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*Islamic Republic of Pakistan*

**COMPREHENSIVE STUDY  
ON  
TRANSPORTATION SYSTEM IN LAHORE**

**FINAL REPORT**

**MAIN VOLUME**

*October 1991*

*Japan International Cooperation Agency*

国際協力事業団

23074

## P R E F A C E

In response to a request from the Government of the Islamic Republic of Pakistan, the Japanese Government decided to conduct the Comprehensive Study on Transportation System in Lahore and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Pakistan a study team headed by Mr. Osamu Ohtsu, ALMEC Co., Ltd., three times between July, 1990 and September, 1991.

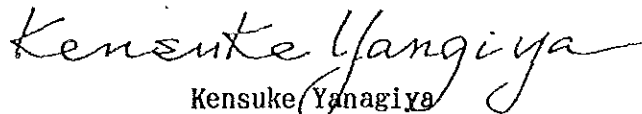
The team held a series of discussions with the officials concerned of the Government of Pakistan, and conducted various field surveys at the study area.

After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Islamic Republic of Pakistan for their close cooperation extended to the team.

October 1991

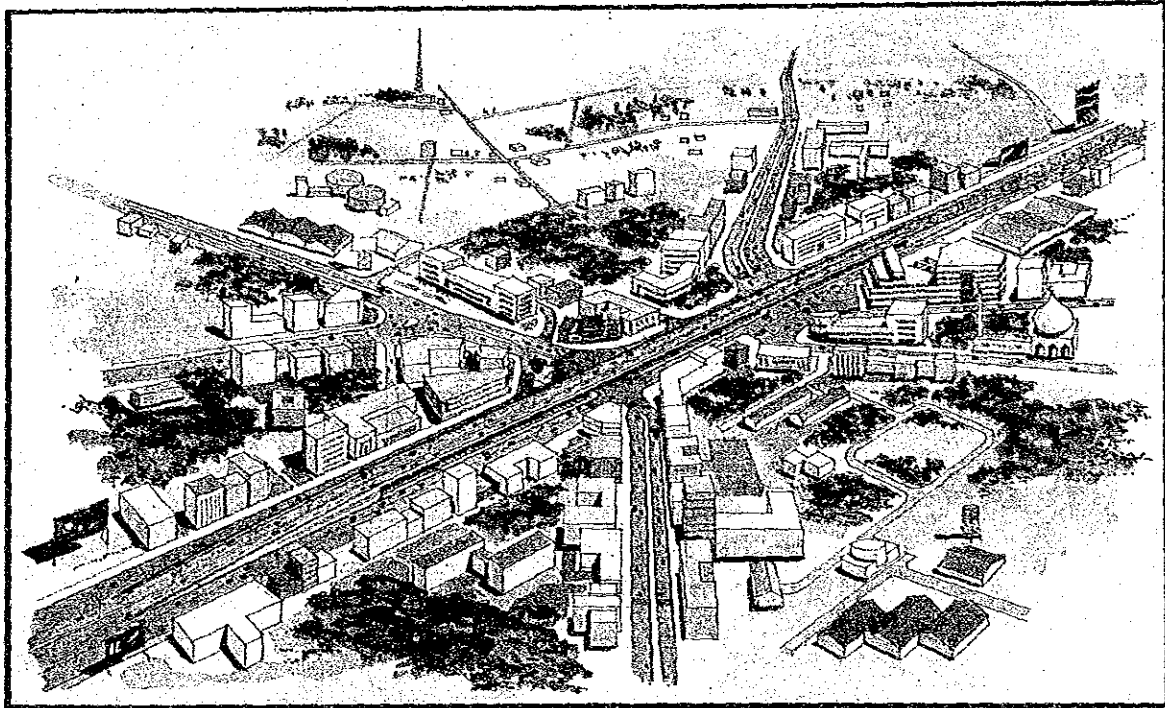


Kensuke Yanagiya  
President

Japan International Cooperation Agency





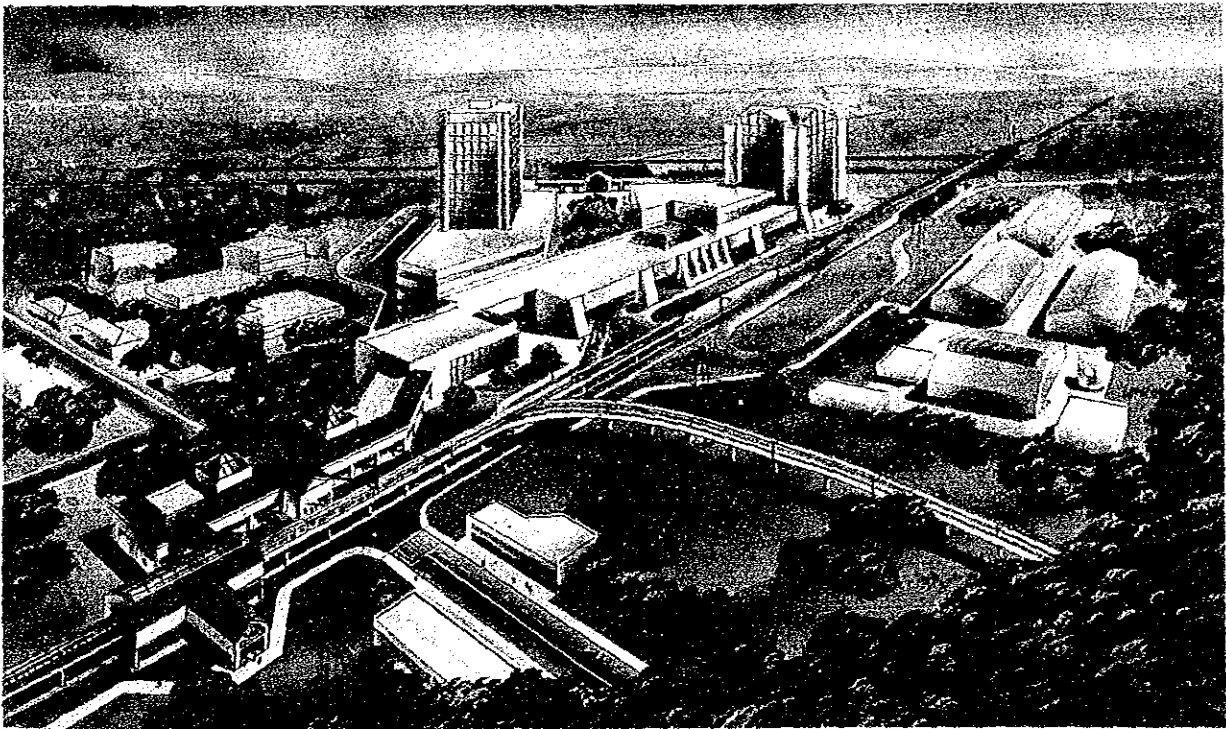


FLYOVER AT QURTABA CHOWK





LRT ALONG THE MALL



MODE INTERCHANGE AREA, MODEL TOWN SOUTH



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# **INTRODUCTION**



## INTRODUCTION

### Study Objectives

The Comprehensive Study on Transportation System in Lahore (CSTS-L, JICA) was commissioned in accordance with the Scope of Work agreed upon by both the Islamic Republic of Pakistan and Japan in October 1989.

The Study commenced in July 1990 with following main objectives;

- (1) To formulate, in the first phase, a Master Plan to solve the urban transportation problems in the Lahore Metropolitan Area.  
The target year was set at the year 2010, with an intermediate stage at the year 2000.
- (2) To conduct, in the second phase, a Feasibility Study on a selected mass transit project and any other selected projects.

### Outline of the Study

The Inception Report was submitted at the commencement of the Study in the middle of July 1990, and Phase I study was conducted both in Pakistan and in Japan as shown in the Work Flow.

The Interim Report, summarizing the interim findings and results of the Phase I study (up to the middle of sub-phase three) undertaken between July 1990 and January 1991, was submitted prior to the sub-phase four.

In accordance with the discussion in the Steering Committee on the Interim Report, the following projects were selected as the theme for Phase II study.

