	3.5	3.0	2.9	2.9
18	CHANDRAGADHI	-5.0	-5.0	-5.0	-5.0	-5.0
19	DANG	1.2	1.9	2.2	2.3	2.5
20	DARCHULA	8.1	5.2	4.3	3.8	3.7
21	DHORPATANG	0.0	0.0	0.0	0.0	0.0
22	DOLPA	7.7	4.5	4.0	3.6	3.4
23	DOTI	6.0	-4.0	1.8	2.4	2.3
24	GORKHA	0.0	0.0	0.0	0.0	0.0
25	JIRI	-5.0	-5.0	-5.0	-5.0	-5.0
26	JOMSOM	8.6	2.7	2.5	2.3	2.3
27	JUMLA	5.0	3.6	2.9	2.8	2.8
28	LAMIDANDA	8.4	3.0	2.5	2.6	2.7
29	LANGTANG	0.0	0.0	0.0	0.0	0.0
30	LUKLA	3.6	3.1	2.0	2.1	2.2
31	MAHENDRANAGAR	8.5	4.1	3.4	3.7	3.6
32	MANANG	9.1	2.4	1.7	1.7	1.7
33	MEGHAULI	5.7	4.6	3.5	3.1	3.1
34	PHAPLU	7.5	2.9	2.0	2.0	2.2
35	RAMECHAP	10.4	2.3	0.5	-5.0	-5.0
36	ROLPA	16.7	3.2	-5.0	1.9	2.0
37	RUKUMKOT	6.1	4.7	3.9	3.5	3.3
38	RUMJATAR	4.1	3.2	2.6	2.6	2.6
39	SANFEBAGAR	9.3	4.3	1.7	2.5	2.7
40	SIMIKOT	10.7	2.8	2.6	2.5	2.5
41	SYANGBOCHE	0.0	0.0	0.0	0.0	0.0
42	TAPLEJUNG	8.5	3.1	2.7	2.7	2.8
43	TIKAPUR	5.5	4.4	3.7	-5.0	-5.0
44	MUGU	0.0	0.0	0.0	0.0	0.0
45	BARDIYA	0.0	0.0	0.0	0.0	0.0
46	MOUNTAIN	1.1	4.4	2.7	2.6	2.6
47	FOREIGN	0.0	0.0	0.0	0.0	0.0

(2) Growth Rate of Domestic Nepalese Passengers

The growth rate of domestic Nepalese passengers is shown in Appendix Table 2.3.5. This is the original growth rate which is not yet adjusted by the influence of road improvement. It is just the simple arithmetical average of the total growth rate of both ends of a sector.

Taking the case of 1995, the growth rate of each of airport is estimated as follows:

a) GD95 = POP95 x UGD95

GD95 = regional potential of an airport in 1995
POP95 = regional population of an airport in 1995
UGD95 = GDP per capita in 1995 (Appendix Table 2.3.7)

b) GRP (95/90) = (EXP (LOG (GD95/GD90)/5) - 1) x DRP95

GRP (95/90) = annual growth rate of an airport from 1990 to 1995
DRP95 = a conversion factor which converts the growth rate of regional potential to the growth rate of domestic air passengers (Appendix Table 2.3.8)

The planned future population in the area influenced by each airport is shown in Appendix Table 2.3.6. The GDP per capita and the conversion factor in equation b) above are shown in Appendix Table 2.3.7 and 2.3.8 respectively.

The growth rate of domestic passengers from 1987 to 1990 is estimated not by using the regional potential but by using the annual average growth rate of actual traffic in recent years. For this reason, in Appendix Table 2.3.5, some sectors show considerable difference between the growth rate of 1987/90 and 1990/95.

Adjusting the growth rate in Appendix Table 2.3.5 by the influence of road improvement, and applying to it the base year traffic in Appendix Table 2.3.9, the sector-wise Nepalese passenger traffic in Table 2.3.4 is obtained.

2.3.3 Forecast of Foreign Passengers

The forecast of international tourists is shown in Table 2.2.1. From this forecast the growth rate is 4.8 to 3.0% as calculated in Appendix Table 2.3.10. In this Table, the reason why the growth rate from 1987 to 1990 is considerably low, say 2.4%, is due to the fact that the actual traffic in 1986/1987 is prominently high. For example, the annual growth rate between 1985 and 1990 is 7.7%.

By applying above growth rate to the base year foreigner passengers in Appendix Table 2.3.9, the sector-wise foreigner traffic in Table 2.3.8 is obtained. By totaling this sector-wise traffic, the airport-wise traffic in Table 2.3.9 was prepared. The domestic tourist movement for each route is explained below.

(1) Kathmandu - Mugu Sector

According to the "Feasibility Study of Talcha (Mugu) Airport, Final Report" (1988, P.21), the annual traffic of Kathmandu - Mugu sector in 1989/90 will be 2200 passengers. Therefore, the traffic in the base year (1986/87) is 2050 passengers.

$$2200 \times (1 + 0.024)^{-3} = 2050 \quad \text{(Appendix Table 2.3.9)}$$

Mugu Airport is not specialized for tourists. As it is also for civil administration, the share of Nepalese passengers will reach some 25% of the total (DCA estimation).

(2) Kathmandu - Bhairahawa Sector

The share of tourists in this sector is almost zero at present. But because of the well-known Lumbini Project, the share of tourists is estimated to be 50% of the total in the future (DCA estimation). Therefore, from 1995, the traffic of this sector will be doubled (Table 2.3.4 and 2.3.8, Appendix Table 2.3.9).

(3) Kathmandu - Syangboche Sector

According to the "Feasibility Study of Syangboche Airport", the sector traffic is estimated to be 5,267 passengers in 1990 and 4,862 passengers in the base year 86/87 ($5,267 \times (1 + 0.024)^{-3.5} = 4,862$). The share of Nepalese passengers will be at least 5%. (DCA estimation, Appendix Table 2.3.9).

(4) Other Sectors

The share of tourists in all other sectors is obtained from the local reports (Appendix Table 2.3.9).

Table 2.3.8 Domestic Foreign Passengers by Sector (1000 Pax)

Sector		86/87	1990	1995	2000	2005	2010
TUMLINGTAR	KATHMANDU	0.6	0.7	0.8	1.0	1.3	1.4
LUKLA	KATHMANDU	12.8	14.0	17.7	22.1	26.8	31.1
PHAPLU	KATHMANDU	0.1	0.1	0.2	0.2	0.3	0.3
KATHMANDU	MOUNTAIN	36.1	39.4	49.8	62.1	75.5	87.4
KATHMANDU	MEGHAULI	10.6	11.5	14.6	18.2	22.1	25.6
KATHMANDU	JIRI	0.0	0.0	0.0	0.0	0.0	0.1
KATHMANDU	POKHARA	22.5	24.5	31.1	38.7	47.0	54.5
KATHMANDU	BHAIRAHWA	0.0	0.0	14.0	17.4	21.2	24.5
KATHMANDU	BAGLUNG	0.6	0.6	0.8	0.9	1.2	1.3
KATHMANDU	JOMSOM	0.2	0.3	0.3	0.4	0.5	0.6
POKHARA	BAGLUNG	3.4	3.7	4.6	5.8	7.0	8.2
POKHARA	JOMSOM	3.3	3.6	4.6	5.7	7.0	8.1
KATHMANDU	SYANGBOCHE	0.0	0.0	6.4	7.9	9.7	11.2
KATHMANDU	MUGU	0.0	0.0	2.1	2.6	3.2	3.7
KATHMANDU	BARDIYA	0.0	0.0	0.0	0.0	0.0	0.0

