CARRYING CAPACITY BASED DEVELOPMENTAL PLANNING OF NATIONAL CAPITAL REGION

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PREFACE

Carrying Capacity Based Development Planning of National Capital Region is a collaborative research project involving four institutions and is being co-ordinated by the National Environmental Engineering Research Institute (NEERI) Nagpur.

The National Institute of Urban Affairs (NIUA), New Delhi has been entrusted with the task of focussing on the Land, Shelter, Energy and Transport Sectors in NCR regions.

Comprising of nine (9) chapters this report introduces a conceptual and methodological framework for carrying capacity based planning with focus on the major urban settlements of the region (CHAPTER I), following which the demographic and economic profiles of the region are presented (Chapters 2 and 3). The carrying capacity analysis of various urban development infrastructure, specifically land, transportation and communication, shelter and energy resources are discussed in chapters 3 through 7. A synthesis of the above analysis has been attempted in chapter 8 in terms of the relative carrying capacities of major urban areas of the region which provides a base for future urban development scenarios. It has been substantiated further through a discussion on institutional arrangements towards urban development in the last chapter (chapter 9).

The information content in this report reflects NIUA's contribution to date in providing directions for the development of alternative development scenarios. However, alternative development scenarios need to be evolved through collaborative efforts of the participating institutions, following which details and structure plans for the preferred scenarios may be developed.

New Delhi
September, 1995

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CARRYING CAPACITY BASED DEVELOPMENTAL PLANNING OF NATIONAL CAPITAL REGION

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CHAPTER 1

CARRYING CAPACITY BASED PLANNING FOR THE NATIONAL CAPITAL REGION-DELHI: CONCEPTS AND PROCEDURE

1.1 Introduction

Planning and management of a metropolitan region towards sustainable growth and development is a dynamic process requiring new institutional capacities and management systems. The process of sustainable development of human settlements calls for strategic and relevant approaches and tools not necessarily associated with the conventional deterministic planning wisdom that rarely question a region's resources and environmental constraints towards unabated growth of urban activities. While on one hand, the large cities and metropolises are increasingly assuming the role of engines of the country's economic growth, rapidly growing problems of pollution, depletion of environmental resources and inadequate urban infrastructure and institutions towards maintenance of quality of life across these cities are beginning to challenge planners' conventional wisdom. A new thesis is emerging where growth and economic development must be made complementary

(rather than conflicting goals) to maintenance of environmental resources in order to sustain quality of life across our cities.

In this context, the notion of "Carrying Capacity" may present an useful concept as well as a tool for sustainable growth of an urban region. Intrinsically, the term refers to the finiteness of a regions natural environment both as a reservoir of resources to support human consumption or activities and as a sink to assimilate wastes generated through such activities. In other words, carrying capacity based planning approach requires the optimisation of environmental resource use through human activities within the regenerative capacities of the region's natural resources and sinks. In the context of planning for an urban region like the National Capital Region of Delhi (NCR), such an approach should lead towards development of policies and strategies towards determination of size, nature, distribution and management of urban-economic activities and their concomitant use of various environmental resources within their supportive

and assimilative capacities in order to sustain growth and quality of life across the region.

Within a broader project objective of Carrying Capacity Based Regional Planning for the National Capital Region (NCR) of Delhi, our study focusses on prospects for growth and development of urban settlements across the region on the basis of their carrying capacities of various environmental resources and infrastructure. The Regional Plan-2001 for the NCR develops urban growth scenarios for the region with an objective of decentralization of Delhi through development of alternative growth centres or counter magnets both within the region (such as DMA and "Priority" towns) and also outside it. The present study examines the development prospects of such major urban centres of NCR (specifically, its class I cities) vis-a-vis Delhi primarily on the basis of various environmental and infrastructure resource supports necessary for their development.

With this brief introduction to our study objective this chapter proceeds to provide an overview of traditional and

modern concepts on carrying capacity approach in order to build up an operational procedure or methodology towards carrying capacity based urban growth and development across the NCR. Specifically, an attempt has been made to identify various environmental parameters and indicators and their measures to be used in the subsequent chapters to analyze the carrying capacity based development potentials of urban centres across the region. These analyses should eventually lead to the development of appropriate scenarios and strategies towards sustainable urban development across the NCR.

1.2 An Overview of Traditional and Modern Concepts on Carrying Capacity Based Planning Approach.

The concept of carrying capacity or environmental limits to growth has been discussed traditionally in the such scientific fields as bio-science and demography, but more recently among economists and planners. Verhulst, for instance, attempted to develop logistic population growth curves indicating limiting biological and economic factors in the environment, as early

as in the 1st Century. Malthusian concept of natural control of population growth through limiting factors as food resources is well known. Population density dependent negative feedbacks brought in through natural resource depletion, desease, predation, etc., were highlighted more formally in the logistic growth models of Lotka (1925) and Volterra (1926). In fact, population density based carrying capacity measures have been operationalised in the practice of forestry and agricultural management for a long time, such as in the sustenance of lumber harvest from a forest range or cattle population in a grazing land, based on non-impairment of the regenerative capacities of the environmental resources to sustain such yields.

