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RAIL PASSENGER TRAFFIC
ORIGIN DESTINATION SURVEY

NTRC- 87

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S U M M A R Y

Introduction

The available rail traffic statistics do not provide information on origin destination of passengers. Such information is useful for detailed scheduling of services and was required to complement the country wide road traffic origin destination survey data to obtain a complete picture of overall traffic flows for the National Transport Planning Study (1983). Accordingly, an origin destination survey of rail passenger traffic was carried out by the National Transport Research Centre. The results of the survey were used for the National Transport Plan Study (1983). Further analysis of data is presented in this report.

Scope and Coverage

The survey covered passenger tickets issued from 24 railway stations, mostly on the main line, during the months of July 1980 and January or February 1981. For analysing the data, stations 1 to 4 (around Karachi) and 12 and 13 (Lahore Shahdra Bagh) were combined as one station. This resulted in 20 origin stations or combination of stations. The tickets issued by these stations for all destinations were analysed.

Table S(1)
List of Railway Stations Covered by the Survey

1. Karachi City	9. Sukkur	17. Peshawar
2. Karachi Cantt	10. Khanewal	18. Quetta
3. Drigh Road	11. Okara	19. Larkana
4. Landhi	12. Lahore	20. Faisalabad
5. Hyderabad	13. Shahdra Bagh	21. Sargodha
6. Nawabshah	14. Gujranwala	22. Sangla Hill
7. Tando Adam	15. Wazirabad	23. Sialkot
8. Rohri	16. Rawalpindi	24. Norowal

Data Sources

The information on number of tickets issued was obtained from the "Summary of Daily Trains Cash Book Forms" (Form No. Sn.23-Revised) which were obtained from Railway Headquarters, Lahore. The forms were edited and transformed into coding sheets at the National Transport Research Centre Islamabad and processed at the Quaid-i-Azam University Computer Centre, Islamabad where all primary tabulations were prepared. Further statistical analysis was carried out by the author on personnel computer.

Sample Size

Pakistan Railways had 885 stations in 1980-81 of which information was obtained for 24 stations. This gives a ratio of 2.7 per cent which is quite small. The tickets issued by the selected stations constituted 16 per cent of the number of passengers handled on the system. If it is assumed that tickets issued from selected origins to various destinations are equal to tickets issued by various destinations for selected stations, the

coverage would amount to 25 per cent of the total which is a significant magnitude. However, there is still a large proportion of stations for which no origin destination information is available. The selected stations do not represent a typical mix of stations, the results are therefore biased in favour of main line station covered by the survey.

The Results

The salient features of the results are briefly described in the following paragraphs.

No. of Tickets Issued

The selected stations issued 1.636 million tickets per month which represent 16 per cent of the tickets over the system. The largest number of tickets were issued from Karachi, 301,086. It was closely followed by Lahore with 300,155 tickets. The two stations together issued 18.4 and 18.3 per cent of tickets issued by selected stations. Faisalabad, Rawalpindi and Hyderabad rank, 3rd, 4th and 5th with 10 per cent, 6.1 per cent and 5.1 per cent tickets issued.

Relation of Tickets to Population

The number of tickets issued per month per 100 persons varied from 3.9 for Peshawar, 4.6 for Gujranwala, 5.8 for Karachi and 216 for Sangla Hill, 187 for Norowal and 88 for Wazirabad.

Cities with larger number of tickets are either not well connected by road like Sangla Hill and Norowal or have good rail connections like Wazirabad. The regression of tickets with population of the cities indicated the following relationship:

$$\text{No. of Tkts} = 4.355 + 0.0586 \text{ Pop.} \dots\dots\dots r^2 = 0.80$$

Destination Stations

There were in all 885 stations in 1980-81 for which tickets could be issued by any station. Of these, 722 stations were noted for which tickets were issued by any of the selected origin stations. The number of destinations for which tickets were issued by various stations varied from 427 to 80. Lahore was on top of the list with 427 destinations. It was followed by Karachi 340 destinations, Faisalabad 260, Quetta 198, Wazirabad 184 destinations and so on. At the other end are Norowal with 80 destinations Peshawar 87 and Tando Adam 88 destinations.

Distribution of destination stations according to Passengers received

The distribution of destination stations was found to be highly skewed. A large number of stations received a small proportion of passengers while a small number of stations received a large proportion of passengers. For example, the lower

30 per cent of the stations received less than 50 passengers a month or less than 2 passengers a day. On the other extreme, top 8 per cent of the stations received more than 6000 passengers per month or 200 passengers per day (Table 4).

Matrix Elements by No. of Tickets

The Origin-Destination matrix has 17,328 elements (24 origins x 722 destinations). Counting of elements according to number of tickets showed that there was no ticket for 11,071 (76.6%) elements, 1-10 passengers for 8.2 per cent of destinations, 51-100 passengers for 4.7 per cent of the destinations. On the other extreme, 0.2 per cent of destinations had more than 6,000 tickets (Table 5).

Destinations according to No. of origin stations

Of the 722 destinations noted, 126 destinations received traffic from only one of the 20 stations, 292 stations received traffic from 2-3 of the origins, 109 stations received 4-5 of the origin stations (Table 7). The destination stations would have received traffic from other origins not covered in the survey.

Destinations in Quartiles of passengers Received

The number of destinations falling in various quartiles (with respect to number of passengers received showed on the average 1.4 stations in the first quartile (covering 25 per cent of the passengers received) 4.4 stations in the second quartile 10.8 stations in the third quartile and 892 stations in the last

quartile (Table 8).

Trip Length Distribution

The trip length distribution showed that 1/3rd of tickets were for less than 50 kilometers distance, about 50 per cent for less than 100 kilometers nearly 2/3rd of the tickets are for less than 200 kilometers and 1/3rd tickets for more than 200 kilometers distance. The pattern is similar for individual stations with few exceptions (Table 9).

Effect of Distance on Tickets

The effect of distance on number of tickets issued was found by Regression Analysis as follows.

$$\text{No. of Tkts} = 218\ 358 - 155 \text{ distance (Km)} \dots\dots\dots r^2 = .435$$

The sign is correct, but r^2 is not so high.

Conclusions and Recommendations

The survey, besides serving its immediate purpose of providing data for the national transport plan study, has provided information on passenger flows from selected origins to main destinations, trip length distribution of traffic originating from selected stations and analysis of a large number of overall stations. The results suggest that there is an imperative need for a more comprehensive survey of passenger

(x)

traffic covering a larger proportion of stations on main
as well as branch line for better scheduling of services
and formulation of policies concerning small stations.

Chapter I

INTRODUCTION

The available rail traffic statistics provide, among other things, information on number of passengers and passenger kilometers carried over the system each year. This information is published in the "Pakistan Railways Year Book of Information" every year. Details of trip length distribution into four distance classes, viz. 1-50, 51-150, 151-300 and over 300 kilometer, with details upto Railway's Divisions are given in the "Commercial Statistics" which have been published upto 1982-83. For subsequent period, the data is available in unpublished form from Pakistan Railway Headquarters. In addition, details of number of passengers booked and earnings for each station are given in the "Combined Traffic Statistics" which have also been published upto 1982-83. All the three sources do not provide information about origin and destination of passengers on Pakistan Railways. It is therefore difficult to have an idea of 'from where to where' main traffic flows on the system are. Such information is very essential for detailed planning and operation of services as well.

A country wide Road Traffic Origin-Destination Survey was carried out by the National Transport Research Centre in 1979-80, in anticipation of the National Transport Plan Study undertaken by the Japan International Cooperation Agency in 1982-83 for the Sixth Five Year Plan. The survey provided origin-destination matrix for 50 zones of the country mostly

corresponding to civil districts. As rail and road are the two competitive modes of inland traffic, corresponding information on rail origin destination was also needed to complete the overall picture of passenger flows.

Accordingly, a rail passenger origin destination survey was undertaken by the Centre to provide urgent information required for the National Transport Plan Study and to fill up the gap in available statistics.

The results of the survey were used in the National Transport Plan Study. Further analysis of data is presented in this report. The scope and coverage of the survey are explained in Chapter II and the results are given in Chapter III. Chapter IV summarises conclusions and recommendations. The main data tabulations are given in Annexures.

Chapter II

SCOPE AND COVERAGE

The survey covered 24 Railway Stations on the main line as listed in table 1 below. For each of these stations information on the number of tickets issued during the months of July 1980 and January or February 1981 was obtained as indicated against each.