Table 2.3.9 Airport-Wise Domestic Foreigner Traffic (1000 Pax)

	86/87	1990	1995	2000	2005	2010
KATHMANDU	83.6	91.1	137.8	171.7	208.7	241.6
BHAIRAHWA	0.0	0.0	14.0	17.4	21.2	24.5
POKHARA	29.2	31.8	40.3	50.3	61.1	70.7
TUMLINGTAR	0.6	0.7	0.8	1.0	1.3	1.4
BAGLUNG	3.9	4.3	5.4	6.7	8.2	9.5
JIRI	0.0	0.0	0.0	0.0	0.0	0.1
JOMSOM	3.6	3.9	4.9	6.1	7.5	8.6
LUKLA	12.8	14.0	17.7	22.1	26.8	31.1
MEGHAULI	10.6	11.5	14.6	18.2	22.1	25.6
PHAPLU	0.1	0.1	0.2	0.2	0.3	0.3
SYANGBOCHE	0.0	0.0	6.4	7.9	9.7	11.2
MUGU	0.0	0.0	2.1	2.6	3.2	3.7
MOUNTAIN	36.1	39.4	49.8	62.1	75.5	87.4
TOTAL	144.4	157.4	244.3	304.5	369.9	428.4

Note:"Total" excludes "Mountain Flight"

2.3.4 Traffic after Adjustment of Air Route Network

Taking into consideration the present traffic as well as future growth, some airports shall be inevitably closed, as studied in Chapter 5.3. Consequently the air link network is adjusted as follows:

(1) Chandragadhi - Kathmandu Sector is discontinued immediately.

(2) Rajbiraj - Kathmandu Sector is discontinued immediately.

(3) Kathmandu - Bharatpur Sector is discontinued immediately.

(4) Kathmandu - Jiri Sector is discontinued immediately.

(5) Kathmandu - Dang Sector is discontinued immediately.

(6) Kathmandu - Tikapur is discontinued immediately.

(7) Napalgunj - Tikapur Sector is discontinued immediately.

(8) Janakpur - Ramechap Sector is discontinued from 2005.

(9) Bhairahawa - Rolpa Sector is discontinued from 2000.

The changes by developing of hub and spoke system, which are described in Chapter 5.5, are as follows:

(10) (Kathmandu - Manang) → (Kathmandu - Pokhara - Manang)

(11) (Kathmandu - Surkhet) → (Kathmandu - Nepalgunj - Surkhet)

(12) (Kathmandu - Rukumkot) → (Kathmandu - Nepalgunj - Rukumkot)

(13) (Kathmandu - Dhangadhi) → (Kathmandu - Nepalgunj - Dhangadhi)

(14) (Kathmandu - Doti) → (Kathmandu - Nepalgunj - Doti)

(15) (Kathmandu-Sanfebagar) → (Kathmandu - Nepalgunj - Sanfebagar)

(16) (Kathmandu - Baitadi) → (Kathmandu - Nepalgunj - Baitadi)

(17) (Kathmandu - Bajang) → (Kathmandu - Nepalgunj - Bajang)

(18) (Kathmandu - Mahendranagar)
→ (Kathmandu - Nepalgunj - Mahendrangar)

(19) (Kathmandu - Bajura) → (Kathmandu - Nepalgunj - Bajura)

(20) Jumla - Simikot sector is discontinued immediately, and the traffic of the sector is divided between Nepalgunj - Simikot and Nepalgunj - Jumla proportionately to the traffic of both sectors.

The above-mentioned adjustment is applied to Appendix Table 2.3.11, and Table 2.3.1 and 2.3.2 are obtained. As a matter of course, the traffic of Nepalgunj increases considerably after the network adjustment.

Chandragadhi and Bharatpur are economically prospering area, but as seen in Appendix Table 2.3.13, they depend on air transportation lightly.

2.3.5 Past Data

The past data which makes the base for future traffic estimation is shown in Appendix Table 2.3.12.

2.3.6 Passenger Transportation by Domestic Chartered Flight

Domestic transportation by chartered flight is concentrated on cargo rather than on passengers. Therefore, the passenger traffic by chartered flight is a matter of small importance and is limited almost completely to TIA.

According to DCA data, the RNAC chartered flights transported to and from TIA 1964 passengers for the one year from November 1987 to October 1988. But this figure does not include four months, specifically February, March, September and October 1988. Making up this deficit by an interpolation, the plausible traffic is estimated to amount to 2619 passengers (1964 x (1 + 4/12) = 2619). In addition UNDP's chartered flights also carried 1122 passengers for the same period to and from TIA (UNDP data). Thus, a total of 3741 passengers are transported annually by the chartered flights to and from TIA.

On the other hand, as seen in Appendix Table 2.3.13, the scheduled and non-scheduled flights transported 203.2 thousand passengers to and from TIA for the one year 1986/87. Therefore, the share of chartered flight passengers in the total is only 1.8%, and this share is within an estimation tolerance.

2.4 Demand Forecast for International Cargo Traffic

2.4.1 Result of Forecast

The final result of the forecast is shown in Table 2.4.1 and Appendix Fig. 2.4.1. Table 2.4.2 shows the tentative forecast by the model. The final forecast is obtained considering the tentative forecast and the time serial balance of the growth rates.

Table 2.4.1 Forecast of International Cargo Traffic

(ton)

Year	Imported Cargo	Exported Cargo	Total	
			Cargo	Growth Rate(%)
(87/88)	(7002)	(7185)	(14187)	
1990	10368	13845	24213	23.8
95	16698	27847	44545	13.4
2000	24535	44845	69380	8.9
05	34412	65893	100305	7.7
10	46052	92418	138470	6.7

Table 2.4.2 Forecast of International Cargo by Past Trend

Year	Imported Cargo $Y=\frac{K}{1+\alpha\exp(\beta X)}$ K=60000 α=56.5158 β=-0.148554 R2 = 0.996			Exported Cargo $Y=\frac{K}{1+\alpha\exp(\beta X)}$ K=100000 α=295.384 β=-0.227873 R2 = 0.985		
	Imported Cargo (ton) (Y)		Year (1976=1.0) (X)	Exported Cargo (ton) (Y)		Year (1976=1.0) (X)
	Actual 1)	Forecast		Actual 1)	Forecast	
75/76	1237	1122	0.5	446	378	0.5
76/77	1271	1297	1.5	521	474	1.5
77/78	1463	1501	2.5	511	595	2.5
78/79	1660	1734	3.5	727	746	3.5
79/80	-	-	-	-	-	-
80/81	2491	2310	5.5	860	1172	5.5
81/82	2744	2664	6.5	1098	1467	6.5
82/83	3403	3069	7.5	1258	1836	7.5
83/84	2408	3531	8.5	1846	2295	8.5
84/85	3356	4059	9.5	3455	2865	9.5
85/86	4360	4659	10.5	5058	3572	10.5
86/87	5801	5339	11.5	5192	4446	11.5
87/88	7002	6107	12.5	7185	5521	12.5
90		8466	15		9362	15
95		15399	20		24401	20
2000		25231	25		50214	25
05		36239	30		75913	30
10		45733	35		90782	35