"Qualitative", rather than mere quantitative measures, like population size or density have also been linked to the concept of carrying capacity. Ackerman(1959), for instance, attempted to link the idea of "standard of living", apart from population size, to carrying capacity, expanding the concept thereby for the first time. Similarly Calhoun (1973) could

relate social pathology or "behavioral sink" in animal population with environmental carrying capacity in terms of space reaching its limit. Today, the idea of "quality of life" that constitute biological, economic and psychological needs of man (Maslow,1954) is an acceptable one to measure the carrying capacity of a region (viz Bishop et al, 1974).

Computer modeling techniques in the seventies stretched the concept of carrying capacity to a notion of "limits to growth" (viz Meadows et al, 1972) that was akin to environmental determinism forecasting doom. This nevertheless raised a controversy about the so-called "limits" of sustainable population size across nations of the world (viz. Westing 1981; Mann, 1981, FAO/HASA,1987) and was challenged also in the light of human technological progress as well as a market economy which balances demands and supplies of environmental resources (viz Kahn,1982; Kirchner et al, 1985; Simon, 1981). More recent economic arguments favour the benefits of optimal growth for sustaining the quality of life through a process of environmental maintenance costs and institutional changes

towards management of externalities (viz, Scott, 1994). At the same time, planners' traditional "business as usual" scenario of unabated population growth, consumption of non-reasonable resources and pollution is rejected.

But how does one operationalise the concept of carrying capacity towards achieving such optimal or sustainable growth across an urban region?

In the context of regional environmental management, Bishop et al (1974) provides a comprehensive outline of a Carrying Capacity Based Planning Process (see Figure 1). In essence this process involves:

1. Identification of likely alternative growth or regional development scenarios (driving forces) having potentials for significant environmental impacts;
2. Estimation of the impacts, i.e., the carrying capacity differentials brought about by these driving forces in the natural and human components of the regions environmental resources; and