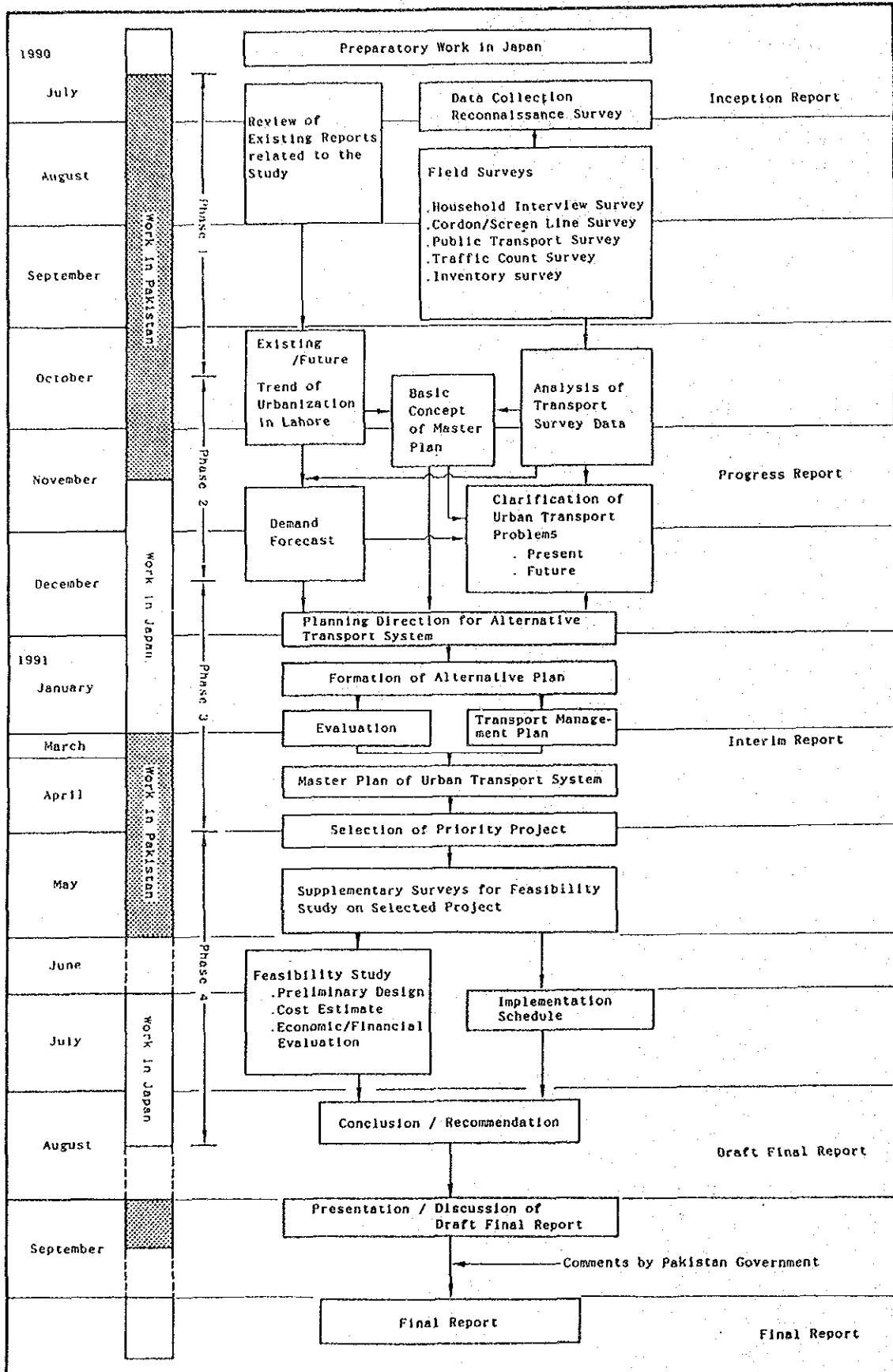
#### 1. For feasibility studies

- An intersection improvement project, including a flyover construction
- An introduction of Mass Transit System along major transport corridor as a long-term project

#### 2. For further detailed consideration

- Alignment and outline of structure of New Ravi River Bridges
- PR improvement for urban transport
- Bus service improvement measures
- Traffic management measures
- Mode interchange area development

Figure I.1 Overall Work Flow of the Study



Phase II study was carried out also in Pakistan and Japan from April, 1990 to August, 1991. The Draft Final Report which presented the entire results of the Study, including the conclusion and recommendation of Feasibility Study, was submitted to the Pakistan Government in August 1991.

The Steering Committee composed of key personnel from the relevant agencies was held in order to discuss the report in September, 1991.

The comments on the report from Pakistan Side were carefully studied, and they were considered in finalizing the Report.

The major items which have been carried out in the course of the Study are;

- 1) Discussions of Inception Report (July 1990), Progress Report (November 1990), Interim Report (May 1991) and Draft Final Report (September 1991).
- 2) Conduct of studies covering:
  - i) Review of existing reports and data related to the study
  - ii) Transport surveys including "person trip survey", public transport survey, traffic count survey and others
  - iii) Data processing of the results of various surveys and analysis of these data
  - iv) Forecast of future traffic demand in accordance with socio-economic prospects and future urban development pattern
  - v) Identification of present and future urban transport problems and establishment of planning direction for future urban transport
  - vi) Formulation of alternative plans
  - vii) Preliminary evaluation and selection of a suitable urban transport system including a mass transit system
  - viii) Discussion with counterparts on selection of priority projects
  - ix) Feasibility study on intersection improvement and LRT introduction
  - x) Other detailed studies on some specific theme
- 3) Conduct close communication between the LDA (TEPA) and the JICA study team throughout the period of the study, and possible technical transfer to the counterparts especially during the study in Pakistan.
- 4) Holding of JICA Advisory Committee meetings to discuss the progress and issues of the study.

A total of eight meetings were held in Tokyo on 10 July, 14

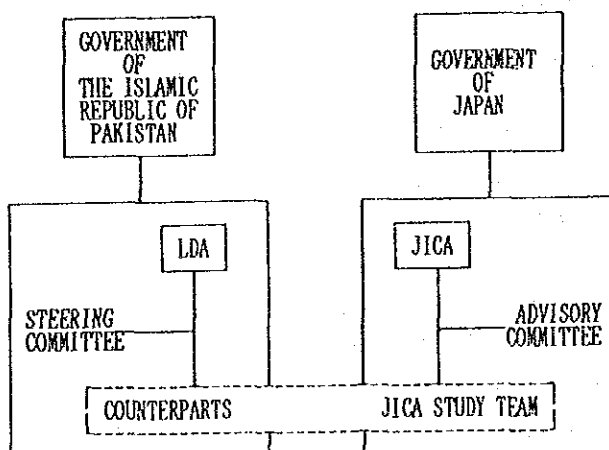
September, 12 October, 20 November 1990, 21 January, 24 May, 24 July and 1 October 1991.

- 5) Preparation of Final Report which summarizes the entire result of the Study including the conclusion and recommendation of the feasibility study, taking into consideration the LDA's comments on the Draft Final Report.

### Study Organization

The study was carried out by the JICA Study Team in close cooperation with the authorities concerned of the Government of Pakistan. The overall organization frame is shown below.

Figure I.2 Study Organization



#### 1) JICA Study Team

The member of the Study Team is listed in Table I.1.

Table I.1 Study Team Members

Assignment	Name
1. Team Leader	Mr. Osamu OHTSU
2. Transport/City Planning	Mr. Masato KOTOH
3. Transport Survey/Analysis	Mr. Hideaki ITABASHI
4. Transport Survey (1)	Mr. Yoichi ENOKIDO
5. Transport Survey (2)	Mr. Ken KUMAZAWA
6. Demand Forecast	Mr. Naoshi OKAMURA
7. Public Transport Planning	Mr. Teruhiko HORIE
8. Traffic Management	Mr. James M. McBRIDE
9. Transport Facility Planning	Mr. Masanao KOYAMA
10. Facility Design/Cost Estimate	Mr. Hiroshi YAJIMA
11. Economic/Financial Analysis	Mr. Daihachiro KAMIMURA

## 2) JICA Advisory Committee

JICA set up the Advisory Committee to give appropriate advice in the process of the Study. The members of the Advisory Committee are;

Table I.2 Advisory Committee Members

Assignment	Name	
Chairman	Dr. Shigeru Morichi	Professor, Tokyo Institute of Technology
Member (Road Transport)	Mr. Kazuhisa Fujisaki	Ministry of Construction (- March 1991)
Member (City Planning/ Demand Forecast)	Mr. Mizuo Kishita	Japan Regional Development/ Ministry of Construction
Member (Public Transport)	Mr. Yosuke Wakabayashi	Ministry of Transport (- March 1991)
Member (Public Transport)	Mr. Tetsuya Uzawa	Ministry of Transport (April 1991 -)

## 3) Counterpart

Lahore Development Authority (LDA) acted as the counterpart agency to the JICA Study Team and the key staff of counterpart team was as follows:

Table I.3 Counterparts

Name	
1. Mr. Khushal Khan	Chief Traffic Engineer, TEPA-LDA
2. Mr. Masud Ahmad Qazi	Director Study, TEPA-LDA
3. Mr. Mohammad Sarwar Rana	Deputy Director Eco/Study, TEPA-LDA





**CHAPTER 1. PRESENT URBAN STRUCTURE  
OF THE STUDY AREA**



## CHAPTER 1 PRESENT URBAN STRUCTURE OF THE STUDY AREA

### 1.1 OVERVIEW OF LAHORE METROPOLITAN AREA (LMA)

Lahore, the capital of the Punjab, in northeastern Pakistan, and is the nation's second largest city with 5.4 million inhabitants.

The boundary of the Lahore Metropolitan Area (LMA) is roughly triangular, with 50 km sides centered on the Walled City. Recent, residential growth towards the southwest has prompted the Lahore Development Authority (LDA) make plans to change the boundary. The CSTS-L JICA study area, therefore, includes the area southwest of the new LMA, as shown in Figure 1.1.2.

The study area covers approximately 2,250 sq. km with the expanded area which is 31% of the total. The area is mostly agriculture land, with numerous villages and small factories distributed along Multan Road.

The administrative area of the LMA comprises Lahore, Chunian, Kasur, and Ferozewala Tehsils. (refer to Figure 1.1.1.)