Source: 1) RNAC

Table 2.4.3 Forecast of International Cargo by GDP

Year	Imported Cargo of TIA $Y = \frac{K}{1+\alpha\exp(\beta X)}$ K=50000 α=195.3 β=-0.093427 R2 = 0.98			Exported Cargo of TIA $Y = \frac{K}{1+\alpha\exp(\beta X)}$ K=100000 α=17575 β=-4.70153E-03 R2 = 0.971		
	Imported Cargo (ton) (Y)		GDP of Nepal	Exported Cargo (ton) (Y)		GDP of all the world (Billion US$
	Actual 1)	Forecast	(Bill. Rs in 1980 price) 3) (X)	Actual 1)	Forecast	in 1980 price) 2) (X)
75/76	1237	1923	21.71	446	617	998
76/77	1271	1923	22.37	521	740	1037
77/78	1463	2103	23.35	511	900	1079
78/79	1660	2300	23.91	727	1074	1117
79/80	-	-	-	-	-	-
80/81	2491	2514	25.30	860	1355	1167
81/82	2744	2746	26.26	1098	1400	1174
82/83	3403	2514	25.45	1258	1601	1203
83/84	2408	2999	27.45	1846	2016	1253
84/85	3356	3274	28.26	3455	2402	1291
85/86	4360	3571	29.41	5058	2871	1330
86/87	5801	4243	30.56	5192	3445	1370
87/88	7002	4620	31.75	7185	4147	1411
90		6443	36.00		6088	1497
95		12768	44.87		16561	1735
2000		24469	55.91		42196	2012
05		38176	68.59		76670	2332
10		46457	84.25		94973	2704

Source:

1) RNAC

2) Estimated by JICA Study Team using the data of Table 1 and 9 in UN Statistics of National Accounts : Main Aggregate 1983/84 P 3 and P 205

3) Up to 1986 : From Statistical Year Book of Nepal 1987
After 1987 : With JICA Study Team projection

On the other hand, IATA and ICAO estimate the growth rate in this region of the world as the figures in Appendix Table 2.4.1 and 2.4.2 respectively.

All over the world, the growth of air cargo in recent years is amazingly high. This phenomenon may not be a transient but a structural one over an extended period of time. Air cargo transportation is now woven tightly into the world trade structure.

2.4.2 Regional Share of International Cargo

Table 2.4.4 shows the regional share of international cargo. For the breakdown, a fixed composition percentage is used, which is the average of the past five years in Appendix Table 2.4.3. The trend in recent years does not show any specific pattern. It shows mere randomness. Therefore, the simple average of the composition rates in the recent five years may be the most plausible solution.

As seen in Appendix Table 2.4.3, imports are mainly from the Asian regions, and exports are destined mostly for America and Europe.

Import cargo is composed mainly of machinery and electric equipment from Japan, Korea and so on. Export cargo is composed exclusively of labor intensive products such as carpet or garment for America and Europe.

Table 2.4.4 Regional Share of International Cargo

(Unit = ton)

		1987/88	1990	1995	2000	2005	2010	Constant Share (%)
Imported Cargo	Asia 1)	4883	7231	11645	17112	24000	32118	69.7
	Africa	2	3	5	7	10	13	0.0
	America	264	391	630	925	1298	1737	3.8
	EEC	932	1380	2223	3266	4580	6130	13.3
	Europe 2)	807	1195	1924	2828	3966	5308	11.5
	Oceania	111	165	265	390	548	733	1.6
	All Others	2	4	6	9	13	18	0.0
	Total	7002	10368	16698	24535	34412	46052	100.0
Exported Cargo	Asia 1)	908	1749	3518	5665	8324	11675	12.6
	Africa	10	19	38	62	90	127	0.1
	America	2677	5158	10375	16707	24549	34431	37.3
	EEC	2651	5109	10276	16548	24315	34104	36.9
	Europe 2)	919	1771	3562	5736	8429	11822	12.8
	Oceania	19	36	72	117	171	240	0.3
	All Others	2	3	6	10	14	20	0.0
	Total	7185	13845	27847	44845	65893	92418	100.0

Note

1): Excluding Asia

2): Excluding EEC

2.5 Demand Forecast for Domestic Cargo Traffic

According to the traffic data in recent years of RNAC, one domestic passenger carries 3.2 kg cargo in average. This figure excludes chartered flight cargo. Appendix Table 2.5.1 shows the cargo transportation by chartered flights of RNAC. On the other hand, the domestic cargo traffic of chartered fllights by UNDP amounted to 900 tons in 1984, 850 tons in 1985, 853 tons in 1986 and 847 tons in 1987. (source: UNDP). The total for RNAC and UNDP amounts to 1973 tons in 1986 and 1796 tons in 1987. Cargo traffic of chartered flights seems to decrease year after year.

From the above-mentioned data, the average cargo per passenger is assumed and the domestic cargo is estimated as shown in Table 2.5.1.

Table 2.5.1 Forecast of Domestic Cargo Traffic

		1987	1990	1995	2000	2005	2010
Passenger (1000 trips)	1)	296	353	418	489	566	648
Average Cargo per Passenger (kg/pax)		9.3	8.3	7.7	7.2	6.8	6.5
Cargo (ton)	2)	2750	2930	3220	3520	3450	4210

Note 1) Estimated in Table 2.3.1
2) Including chartered flight cargo

These figures show the demand which is suppressed by the aircraft shortage of RNAC. If RNAC will obtain enough aircraft in future, the air cargo demand will increase considerably. Cargo traffic volume by airport is similarly estimated by using some unit cargo volume per passenger.

CHAPTER 3 EVALUATION OF EXISTING AIRPORTS AND RELATED FACILITIES

CHAPTER 3 EVALUATION OF EXISTING AIRPORTS AND RELATED FACILITIES

3.1 General

Tribhuvan International Airport, (hereinafter referred to as "TIA"), Nepal's one and only gateway to the world does not have adequate facilities because of topographical restrictions and a shortage of funds. For example, a precision approach system, which should be provided at an international airport to ensure the safety of landing operation of large jet aircraft, has not yet been installed.

Moreover the usability factor in TIA is also low due to severe weather conditions. Therefore, TIA must be immediately improved in order to cope with the increase of air traffic demand in the future.

The future development plan for TIA should be prepared so as to catch up with international standards. Therefore, the evaluation of TIA is performed by comparison with the internationally standard level.

As previously outlined in Chapter 1, many airports outside of the Terai region are operationally limited because the runways are not long enough due to topographical limitations, many runways are not paved, and at many airports take-off and approach patterns are limited to one direction.

It is difficult to ensure punctuality, one of the most basic advantages of air transportation, because weather conditions are so severe. Consequently, in consideration of Nepal's special circumstances, it is not appropriate to apply international standards or even national uniform standards in evaluating airports. Therefore, the evaluation of airports is performed in preparing development plans with the aim of increasing safety and punctuality as much as possible.