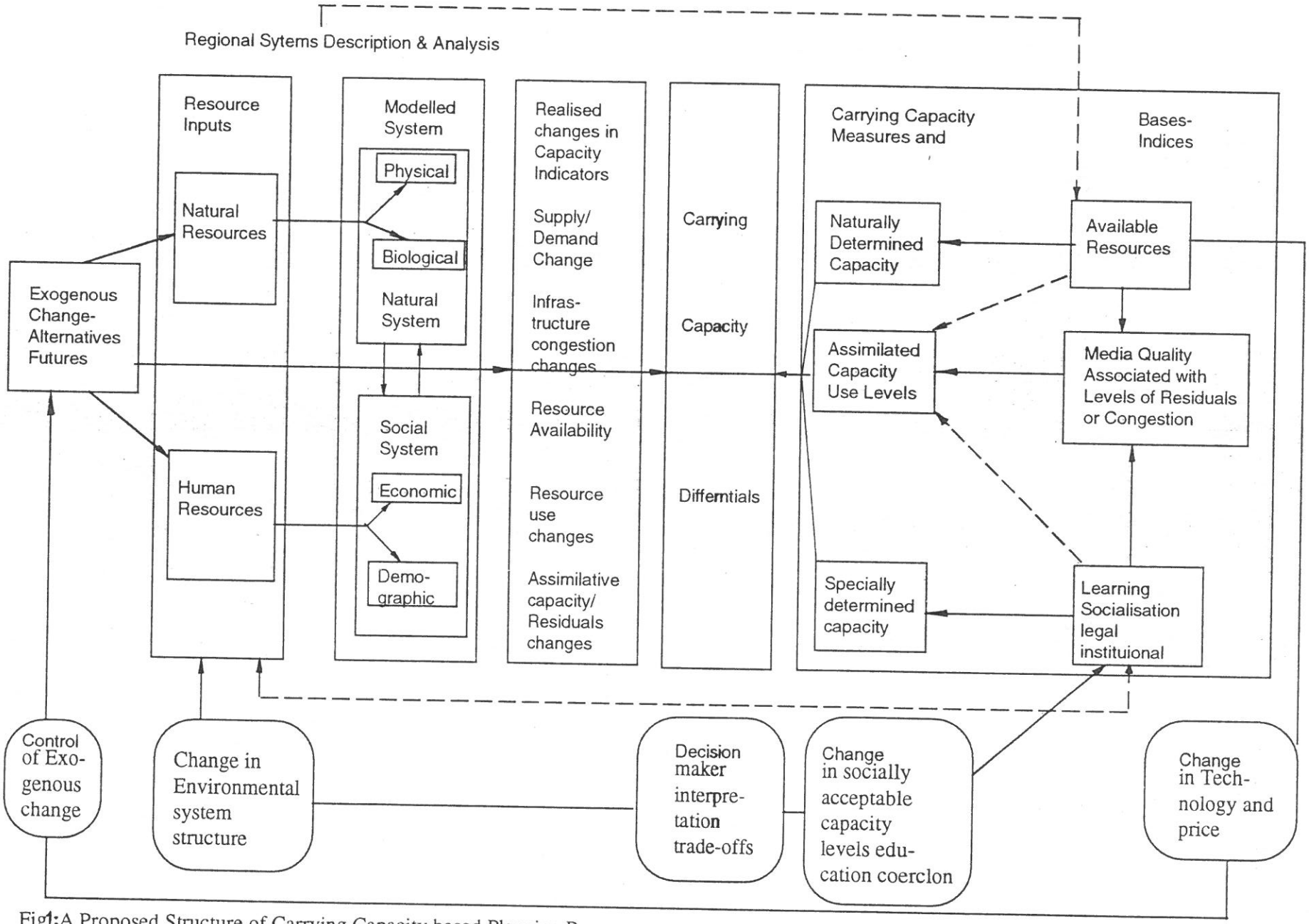

Fig1:A Proposed Structure of Carrying Capacity based Planning Process
[After Bishop et. al. (1974)]

3. Development of strategies and action programs primarily through "trade offs" among alternatives, leading to a preferred scenario or the best course of actions.

A critical aspect of the carrying capacity based planning process is to establish means for resolving conflicts and making trade offs necessary to converge on socially and economically viable and environmentally sound decisions on development alternatives. The emphasis is on a dynamic "planner-decision maker-public" interactive process rather on development of a model to generate a "plan".

Deriving from the above concept, carrying capacity based planning process is hardly different from all planning processes in a democratic context, in term of their normative and rhetorical aspects. For, any successful planning process should reconcile among the plethora of values in a pluralistic society, be they economic, social or ecological in nature. Planning is fundamentally a process of arguments, assertions and propositions influenced by interest groups and a

participatory process where rhetorie is integral to the art of suasion. However, the key difference between the two is that the carrying capacity concept necessitates the development of a process that would reconcile the varied social and economic developmental expectations (which are the prime issues in the traditional urban planning process) and the quality and stability of the natural system that support such human developmental expectations.

1.3 An Operational Procedure for Carrying Capacity Based Urban Development Across Natural Capital Region.

1.3.1 Alternative Development Scenarios

While there is no established procedure for generating alternative urban development scenarios, it is useful to organise various existing and potential socio-economic and political driving forces imperative in urban development in a region into a set of alternative scenarios in order to study their implications in terms of various environmental carrying capacities and also to

generate a basis for inter-active decision making for to identifying trade offs among such alternatives.

The focus in this study is on the alternative roles of major urban centres of NCR and their implications in terms of various human carrying capacities. The principal aim of the Regional Plan for NCR has also been to identify different growth options. Alternative urban growth scenarios for the region may be developed on the basis of alternative normative or value based developmental goals of the society, such as (a) "equity" or planned equitable redistribution of goods and services and environmental qualities across the region; (b) dependence on local desires and initiatives in the exploitation of varied environment resources in a free market situation which may initially lead to intra-regional imbalances in growth structure, (c)

decentralisation of the main center of the region, i.e., Delhi (based on perceived problems) which in effect is the goal of the NCR Regional Plan-2001; or (d) an optimal mix of such various goals.

1.3.2 Carrying Capacity Assessment related to Development Scenarios.

There is no single way to organise information on carrying capacity changes related to alternative development scenarios. But an organisation or classification of carrying capacity changes related to development alternatives is essential to help the decision making process.

According to Bishop (1974), carrying capacity analysis of a region's human and natural resource base would include the assessment of: (1) resource capacities to support the production demands; (2) production capacities to support demands for goods and services for the population; (3) infrastructure

capacity for distribution of production resources and goods and services; (4) natural waste assimilation capacity. While the assessment of the last element in the above list, i.e., the waste assimilative capacities of air, water, soil, biological, etc., components of the environment has been dealt primarily by other institution involved in the project our focus will be on assessments of carrying capacities in respect of the other three elements.