Figure 1.1.1 Lahore Metropolitan Area (LMA) and its Boundary

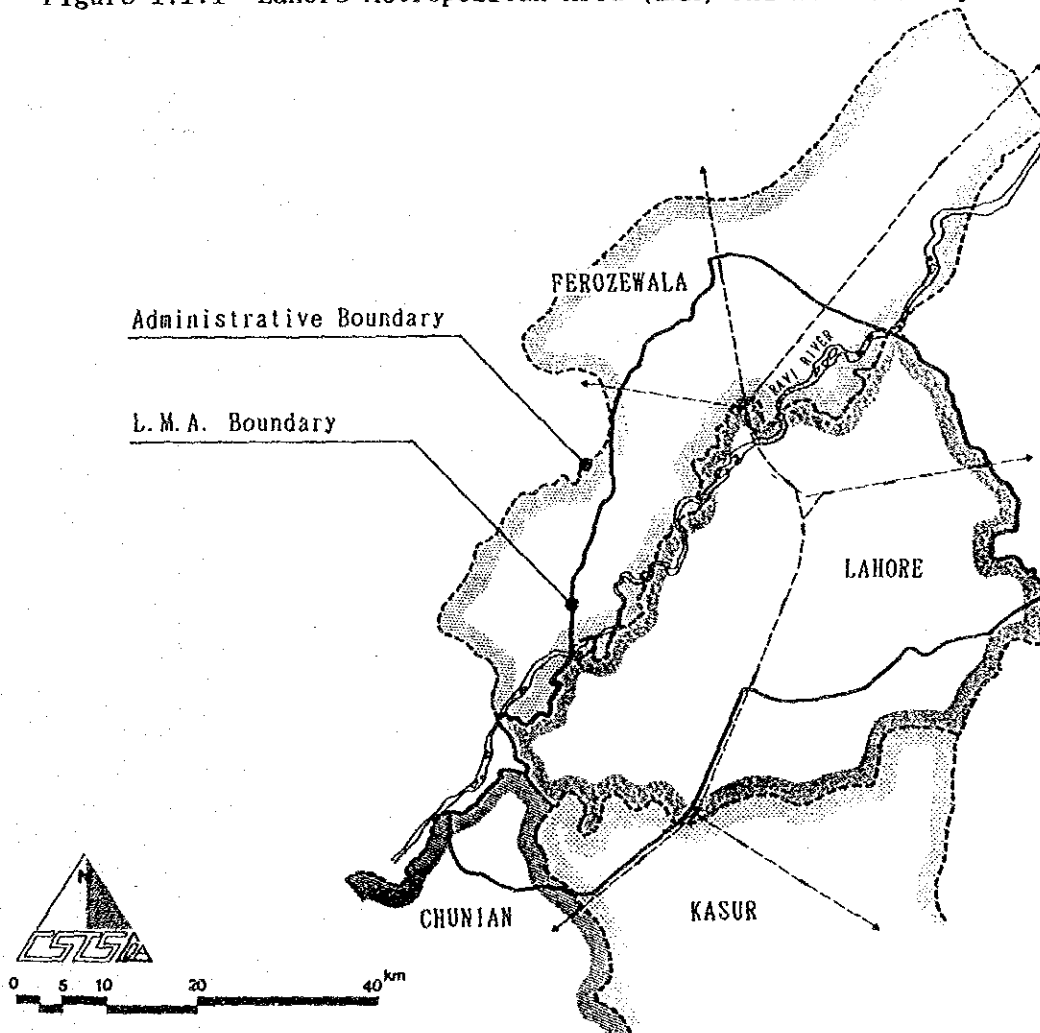
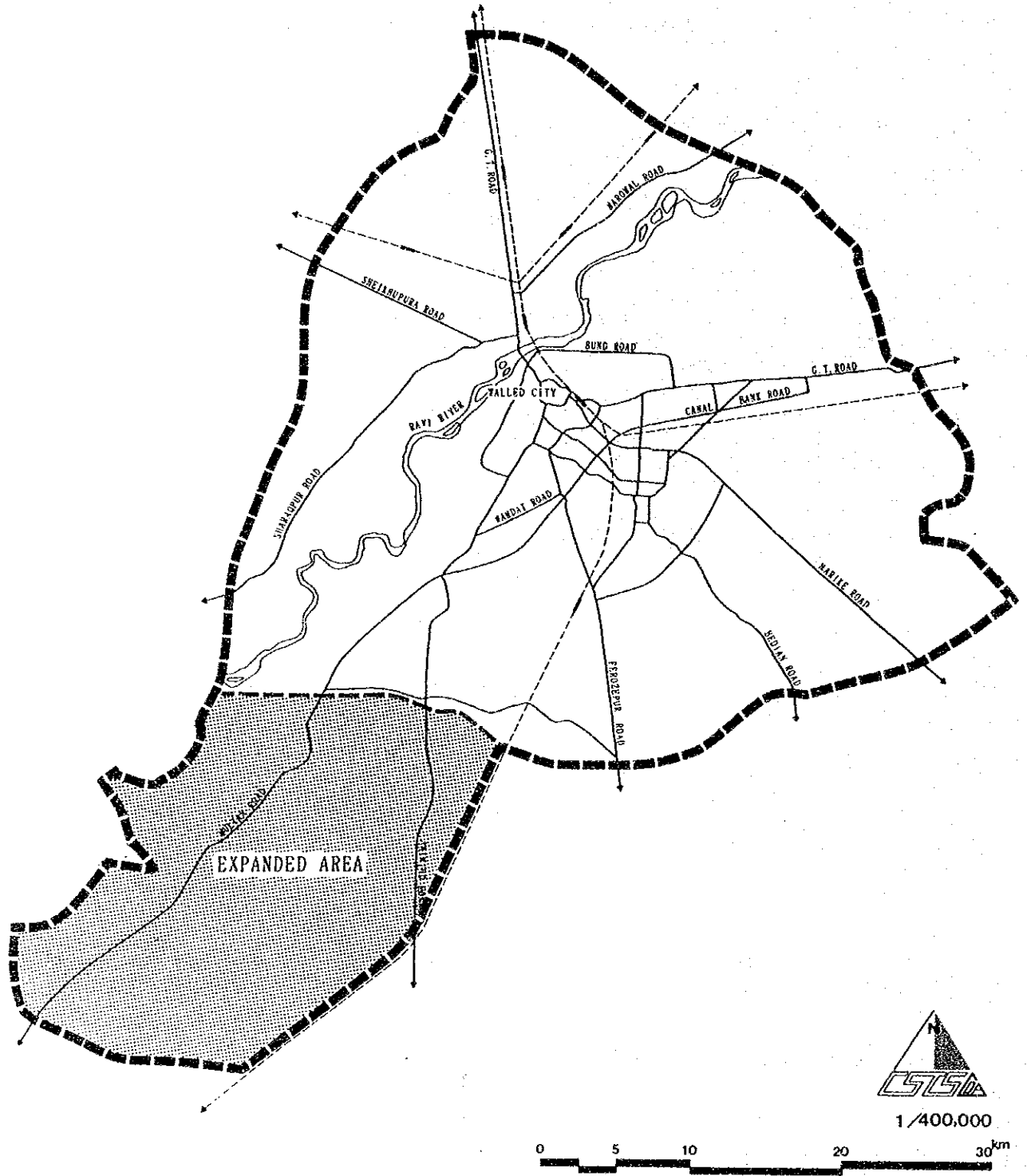


Figure 1.1.2 The Study Area (LMA)



## 1.2 SOCIOECONOMIC CHARACTERISTICS

### 1.2.1 Population

The population of the Lahore district, which includes the expanded LMA and surround rural areas, in 1990 is estimated as 5.0 million, its 1951 population of 1.1 million. The population has increased over fourfold in these four decades. Total population of the Lahore District represents about 8.1% of the total 1990 population of the Punjab, estimated at 61.0 million. Table 1.2.1 shows the changes in population.

The population density in Lahore District is 2,800 people/sq.km and can be compared with 300 people/sq.km in Punjab.

Figure 1.2.1 shows the age and sex distribution of the population in Lahore District. The overall population of males represents 54% of the total.

Table 1.2.1 Population Trends, Punjab and Lahore District

YEARS	PUNJAB		LAHORE	
	POPULATION (000)	POP. DENSITY (PERSON/km <sup>2</sup> )	POPULATION (000)	POP. DENSITY (PERSON/km <sup>2</sup> )
1951	20,541	100	1,135	640
1961	25,464	124	1,626	918
1972	37,607	183	2,588	1,460
1981	47,294	230	3,545	2,001
1990	60,898	297	4,955	2,796

SOURCE: DENSITY CALCULATED FROM '1981 POPULATION CENSUS OF PAKISTAN' DATA

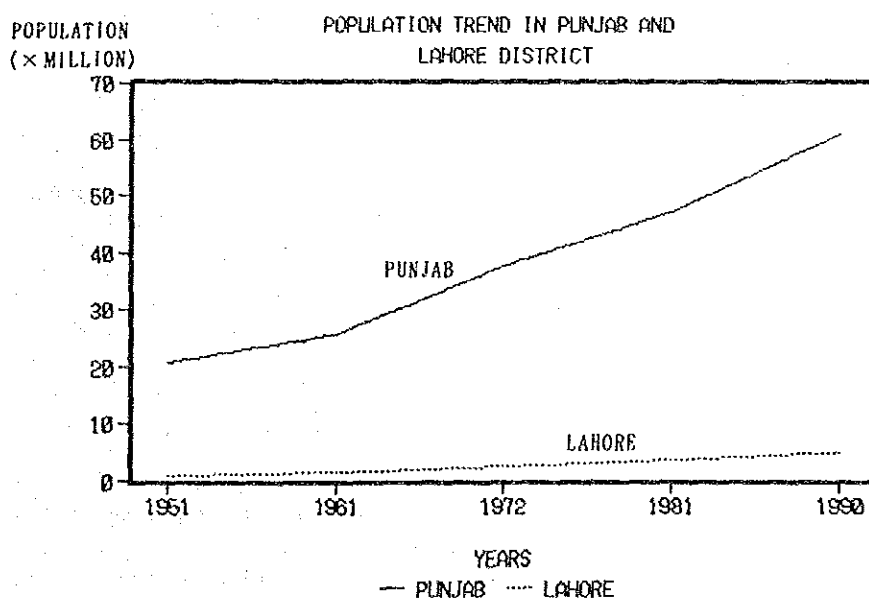
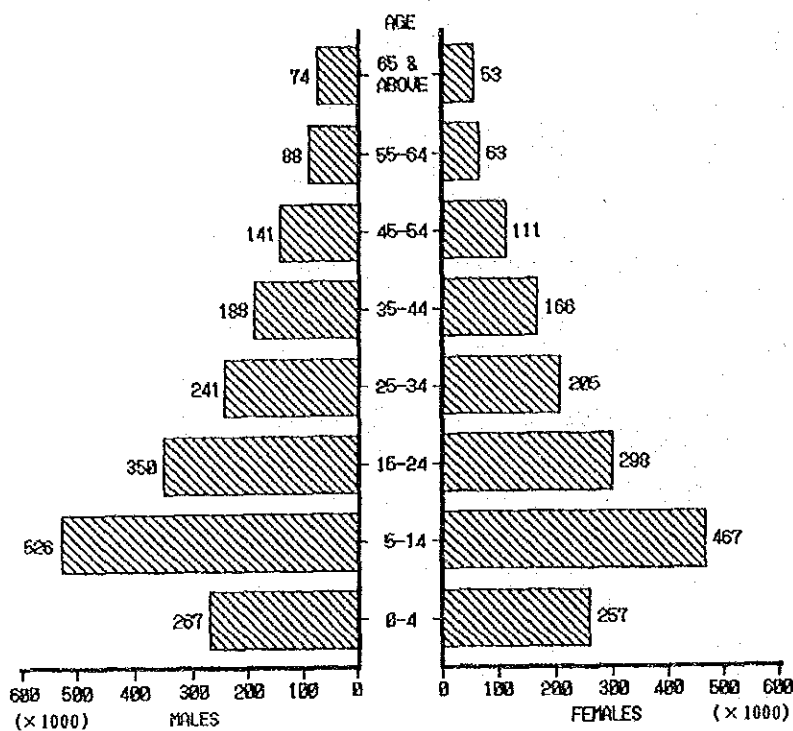