Table 1
Coverage of Survey

Sl. No.	Name of Station	Months for which information compiled		
		July '80	Jan '81	Feb '81
1	2	3	4	5
1.	Karachi City	x	x	
2.	Karachi Cantt	x	x	
3.	Drigh Road			x
4.	Landhi	x		x
5.	Hyderabad	x	x	
6.	Nawabshah			x
7.	Tando Adam	x		
8.	Rohri	x	x	
9.	Sukkur		x	
10.	Khanewal	x	x	
11.	Okara	x	x	
12.	Lahore	x	x	
13.	Shahdra Bagh	x	x	
14.	Gujranwala	x	x	
15.	Wazirabad	x	x	
16.	Rawalpindi	x	x	
17.	Peshawar		x	
18.	Quetta		x	x
19.	Larkana		x	
20.	Faisalabad		x	x
21.	Sargodha	x	x	
22.	Sangla Hill	x	x	
23.	Sialkot		x	x
24.	Narowal	x	x	

As would be seen from the above table, 18 of the 24 stations have data for two months and the remaining 6 stations have data for one month only. The data of stations with two months' information was divided by two to have average per month and make it comparable to other stations for which information was available for one month only.

After compiling the data for each of the 24 stations, stations around Karachi viz. Karachi City, Karachi Cantt, Drigh Road and Landhi were combined as one station. Similarly, Shahdra Bagh and Lahore were combined as one station. This reduced the number of origins from 24 to 20.

Data Sources

The data was obtained from 'Summary of Daily Trains Cash Book Forms' (No. Sn.23-Revised) which are prepared by every railway station at the end of each month and give number of tickets of different classes (AC, I, II, concession, etc.) for each of the destinations, rate of fare, amount realized. These forms are available for past years at Railway Headquarters Lahore. However, the forms are stacked in huge bundles in such a way that retrieval of forms of any particular station and time is very laborious and time consuming.

The data forms were transcribed into computer readable form indicating station code, class of travel and number of tickets sold during the month under reference. The fare collected was not compiled. The stations were coded according

to Pakistan Railways Manual of Code Numbers. The distances from 24 origins to all the destinations for which tickets were issued were compiled from Railway Time and Fare Table. The distances thus compiled were used for estimating trip length distributions.

Data Processing

The data was processed at the Quaid-i-Azam University Computer Centre where primary tabulations were prepared. Further statistical analysis was done on micro computer by the author.

Sample Size

Due to limited number of stations covered by the survey, the nature of resulting sample should be clearly understood as explained in the following paragraphs.

The sample size can be considered in 3 different ways; one, in terms of proportion of stations covered; two, in terms of proportion of passengers observed; and three, in terms of the proportion of the origin-destination places covered by observations.

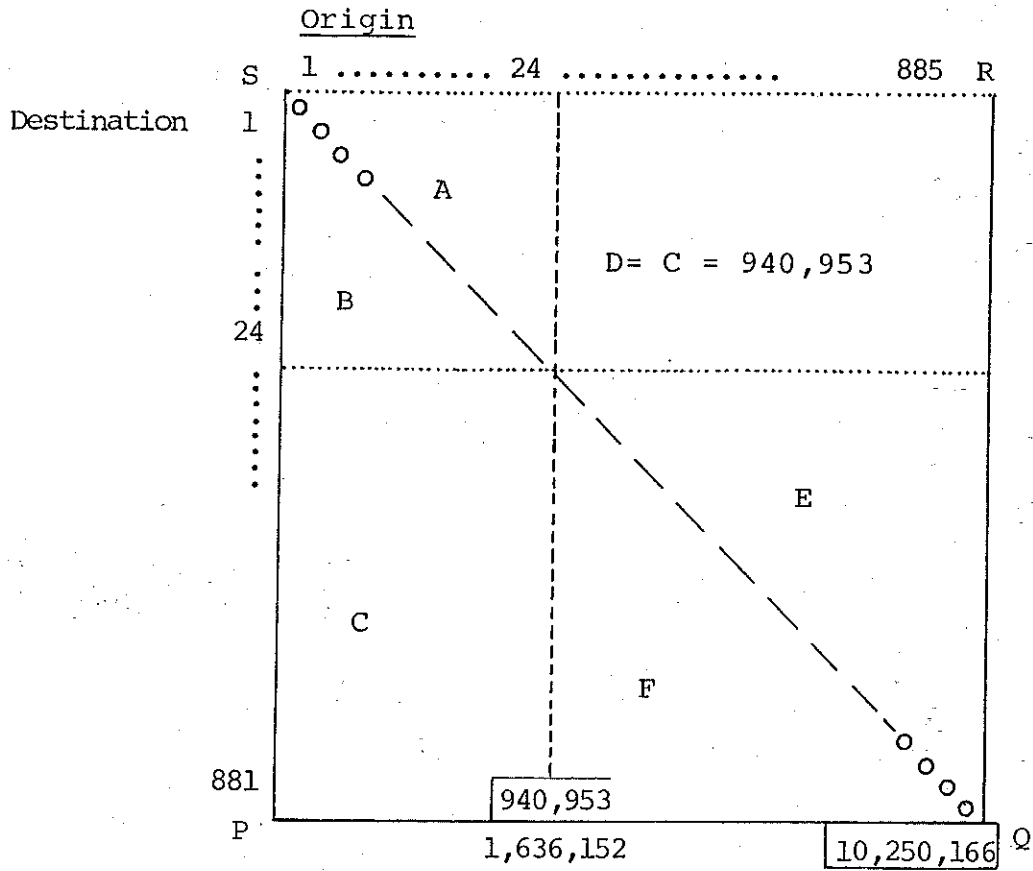
Pakistan Railways had 885 stations in 1980-81 of which information was obtained for 24 stations. This gives a ratio of 2.71 per cent which is quite small. Most of the stations covered are on the main line. In terms of destinations, there were 722 stations for which tickets were issued by one or the

other selected station. Thus more than 81 per cent of the stations have been noted in the destination. The remaining 163 stations are the ones for which no tickets were issued by any of the selected stations. Some of these stations might have been rounded in the category of Miscellaneous which could not be identified.

In terms of number of passengers, the sample size works out to about 16 per cent. During 1980-81, Pakistan Railways carried 123 million passengers. This gives an average of 10.25 million passengers per month. The number of tickets issued from 24 stations covered under the survey adjusted to monthly average amounted to 1,636,152. This gives a sampling ratio of 15.96 per cent.

In the form of a plane, the sample frame and sample size are illustrated in figure 1. The square PQRS depicts the overall frame which contains 885 origins and 885 destinations. Since one station cannot issue tickets to itself, the possible destination are $n \times n - n$ or $885 \times 885 - 885 = 782,340$. The area covered by the survey consists of portions A, B and C. Of the 1,636,152 tickets issued per month by the sample stations 695,199 or 42.49 per cent were to and from 24 selected stations and the balance 940,953 or 57.51 per cent were for other 698 stations. If it is assumed that traffic from 24 selected stations to all other stations is equal to traffic from all other stations to selected stations, the area 'C' can be treated as equal to 'D'. This increases the coverage to more than 25 per cent

Fig.1. Sample frame and sample size



Sample frame = PQRS = 100

Observations = A+B+C = 16%

Adjusted D=C = A+B+C+D = 25%

as follows.

i) Traffic within 24 selected stations (A+B)	695,199
ii) From selected stations to all other stations	940,953
iii) From all other stations to selected stations assuming e.g. C = D	<u>940,953</u>
iv) Total (i) to (iii)	<u>2,577,105</u>
v) Traffic during 1980-81 (123,002,000/12)	<u>10,250,166</u>
vi) iv/v x 100	25.14%

The sample has the weakness of being biased in favour of main line stations. There is virtually no coverage of branch line stations so that pattern of flow between smaller stations in area marked as E & F in figure 1 is not known. As such it is not possible to blow up the results for overall flow pattern.

Besides, the number of passengers originating from 24 selected stations for numerous destination stations gives a partial picture of total destinations for those stations. It is in no way a relevant figure for number of passengers arriving at those stations which would be far higher. However, the situation of departure from selected stations is more or less complete, subject to sampling variations.

Subject to the above limitations, the results of the survey are presented in Chapter III that follows.

Chapter III

THE RESULTS

The most important result of the survey is contained in the main origin destination table at Annexure A. The placing of this table in the Annexure is not because of its importance but is due to its magnitude. The table shows number of tickets issued per month from selected 20 stations or combination of stations to various destinations which number 722. To simplify the data, the destination stations have been aggregated into sections in Annexure-B. The following paragraphs highlight main features of the basic origin destination table.