The above outlined carrying capacity assessments essentially refer to the supply-demand differentials in various economic resources, human resources, institutional capacities and various infrastructural resources, including land, transport and communication and urban utilities and services in relation to demographic and economic growths across the region. What is required, therefore is the development of a set of carrying

capacity based indicators or measures which will reflect such supply-demand gaps in respect of an array of human and natural resources required to support alternative demographic and economic growth scenarios. These indicators or indices may be used to compare among different parts of the region, specifically the major urban centres to analyze their "relative carrying capacities" to support future growth leading further to policies and strategies for augmentation of these carrying capacities to meet the desired development scenarios.

1.3.3 Carrying Capacity Based Urban Development Indicators

Indicators are generally considered as measures of change in the states of individual components of natural and human environments. Indicators considered here reflect both the supply and the demand side of the equation in assessing the relative carrying capacities across part of the NCR for development of future urban growth scenarios.

They relate specifically to the demographic, economic development, infrastructural resources and institutional carrying capacities across the region.

Several methodological issues related to measurment of carrying capacities in respect of such a large array of environmental resources should be discussed, however. While quantitative measures are possible in respect of many of these indicators, some may lend themselves only to qualitative measures, whereby comparison among parts of the region is possible only in subjective terms. Further, there is the question of defining an appropriate indicator for a particular resource. In case of water supply, for instance, one may look into the actual supply level in a locality against an aggregate demand set against some standards. But for many resources systems, such as transportation system, it may not be possible to identify any single key indicator of carrying capacity and a set of indicators need to be studied. This situation when compounded at the level of multiple indicators for all the environmental resources would lead

to the critical methodological issue of multi-dimensional scaling problems, which in other words, is a problem of "comparing apples and oranges" in an aggregate measurement task. While the system of assigning "weights" and deriving a common scale (such as the EQI developed by Batle-Columbus) is a common approach is such multi-variate analysis, judgmental approach in the determination of relative values or weights for different indicators is commonly followed. Such choice of weight for different capacity indicators may even involve political decisions is a our task of development of alternative urban development scenarios. Thus an artifice like aggregative index may not be devised at this stage where various elements within it are open to judgement calls and interactive decision making process.

1.3.3.1 **Demographic Indicators**

Demographic factor like population size, growth trends, relative concentration and distribution across space, purchasing power etc., will not only reflect the relative

demands of various supportive and assimilative resource capacities across the region, but also to a large extent guide economic development and resource management scenarios. "Population Resource Balance" has been a traditional dictum in carrying capacity based planning. Time-series analysis of rank-size distribution of urban settlements across the NCR would show the relative balanced an unbalanced nature of population growth thereby indicating the relative population pressure and stress on environmental resources as well as its temporal change.

Similarly, density measures across urban centres of the region can be linked to carrying capacity measures of individual social infrastructures, especially land, shelter, transportation, water supply, sewerage, energy, etc. Density measures for urban centres across the region will be indicative of the relative "stress" an such urban infrastructure. However, the most vexing question about population density of cities is to apply

any norm for optimal density. In other words, what should be carrying capacity norms for such urban infrastructures in order to support an optimal population size or density? The relationship between population size, density and various social infrastructure may be studied at best in relative terms. For, on one hand, density norms are influenced by a range of socio-economic variables line income, life style, culture, technology and so on that vary widely both across and within societies and there is no such thing as ideal density or population size. On the other hand, while it is possible to delineate norms or absolute standards in respect of several environmental resources such as pollution eminision standards air quality standards or even water supply standards, etc., such absolute measures are hard to define for a host of social infrastructure, such as land, housing, community facilities or even transportation facilities and energy supply.

1.3.3.2 Economic Development Indicators

Economic development across the region will determine to a large extent the population carrying capacities of various settlements, the purchasing power of the population and thereby the demands on various goods and services and in general the quality of life across the region including capacities to control environmental degradation. In turn, the economic development potential of various growth centres will depend on their various supportive as well as assimilative carrying capacities, specifically in respect of

- economic resource supply: raw materials, mineral resources, capital, labour, etc.;
- economic institutional capacities: organisation, development policies and programs, technology and training, etc.;
- industrial infrastructure capacities: road and rail transportation facilities, communication, power, water and other urban utilities, land and housing supply, etc.;

- pollution assimilative capacities: in term of pollution generation and control measures, local sink assimilative capacities.

1.3.3.3 Infrastructure Capacity Indicators

Analysis of various urban infrastructure capacities across NCR has been the major thrust in this study in order to determine their relative carrying capacities to support demographic and economic growths. Apart from assessment of various infrastructural resource capacities in terms of their size, densities, etc., emphasis has been made to study various critical stress indicators or their "breakdown" conditions in capacities, such as "blackouts" in power supply, traffic accident rates and accident deaths, etc.