Figure 1.2.1 Age Distribution by Sex, Lahore District



### 1.2.2 Industry

In 1987, the number of registered factories in Lahore District was 1,020 and the total employment was 72,000. About one fourth of all the factories in Punjab concentrates in Lahore District.

Table 1.2.2 Registered Factories and Employment, Punjab and Lahore District

REGION	1985		1986		1987	
	NO.	EMP. (000)	NO.	EMP. (000)	NO.	EMP. (000)
PUNJAB	3,402	300	3,887	306	4,075	316
LAHORE DIVISION	1,112	102	1,210	104	1,332	106
LAHORE DISTRICT	864	69	924	71	1,016	72

SOURCE: PUNJAB DEVELOPMENT STATISTICS, 1989

### 1.2.3 Labour Force

Table 1.2.3 shows the distribution of population aged 10 years and above by activity in the Lahore District. It indicates that the proportion of working population is 35 percent (62% of males have jobs, females have a 3% of employment rate). Primary, secondary, and tertiary industries share 11.4%, 26.2% and 62.4%, respectively. The majority of women are engaged in house keeping.

Table 1.2.3 Distribution of Work Force (10 years and above) by Activity, Lahore District

	BOTH SEXES (000)		MALE (000)	FEMALE (000)
TOTAL WORK FORCE	2502.2	100.0%	1361.4	1140.8
WORKING	881.5	35.2%	843.5	38.0
LOOKING FOR WORK	75.1	3.0%	71.1	40.0
HOUSEKEEPING	943.1	37.7%	-	943.1
STUDENT	361.7	14.5%	206.3	155.4
OTHERS	240.8	9.6%	240.5	0.3
WORKERS BY INDUSTRY:				
PRIMARY	100.3	11.4%		
SECONDARY	231.2	26.2%		
TERTIARY	550.0	62.4%		

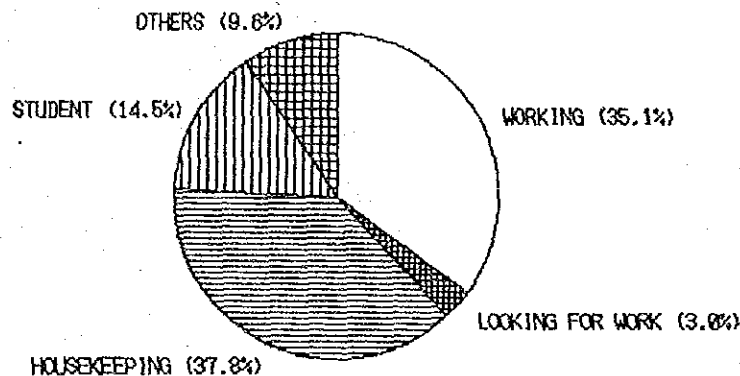


Table 1.2.4 shows the distribution of Labor Force (including those either for work) according to occupation. The highest share is "Production, transport, etc.", the second is "Sales".

Table 1.2.4 Distribution of Labour Force by Occupation Groups, Lahore District

MAJOR OCCUPATION GROUPS	NUMBER (000)	PERCENTAGE
1. PROFESSIONAL, TECHNICAL, ETC.	60.1	6.3
2. ADMN., MANAGERAL, ETC.	19.7	2.0
3. CLERICAL	78.5	8.2
4. SALES	164.1	17.1
5. SERVICE	70.7	7.4
6. AGRICULTURE, ETC.	101.2	10.6
7. PRODUCTION, TRANSPORT, ETC.	359.6	37.6
8. OTHERS	102.7	10.7
ALL OCCUPATION GROUPS	956.6	100.0

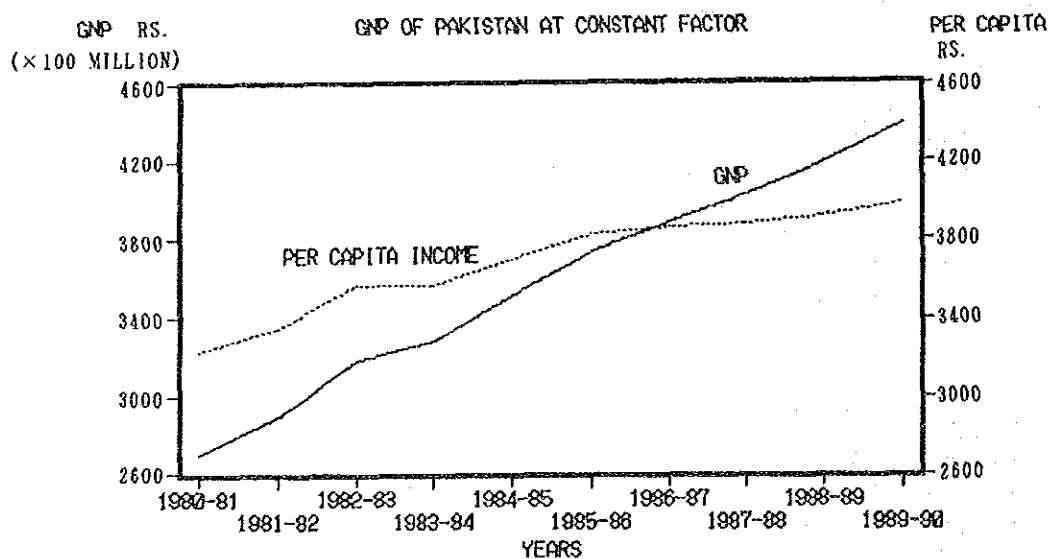
SOURCE: 1981 POPULATION CENSUS OF PAKISTAN

### 1.2.4 GNP(Gross National Product)

Table 1.2.5 shows the trend of GNP of Pakistan and GNP per capita at constant 1980-81 prices. It shows that the GNP index rose from 100 in 1980-81 to 163 in 1989-90. The index of GNP per capita increased by 23 per cent during the same period. The difference between GNP growth and per capita growth is due to the high population growth.

Table 1.2.5 GDP and GNP of Pakistan at Constant Factor  
(Base Year 1980-81)

YEARS	GDP		GNP		PER CAPITA	
	RUPEES (MILLION)	PERCENTAGE	RUPEES (MILLION)	PERCENTAGE	RUPEES (MILLION)	PERCENTAGE
1980-81	247,831	100	270,523	100	3,227	100
1981-82	266,571	108	289,453	107	3,349	104
1982-83	284,667	115	317,667	117	3,564	110
1983-84	295,977	119	327,607	121	3,566	110
1984-85	321,751	130	350,565	130	3,701	115
1985-86	342,224	138	373,506	138	3,824	118
1986-87	362,110	146	388,685	144	3,860	120
1987-88	385,416	156	402,516	149	3,877	120
1988-89	404,054	163	418,594	155	3,911	123
1989-90	424,950	171	439,614	163	3,983	123





### 1.2.5 Income Distribution

Table 1.2.6 shows data on household monthly average income and expenditure for the years 1979 and 1986-87. The overall monthly income in Pakistan during this period increased from Rs. 1,032 to Rs. 2,062. During the same period changes in average monthly expenditure and others can be found in the same table. The same period household size increased about 6.6 per cent, however, the number of income earners per household fell by about 10.5 per cent. Savings fell from 7% in 1979 to 4% in 1986.

Table 1.2.6 Average Household Size, Monthly Income & Expenditure

HOUSEHOLD	1979			1986-87		
	PAKISTAN	RURAL	URBAN	PAKISTAN	RURAL	URBAN
AVERAGE SIZE OF HOUSEHOLD	6.1	6.0	6.4	6.5	6.3	6.8
NUMBER OF INCOME EARNER/H. H.	1.9	2.0	1.7	1.7	1.7	1.7
AVERAGE MONTHLY INCOME (RS.)	1,032	836	1,346	2,062	1,775	2,739
AVERAGE MONTHLY EXPENDITURE (RS.)	958	805	1,201	1,979	1,711	2,612

SOURCE: ECONOMIC SURVEY - 1989-90, GOVT. OF PAKISTAN

## 1.3 LAND USE AND URBAN STRUCTURE

### 1.3.1 Existing Land Use

The existing land use in Lahore Metropolitan Area is shown in Figure 1.3.1. Its characteristics are as follows:

#### (1) Commercial Area

- a) Traditional business as like those found in and around the Walled City, and stretching along trunk roads.
- b) The commercial center of Lahore is located along the Mall.
- c) New commercial areas are mixed with the planned residential areas in the southern part of the UBD Canal.