No. of Tickets Issued

The number of tickets issued by 24 selected stations (aggregated to 20 stations) is shown in table 2. It would be seen therefrom that Karachi and Lahore issued more than 300,000 tickets per month each. The two stations account for 18.4 and 18.3 per cent tickets of selected stations. The third highest station was Faisalabad where ticket sales were 54 per cent of the second highest. It is followed by Rawalpindi, Hyderabad, Sargodha, Sialkot which account for 4 to 6 per cent of sales of selected stations. The Provincial capitals of Quetta and Peshawar with ticket sales of 35,712 and 22,102 occupy 15 and 18th position in the list of 20 stations.

Table 2
Number of Tickets Issued per Month from Selected Stations

Sl. No.	Name of Station	Ticket Issued per Month	
		No.	%
1	2		
1.	Karachi	301,086	18.4
2.	Lahore	300,155	18.3
3.	Faisalabad	163,229	10.0
4.	Rawalpindi	99,747	6.1
5.	Hyderabad	82,641	5.1
6.	Sargodha	78,914	4.8
7.	Sialkot	73,273	4.5
8.	Sangla Hill	72,944	4.5
9.	Norowal	65,715	4.0
10.	Khanewal	59,313	3.6
11.	Wazirabad	55,490	3.4
12.	Nawabshah	50,438	3.1
13.	Rohri	50,430	3.1
14.	Sukkur	37,495	2.3
15.	Quetta	35,712	2.2
16.	Gujranwala	30,562	1.9
17.	Larkana	27,322	1.7
18.	Peshawar	22,102	1.4
19.	Okara	17,414	1.1
20.	Tando Adam	12,173	0.7
Total:		1,636,152	100.0

Relation with Population

Rohri and Sukkur were combined as one city. The number of tickets issued by selected stations per month per 100 people varied from 3.90 for Peshawar, 4.64 for Gujranwala and 5.78 for Karachi to 216 for Sangla Hill, 187 for Norowal and 88 for Wazirabad. The average number of tickets for all stations combined worked out to 11.86 per month for every 100 people. The cities with higher number of tickets are either not well connected by road e.g. Sangla Hill and Norowal or have good rail connections e.g. Wazirabad and Khanewal.

The number of tickets issued by selected stations were related to population of selected cities by simple linear regression analysis of the form.

$$Y = a + bx$$

Where

- Y = No. of Tickets issued per month,
- X = Population of the city (1981),
- a = Constant; and
- b = Coefficient

and the following results were obtained.

$$\text{No. of Tkts} = 4.3551 + 0.0586 \text{ Pop} \dots\dots\dots r^2 = 0.80$$

The value of $r^2 = 0.80$ implies that 80 per cent of explanation is provided by the population of the city. The data and regression out put is given at Annexure C.

Destinations

There were in all 885 stations in 1980-81. This is the maximum possible number for which tickets can be issued from any of the stations on the system.

The number of destinations for which tickets were issued from the selected origins varied from 427 to 80 as shown in table 3.

Table 3
No. of Destinations for which Tickets were Issued from Selected origins

S.No.	Origin	No. of Destination	% of stations on the system
1	2	3	4
1.	Lahore	427	48.2
2.	Karachi	340	38.4
3.	Faisalabad	260	29.4
4.	Quetta	198	22.4
5.	Wazirabad	184	20.8
6.	Khanewal	181	20.5
7.	Rawalpindi	175	19.8
8.	Sargodha	167	18.9
9.	Sialkot	165	18.6
10.	Hyderabad	153	17.3
11.	Rohri	141	15.9
12.	Sangla Hill	141	15.9
13.	Gujranwala	132	14.9
14.	Sukkur	125	14.1
15.	Okara	118	13.3
16.	Larkana	102	11.5
17.	Nawabshah	100	11.3
18.	Tando Adam	88	9.9
19.	Peshawar	87	9.8
20.	Norowal	80	9.0
Total:		3,364	

It is evident from the above table that Lahore is on top of the list with 427 destinations for which tickets were issued; Karachi followed with 340 destinations and Faisalabad with 260 destinations. On the other extreme, Norowal issued tickets for 80 destinations and Peshawar was second last with 87 destinations. Even the smallest number of destinations is quite significant and shows the diversity of traffic catered by Pakistan Railways.

Distribution of Destinations according to Tickets Issued

Although tickets were issued by each origin station for a large number of destinations, the distribution is highly skewed. A large proportion of tickets was accounted by a small number of destinations and a large number of stations received a small proportion of passengers. For example, out of 722 stations, 216 stations received less than 50 passengers in a month or less than 2 passengers a day (from selected origins, of course). On the other hand, 59 stations received more than 6000 passengers a month or 200 passengers daily. The details are shown in table 4.

Table 4
Distribution of Destination Stations according to Number of Passengers Received from Selected Stations

No. of Passengers Received	No. of Stations	% of Total	Cumulative
1	2	3	4
1-49	216	29.9	29.9
50-99	63	8.7	38.6
100-199	55	7.6	46.2
200-399	73	10.1	56.3
400-599	47	6.5	62.8
600-799	26	3.6	66.4
800-999	30	4.2	70.6
1000-1,999	63	8.7	79.3
2000-3,999	55	7.6	86.9
4000-5,999	35	4.8	91.7
6000-7,999	14	1.9	93.6
8000-9,999	7	1.0	94.6
10,000-19,999	26	3.6	98.2
20,000-39,999	7	1.0	99.2
41,000 and over	5	0.7	100.0
722			

It is evident from the above that 30 per cent of the stations received less than 50 passengers in a month from

20 selected origins, 46 per cent stations received less than 200 passengers. The top 20 per cent stations received more than 2000 passengers per month and the top 5 per cent stations received more than 10,000 passengers in a month.

The above figures relate to number of passengers received from 20 origin stations which is not the whole number of passengers received by the given destination stations. In addition there would be passengers from the other 861 stations for which data of tickets issued has not been obtained.

Percentage Distribution of Destinations and Tickets

The distribution of destination stations according to tickets issued from selected origins is further illustrated in table 5 which shows percentage distribution of stations and tickets.

Table 5
Percentage Distribution of Stations and Tickets

Percent of Tickets Issued	Percent of Destination Stations	Percent of Destinations	Percent of Tickets
1	2	3	4
10	0.14	1	32.4
20	0.28	5	58.8
30	0.83	10	73.6
40	1.80	15	82.26
50	3.32	20	87.86
60	5.40	25	91.40
70	8.59	50	98.6
80	13.57	100	100
90	22.85		
100	100		