Capacity indicators have been studied in respect of the following major infrastructure components:

- Urban Land Resource: land-man ratios, densities and holding capacities of urban areas, potential urbanisable lands, land price;

- Transportation and Communication Resources: Accessibilities and nodalities of urban centres, road lengths and densities, road pattern or structure, traffic volumes, vehicle densities and growth trends, traffic accident rates and growth trends, telephone and postal facility densities;
- Shelter and Related Social Amenities: housing supply and shortage, housing condition, slum population, education, health and cultural facilities densities;
- Energy: supply, demand, production and breakdown conditions;
- Water Supply: water resource potential, supply coverage and level, treatment facilities;
- Sanitation: sewerage and drainage coverage, treatment facilities, collection level of solid wastes.

1.4 Analysis of the NCR in respect of the various carrying capacity indicators as outlined above, i.e., the demographic

characteristic, economic development, and various infrastructures have been presented separately under individual respective sections of the report. The focus has been to analyse these carrying capacities specifically for the major urban centres, (i.e., the 13 class I cities including Delhi). A synthesis representing the relative carrying capacities of these major centres follows these analytical portions and has been summarized in the TABLE. This comparative evaluation of the major urban centres in respect of their various carrying capacities provides the base for further urban development scenarios and strategies.

CHAPTER 3

REGIONAL ECONOMY

1. Existing Industrial Scenario :

1.1 Industrial Growth :

While urban development is mostly along transportation corridors, population analysis indicates that the growth and density of the class I towns of the NCR are not related to distance from Delhi. In fact, density of population is a function of their regional primacy, past history and linkage.

As per 1991 census, judged by the proportion of workforce employed in the different industrial categories, Delhi (UA), NOIDA, Ghaziabad, Sonepat, Meerut and Alwar are all categorised as *industry-cum-service* towns. Panipat, Faridabad and Modinagar are monofunctional *industrial* towns. Gurgaon, by 1991 Census figures fall into the *service* category. It is hoped that by the turn of the century Gurgaon will be classified as an industrial-cum-service town as well, considering the rapid industrial developments that is taking place. Hapur, Bulandshahr and Rohtak, a little distance away from Delhi, are *service-cum-trade* centers. These are the lower order settlements.

There has been a rapid growth of industries between 1980-92. While in Delhi small-scale and unorganised industries are growing rapidly, the DMA towns, Gurgaon, Faridabad, Sonepat,

TABLE : I
INDUSTRIAL SCENARIO ACROSS N.C.R.

SUB-REGION	DISTRICTS/ TOWNS *	NUMBER OF UNITS(1992-93) L & M	S.S.I.	%AGE ANNUAL GROWTH RATE L & M	S.S.I.	MAJOR SECTORS	MEAN GROSS OUTPUT(Rs.Lakhs) L & M	S.S.I.	MEAN VALUE ADDED(Rs.Lakhs) L & M	S.S.I.	TOTAL GROSS OUTPUT('000 Crore) L & M	S.S.I.	TOTAL VALUE ADDED('000 CRORE) L & M	S.S.I.	ESTIMATED EMPLOYMENT (LAKH L & M	S.S.I.	L & M UNITS WITH POLLUTION N.O.C. %AGE	S.S.I. UNITS WITH POLLUTION MEASURE %AGE
UTTAR PRADESH							2819.8	38.64	400.62	9.67	9.15	4.71	1.66	1.11	1.43	2.59		
	GHAZIABAD	222	3304	12.68	19.62	Food Products,Paper/Printing Rubber/Plastic,Chemicals,Engg.											95.1	2.2
	NOIDA *	40	2271	@		Chemicals,Electrical Machinery Rubber/Plastic												
	MEERUT	29	4575	11.8	20.09	Food Products,Paper,Printing Publishing											87.5	5.7
	BULANDSHAHR	32	1780	15.9	31.45												100	21.4
	HAPUR *		309		11.53													
RAJASTHAN							2217.73	10.98	829.06	4.49	2.26	0.67	0.78	0.26	0.29	0.46		
	ALWAR	84	2982	35.42	4.8	Engg.,Wool & Synthetic Fibre Chemicals,Rubber & Plastic											100	13.6
HARYANA							4387.5	23.81	733.9	7.12	14.88	9.36	3.11	3.78	3.15	4.27		
	FARIDABAD	51	5481	1.55	20.22	Textile Products,Chemicals Engineering Products											96.6	5.6
	GURGAON	15	4062	54.12	23.13	Engineering & Chemical Prod.'s											81.8	4.5
	ROHTAK	9	2135	NO GROWTH	17.06	Food Products,Metal Products Non-Metallic Minerals											88.9	3.1
	PANIPAT	8	3911	2.78	16.15	Food Products & Other Sectors											75	5.3
	REWARI	13	183	45.83		Wool & Synthetic Fibre Engineering Products											100	-
	SONEPAT	12		5.95		Food Products,Engg. Products											93.3	25.6
	PALWAL *		445		7.71													
NCT DELHI		53	13715	3.6	7.33		1014.73	59.07	246.1	17.97	2.04	5.37	0.47	1.92	0.2	2.97	78.7	17.2

* : TOWNS IN N.C.R.
@ : FIG. BASED ON ORG SAMPLE SURVEY

SOURCE : ORG, 1994.