#### (2) Industrial Areas

- a) Most large factories are located along trunk roads in the suburbs and concentrated along Sheikhpura Road and G.T. Road.
- b) There are a number of steel bar plants located north of Badami Bagh bus terminal and car body manufacturing plants along Bund Road of Multan Road.
- c) The Pakistan Railways (PR) workshop is one of the largest factories in Lahore. The total number of employees in the Mughalpura is approximately 17,000.
- d) Most of these heavy industry factories were established before 1960, and are shown in Figure 1.3.2.

#### (3) Government offices

They are concentrated along the Lower Mall and the Upper Mall.

#### (4) Residential Areas

- a) Traditional houses are located in and around the Walled City.
- b) A mixed use industrial and residential area is located along the western portion of Bund Road.
- c) Another mixed use agricultural and residential area is situated between G.T. Road and Bund Road.
- d) Well-planned housing areas are Main Gulberg, Model Town, and others located in the southern part of the UBD Canal.
- e) Low density residential areas are located in the Cantonment.
- f) Active housing development is ongoing in the southern urbanized

area.

(5) Open spaces

Parks, for example Jahangir's Tomb: 36 ha, Minar-i-Pakistan: 45 ha and Bagh-i-Jinnar: 45 ha) are scattered all over the urban area.

(6) Major urban facilities

- Inter-City Bus Terminal: Badami Bagh and G.T.S.
- Lahore City Station, the largest railway station in the country
- Punjab University, the largest and oldest university in the country
- Lahore Airport located in the Cantonment

(7) Army camp in the Cantonment

Figure 1.3.1 Existing Land Use

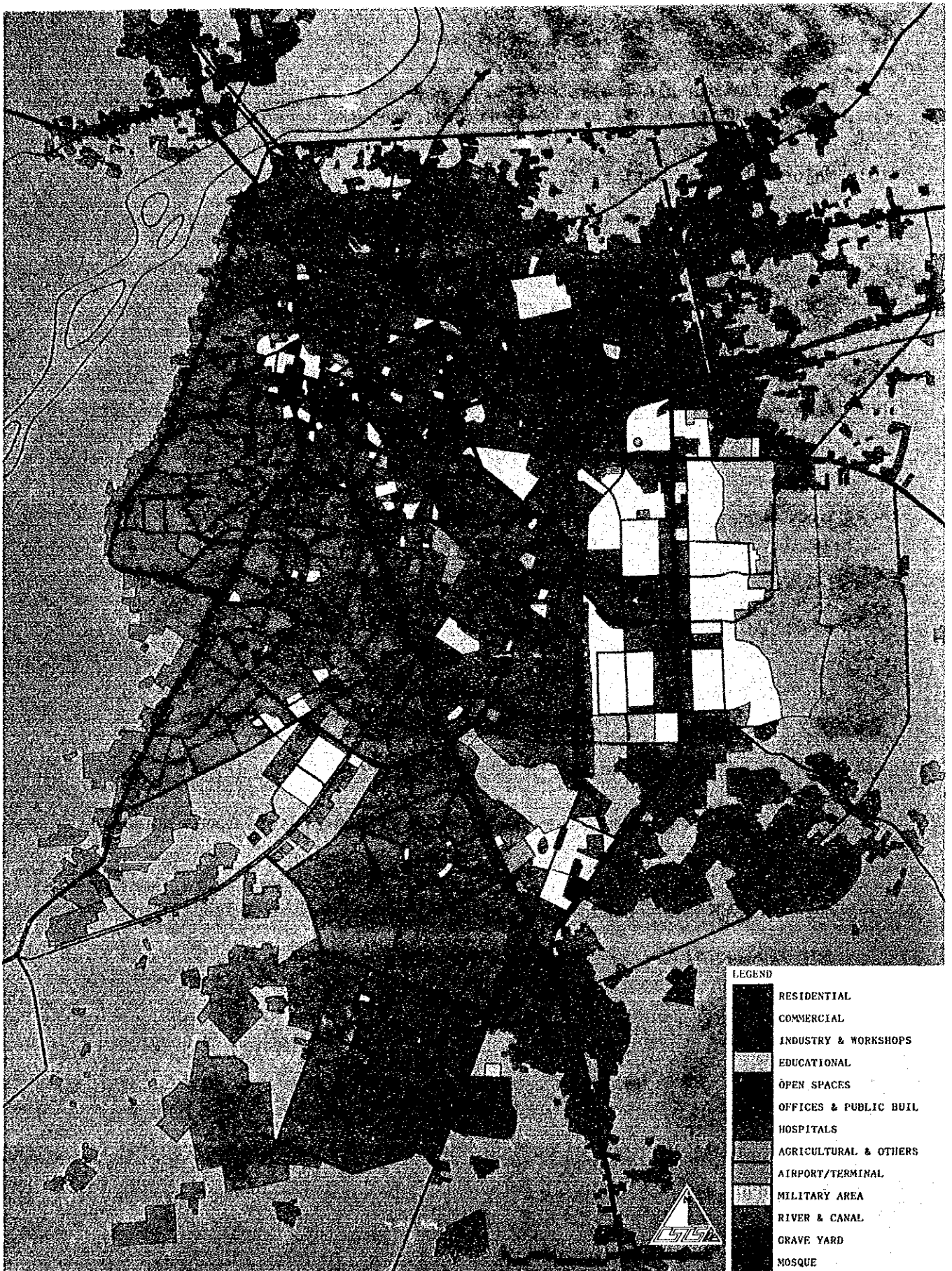
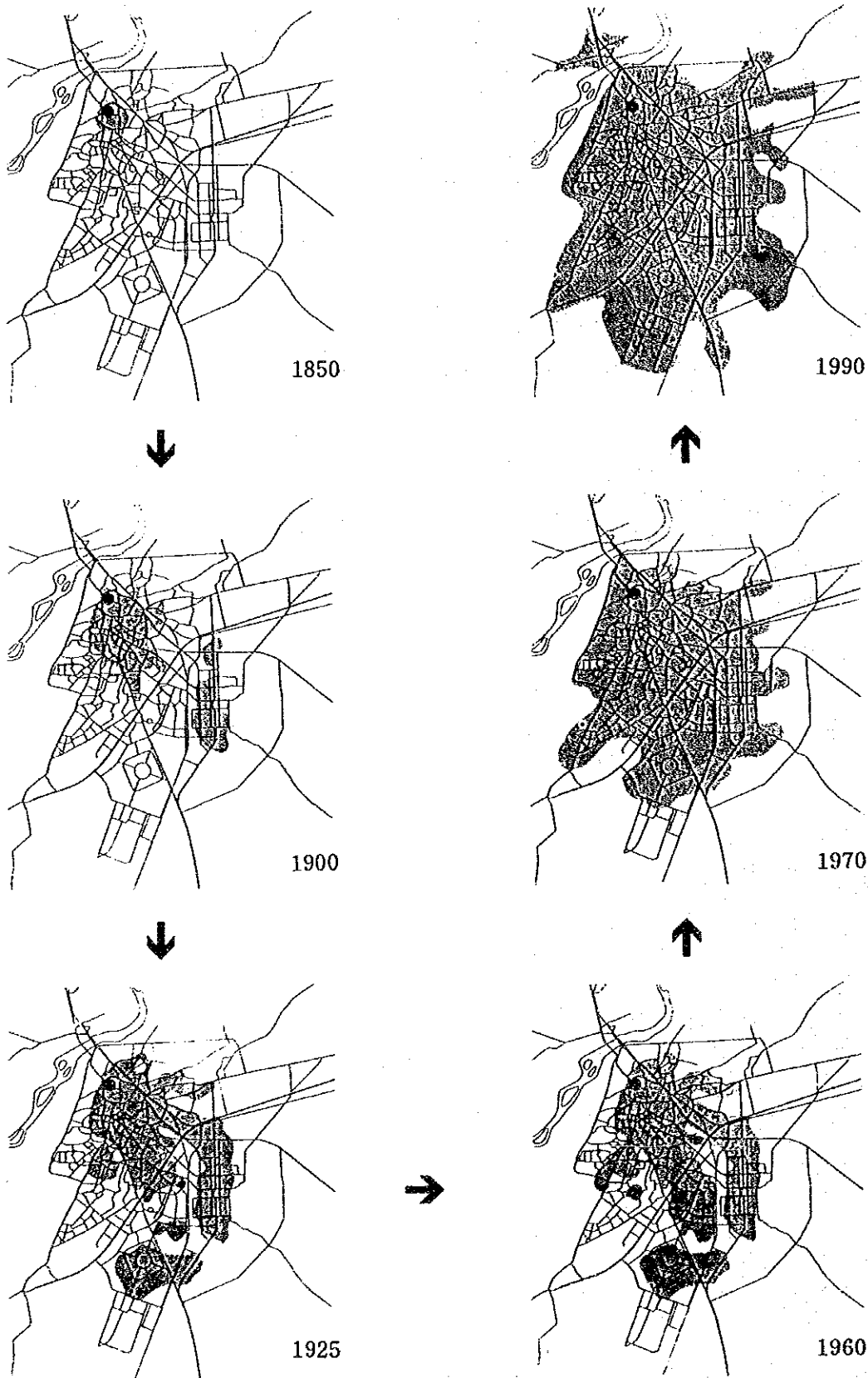




Figure 1.3.3 Trend of Urbanization in Lahore City



● Walled City

▨ Urban Area



### 1.3.2 Urban Structure

Historically, Lahore City has developed from the Walled City, which originated in Moghul era and expanded southward. (Refer to Figures 1.3.3). The Master Plan for Greater Lahore and the Structure Plan of Lahore in 2001 (Lahore Urban Development and Traffic Study, August 1980) are illustrated in Figure 1.3.4 and 1.3.5, respectively. Both studies espoused the southern expansion of the LMA.