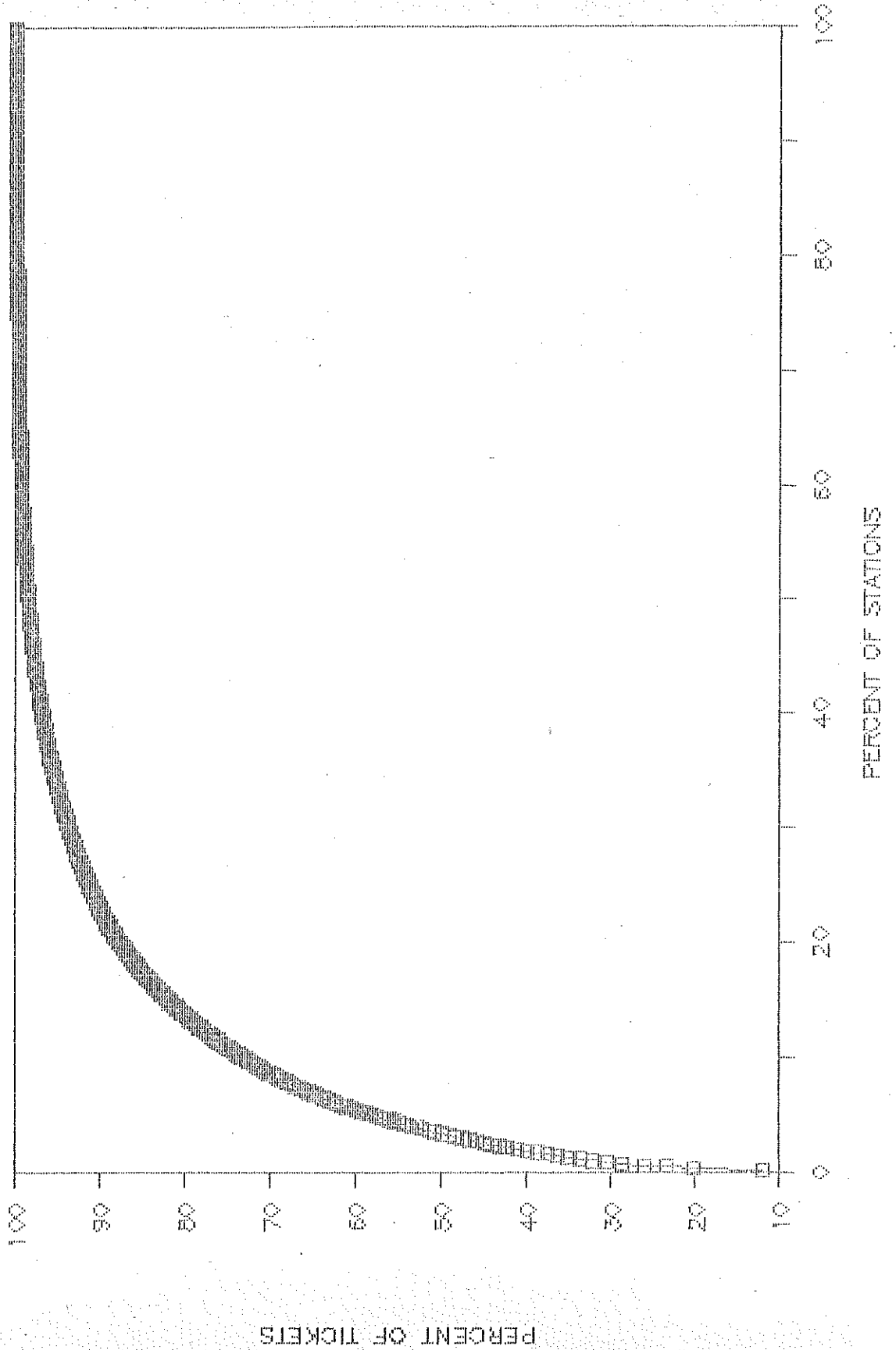
Columns 3 and 4 of the table contain the same information as in column 1 and 2 but in a different form. In column 1, values of per cent of tickets issued are fix and corresponding values of per cent of destination stations are variable. On the other hand, in column 3 values of per cent of destination stations are fixed and their corresponding values of per cent of tickets issued are variable.

It would be seen from the above table that 50 per cent of the tickets were issued for 3.32 per cent of the stations, 80 per cent of tickets for 13.57 per cent stations, 90 per cent tickets for 22.85 per cent of stations. At the other end, last 10 per cent of the tickets were issued for 77.15 per cent of stations and 86.43 per cent of the tickets for 20 per cent of the stations.

Looking from the other side, it would be seen that 1 per cent of the destinations accounted for 32.4 per cent of tickets, 5 per cent destinations accounted for 58.8 per cent of tickets and 10 per cent of the destinations accounted for 73.6 per cent of the tickets. At the other end, last 50 per cent of the destinations accounted for 14 per cent of the tickets while the last 75 per cent of the destinations received only 8.6 per cent of tickets.

The percentage distribution of destination stations and Tickets is also shown in graph 1.

DISTRIBUTION OF DESTINATION STATIONS ACCORDING TO NO. OF TICKETS



Destination stations according to Tickets issued from each of the 20 stations

There were 772 stations for which tickets were issued by any of the 20 stations. Thus the origin destination matrix consisted of $772 \times 20 = 1440$ elements or possible destinations. Of these there was no entry in 11,076 or 76.6 per cent of the elements of the table. Of the remaining 3364 elements of the table (stations), there were 1189 (stations) (35%) with 1-10 tickets, 684 stations with 11-50 tickets, 305 stations with 51-100 tickets. On the other extreme there were 16 stations with each 8001-10,000 and more than 10,000 tickets from any one of the origin station. Details are shown in Table 6.

Table 6
Distribution of 20x772 Destinations according to Number of Tickets issued from any of the 20 Origins

No. of Tickets Issued	No. of Destination*	% of Total	Cumulative %
1	2	3	4
0	11,071	76.6	76.6
1- 10	1,189	8.2	84.9
11- 50	684	4.7	89.6
51-100	305	2.1	91.7
101-200	274	2.0	93.7
201-400	258	1.8	95.5
401-600	150	1.0	96.5
601-800	78	0.5	97.0
801-1000	69	0.5	97.5
1001-2000	156	1.1	98.6
2001-4000	111	0.8	99.4
4001-6000	44	0.3	99.7
6001-8000	13	0.1	99.8
8001-10,000	16	0.1	99.9
10001 and above	16	0.1	100.0

* Elements of O-D matrix.

No. of origins from which traffic received

A large number of destination stations received passengers from a few origin stations as shown in table 7 which gives distribution of destination stations according to number of origin stations from which passengers were received.

Table 7
Distribution of Destination Stations according to Stations
from where passengers were received

No. of Origins Stations	No. of Destination	% of Total	Cumulative %
1	2	3	4
1	126	17.5	17.5
2- 3	292	40.4	57.9
4- 5	109	15.1	73.0
6- 7	69	9.6	82.6
8- 9	34	4.7	87.3
10-11	21	2.9	90.2
12-13	9	1.2	91.4
14-15	13	1.8	93.2
16-17	19	2.6	95.8
18-19	22	3.0	98.9
20	8	1.1	100
Total	722	100.0	

As is evident from the above, about 58 per cent of destination stations received passengers only from 1-3 selected origin stations; 90 per cent of destination stations received passengers from 11 of the selected origin stations. There were only 8 destination stations which had received passengers from all the 20 origin stations and another 22 stations received passengers from 18-19 origin stations. This indicates that a large proportion of small stations have traffic linkages with only a few stations.

The distribution of destination stations for each of the origin station is shown in table 8 which gives

number of destination stations covering tickets in different quartiles. It would be seen from this table that for 17 of the 20 origin stations, there are 1-3 destination stations in the first quartile. On the whole there are 47 stations in the first quartile, 100 in the second quartile, 216 in the third quartile and 359 in the fourth quartile.

Table 8
No. of Destinations in various quartiles of tickets issued
for 50% or more tickets issued for selected origins

Sl. No.	Origin	No. of Tkts Issued	No. of Stn in Quartile				Total No. of Stn tickets issued
			Ist	2nd	3rd	4th	
1	2	3	4	5	6	7	8
1.	Karachi	301,086	2	7	16	315	340
2.	Hyderabad	82,641	2	6	14	131	153
3.	Tando Adam	12,173	2	4	10	72	88
4.	Nawabshah	50,386	4	4	7	85	100
5.	Larkana	27,322	3	6	8	85	102
6.	Rohri	50,422	4	8	15	114	141
7.	Sukkur	37,495	1	4	12	108	125
8.	Quetta	35,704	3	3	9	183	198
9.	Khanewal	59,299	3	6	14	158	181
10.	Okara	17,143	1	4	10	103	118
11.	Lahore	300,155	5	12	28	382	427
12.	Sangla Hill	72,944	2	3	5	131	141
13.	Faisalabad	163,229	3	10	16	231	260
14.	Sargodha	78,914	2	5	7	153	167
15.	Gujranwala	30,554	1	2	5	116	132
16.	Wazirabad	55,491	3	3	9	179	184
17.	Sialkot	73,273	2	3	5	155	165
18.	Norowal	65,715	1	3	4	72	80
19.	Rawalpindi	99,747	2	6	18	149	175
20.	Peshawar	22,102	1	1	4	81	87
			47	100	216	3001	3364
			1.4%	4.4%	10.8%	89.2%	100%

Main Destinations

The main destinations from each of the selected origin stations are shown in tabular form in Annexure D.

It would be seen therefrom that Karachi has

issued tickets for 340 destinations but nearly 50 per cent of the tickets (excluding local and sub-urban traffic which accounts for 1/3rd of tickets issued from Karachi) are accounted for by 9 destinations including, in order of magnitude, Lahore, Multan, Rawalpindi, Sukkur/Rohri, Hyderabad/Kotri, Faisalabad, Quetta, Peshawar and Khanewal.

Similarly, Lahore issued tickets for 427 stations of which more than half are accounted for by 17 stations including, in order of magnitude, Karachi, Faisalabad, Norowal, Rawalpindi, Narang, Sangla Hill, Gujranwala, Baddomali, Qila Sheikhupura, Sahiwal and Hyderabad. It may be mentioned that Sangla Hill, though a small town, ranks third in terms of number of tickets issued from Lahore as there is no direct road between Lahore and Sangla Hill and rail link is shorter and faster.