Ghaziabad and NOIDA have more of large and medium (L&M) industries. These towns also have a large number of small industries. In fact, industrial growth in the NCR in influenced by NCRPB's development plans and policies. Distribution of industries by sub-regions, therefore, shows that U.P. and Haryana have larger concentrations of industries than DUT.[1]

1.2 A Profile of Large, Medium and Small Industries :

Table 1 provides a profile of the existing industries across different sub-regions and districts of NCR in terms of their scale, type, growth rate, income and environmental control.

- The number of L&M units are largest in Ghaziabad followed by Delhi, Faridabad and Noida. They are the least in Panipat, closely followed by Rohtak, while the rest districts comprising the class I cities have moderate number of units.
- The SSI units are far greater in Delhi other areas. Among the rest areas Faridabad, Meerut and Gurgaon have moderate development while Hapur has the least number of units.
- The fastest rate of growth in the entire organised industrial sector is evidenced in Gurgaon. While Faridabad has a high rate of growth in the SSI, its growth rate in L&M units is very small. Ghaziabad,

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1 Delhi has many SSI units.

Bulandshahr and Meerut show moderately high growth rate in both L&M and SSI sectors. The growth rate of SSI is the least in Alwar, although this centre exhibits one of the highest growth rate in L&M sector.

- Delhi shows the highest mean output in both L&M and SSI sectors, although its gross output in the former sector is the least. The Haryana sub-region appear to have a much superior industrial out put than the U.P. and the Rajasthan sub-regions.
- Also, the industrial income (value added) appears to be much higher in Haryana than the Delhi, U.P. and Rajasthan sub-regions.
- Furthermore, Haryana sub-region fares much better than other areas in term of in industrial employment in all sectors. While Delhi and U.P. sub-region have moderate employment in the small sector, in the L&M sector, employment is relatively poor, especially in Delhi. Rajasthan has the worst industrial employment scenario.
- In term of pollution control by industrial units, Bulandshahr is much better off than the rest, while the number of L&M units are moderate here. Ghaziabad and Faridabad are the two other centers having large number of L&M units where 95% of the units have obtained pollution Board NOCs. No information is available for Noida. Although Meerut and Gurgaon have larger SSIs than other regional centers, they hardly have any pollution

control measure. Similarly, only 17.2% of the 13715 SSI units in Delhi have pollution control measures.

Apparently, therefore, Delhi presents a scenario of very high presence but relatively low growth rate of small scale industrial sector while large and medium industries are phasing out of the capital through a policy of dispersal. Although Ghaziabad in U.P. in the strongest centre in term of number of L&M industrial units, it is the Haryana sub-region, represented primarily by Faridabad and Gurgaon which is far ahead of others in term of industrial output, value added and employment. Industrial pollution stress appears to be high in all growth centers, particularly in the SSI sectors and especially in Delhi, Gurgaon, Ghaziabad, Meerut and Panipat.

1.3 Sectoral Contribution to Gross Industrial Output

In UP sub-region textiles, electrical machines and rubber and plastic rank as the first 3 sectors contributing to the gross output of the sub-regions. In Haryana Sub-region textiles, machine tools, transport equipments, and metal products are the prominent sectors. In Rajasthan sub-region textiles, chemicals, basic metals and mineral resource based industries assumes significance. NCT Delhi shows high contribution to gross output through textile product, electrical machinery, basic metals and machine tools sectors.

Contribution to income by different sectors in UP sub-region indicate high contribution from chemicals, electrical machinery, cotton and woollen textiles and rubber and plastic. In Haryana sub-region textiles, machinery and machine tools and chemicals constitute the main sector contributing to the sub-regional income generation. In Rajasthan sub-region basic metals, textiles, chemicals and electrical machinery are the main industries. While in NCT Delhi basic metals, mineral products, textiles and chemicals add significant value.