Presently, a number of housing development schemes are proposed along a planned bypass connecting Bund Road to Ferozpur Road in the southern LMA. (Refer to Figure 1.3.6).

### 1.3.3 Urban Development and Building Regulations in LMA

#### 1) Building Regulation

LDA approves various development schemes in accordance with the Structure Plan for 2001, and has responsibility of building control about the followings:

- (1) Land use and building construction
- (2) Minimum right of way width of roads
- (3) Buildings and building lines
- (4) Maximum coverage of site and plot-floor area ratio, size of lot.
- (5) Height of building and number of stories
- (6) Car parking requirements

#### 2) Special Control Areas

Following areas are put under additional special control:

- (1) Government House Precincts
- (2) Precincts of Aiwan-e-Iqbal, Complex-Kashmir, and the Egerton Road Scheme.
- (3) Shahrah-e-Quaid-e-Azam (the Mall)
- (4) Gulberg Road, Main Boulevard in Gulberg, New Garden Town, New Muslim Town, Allama Iqbal Town, and other areas subject to conversion of use.
- (5) Roads approved for general and special commercial use.

Figure 1.3.4 The Master Plan for Greater Lahore

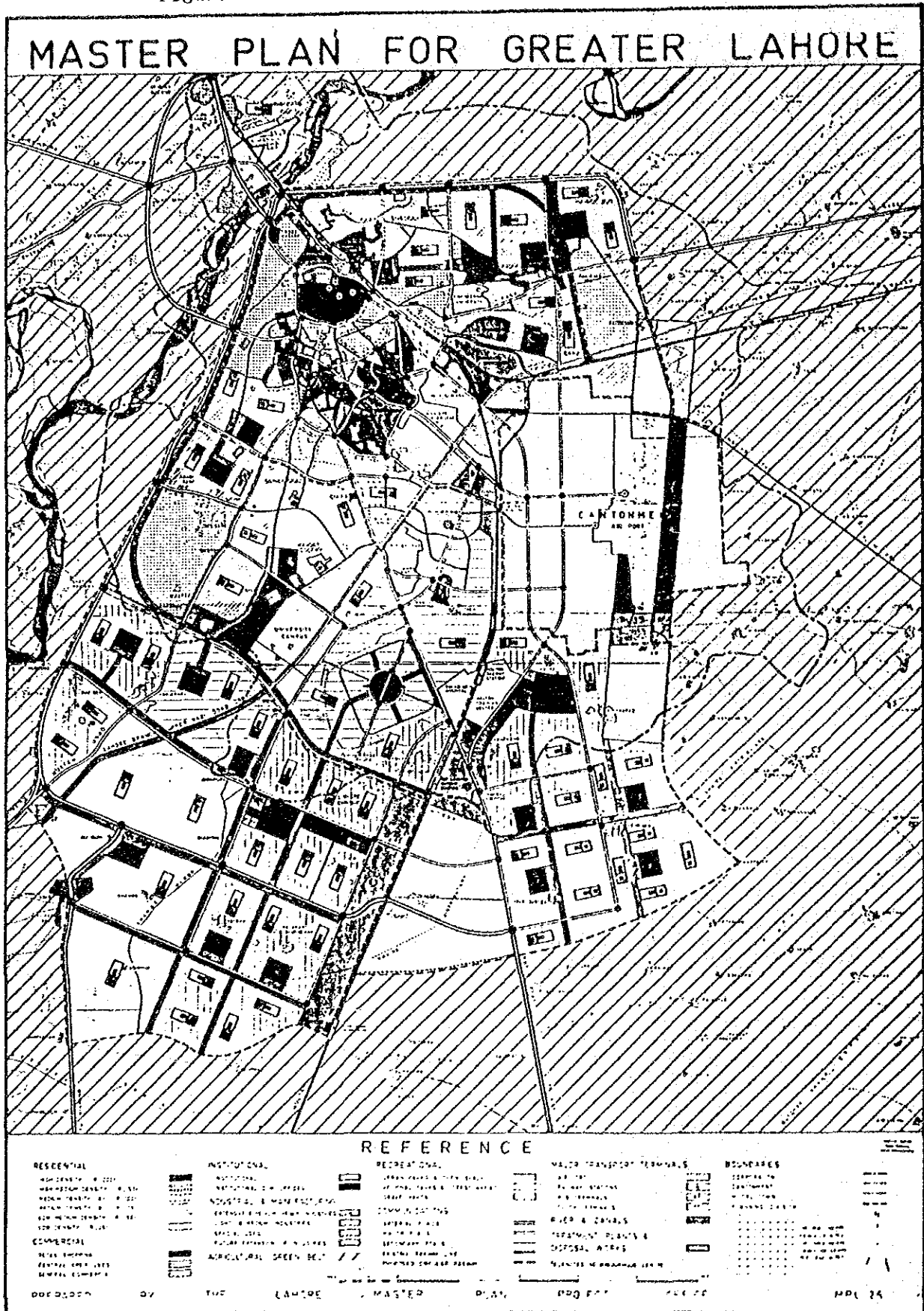


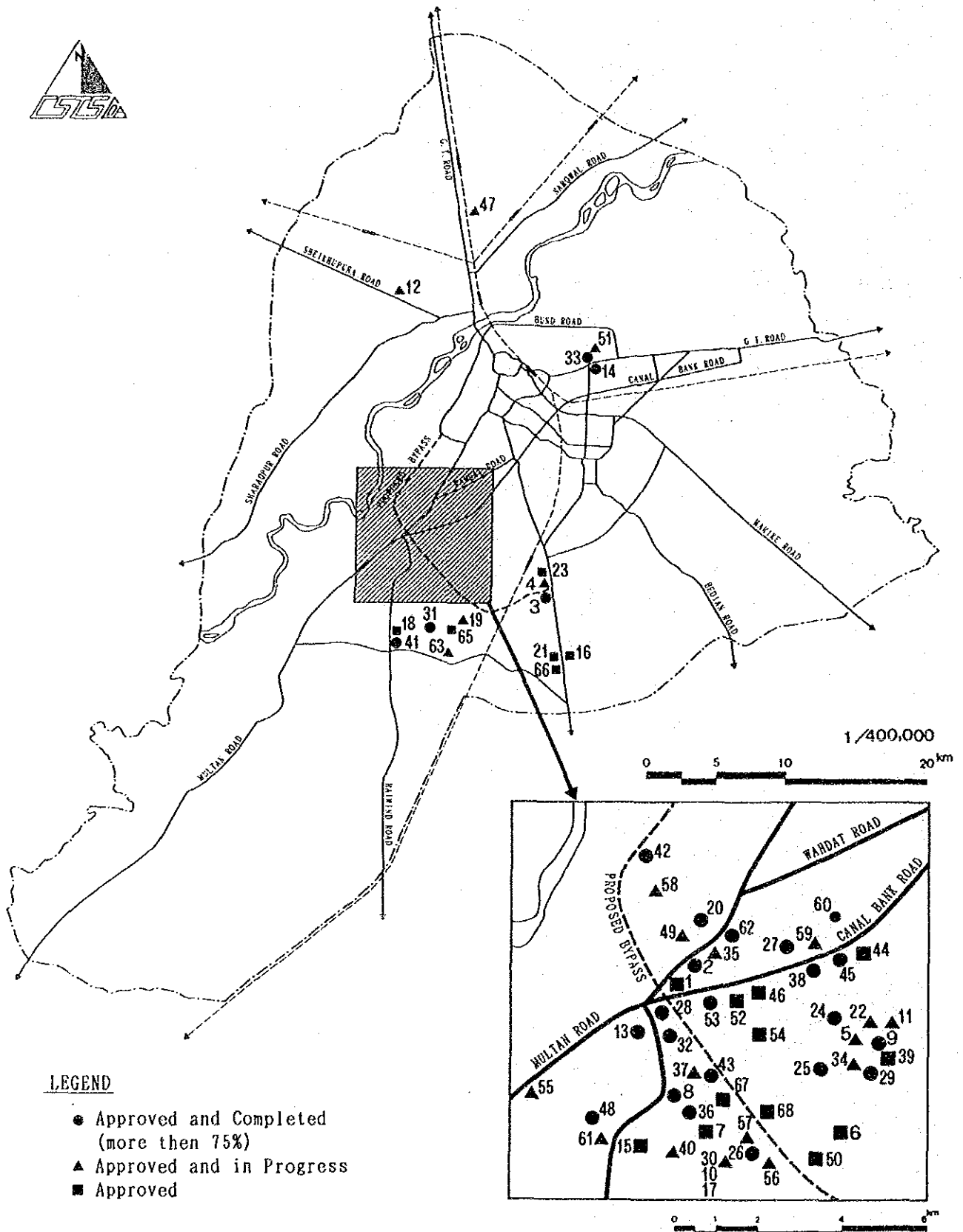


Figure 1.3.5 The Structure Plan of Lahore for 2001



SOURCE: LAHORE URBAN DEVELOPMENT AND TRAFFIC STUDY  
AUGUST, 1980.

Figure 1.3.6 Housing Schemes along the Proposed Bypass



SOURCE: Lahore Development Authority

#### 1.3.4 Major Facilities and Greenery

Lahore, once the Capital of Pakistan and presently a provincial capital, has various functions as the regional center of Punjab Province. Industrial development had been extended mainly before the capital was shifted to Islamabad around the Walled City and along the main roads such as G.T. Road, Sheikhpura Road, Ferozepur Road, and part of Bund road. (see Figure 1.3.2)

With the Walled City as its center, mixed commercial and housing area expanded and outside of it (especially southern part) there are rather orderly planned housing areas. Lahore is characterised by this mixture of traditional and modern atmosphere.