In the case of Peshawar, tickets were issued for 87 destinations of which 62 per cent tickets were accounted for by 3 destinations viz. Karachi, Lahore and Rawalpindi and another 8 per cent are accounted for by Attock and Nowshera. In the case of Quetta, tickets were issued for 198 destinations. Half the tickets were accounted for by 7 destinations including Sibi, Karachi, Lahore, Jacobabad, Rawalpindi and Multan. In the case of Rawalpindi, tickets were issued for 175 destinations of which 53 per cent were accounted for by 9 stations including Karachi, Lahore, Faisalabad, Kohat, Sialkot, Sargodha, Peshawar, Gujranwala, Multan. Further details are contained in Annexure D.

Trip Length Distribution

The trip length distribution has been estimated on the basis of distances given in the Railway Time and Fare Tables. These distances may be different from the actual distances traversed by trains following different routes between the two places. For example, mail and express trains between Karachi and Peshawar follow several routes e.g. via Lahore or Faisalabad, Sargodha (Chenab Express). Similarly, between Lodhran and Khanewal, some trains use chord line and other follow the lop line traversing 45 kilometers of extra distance. The ^{distance in} /time table however, follows shorter of the two routes although most of the trains follow the longer route.

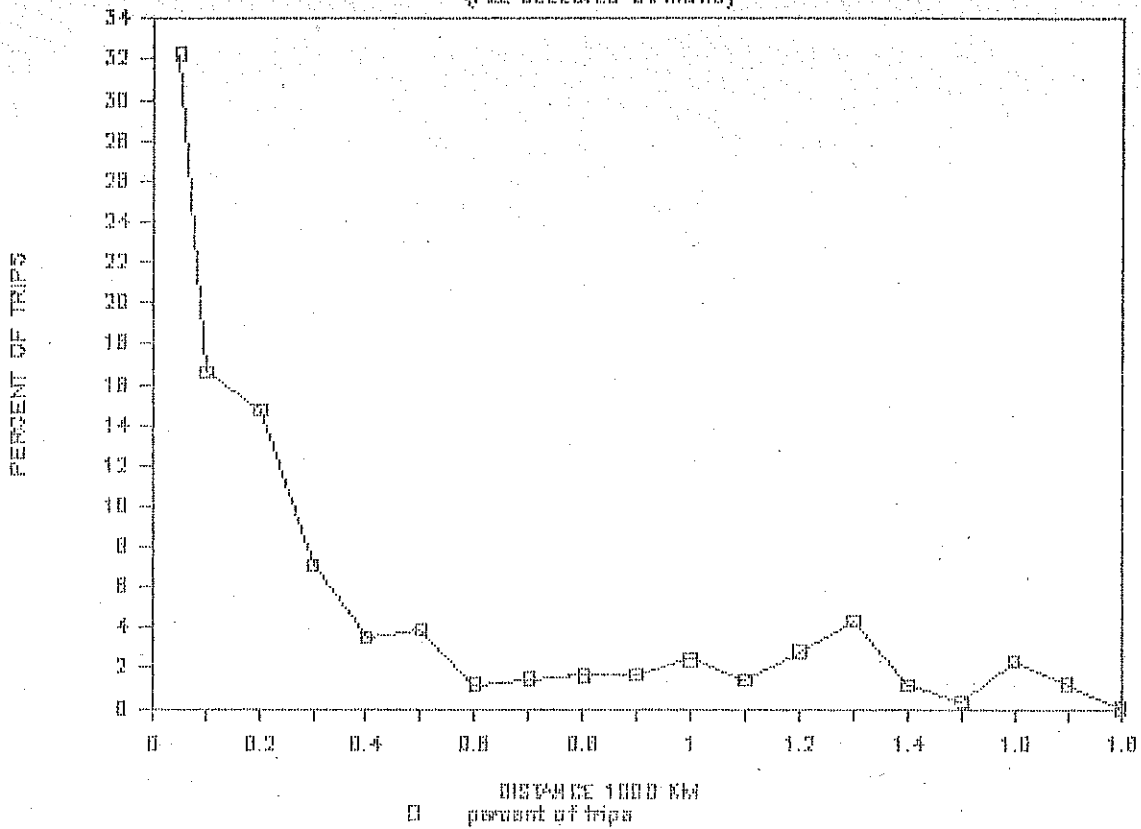
The distances from each of the origin stations to all destination stations for which traffic was observed were noted from the time and fare table and trip length distributions were calculated for each origin station using class intervals of 1-49, 50-99 and thereafter 100 kilometers upto 1800 kilometers for which traffic was observed. Adding up the rows provided trip length distribution for the total traffic. All distributions are shown in absolute numbers and in percentage terms. The results are contained in table 9 and following graphs. The distances in column 1 are less than the figures given.

- 24 -
Table 9
TRIP LENGTH DISTRIBUTION

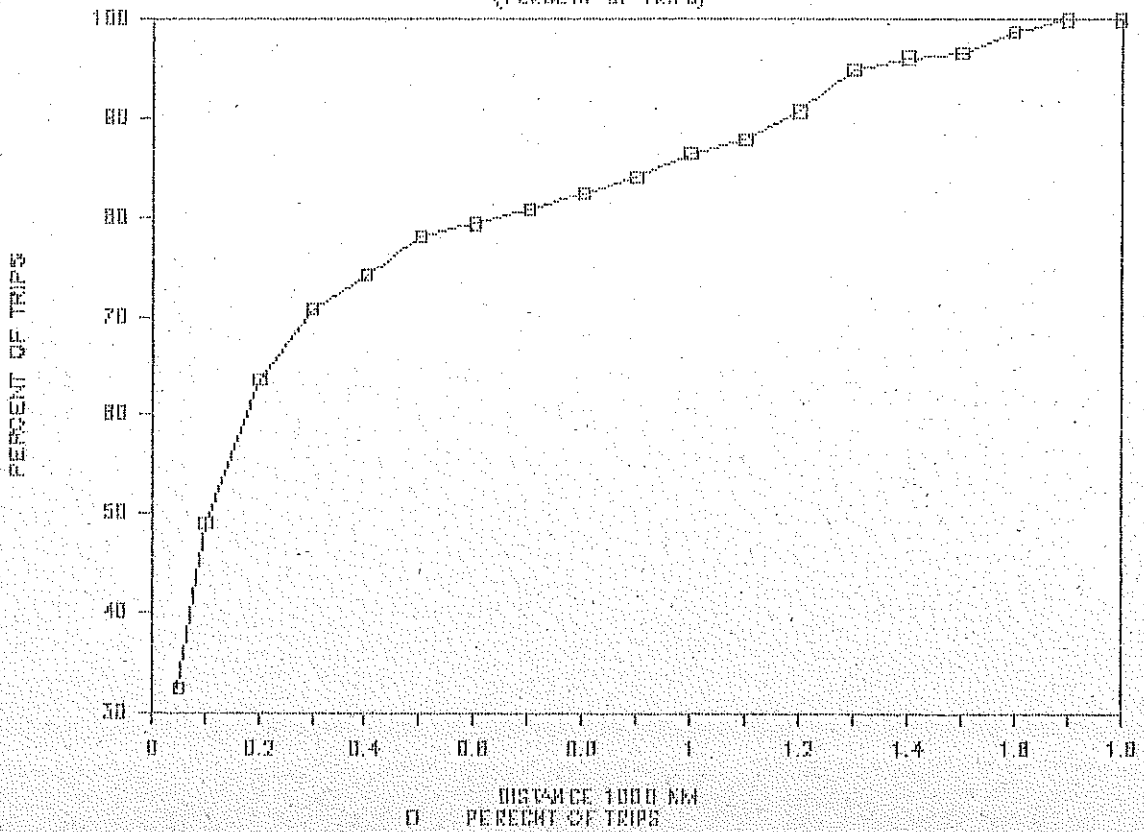
DIST	SLKOT	NRWAL	RWLPDI	PSHWR	TOTAL	PERCENT
1	18	19	20	21	22	23
< 50	51189	40152	6657	822	527823	32.27
100	5946	24052	9259	1131	271398	16.59
200	5042	703	16800	2343	241544	14.77
300	3443	120	25969	194	115493	7.06
400	218	531	8805	1471	57844	3.54
500	666	140	4011	2715	63477	3.88
600	321	4	868	281	19840	1.21
700	146	4	2721	154	24076	1.47
800	217	0	88	345	26335	1.61
900	199	0	353	48	27767	1.70
1000	83	0	25	36	39427	2.41
1100	171	0	939	81	23234	1.42
1200	466	0	29	418	45635	2.79
1300	58	0	273	1009	70368	4.30
1400	5107	9	1702	40	18675	1.14
1500	1	0	1806	1028	5531	0.34
1600	0	0	19442	677	37700	2.30
1700	0	0	0	9309	19624	1.20
1800	0	0	0	0	4	0.00
	73273	65715	99747	22102	1635795	100