3.2 Evaluation of All Existing Airports

Tables 3.2.1 and 2 summarize the evaluation of all existing airports. The white circles represent satisfactory facilities while the black ones represent unsatisfactory or non-existent facilities.

Table 3.2.1 Summary of Evaluation of Existing Facilities - Runway -

NO.	CATEGORY DCA	CATEGORY JICA	AIRPORT	CODE	INTDOM	RUNWAY ELEV. (M)	DESIG-NATION	DIMENSION (M)	SUR-FACE	LDG RWY	TKOF RWY	CONDITION AS	CONDITION FW	CDM	EXISTING CONDITION MAX. ACFT	OPERATION YR	SN	ACFT	CHTR	MAJOR PROBLEMS
(1)	(2)		(3)	(4)	(5)	(6) (7)	(8)	(9)	(10)	(11)	(12)	(13)			(14)	(15)		(16)	(17)	(18)
1	A	A	KATHMANDU (TRIBHUVAN)	KTM	*	1338	02/20	3050 X 45	AS	02	02/20	O			DC-10	*		DC-10		See.3.3.1.
2	B	B	BHAIRAHAWA	BWA	*	109	10/28	1524 X 30	ASP	10/28	10/28	O			HS748	*		HS748		
3	B	B	BIRATNAGAR	BIR	*	72	09/27	1524 X 30	ASP	09/27	09/27	O			HS748	*		HS748		
4	B	B	NEPALGUNJ	KEP	*	165	08/26	1524 X 30	ASP	08/26	08/26	O			HS748	*		HS748		Puddling runway,Poor paving condition
5	B	B	POKHARA	PKR	*	827	03/21	1433 X 30	GRV	03/21	03/21	O			HS748	*		HS748		See 3.3.2
6	C	C	BHARATPUR	BHR	*	183	14/32	1158 X 30	GRS	14/32	14/32			●	HS748		*	DHC-6		
7	C	C	DHANGADHI	DHI	*	210	09/27	1524 X 30	GRS	12/30	12/30		●		HS748	*		DHC-6		Inadequate strength of runway for Hs748
8	C	C	JANAKPUR	JKR	*	78	09/27	1006 X 30	ASP	09/27	09/27				HS748	*		DHC-6		Flooding of the apron during monsoon
9	C	C	RAJBIRAJ	RJB	*	76	11/29	1280 X 46	GRS	11/29	11/29		●		HS748	*		DHC-6		
10	C	C	SIMRA	SIF	*	137	02/20	1219 X 46	GRS	02/20	02/20		●		HS748	*		DHC-6		
11	C	C	SURKHET	SKH	*	732	02/20	1036 X 30	GRS	02/20	02/20		●		HS748	*		DHC-6		
12	C	C	TUMLINGTAR	TMI	*	518	16/34	1219 X 46	GRS	16/34	16/34		●		HS748	*		DHC-6		Soft during the monsoon
13	D	D	BAITADI (PATAN)	BIT	*	1280	03/21	500 X 30	CLY	● 03	● 21			●	DHC-6		*	DHC-6		Roughest runway of the STOL airport
14	D	D	BAGLUNG (BALEWA)	BGL	*	1012	01/19	610 X 30	GRS	● 19	● 01		●		DHC-6	*		DHC-6		Rough and slippery runway when wet
15	D	D	BAJHANG	BJH	*	1250	07/25	640 X 30	GRS	● 07	● 25		●		DHC-6	*		DHC-6		Existence of bamboo trees obsruction and a low hump in the runway
16	D	D	BAJURA	BJU	*	1311	09/27	573 X 30	GRV	● 27	● 09		●		DHC-6	*		DHC-6		Stony runway. High ground obstruction for the pilot view
17	D	D	BHOJPUR	BHP	*	1219	17/35	533 X 30	CLY	● 35	● 17		●		DHC-6	*		DHC-6		- Difficult operation due to undesirable runway vertical curve - Invisible the whole runway from pilot and controller
18	D	C	CHANDRAGADI	BDP	*	91	10/28	1524 X 46	GRS	10/28	10/28		●		HS748	*		DHC-6		Soft during the monsoon
19	D	C	DANG (TULSIPUR)	DNP	*	640	16/34	832 X 46	GRS	16/34	16/34		●		HS748	*		DHC-6		Existance of peepal tree at both ends of runway
20	D	D	DARCHULA	DAP	*	649	07/25	590 X 30	GRS	● 07	● 25			●	DHC-6		*	DHC-6		
21	D	D	DHORPATAN		*	2728	09/27	366 X 30	GRS	-	-		●		PC-6				*	Soft when wet because of inadequate drainage
22	D	D	DOLPA	DOP	*	2500	15/33	● 457 X 30	GRS	● 15	● 33		●		DHC-6	*		DHC-6		See.3.3.3
23	D	D	DOTI (DIPAYAL)	SIH	*	640	14/32	● 427 X 30	GRS	● 32	● 14		●		DHC-6	*		DHC-6		
24	D	D	GORKHA (PALUNGTAR)	GKH	*	457	02/20	1097 X 46	GRS	● 02	● 20		●		HS748				*	
25	D	D	JIRI	JIR	*	1828	14/32	366 X 18	GRS	● 32	● 14			●	DHC-6		*	PC-6		
26	D	D	JOMSOM	JMO	*	2682	06/24	● 610 X 30	SND/STN	6/24	06/24		●		DHC-6	*		DHC-6		See 3.3.3
27	D	D	JUMLA	JUM	*	2347	09/27	670 X 30	GRS	● 09	● 27		●		DHC-6	*		DHC-6		See 3.3.3
28	D	D	LAMIDADA	LDN	*	1250	08/26	518 X 30	GRS	● 26	● 08		●		DHC-6	*		DHC-6		
29	D	D	LANGTANG		*	3658	09/27	421 X 30	GRS	● 12	● 30		●		PC-6				*	
30	D	D	LUKLA	LUA	*	2774	07/25	488 X 30	GRS	● 07	● 25		●		DHC-6	*		DHC-6		See 3.3.3
31	D	C	MAHENDRANAGAR	XMG	*	198	17/35	884 X 30	GRS	17/35	17/35			●	HS748		*	DHC-6		
32	D	D	MANANG	MGX	*	3353	11/29	610 X 30	GRS	● 29	● 11			●	PC-6		*	PC-6		
33	D	B	MEGHAULI	MEY	*	183	08/26	1067 X 46	GRS	08/26	08/26			●	HS748		*	HS748		
34	D	D	PHAPLU	PPL	*	2743	02/20	670 X 30	GRS	● 02	● 20			●	PC-6		*	DHC-6		See.3.3.3
35	D	D	RAMECHHAP	RHP	*	474	03/21	518 X 30	GRS	03/21	03/21		●		DHC-6	*		DHC-6		Soft when wet
36	D	D	ROLPA	RPA	*	1250	06/24	457 X 30	CLY	● 06	● 24			●	DHC-6		*	DHC-6		
37	D	D	RUKUMKOT (CHAURAJHARI)	HRJ	*	762	03/21	488 X 30	GRS	03/21	03/21		●		DHC-6	*		DHC-6		Inadequate drainage
38	D	D	RUMJATAR	RUM	*	1524	01/19	549 X 30	CLY/GRS	● 01	● 19		●		DHC-6	*		DHC-6		Slippery and soft when wet
39	D	D	SANFEBAGAR	FEB	*	695	03/21	● 427 X 30	GRS	● 03	● 21		●		DHC-6	*		DHC-6		See 3.3.3
40	D	D	SIMIKOT (HUMLA)	IMK	*	2818	10/28	● 549 X 18	GRS	● 28	● 10		●		DHC-6	*		DHC-6		See 3.3.3
41	D	D	SYANGBOCHE		*	3748	13/31	405 X 30	GRS	● 31	● 13		●		PC-6				*	see 3.3.3
42	D	D	TAPLEJUNG	TPJ	*	2377	07/25	594 X 30	GRS/GRV	● 07	● 25			●	DHC-6		*	DHC-6		Existence of obstruction of hill at the side of the runway
43	D	C	TIKAPUR	TKP	*	183	05/23	549 X 30	GRS	05/23	05/23		●		DHC-6	*		DHC-6		