Other than the administrative facilities, Lahore is inlaid with many spiritual and religious facilities with its historical importance such as mosques and tombs of kings and saints. They attract people not only as a shopping center but also a center of pilgrims from the surrounding area.

##### 1) Mosque

There are some 30 famous mosques mainly within or around the Walled city and numerous small ones for the service of local population.

- Badshahi Mosque : next to Walled City
- Niwin Masjid : Kucha Dogran between Lohari and Shah Alam Gates
- Begum Shahi Masjid : near Masti Gate
- Masjid Khurasian : in the Lohari Mandi Chow inside Lohari Gate
- Masjid Wazir Khan : in the center of Walled City
- Masjid Pari Mahal : inside Mochi Gate
- Masjid Mohammad Saleh : in Changar Mohalla inside Delhi Gate
- Masjid Chinianwali : in Mohalla Chabak Sowaran inside the Walled City
- Sunehri Masjid : at the junction of Dabbi and Kashmiri bazar inside Walled City
- Masjid Moran : inside the Shahalam Gate quarters
- Masjid Nawab Imam-ud-dim Khan : in Mohalla Chele Ka Hammam inside Lohari Gate
- Masjid Bukkan Khan : in Mohalla Dhal inside Mochi Gate
- Masjid One Night : on the Circular Road outside Shah Alam Gate
- Masjid Sheranwala : inside Sheranwala Gate

- Muslim Masjid : outside Lohari Gate
- Nakiban Wali Masjid : near the tomb of Hazrat Musa Ahangan
- Masjid Amir Khan : in the abadi of Mohammad Nagar on Allama Iqbal Road
- Masjid Dai Anga : Adjoining to the Railway Station
- Australia Masjid : near the Railway Station
- Masjid Dalgaran : in the junction of Railway Road and Brandreth Road
- Masjid Mohammad Amin : behind the mausoleum of Bibi Pak Daman
- Masjid Dai Lado : close to the Mayo Hospital
- Masjid Nawab Zakariya Khan : in Baghbanpura to the west of the shrine of Hazrat Madho Lal Hussein
- Masjid Karim Baksh : in Langey Mandi near the water reservoir
- Shahid Masjid : on the Mall in the Regal Chowk
- Jamia Masjid : in Model Town

## 2) Park, Garden and Open Space

Other than mosques, there are many historical monuments and parks serving as urban greenery and the places of rest for citizen.

- in Shahdara : Jahangir's Tomb (80 acres)  
Nur Jahan Tomb Park (13 acres)  
encamping (exhibition) ground (more than 40 acres)
- along the Ravi : forest plantation (Ravi National Park : 86 acres)
- in front of Badshahi Mosque : Hazuri Bagh (7 acres)
- on G.T. Road : Iqbal Park (110 acres)
- along the Circular road: Circular Park (over 80 acres)
- in front of Town Hall : Gold Bagh (Nasser Bagh : 14 acres)
- on the Lower Mall : Punjab University Ground
- Baghbanpura (along G.T. Road) : Shallmar Garden (80 acres)
- Upper Mall : Jinnar Bagh (120 acres)

Railway Burt Institute ground (16 acres)  
 Railway Griffin Institute ground (20 acres)  
 Railway Golf Course (120 acres)  
 Gymkhana Club Golf Course (125 acres)  
 Race Course (120 acres)  
 Aitchison College ground (84 acres)  
 Fatima Jinnah College Campus ground (66 acres)  
 Mew Punjab University Campus ground (100 acres)

- in Model Town : total 170 acres of parks and green belt
- in Gulberg area : total 110 acres of parks and green belt
- along Ferozepur Road : Lahore (Qaddafi) Stadium (124 acres)  
 Military Fortress Stadium (85 acres)
- Cantonment : parade grounds (690 acres)
- Lower Bari Doab Canal : green belt along the canal (total 70 acres)

### 3) University

As Lahore is the cultural center of Punjab region there are many higher educational institutions. There are two universities namely University of the Punjab (Old Campus on the Mall and Kutcheri road and New Campus along the western UBD Canal) and University of Engineering and Technology (in the premises of the former Government College of Engineering and Technology on G.T. Road). Other than those universities, some 21 colleges, several training schools and 68 high schools are situated becoming periodic traffic focal points.

### 4) Hospital

As sporadic traffic focal points, there are some 20 large hospitals within the LMA.

- Mayo Hospital
- Sir Ganga Ram Hospital
- Services Hospital
- Mental Hospital
- Ittifaq Hospital
- Sheikh Zaid Hospital
- General Hospital
- Lady Willington Hospital
- Lady Aitchison Hospital
- Ghulab Davi Memorial Hospital
- Social Security Hospital
- Punjab Dental Hospital
- Fatima Jinnah Memorial Hospital (Shadman)
- Cantonment General Hospital
- Dental Hospital (Cantonment)
- Data Darbar Hospital
- Combined Military Hospital



## **CHAPTER 2. TRANSPORT DEMAND CHARACTERISTICS**





## CHAPTER 2 TRANSPORT DEMAND CHARACTERISTICS

### 2.1 OUTLINE OF PERSON TRIP SURVEY

#### 2.1.1. Survey Components

For the purpose of formulating a master plan for transport in Lahore, a transportation planning process incorporating a person trip survey was adopted. This survey was necessary to provide the basic data for analysis of present transport characteristics as well as for future traffic demand projections. The overall Person Trip Survey consists of the Household Interview Survey (HIS), and supplement survey such as the Cordon Line Survey and the Screen Line Survey.

##### 1) Household Interview Survey (HIS)

The HIS was made by visiting 11,089 households in the study area, and interviewing all household members 5 years old and above about their transport activities in a typical weekday. Effective replies were given by 67,064 persons, which is equivalent to 1.5% of the total population of 5 years and above in the study area (Total population = 4,578 thousand). The field work for the HIS was conducted in September and October, 1990. Household visits were made from Monday to Friday, and the recorded trip information is the pre-selected day that was the most recent weekday (Sunday - Wednesday). Selection of the sample households was made randomly by dividing the 84 HIS zones into a total of 400 sub-zones, each with a population of about 12,000.

The survey items for the HIS are classified as household characteristics, household members characteristics and trip characteristics.

For household characteristics, household size, household income, car ownership, type of residence, etc. were interviewed.

For household members' characteristics, age, sex, work place (or school place), occupation, employment sector, individual income and driving license were interviewed.

For Trip characteristics, address of origin and destination, type of facilities of origin and destination, departure and arrival time, trip purpose, transport mode used, etc. were interviewed.

A set of the questionnaire forms for HIS is attached in Appendix 2.1.

##### 2) Cordon Line Survey

The Cordon Line Survey was to supplement the HIS and to obtain information about person trips of the non-residents of LMA passing through the Lahore Metropolitan boundary, as this information cannot be obtained from the HIS. The Cordon Line Survey is thus used to estimate the overall person trip O-D tables related to the study area by combining the Cordon Line Survey data with HIS data.

The following two types of surveys were conducted to sample the persons who travel coming into and going out of the LMA at Cordon line survey stations.

- Roadside Interview Survey (Passenger Cars) : Interview and traffic count survey of passenger car users on 9 principal road sections of national highway and provincial highway crossing the Lahore Metropolitan boundary.
- Railway Passenger Interview Survey : Interview and traffic count survey of railway users crossing the Lahore Metropolitan boundary at Lahore City Station.

In the survey, the driver's place of residence ( or passenger's place of residence in the case of bus and taxi), origin and destination of trip, and trip purpose and number of passengers, etc. were checked for the sampled vehicles for the survey.

The number of interviewed passengers was 3,164. At the same station and on the same days as the interview survey, a traffic count survey by direction and by vehicle type was also carried out in order to calculate expansion factors.

### 3) Screen Line Survey

For the Screen Line Survey, four imaginary lines, which were drawn to divide the survey area, were selected on the Canal Bank Road, the Main Line of the Pakistan Railways, the Ravi River and the boundary of the inner area of the LMA. The traffic counts were made at 36 survey stations across these screen lines. The results were used not only to calibrate the O-D tables obtained by HIS and the Cordon Line Survey but also to analyze the existing road traffic conditions.

In order to collect the data about the number of boarding passengers by vehicle type, the occupancy survey was also conducted at representative stations on the screen lines. The results were used to convert person trip O-D table to a vehicle trip O-D table.

#### 2.1.2 Zoning System

Generally, it is necessary to decide beforehand the area, size, and number of zones required or needed for zoning. The topography, existing road network and land use of the area, etc., must also be taken into consideration when deciding on the zone boundary or survey boundary, such as in the census, is adopted as the zone boundary because of data limitation.

For the zoning in the LMA, the following factors were taken into consideration:

- Administrative boundary, e.g., Tehsil and Ward;
- Survey boundary of national population census;
- Rivers, railways, and trunk roads;
- Existing land use and development scheme; and
- Zoning system used in the previous related studies ( Bus Passenger O-D Survey by NTRC, World Bank Studies ).

The zoning system applied in this study is shown in Figure 2.1.1 and 2.1.2. Table 2.1.1 shows the number of the zones by each zoning system in LMA.