2. A Scenario of Unorganised Industrial Sector Growth

Unorganised or informal sector industries have a strong presence across the region and particularly across the centers shown in the Table 2 . This sector represents a wide range of manufacturing/processing and service activities. Generally, located across residential environments of these cities, they pose acute health hazards and pollution problems in terms of noise, air pollution and effluent discharge. Municipal infrastructure to serve this sector is almost non-existent or insufficient in all clusters of growth of these industries, especially in terms of drainage and water supply. Power problem is also acute. Although these industries are enjoying strong linkages with the formal sector, they suffer from shortage of capital, marketing problems and lack of technical and financial assistance.

TABLE : 2

UNORGANIZED SECTOR PROFILE IN THE TOWNS OF N.C.R.

CITIES	TYPE OF INDUSTRY	NO. OF UNITS	CLUSTERS	AVERAGE EMPLOYMENT/ UNIT	TOTAL INVESTMENT/ UNIT(LAKHS)
MEERUT	Food Products,Textiles,Woodwork,Leather Rubber,Plastics,Mineral & Metal,Machinery Electrical Goods,Repairing Services Etc.	3534	8	4	2.08
GHAZIABAD	Food Products,Textiles,Wooden Items Printing,Leather,Rubber,Chemicals Minerals & Metal Products,Electrical Goods Machinery Parts,Tpt.Equipment,Repair Service	2808	5	5	1.9
FARIDABAD	Food Products,Woodwork,Textiles,Printing Rubber,Plastic,Mineral Products,Metalwork Electrical Goods,Transport Equp.,Other Services	690	6	3	2.26
SONEPAT	Food Products,Textiles,Woodwork,Printing Leather,Rubber,Plastic,Metal & Metal Products Machinery & Parts,Repair Services Etc.	365	6	3	0.93
GURGAON	Food Products,Wooden Products,Printing Leather Goods,Metal & Metal Works Machinery & Parts & Repair Services Etc.	451	8	3	2.26
ROHTAK	Food Products,Textiles,Woodwork,Printing Leather,Chemicals,Mineral Products Metal Products,Machinery,Electrical Goods Transport Equipment & Repair Services Etc.	1109	27	3	0.66
PANIPAT	(MAINLY TEXTILE UNITS WHICH HAVE NOW CONVERTED TO SMALL SCALE INDUSTRY)	1080	10		
DELHI	Food Products,Textiles,Woodwork,Printing Leather,Rubber,Plastic,Chemicals,Metal Metal Products,Machinery Parts,Electricals Transport Equipment,Other Services Etc.	75422		5	9.3

SOURCE : ORG,1994.

Their growth has been phenomenal especially in Delhi with migration of semi-skilled labour. The average employment as well as the total investment in this sector is also highest in Delhi among the cities of NCR. Among rest cities, Meerut and Ghaziabad are also large centers of informal industrial sector growth. While Panipat used to be one of largest centre in this sector, especially in textile until a few years back, most textile units here have since been registered and transferred to SSI sector.

3. Economic Development in General :

While the distribution of land is 5 percent for DUT, 44.4 percent for Haryana, 35.8 percent for U.P. and 14.8 percent for Rajasthan, human resources are 35.5 %, 25.1%, 5.4% and 34% for Delhi, Haryana, Rajasthan and U.P. respectively. Urban population constitute 52% and rural 48%. Demographic growth, in absolute terms, is the most in Delhi (32.2 lakhs out of 73 lakh for the whole region for 1981-91). Both land and population are important components of urban and economic development of a region. Hence details regarding use of land, its productivity, human resources and the overall economic benefits need careful analysis. In the case of NCR, this needs to be assessed and revised.

In the agricultural sector, the cropping pattern in the different sub-regions are:-

- Cereals and pulses in Delhi,
- sugar-cane in U.P.,
- cereals and oilseeds in Haryana,
- cereals and oilseeds in Rajasthan.

The total cropped area is 37.04 lakh hectares; and the net shown area is 24.89 lakh hectares. The total agricultural production is 216.52 lakh tonnes. There are 2000 flour mills in the NCR and 900 edible oil mills. The region has 300 dairy product industries. Land productivity is the highest in U.P. The total forest area in the region is around 0.9 lakh ha. About 50 percent of the total forest area lies in Haryana sub-region. Rajasthan and U.P. have 28 percent and 20 percent respectively. The area under forests is about 3.3 percent of the total geographical area in both Haryana and Rajasthan sub-region. This figure is high compared to the other sub-regions. As a result, Alwar, Rohtak, Sonepat and Rewari districts have many wood-based industries. Horticulture activities in NCR is limited to 7259 ha. Haryana, U.P. and Delhi has 41 percent, 33 percent and 18 percent of this area under horticulture.