	<u>Cumulative</u>					
< 50	69.86	61.10	6.67	3.72	32.27	32.27
100	8.11	36.60	9.28	5.12	16.59	48.86
200	6.88	1.07	16.84	10.60	14.77	63.62
300	4.70	0.18	26.03	0.88	7.06	70.68
400	0.30	0.81	8.83	6.66	3.54	74.22
500	0.91	0.21	4.02	12.28	3.88	78.10
600	0.44	0.01	0.87	1.27	1.21	79.31
700	0.20	0.01	2.73	0.70	1.47	80.79
800	0.30	0.00	0.09	1.56	1.61	82.40
900	0.27	0.00	0.35	0.22	1.70	84.09
1000	0.11	0.00	0.03	0.16	2.41	86.50
1100	0.23	0.00	0.94	0.37	1.42	87.92
1200	0.64	0.00	0.03	1.89	2.79	90.71
1300	0.08	0.00	0.27	4.57	4.30	95.02
1400	6.97	0.01	1.71	0.15	1.14	96.16
1500	0.00	0.00	1.81	4.65	0.34	96.50
1600	0.00	0.00	19.49	3.06	2.30	98.80
1700	0.00	0.00	0.00	42.12	1.20	100.00
1800	0.00	0.00	0.00	0.00	0.00	100
TOTAL	100	100	100	100	100	

TRIP LENGTH DISTRIBUTION (ALL SELECTED STATIONS)



TRIP LENGTH DISTRIBUTION (CUMULATIVE) (PERCENT OF TRIPS)



It would be seen from table 9 column 23 that major proportion of traffic is short haul; 1/3rd of tickets issued by selected stations are for less than 50 kilometer distances; another 17 per cent are for distances ranging from 50 to 99 kilometers and 15 per cent for distances from 100 to 199 kilometer. Thus 66.3 per cent tickets are for less than 200 kilometer distance. The distance bands 200 to 499 and 500-999 kilometer covers 14.5 and 6.0 per cent tickets respectively. The remaining 13.2 per cent tickets are for distances of 1000 kilometers and above.

The pattern is similar for individual stations with few exceptions, although variations between stations were statistically significant. The analysis of variance provided F ratio of 3.5 which is greater than critical value of $F = 2.57$ with 19,380 $\frac{\text{degrees}}{\text{of freedom}}$ at 1% significance level (Annexure E).

The distribution of tickets over various distances is not very smooth. For example, contrary to overall trend, 42 per cent of tickets from Peshawar are in distance band of 1600-1699 kilometers i.e. for Karachi. Similarly, 19.5 per cent tickets from Rawalpindi are in the 1500-1599 kilometer range, again for Karachi. There are many small humps in the curve depending upon location of important cities like Karachi, Lahore, Faisalabad, etc.

The effect of distance was further examined by regressing the number of tickets issued with distance. The results for the overall traffic are shown below.

$$Y = 218358 - 155 \text{ Distance (Km)} \dots\dots\dots r^2 = .435$$

Where

Y = No. of tickets issued (Total)

X = Distance

The r^2 is quite low implying weak effect of distance. There are perhaps strong linkages with main cities which affect the effect of distance.

The results for individual stations are given at Annexure F where it would be seen that r^2 for Karachi, Peshawar and Sangla Hill was less than 0.1; the maximum r^2 is 0.60 for Rohri station. However, the sign of the coefficient is correctly negative in all cases. It indicates the negative effect of distance but the rate of decline is not smooth over the range, obviously due to strong linkages with main cities.

Chapter IV

CONCLUSIONS AND RECOMMENDATIONS

Besides serving its immediate purpose of providing data for the National Transport Plan Study, the survey has provided, among other things, information on passenger flows from selected origins to main destinations, trip length distribution of passenger traffic originating from selected stations and analysis of a large number of small destination stations. This information would be useful in transport planning in general and scheduling of services in accordance with demand in particular. However, the results are biased in favour of the stations covered which do not include branch line stations. The survey thus presents a partial picture of passenger flows. Nevertheless, the analysis of destination stations suggests that there is imperative need for a more comprehensive survey to have a complete picture of flows over the system. Such a survey would be extremely useful for scheduling of passenger services in accordance with demand and would also be helpful in formulation of policies concerning small stations.

5805	609A	498	216	31	115	56	780	0	1233	0	324	63	16	2	0	11	11793	739	258	138	58	16348	500	
5810	KOT SALLINSHAHID	0	0	0	0	0	6	0	17	0	0	0	0	0	0	0	544	14	0	0	0	580	501	
5815	KOT ABAQAN	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	1014	33	0	0	0	1064	502	
5820	PAKKA ANNA	0	0	0	0	0	34	0	76	0	3	0	0	0	0	0	3063	79	0	0	0	3253	503	
5825	SIR SHAMIR ROAD	1	0	0	0	0	47	0	118	0	0	0	0	0	0	0	2921	44	0	0	0	3130	504	
5830	ABBASPUR	0	0	0	0	0	30	0	18	0	0	0	0	0	0	0	2099	19	0	0	0	2166	505	
5835	RESALEHALA	0	0	0	0	0	4	0	9	0	0	0	0	0	0	0	499	20	0	0	0	551	506	
5840	SANABAD	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	477	82	0	0	0	573	507	
5850	NISHATABAD	9	0	0	0	43	0	0	108	0	584	0	0	0	0	0	803	464	0	815	0	2825	508	
5855	BATTI	1	0	0	0	0	0	0	29	0	10	0	0	0	0	0	1264	79	17	0	0	1398	509	
5860	SULTAN MASAR	1	0	0	0	0	0	0	5	0	0	0	0	0	0	0	1205	28	0	0	0	1238	510	
5865	CHAK JUMRA	22	20	11	0	47	69	0	1934	2	771	145	7	0	0	0	13071	1911	142	421	1	18571	511	
5880	SALIANWALA	0	0	0	0	0	0	0	402	0	107	0	0	0	0	0	1482	550	25	0	0	2545	512	
5885	DARUL IHSAN	0	0	0	0	0	15	0	1237	0	565	0	0	0	0	1	3245	1619	37	55	21	6814	513	
5905	YAKH BALUCHAN	0	0	0	0	0	13	0	12	0	267	0	0	0	0	0	1642	6287	24	0	0	8243	514	
5910	RATTIAN	0	0	0	0	0	0	0	0	0	64	0	0	0	0	0	287	1962	0	0	0	2312	515	
5915	SUKHEE	38	0	0	0	0	89	0	1	0	1209	79	0	0	0	0	3213	4552	127	0	0	9317	516	
5920	NAUTHEH	0	0	0	0	0	0	0	4	0	136	0	0	0	0	0	247	202	0	0	16	600	517	
5925	KALEE	0	0	0	0	0	21	0	0	0	454	0	0	0	0	0	925	932	14	0	0	2349	518	
5930	MUDHAPCHAWALA	0	0	0	0	0	0	0	0	0	59	0	0	0	0	0	202	160	0	0	0	421	519	
5935	HAFIZABAD	257	79	11	0	43	338	0	0	0	4571	457	0	0	0	0	8513	5657	318	1	5	20227	520	
5940	SHAH BHATTIA	0	0	0	0	0	0	0	0	0	208	0	0	0	0	0	61	58	0	0	0	326	521	
5945	SAJUR GOLA	0	0	0	0	0	0	0	1	0	554	1	0	0	0	0	133	69	8	0	0	765	522	
5950	ALITUR CHAITTA	133	0	0	0	0	153	0	5	0	4176	145	0	0	0	0	2187	840	156	0	0	7793	523	
5955	HANJER CHAITTA	0	0	0	0	0	0	0	2	0	932	0	0	0	0	0	74	12	16	0	0	1035	524	
5960	JAMKE CHAITTA	0	0	0	0	0	14	0	3	0	1328	0	0	0	0	0	385	144	14	0	0	1887	525	
5965	DHAROWAL KANG	0	0	0	0	0	0	0	1	0	1159	0	0	0	0	0	0	6	0	0	0	1178	526	
5970	MANSOORWALI	0	0	0	0	0	18	0	0	0	4871	0	0	0	0	0	261	98	14	0	0	5262	527	
5975	HADALA CHEEMA	0	0	0	0	0	0	0	0	0	522	0	0	0	0	0	20	0	0	0	0	541	528	
6005	BHAKKA MITTAR	0	0	0	0	0	0	0	0	0	621	0	0	0	0	0	0	0	87	0	0	708	529	
6010	SODHRA KEPRA	0	0	0	0	0	0	0	0	0	838	0	0	0	0	0	0	0	348	0	0	1186	530	
6015	BEGOWAL GHARTAL	0	0	0	0	0	0	0	1	0	487	0	0	0	0	0	4	6	1037	0	29	1563	531	
6020	SHIBTAL	62	0	0	0	0	30	0	348	66	731	79	0	0	0	1	224	71	9726	5	153	11494	532	
6025	SOMWAL	0	0	0	0	0	0	0	16	0	203	0	0	0	0	0	19	7	1840	0	28	2112	533	
6030	UGOKE	14	0	0	0	0	0	0	40	19	1823	0	0	0	0	0	45	5	5976	3	39	7963	534	
6055	SUCHETGARH	10	0	0	0	0	0	0	3	3	16	0	0	0	0	0	0	3	1	0	0	34	535	
6155	KHANDRA	0	0	0	0	0	73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	536	
6120	MARYAM	0	0	0	0	0	150	0	1	0	0	0	0	0	0	0	0	0	0	69	0	230	537	
6125	RUSTAM SARGANA	0	0	0	0	0	48	0	0	0	0	0	0	0	0	0	0	0	0	1	8	57	538	
6130	GILWALA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	539	
6135	MUDDUKI	0	0	0	0	0	82	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	540
6140	JHANG	44	1	2	0	0	372	0	17	0	0	10	0	0	0	0	0	0	0	0	17	108	541	
6150	THATTI MAHLA	0	0	0	0	0	0	0	0	0	0	799	0	0	0	5	0	0	0	1095	0	2333	542	
6165	CHAND	1	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	543	
6170	SHAH JEVAN	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	52	0	61	543	
6175	SHAH NIKDAR	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	436	0	471	544	
6185	SOBHAGA	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	1525	0	1555	545	
6190	HAFIZABAD	0	0	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0	1194	0	1218	546	
6195	HAFIZANWALA	28	0	0	0	0	0	0	0	1	9	0	0	0	0	0	0	0	0	497	0	534	547	
6197	KHALIDABAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	497	0	497	548	
6200	SILLANWALI	2	0	0	0	0	229	0	30	0	0	6	0	0	0	0	0	0	0	139	0	146	549	
6205	MAGUANA	0	0	0	0	0	0	0	1	0	0	85	0	0	1	3	0	0	2	2012	0	2363	550	
6210	ALPANA	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	327	0	328	551	
6215	SHAHINABAD	2	0	0	0	0	35	0	31	0	0	33	0	0	0	0	0	0	0	1775	0	1796	552	
6220	PINDI RASUL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	0	0	4429	0	4554	553	
6235	CHARWALI	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94	10	0	6254	0	6357	554	
																	67			3958	0	4027	555	