Table 2.1.1 Zoning System in the Study Area

Area	Number of Zones		
	Large Zone(A)	Integrated Zone(B)	HIS Zone(C)
LMA	1	18	84
Inner Area	-	12	57
Outer Area	-	6	27
Outside of LMA	7	16	18
Total	8	34	102

Figure 2.1.1 Zoning Map, Inner Area of LMA

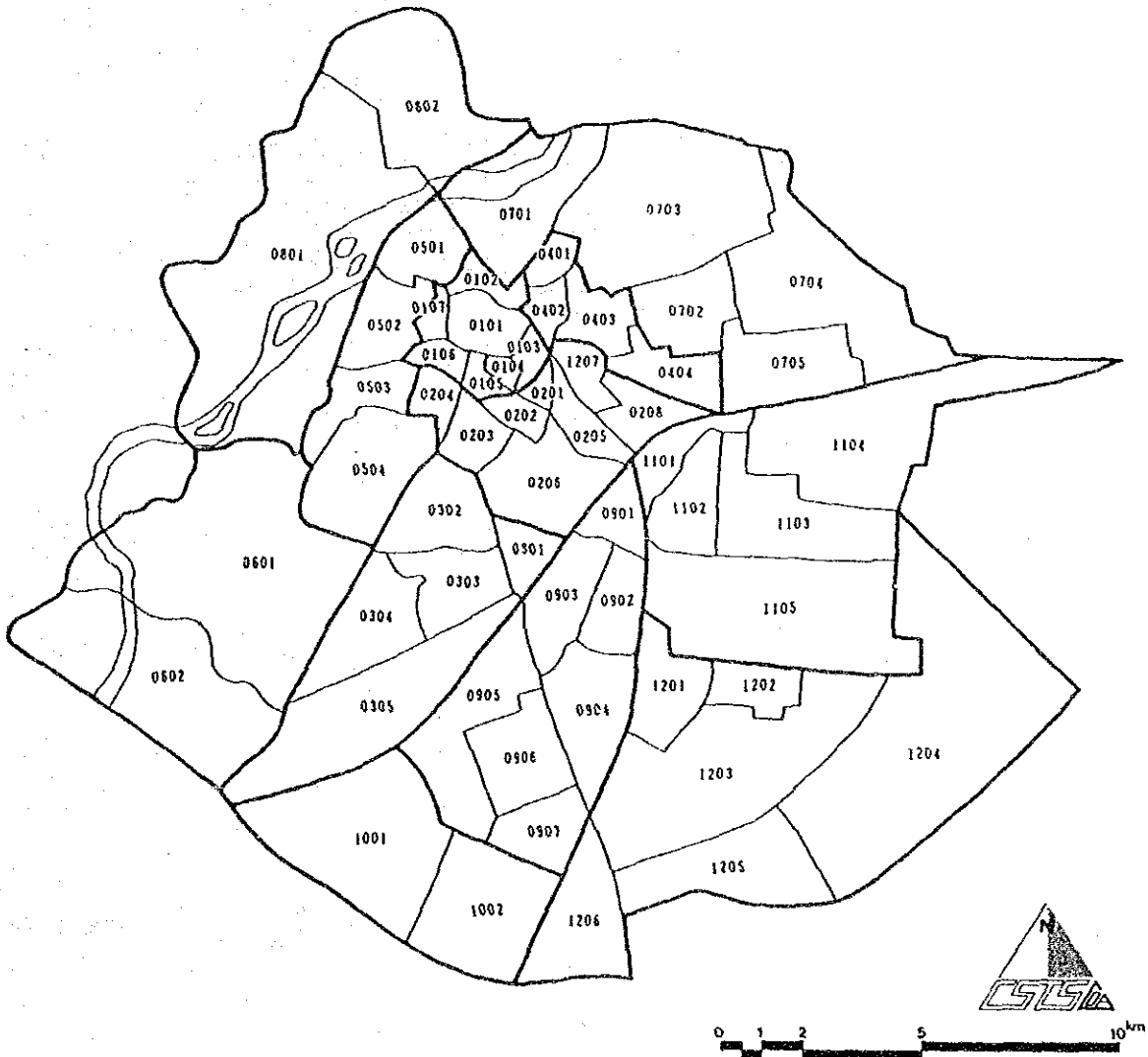


Figure 2.1.2 Zoning Map, Outer Area of LMA

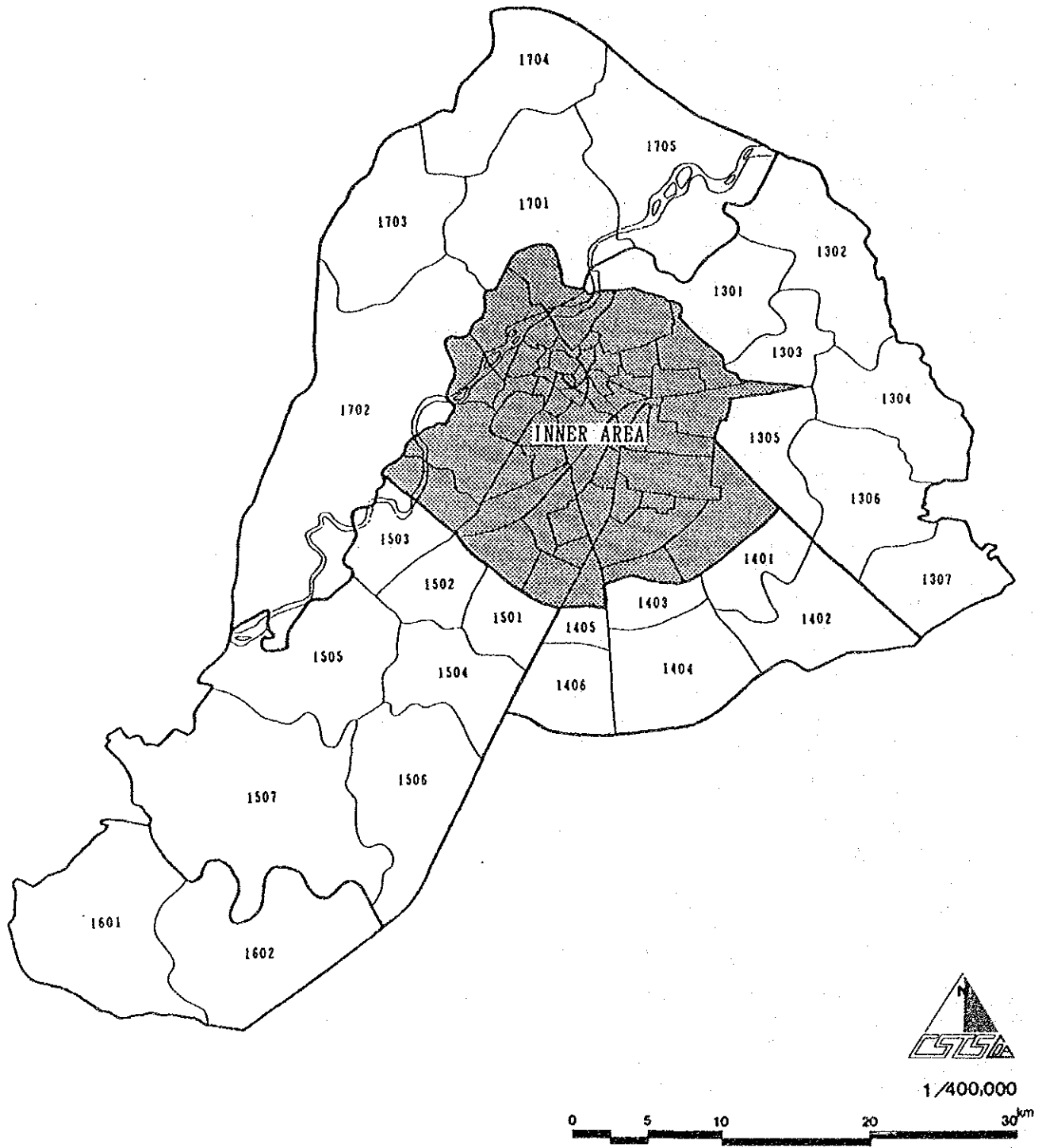


Table 2.1.1 Zone Coding System

Original HIS Zone No.	O-D Tabulation Zone No.	18-Zone System No.	Original HIS Zone No.	O-D Tabulation Zone No.	18-Zone System No.
INNER AREA, LMA			OUTER AREA, LMA		
10101	1	1	11301	58	13
10102	2	1	11302	59	13
10103	3	1	11303	60	13
10104	4	1	11304	61	13
10105	5	1	11305	62	13
10106	6	1	11306	63	13
10107	7	1	11307	64	13
10201	8	2	11401	65	14
10202	9	2	11402	66	14
10203	10	2	11403	67	14
10204	11	2	11404	68	14
10205	12	2	11405	69	18
10206	13	2	11406	70	18
10207	14	2	11501	71	18
10208	15	2	11502	72	18
10301	16	3	11503	73	18
10302	17	3	11504	74	18
10303	18	3	11505	75	18
10304	19	3	11506	76	15
10305	20	3	11507	77	15
10401	21	4	11601	78	16
10402	22	4	11602	79	16
10403	23	4	11701	80	17
10404	24	4	11702	81	17
10501	25	5	11703	82	17
10502	26	5	11704	83	17
10503	27	5	11705	84	17
10504	28	5	OUTSIDE OF LMA		
10601	29	6	ISLAMABAD *1	85	19
10602	30	6	FAISALABAD *2	86	20
10701	31	7	MULTAN *3	87	21
10702	32	7	KASUR *4	88	22
10703	33	7	*1 : 30100, 30400, 50000, 70000		
10704	34	7	*2 : 20202, 30200, 30500		
10705	35	7	*3 : 20302, 20400, 30300, 30600, 30700, 40000, 60000		
10801	36	8	*4 : 20100, 20201, 20301		
10802	37	8			
10901	38	9			
10902	39	9			
10903	40	9			
10904	41	9			
10905	42	9			
10906	43	9			
10907	44	9			
11001	45	10			
11002	46	10			
11101	47	11			
11102	48	11			
11103	49	11			
11104	50	11			
11105	51	11			
11201	52	12			
11202	53	12			
11203	54	12			
11204	55	12			
11205	56	12			
11206	57	12			