NOTE:

ACFT : AIRCRAFT
ASP : ASPHALT
AS : ALL SEASONS
CDM : CLOSED DURING MONSOON
CHTR : CHARTER FLIGHT
CLY : CLAY
DOM : DOMESTIC
ELEV : ELEVATION
FW : FAIR WEATHER
GRS : GRASS
GRV : GRAVEL
INT : INTERNATIONAL
LDG : LANDING
SND : SAND
STN : STONE
TKOF : TAKEOFF
O : Satisfactory facilities
● : Unsatisfactory facilities
SN : SEASONAL
YR : YEARLY

Table 3.2.2 Summary of Evaluation of Existing Facilities - Buildings -

NO.	CATEGORY DCA	CATEGORY JICA	AIRPORT	TB	CT	PQ	SQ	GH	FS	Store	Coments
1	A	A	KATHMANDU (TRIBHUVAN)								
2	B	B	BHAIRAHAWA	1	1	1	8	1	1	2	4Quarter Required Additionally
3	B	B	BIRATNAGAR	1	1	1	8	1	1	2	
4	B	B	NEPALGUNJ	1	1	1	10	1	1	-	
5	B	B	POKHARA	1	1	1	2	1	1	-	Temporary Building
6	C	C	BHARATPUR	1	1	1	2	1	-	-	
7	C	C	DHANGADHI	1	1	1	4	1	-	-	
8	C	C	JANAKPUR	1	1	1	6	1	1	2	
9	C	C	RAJBIRAJ	1	1	1	2	1	-	-	
10	C	C	SIMRA	1	1	1	4	1	1	-	
11	C	C	SURKHET	1	1	1	4	1	-	-	
12	C	C	TUMLINGTAR	1	1	1	2+1	1	-	-	1Staff Quarter Under Construction
13	D	D	BAITADI (PATAN)	1	1	1	2+1	-	-	-	
14	D	D	BAGLUNG (BALEWA)	1	1	-	1	1	-	-	
15	D	D	BAJHANG	1	1	1	2	-	-	-	
16	D	D	BAJURA	1	1	*1	2	-	-	-	*Temporary
17	D	D	BHOJPUR	1	1	-	*1+1	-	-	-	*1Under Construction
18	D	C	CHANDRAGADI	1	1	1	5	1	-	-	
19	D	C	DANG (TULSIPUR)	1	1	1	3	1	-	-	
20	D	D	DARCHULA	1	1	-	2	-	-	-	
21	D	D	DHORPATAN								
22	D	D	DOLPA	1	1	1	1	-	-	-	
23	D	D	DOTI (DIPAYAL)	1	1	1	2	1	-	-	
24	D	D	GORKHA (PALUNGTAR)	1	1	-	1	1	-	-	
25	D	D	JIRI	-	-	-	-	-	-	-	
26	D	D	JOMSON	1	1	-	2	-	-	-	
27	D	D	JUMLA	● 1	1	1	*1+1	1	-	-	*1Under Construcion, TB is very old.
28	D	D	LAMIDADA	1	1	1	2	1	-	-	
29	D	D	LANGTANG	-	-	-	-	-	-	-	
30	D	D	LUKLA	1	1	1	1	2	-	-	
31	D	C	MAHENDRANAGAR	*1	-	-	-	-	-	-	*Temporary
32	D	D	MANANG	-	-	-	-	-	-	-	
33	D	B	MEGHAULI	-	-	-	-	-	-	-	
34	D	D	PHAPLU	-	-	-	-	-	-	-	
35	D	D	RAMECHHAP	1	1	-	-	-	-	-	
36	D	D	ROLPA	1	1	-	*1	-	-	-	*Site Office
37	D	D	RUKUMKOT (CHAURAJHARI)	1	1	1	2	-	-	-	
38	D	D	RUMJATAR	1	1	-	-	-	-	-	
39	D	D	SANFEBAGAR	1	1	1	1	-	-	-	
40	D	D	SIMIKOT (HUMLA)	1	1	1	-	-	-	-	
41	D	D	SYANGBOCHE	● 1	● 1	-	-	-	-	-	Very Old, Incompleted
42	D	D	TAPLEJUNG	-	-	-	-	-	-	-	
43	D	C	TIKAPUR	-	-	-	-	-	-	-	

TB : Terminal Building
CT : Control Tower
PQ : Police Quater
SQ : Staff Quater
GH : Guard House
FS : Fire Station
● : Unsatisfactory facilities

3.3 Evaluation of Key Airports and Related Facilities

This section provides a comprehensive evaluation of the following key airports which are considered to require the development immediately.

- Tribhuvan International Airport
- Pokhara Airport
- Nepalgunj Airport
- Dolpa Airport
- Jomsom Airport
- Jumla Airport
- Lukla Airport
- Phaplu Airport
- Sanfebagar Airport
- Simikot (Humla) Airport
- Syangboche Airport

3.3.1 Tribhuvan International Airport

The existing airport layout and outline of the facilities are illustrated and summarized in Fig. 3.3.1 and Table 3.3.1 respectively. The major problems at the existing airport are summarized hereinafter.

(1) Runway and Runway Strip

a) The existing runway shoulder width of two meters is less than the ICAO recommendation of 7.5 m. Grass is encroaching the runway shoulder pavement.

b) The runway length of Runway 02/20 is stated as 3,050 m in AIP, Nepal. However, the runway threshold marking for Runway 20 is set 123 m inside of the actual threshold. Accordingly, the actual distance between both runway threshold markings is 2,927 m.

c) Rubber from aircraft tires has accumulated on the touch down zone of Runway 02. Although no problems have been reported it is necessary to clean the runway to provide proper friction for the wheels of landing aircraft.

d) Since 1982, no repair or maintenance work has been done. In spite of this, the pavement surface is still in good condition, judging from visual checks and DCA staff reports.

e) The width of the runway strip is only 150 m. It should be expanded to 300 m for instrument approach procedures in accordance with ICAO recommendations.

f) The runway strip is not extended to the north beyond the end of the runway. According to ICAO recommendation, runway strip should extend at least 60 m before the threshold and beyond the end of the runway.