Table with columns: S.NO., SECTION, KARACHI, HYD.ABD, TAND. ADM, MBD, SHAH, ROHRI, KHAYWAL, OKARA, LAHORE, G'WALA, MAZ'ABD, AM'INDI, PESHAW, LARKANA, SUKUR, QUETTA, F'ABAD, S'HILL, SL'YOT, SOGHA, NR'WAL, TOTAL. Rows 1-81 include station names like KARACHI, HYDERABAD, TANDODAN, etc.

TOTAL ... 391036 62641 12173 50438 50430 59313 17414 300155 30522 55490 59747 22102 27322 33495 35712 162029 72544 73273 78514 65715 1636152

RATIO OF TICKETS ISSUED TO POPULATION
OF SELECTED CITIES

S NO	STATION	TICKETS	POPUL.	C/D*100
a	b	c	d	e
1.	KARACHI	301086	5208132	5.78
2.	HYDERABAD	82641	751529	11.00
3.	TANDODAM	12173	62744	19.40
4.	NAWABSHAH	50438	102139	49.38
5.	ROHRI/SKKR	87925	221883	39.63
6.	KHANEWAL	59313	89090	66.58
7.	OKARA	17414	153483	11.35
8.	LAHORE	300155	2952689	10.17
9.	GUJRANWALA	30562	658753	4.64
10.	WAZIRABAD	55490	62725	88.47
11.	RAWALPINDI	99747	794843	12.55
12.	PESHAWAR	22102	566248	3.90
13.	LARKANA	27322	123890	22.05
14.	QUETTA	35712	285719	12.50
15.	FAISALABAD	163229	1104902	14.77
16.	SANGLA HILL	72944	33771	216.00
17.	SIALKOT	73273	302009	24.26
18.	SARGODHA	78914	291362	27.08
19.	NOROWAL	65715	35125	187.09
TOTAL		1636155	13801036	11.86

Regression Output:

Constant	43551.53
Std Err of Y Est	37928.42
R Squared	0.804787
No. of Observations	19
Degrees of Freedom	17
X Coefficient(s)	0.058595
Std Err of Coef.	0.006999

Main Flows

S.No.	Origin/ No. of Tkts	Main Destination and No(%) of Tickets			
1	2	3			
1.	<u>Karachi</u> 202,095	1. Lahore	35,361 (17.5%)	6. Faisalabad	8,897 (4.4%)
		2. Multan	15,909 (7.9%)	7. Quetta	7,761 (3.8%)
		3. Rawalpindi	13,877 (6.9%)	8. Peshawar	5,846 (2.9%)
		4. Rohri/Sukkur	12,280 (6.1%)	9. Total	111,855 (55%)
		5. Hyd/Kotri	11,924 (5.9%)		
2.	<u>Hyderabad</u> 82,641	1. Mirpur Khas	9,996 (12.10%)	6. Multan	2,932 (3.55%)
		2. Karachi	9,447 (11.43%)	7. Nawabshah	2,786 (3.37%)
		3. Lahore	6,194 (7.50%)	8. Kotri	2,596 (3.14%)
		4. Rohri	4,209 (5.09%)	9. Tando Adam	2,356 (2.85%)
		5. Tandojam	3,077 (3.72%)	10. Total	43,593 (52.75%)
3.	<u>Tando Adam</u> 12,173	1. Nawabshah	2,251 (18.49%)	5. Bhiria Road	442 (3.36%)
		2. Rohri/Sukkur	1,418 (11.65%)	6. Mehrabpur	419 (3.44%)
		3. Hyderabad	1,160 (9.53%)	7. Total	6,491 (53.32%)
		4. Karachi	801 (6.58%)		
4.	<u>Nawabshah</u> 50,438	1. Shadadpur	3,915 (7.76%)	7. Kot Lalu	2,998 (5.94%)
		2. Sarhari	3,668 (7.27%)	8. Tando Adam	2,795 (5.54%)
		3. Padidan	3,608 (7.15%)	9. Karachi	2,376 (4.71%)
		4. Daur	3,349 (6.64%)	10. Hyderabad	1,856 (3.68%)
		5. Rohri	3,310 (6.56%)	11. Total	31,014 (61.49%)
		6. Bhiria Road	3,139 (6.22%)		
5.	<u>Rohri & Sukkur</u> 83,730	1. Karachi	12,649 (15.11%)	7. Shahnawaz	3,406 (4.07%)
		2. Hyderabad	5,021 (6.00%)	8. Sehwan	2,360 (2.82%)
		3. Lahore	4,065 (4.85%)	9. Khanpur	2,350 (2.81%)
		4. Nawabshah	3,689 (4.41%)	10. Rahim Yar	2,045 (2.44%)
		5. Quetta	3,621 (4.32%)	11. Larkana	2,032 (2.43%)
		6. Jacobabad	3,434 (4.10%)	12. Total	44,872 (53.59%)
6.	<u>Larkana</u> 27,322	1. Sind University	2,602 (9.58%)	6. Sukkur	1,154 (4.22%)
		2. Mashori Sharif	2,220 (8.12%)	7. Rehman Nagar	1,092 (3.97%)
		3. Radhain	1,940 (7.10%)	8. Badupur	1,039 (3.80%)
		4. Karachi	1,917 (7.02%)	9. Quetta	1,020 (3.73%)
		5. Dadu	1,224 (4.48%)	10. Total	14,190 (51.94%)
7.	<u>Quetta</u> 35,704	1. Sibi	3,759 (10.53%)	6. Rawalpindi	1,734 (4.86%)
		2. Karachi	3,577 (10.02%)	7. Multan	1,388 (3.89%)
		3. Lahore	3,473 (10.00%)	8. Dadu	1,210 (3.39%)
		4. Jacobabad	3,102 (8.69%)	9. Total	20,402 (57.14%)
		5. Jangshahi	2,159 (6.05%)		
8.	<u>Khanewal</u> 59,299	1. Karachi	5,982 (10.09%)	7. Faisalabad	1,994 (3.36%)
		2. Multan	5,161 (8.70%)	8. Lahore	1,948 (3.29%)
		3. Kot Abbas Shah	4,322 (7.29%)	9. Dunya Pur	1,933 (3.26%)
		4. Shorkot Cant	3,386 (5.71%)	10. Riazabad	1,527 (2.58%)
		5. Mukhdumpur	3,205 (5.40%)	11. Total	32,127 (54.18%)
		6. Shamkot	2,669 (4.50%)		