(2) Taxiway

a) The distance between the taxiway center line and runway center line is 110 m which is less than the minimum of 176 m stipulated in ICAO recommendation.

b) Neither end of the parallel taxiway connects with the runway ends. These connections should be made to increase the runway capacity.

c) The taxiway shoulders are too narrow, the width of which is stipulated 10.5 m in the ICAO recommendation, and are partly covered with grass.

d) An aircraft standing on the taxi-holding position of Taxiway No. 1 obstructs the VASIS light beam.

(3) Apron

a) The depth of the domestic apron from the parallel taxiway is insufficient for minimum separation requirement of 42.5 m between taxiway center line and parked aircraft stipulated in ICAO recommendation. Therefore, during the time aircraft are parked in the domestic apron, the international aircraft including DC-10 and A300 class large jet aircraft abandon to pass the parallel taxiway in front of the domestic apron and go around the runway.

b) The international apron which has six gate positions is insufficient to accommodate the present needs.

c) There is no apron service road exclusive for ground service equipment.

(4) Passenger Terminal Building

a) Domestic terminal building is deficient in capacity and function: floor space, passenger flow, equipment, curb length, and the information system are all inadequate. Although the design of a new domestic terminal building is complete, construction has not yet begun. The design of this building was based on an arriving passenger traffic volume of 499 passengers per hour.

b) A new international building was completed in January 1989. The target volume is 430 - 530 during the peak hour.

(5) Cargo Terminal Building

a) The cargo terminal buildings are scattered into three blocks. These have similar problems to the passenger terminal buildings in capacity and function.

b) Building No. 1 penetrates the obstacle limitation surface.

c) Vehicles moving between building No. 3 and aprons or building No. 1 must go around POL area for the lack of an appropriate connecting road.

(6) Maintenance Hangar

The maintenance hangar cannot accommodate the B-757 because the roof is too low.

(7) POL

The underground fuel storage tanks are too close to the parallel taxiway. They are only 50 to 60 m from the taxiway.

(8) Fence

Pedestrians sometimes cross the runway even during operation hours. Fencing around the airport needs to be installed immediately so as to prevent accidents between aircraft and pedestrians or animals.

(9) Perimeter Road

A perimeter road should be constructed outside the runway strip for maintenance vehicles and security patrols.

(10) Utility

Water supply from WSSC is currently not sufficient, and quality of well water which is taken in the airport to make up for a deficiency of city water, is not so good.

Supply of electricity from the outside of the airport is not reliable.

There is not an incinerator for the garbage disposal in the airport.

(11) Use of Runway

As the Tribhuvan International Airport is surrounded by the high mountains, operation procedures established for this airport are strictly limited. A straight-in approach from the north is difficult due to high mountains located in the final approach area for Runway 20.

Accordingly, a straight-in approach procedure to this airport can be made only from the south. On the other hand, almost all aircraft take off to the south. Since the runway is used by such preferential operations, its capacity is lower than that by normal operations.

KEY TO TERMINAL AREA

① INTERNATIONAL PASSENGER TERMINAL
② DOMESTIC APRON
③ CARGO TERMINAL
④ DOMESTIC PASSENGER TERMINAL
⑤ MILITARY HANGAR
⑥ RNAC HANGAR
⑦ FIRE STATION
⑧ FUEL FARM
⑨ CENTRAL WORKSHOP(DCA)
⑩ NEW OPERATION / AIRLINE COMPLEX

——— 1978 AIRPORT BOUNDARY
—·—·— AIRPORT BOUNDARY

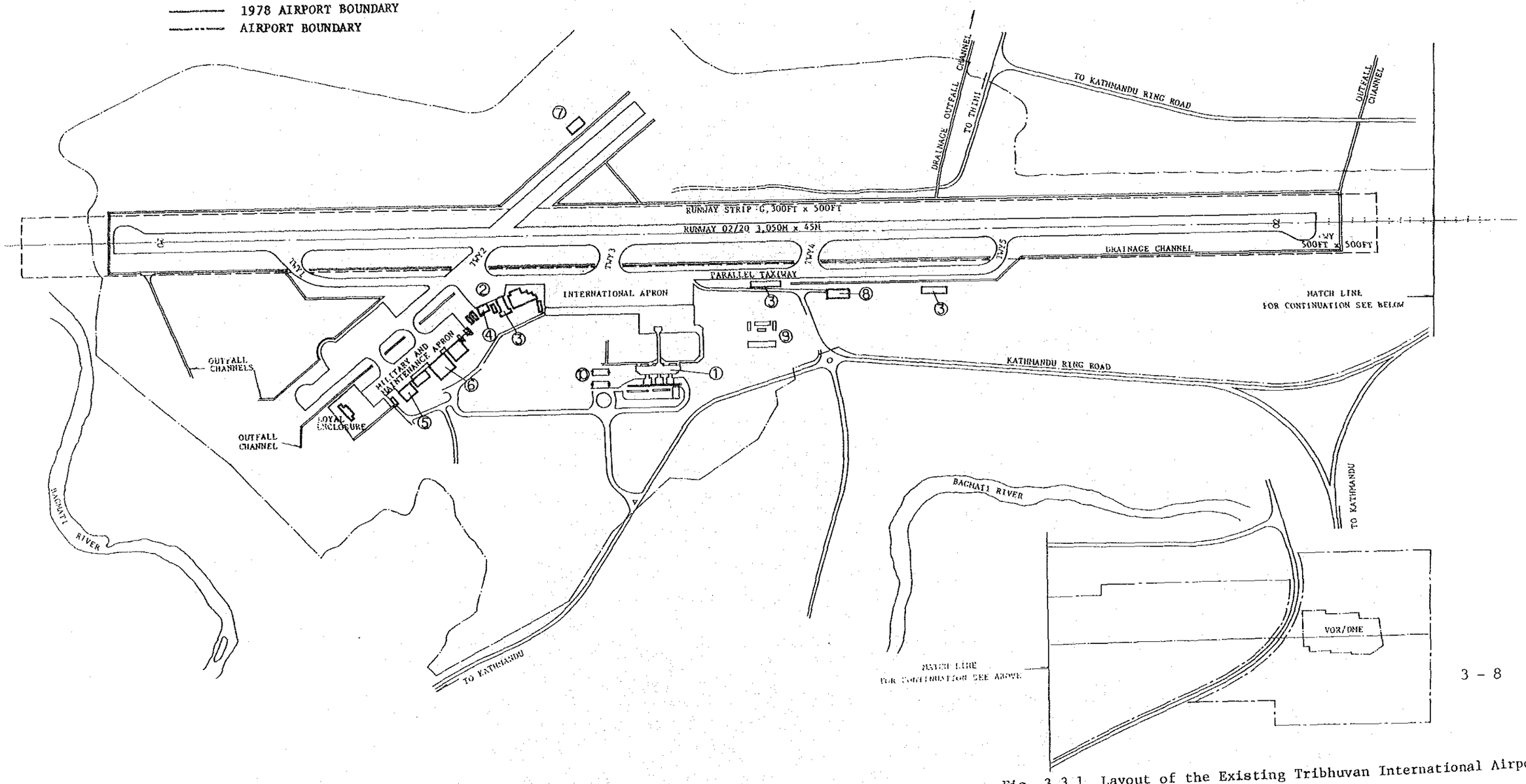


Fig. 3.3.1 Layout of the Existing Tribhuvan International Airport

Table 3.3.1 Outline of Existing Kathmandu Airport

Country	Name of Airport	INTL/DOM / ICAO CODE	Commencement of Services	Total Area of Airport	Aerodrome Reference Point	Airport Elevation	Runway Bearing	Aerodrome Reference Temperature	Operation Hour	Seasonal Availability	Administrative Authority
NEPAL	TRIBHUVAN	INTL / 4D	1950	—	27°41'47"N / 85°21'42"E	1338m (4390ft)	02-20	27.8°C	Sunrise to sunset	All Seasons	Department of Civil Aviation

City/Town			Transportation			Wind Coverage	Aerodrome Operationg Minima
Name	Population	Distance to Airport	Railway	Taxi	Bus		
Kathmandu	Kathmandu District 422,000 as of 1981	5.6 km	—	○	○	—	

Name of Approach Procedure	Runway	S T A MDA Day	S T A MDA Night	S T A VIS Day	S T A VIS Night	Circling MDA Day	Circling MDA Night	Circling VIS Day	Circling VIS Night
Echo Approach (VOR/DME)	02	—	—	—	—	5186'	—	2500m	—
	20	—	—	—	—	5186'	—	2500m	—
Sierra Approach (VOR/DME)	02	5186'	5186'	1500m	3000m	5186'	—	2500m	—
	20	—	—	—	—	5186'	—	2500m	—

Air Navigation Aids

Radio	NDB	LO	VOR	DME	TACAN	ILS	ASR	PAR	SSR	ARTS	ASDE	HF	VHF	UHF	ITS	VDF	ITV	TTY	AFTN
Existing	Yes	Yes	Yes	Yes	—	—	—	—	—	—	—	Yes	Yes	—	—	Yes	—	Yes	Yes
Plan																			

Lightings	ALS	SFL	SALS	ALB	AGL	CGL	REIL	VASIS	PAPI	RWYL	RWTL
Existing	—	—	Yes	—	—	—	—	Yes	—	Yes	Yes
Plan											

Lightings	RCLL	TDZL	OL	DML	TWYL	TWCL	TGL	ABN	WDIL	AFL
Existing	—	—	—	—	—	—	—	Yes	Yes	Yes
plan										

Meteorological Facilities	
Runway Surface Sensors	Yes
Weather Facsimile	Yes
APT Receiver	Yes
Radiosonde	
Weather Radar	—
VOLMET Broadcast	—

Basic Facilities

	Size	Structure	Note
Runway Strip	3140m x 150m		
Runway	3050m x 45m	Asphalt 54F/A/W/T	Rwy
Runway			Old Rwy closed
Taxiway	1945m x 23m	Asphalt 54F/A/W/T	5 connecting 1 Parallel Twy

Apron	Design Aircraft	No. of Stand	Pave-ment	Area (m²)	Parking Configuration
Dom.	HS-748	HS-748 DHC-6	PCC	5,376	Self Manoeurving 53/R/B/W/T
Int'l	DC-10	B-757 etc;6	"	38,072	
Maint.	HS-748	—		17,000	61/F/B/W/T

Flight Services

Domestic Flights by RNAC

Flight Route	Type of Aircraft	WAM
KTM - KEP	HS-748	6
	DHC-6	17
-PKR	HS-748	14
	DHC-6	28
-BIR	HS-748	14
-SIF	DHC-6	28
-LUA	DHC-6	14
-SKH	DHC-6	8
-DHI	DHC-6	8
-Other		65
Total		202

International Flights by RNAC

Flight Route	Type of Aircraft	WAM
KTM -Bangkok	B727	8
-Culcutta	B757	2
	B727	4
-Colombo	B727	2
-Delhi	B757	12
	B727	8
-Dhaka	B737	6
-Dubai	B757	2
-Hongkong	B757	4
**-Other		10
Total		58

International Flights by Foreign Airlines

Flight Route	Type of Aircraft	WAM
KTM - Bangkok	A300-4	8
-Culcutta	B737	10
-Colombo		
-Delhi	B737	14
-Dhaka	A310	4
	B707	6
	F28	6
-Dubai		—
-Hongkong		
*-Other		24
Total		72

Note:

WAM: Weekly Aircraft movement

Other Facilities

	Size	Structure	Note
Access Road	250m x 11.0m#	Asphalt	
Autopark	17,000 m² App.	Gravel	temporary use
Pax.T.Building	10,750m² App.	R.C.	Intl
	700 m²	"	Dom.
Cargo.T.Building	3,500 m² App.	R.C.& Quonset	3 buildings
Office Building		R.C.	Part of Pax. Bldg.
Control Tower	390m²##	"	OPS Building
Fire Station	800 m² App.	"	for 6 Vehicles
POL	756 kl x 2 70 kl x 8 15 kl x 2		Nepal Oil Corporation
Hangar	5,800 m² App.		3 Hangars RNAC

Statistics of Air Traffic

KEP...Nepalgunj LUA...Lukla *...Including Rangoon, Lhasa, Karachi, etc..
PKR...Pokhara SKH...Surkhet **...Including Lhasa.
BIR...Biratnagar DHI...Dhangadhi
SIF...Simara

#...including shoulders
##...The new Control Tower will be commissioned in the near future.

No. of Landing &Take-off	19,729	20,731	15,336	17,761	—
Annual Freight Volume(ton)	4661	4254	6811	9418	10993
No. of Annual Passengers	Int'l 415	465	483	523	574
	Dom. 154.9	162.0	186.5	174.7	203.2
Year (Fiscal)	1982/83	1983/84	1984/85	1985/86	1986/87

General Notes:

DCA: Department of Civil Aviation

RNAC: Royal Nepal Airlines Corporation

	◇	
DATE	◇	By
REVISION		
Drawn By		JICA
Date		Sept.'89

3.3.2 Pokhara Airport

Since the existing airport has significant safety and functional faults, a new airport site was selected 16 years ago and the land acquisition was almost completed. A design was completed to meet ICAO standards but the project was not implemented due to decreased demand and budget constraints.

Table 3.3.2 shows the outline of the existing Pokhara Airport.

The shortcomings of the existing airport are as follows:

a) Approach from and take-off to the north are operationally limited due to high mountains in that direction. Therefore, 95% of the operating aircraft approach from and take-off to the south. A detailed assessment of this obstruction is shown in Fig. 3.3.2.

b) The terminal buildings and a large tree which has religious meaning are located just 55 m from the runway center line.

c) The existing airport site cannot be developed as it is adjacent to a city and environmental concerns would become a problem in the near future. Also, extending the runway is difficult due to limited space.

d) The runway orientation is nearly at a right angle to the prevailing wind.

e) Almost all the airports which handle the same traffic volume as Pokhara Airport have a paved runway and apron, while Pokhara Airport has no pavement.