Main Flows

S.No.	Origin/ No. of Tkts	Main Destination and No (%) of Tickets			
1	2	3			
9.	<u>Okara</u> 17,143	1. Lahore	4,870 (28.41%)	5. Sahiwal	737 (4.30%)
		2. Kot Radha	1,261 (7.36%)	6. Pattoki	684 (3.99%)
		3. Raiwind	1,166 (6.80%)	7. Karachi	634 (3.70%)
		4. Multan	813 (4.74%)	8. Total	10,165 (59.30%)
10.	<u>Lahore</u> 300,155	1. Karachi	23,923 (7.97%)	8. Baddomali	6,437 (2.14%)
		2. Faisalabad	15,491 (5.16%)	9. Sheikhpura	6,103 (2.03%)
		3. Norowal	15,225 (5.07%)	10. Sahiwal	6,032 (2.01%)
		4. Rawalpindi	9,780 (3.26%)	11. Hyderabad	5,977 (1.99%)
		5. Narang	9,025 (3.01%)	12. Dadu	5,769 (1.92%)
		6. Sangla Hill	8,772 (2.92%)	13. Total	120,997 (40.31%)
		7. Guj'wala	8,463 (2.82%)		
11.	<u>Faisalabad</u> 163,229	1. Chak Jhomra	13,071 (8.01%)	6. Lahore	9,051 (5.54%)
		2. Karachi	12,802 (7.84%)	7. Hafizabad	8,513 (5.22%)
		3. Gojra	11,793 (7.22%)	8. Multan	5,535 (3.39%)
		4. Sangla Hill	11,273 (6.91%)	9. R'Pindi	4,315 (2.64%)
		5. T.T.Singh	9,140 (5.60%)	10. Total	85,493 (52.38%)
12.	<u>Sargodha</u> 78,914	1. Pindi Rasul	6,254 (7.92%)	7. M. B. Din	3,780 (4.79%)
		2. Karachi	5,606 (7.10%)	8. Shahinabad	3,175 (4.02%)
		3. Lalamusa	4,823 (6.11%)	9. Phularwan	2,994 (3.79%)
		4. Shahinabad	4,429 (5.61%)	10. Bhalwal	2,578 (3.27%)
		5. Charnali	3,958 (5.01%)	11. R'Pindi	2,159 (2.74%)
		6. Malakwal	3,882 (4.92%)	12. Total	43,635 (55.28%)
13.	<u>Sangla Hill</u> 72,944	1. F'abad	11,639 (15.96%)	5. Hafizabad	5,657 (7.76%)
		2. Lahore	8,582 (11.77%)	6. Sukheke	4,552 (6.24%)
		3. Mahr Balucha	6,287 (8.62%)	7. Total	42,748 (58.60%)
		4. Sheikhpura	6,032 (8.27%)		
14.	<u>Gujranwala</u> 30,554	1. Lahore	10,072 (32.96%)	4. Wazirabad	2,243 (7.34%)
		2. R'pindi	3,376 (11.05%)	5. Multan	1,639 (5.36%)
		3. Karachi	2,956 (9.67%)	6. Total	20,286 (66.39%)
15.	<u>Wazirabad</u> 55,490	1. Mansoorwali	4,871 (8.78%)	6. Gujranwala	4,006 (7.22%)
		2. Sialkot	4,661 (8.40%)	7. Faisalabad	2,541 (4.58%)
		3. Hafizabad	4,571 (8.24%)	8. Karachi	1,961 (3.53%)
		4. Lahore	4,392 (7.91%)	9. Sangla Hill	1,898 (3.42%)
		5. Alipur Chatta	4,176 (7.52%)	10. Total	33,075 (59.60%)
16.	<u>Sialkot</u> 73,273	1. Sambrial	9,726 (13.27%)	5. Wazirabad	5,431 (7.41%)
		2. Chawinda	7,465 (10.19%)	6. Karachi	5,106 (6.97%)
		3. Gunna Kalan	6,318 (8.62%)	7. Total	40,021 (54.62%)
		4. Ugoke	5,976 (8.16%)		

Main Flows

S.No.	Origin/ No. of Tkets	Main Destination and No (%) of Tickets			
1.	2.	3.			
17.	<u>Norowal</u> 65,715	1. Lahore	15,805 (24.05%)	5. Pejawali	4,182 (6.36%)
		2. Raya Khas	6,780 (10.32%)	6. Sialkot	3,930 (5.98%)
		3. Daud	6,432 (9.79%)	7. Total	41,519 (63.18%)
		4. Baddomalli	4,391 (6.68%)		
18.	<u>Rawalpindi</u> 99,747	1. Karachi	19,443 (19.49%)	7. Peshawar	2,550 (2.56%)
		2. Lahore	14,599 (14.64%)	8. Guj'wala	2,392 (2.40%)
		3. F'abad	3,588 (3.60%)	9. Multan	2,248 (2.25%)
		4. Kohat	2,936 (2.94%)	10. Havelian	2,165 (2.17%)
		5. Sialkot	2,877 (2.88%)	11. Haripur Hazara	2,125 (2.13%)
		6. Sargodha	2,682 (2.69%)	12. Total	55,480 (55.62%)
19.	<u>Peshawar</u> 22,102	1. Karachi	9,299 (42.07%)	6. Sukkur	999 (4.52%)
		2. Lahore	2,267 (10.26%)	7. Gujranwala	707 (3.20%)
		3. Rawalpindi	2,088 (9.45%)	8. Quetta	658 (3.00%)
		4. Attock	1,090 (4.93%)	9. Total	18,107 (81.92%)
		5. Hyderabad	999 (4.52%)		

Analysis of Variance of Trip Length Distribution

Source	s.s.	d.f.	m.s.	v.r.
Variations between stations	7,164	19	377	3.5
Variations within stations	38,625	361	107	
Total variations	45,789	380		

Analysis of variance of Trip length Distribution
(Ignoring blank columns)

Source	s.s.	d.f.	m.s.	v.r.
Variations between stations	8,266	19	435	3.3
Variations within stations	35,771	273	131	
Total variation	44,037	292		

Results of Regression Analysis
No. of Tickets as a function of Distance

S.No.	Station	Constant a	Coefficient b	r ²
1	2	3	4	5
1.	Karachi	27,245	-13.326	0.085
2.	Hyderabad	11,851	-9.4667	0.522
3.	Tando Adam	2,403	-2.5249	0.368
4.	Nawabshah	9,149	-8.8169	0.584
5.	Larkana	5,326	-5.3371	0.575
6.	Rohri	7,715	-6.7824	0.603
7.	Sukkur	6,096	-5.6288	0.499
8.	Quetta	2,582	-0.6367	0.039
9.	Khanewal	11,450	-12.803	0.409
10.	Okara	3,139	-3.2653	0.449
11.	Lahore	49,579	-46.347	0.479
12.	Sangla Hill	17,172	-20.730	0.398
13.	Faisalabad	30,176	-31.593	0.456
14.	Sargodha	17,525	-17.312	0.395
15.	Gujranwala	4,854	-4.4010	0.305
16.	Wazirabad	10,366	-10.151	0.388
17.	Sialkot	13,170	-12.164	0.202
18.	Norowal	23,262	-48.156	0.505
19.	Rawalpindi	10,019	-5.4925	0.120
20.	Peshawar	402	-1.0258	0.062
Total		218,358	-154.64	0.435