Table. 3.3.2 Outline of Existing Pokhara Airport

Country	Name of Airport	INTL/DOM / ICAO CODE	Commencement of Services	Total Area of Airport	Aerodrome Reference Point	Airport Elevation	Runway Orientation	Aerodrome Reference Temperature	Operation Hour	Seasonal Availability	Administrative Authority
Nepal	POKHARA	DOM / 3c	1951	218.000 m²	28°12'N / 83°59'E	827 m (2712')	03-21	27.8 °C	Sunrise to sunset	All Seasons	Department of Civil Aviation

City/Town			Transportation			Wind Coverage	Aerodrome Operating Minima	Runway	Approach Distance	Approach Procedure	Jet		Turbo Prop		Note
	Population	Distance to Airport	Railway	Taxi	Bus						MDA	Visibility	MDA	Visibility	
POKHARA	KASKI DISTRICT 221000 as of 1981	4 km	—	O	O	—		03		VMC only					IFR procedure not yet established.
								21							

Air Navigation Aids — Radio

	NDB	VOR	DME	TACAN	ILS	ASR	PAR	SSR	ARTS	ASDE	HF	VHF	UHF	ITS	VDF	ITV	TTY	AFTN
Existing	Yes	—	—	—	—	—	—	—	—	—	Yes	Yes	—	—	—	—	—	—
Plan																		

Air Navigation Aids — Lighting

	ALS	SFL	SALS	ALB	AGL	CGL	PAPI	RWYL	RTL	REIL
Existing	—	—	—	—	—	—	—	—	—	—
Plan										

	RCLL	TDZL	OL	DML	TWYL	TWCL	TGL	ABN	WDIL	AFL
Existing	—	—	—	—	—	—	—	—	—	—
Plan										

Meteorological Facilities

Runway Surface Sensors	—
Weather Facsimile	—
ART Receiver	—
Radiosonde	—
Weather Radar	—
VOLMET Broadcast	—

Note:

Basic Facilities

	Size	Pavement	Note
Runway Strip	1,570m x 150m		
Runway	1,433m x 30m	Gravel	
Taxiway	—	Grass	

Apron — Design Aircraft	Number of Stand	Pavement	Area	Parking Configuration
HS-748	HS-748:1 DHC-6 :1	Grass	— m²	Self Manoeuvering

Other Facilities

	Size	Structure	Note
Access Road	W=5.5m	Asphalt	
Autopark	—		
Pax.T.Building		R.C.	
Cargo.T.Building			
Office Building			1F of T/B
Control Tower			
Fire Station			No Fire Vehicle
Electrical & Mechanical Workshop		R.C.	
Power House		R.C.	
Staff Quarter			
POL	—		

Flight Services

Intl/DOM	Major Air Route	Name of Airline	Type of Aircraft	No. of Flight/Week	Note
DOM	POKHARA - KATHMANDU	RNAC	HS-748	7	Monsoon schedule 1988
			DHC-6	14	
	- JOMSOM	RNAC	DHC-6	3+11*	*11: charter flights
	-BAGLUNG	RNAC	DHC-6	5	

Note:
RNAC: Royal Nepal Airlines Corporation

Statistics of Air Traffic

Note: Indicating RNAC scheduled traffic only

No. of Landing & Take- off					
Annual Freight Volume (ton)					
No. of Annual Passengers	20,000	23,000	34,200	36,400	46,500
Year (Fiscal)	1982/83	1983/84	1984/85	1985/86	1986/87

	◇	
DATE	◇	By
REVISION		
Drawn By		JICA
Date		Sept.'89

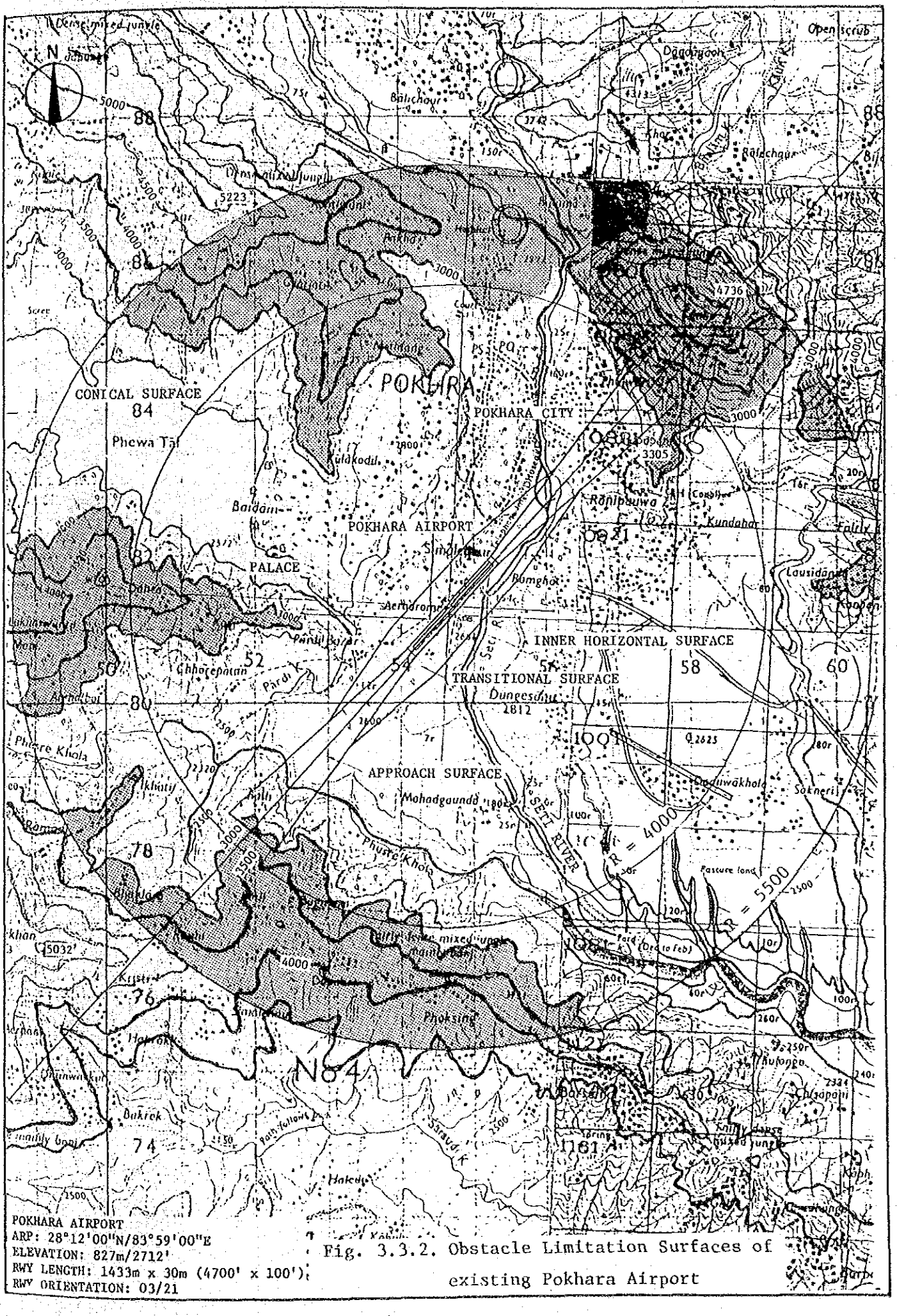


Fig. 3.3.2. Obstacle Limitation Surfaces of existing Pokhara Airport