The livestock population is to the tune of 67.4 lakhs, with 25.7 lakh poultry birds in the region. Haryana and U.P. have 39% and 35% of the region's livestock population, respectively. Haryana and Rajasthan sub-regions have significant mineral-wealth. Haryana has kaolin and silica-

sand, used in glass and ceramic manufacturing. Rajasthan has copper, feldspar, fire clay, quartz and steatite. Literacy, also, is a very important factor of development. DUT has a literacy level of 75% (1991). But the other sub-regions, Haryana, Rajasthan and U.P. have only 40%, 20% and 44% literacy. Urban literacy, as usual, is higher than rural literacy. Work participation (main workers) is the most in Delhi and least in U.P. sub-regions. Among the towns NOIDA has 33%, Delhi has 32%, and Panipat and Faridabad 30% each. The other towns range between 25% to 30%. The average figure for NCR is 29%. The NCR is characterised by large scale development in the primary sector, and industry, trade and commerce in the secondary & tertiary sectors. But the primary sector, which employs majority of the people, contribute the least. Income from agriculture is to the tune of Rs.2.4 thousand crores. Haryana and U.P. contribute about 36% and 32% of the agricultural income. Industry contributes 13.1 thousand crores. Small scale industries contribute 54%, while large and medium 46%. Income generation in the tertiary sector is around 10 thousand crore rupees, of which Delhi contributes 96%.

The DUT stands out as the single largest and dominating sub-region of the NCR in terms of population, infrastructure development and economic development. The employment scenario in Delhi is as follows:-

- total employment is 26.9 lakhs out of 36.6 lakhs for NCR (73.50%);
- sectors providing employment are household industry, trade and commerce, transport, communication and other services;
- construction sector has led to large in-migration of labour and growth of slums;
- employment increase in trade and commerce has been because of the favourable tax structure and Delhi's infrastructure facility and growing market;
- public sector employment is to the tune of 6.2 lakhs;
- efforts to shift offices outside Delhi has failed;
- local bodies within Delhi provide employment to 1.87 lakhs;
- wholesale traders in Delhi grew by 63% between 1981-91. Dispersal of wholesale trade to other areas has lowered its growth rate;
- non-agricultural enterprises grew by 58% between 1980-90;
- social, commercial and personal services have grown significantly.

The percapita expenditure in infrastructure in Delhi is Rs. 2365 as compared to Rs.1428 for Haryana, Rs. 985 for Rajasthan, and Rs. 854 for U.P.

As per the latest statistics available, Delhi has about 95,000 industrial units of all categories. Of this, only 173 are large and medium industries, and 21,000 small scale industries. The remaining are all in the household sector. It generates employment to the tune of 7.65 lakhs. The

percapita subsidy in Delhi is Rs. 623 (1981-91), which is 21% of the per capita income. The same in the other towns does not exceed Rs.22. It indicates the differential benefits enjoyed by the Delhities. Unemployment is to the tune of 11.6 lakhs (1989). Delhi alone accounts for 69% of the job seekers. Employment has become difficult over the years while 25.7% of the registered applicants got employment in 1987, this percentage has reduced to 12.6% in 1991. The employment position in the other sub-regions is also not encouraging. The size of the marginal workers is considerable in the rural areas, and needs effective employment generating schemes.

The ORG study (1994) indicates that considerable institutional strengthening is necessary for skill training for the unorganised industrial sector. It is recommended that PHDCCI and state industries departments through DICs can organise routine training and capacity building.

4. Industrial Resources and Potential Activities

4.1 A profile of industrial resource base across the NCR (excepting Delhi) is presented is Table 3 . Infrastructural resources for urban-industrial developments have been dealt separately in different sections of this study, i.e., on land, transportation, power/energy, shelter, water supply, etc.[2]

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[2] Also see the Table on Relative Carrying Capacities of NCR Cities.

Potential industrial activities in different centers have been outlined in Table 4 .

- Forest resources are the highest in Alwar district, followed by Gurgaon, while they are lowest in Ghaziabad.
- The supply of main workers is the highest in Meerut, followed by Bulandshahr and Ghaziabad (all in U.P.), while Sonipat, Panipat and Gurgaon represent the lowest end of manpower supply.
- Gurgaon, Bulandshahr, Alwar and Meerut are much more endowed than other districts in terms of live stock resources;
- Mineral production is highest in Faridabad. Alwar has a high production of copper ore . Most other district either do not produce or have very little mineral production.
- All the districts of U.P. sub-region, especially Bulandshahr, have higher agricultural production than other part of NCR.

5. Institutional Resources and Policies

5.1 Industrial Locational Policies

The NCR planning board has laid down certain policies with regard to location of different types of industrial activities across the NCR:

- Large and Medium scale industries should not be promoted within Delhi.

TABLE 3

DISTRICTWISE DISTRIBUTION OF INDUSTRIAL DEVELOPMENTAL RESOURCES

RESOURCES	HARYANA SUB-REGION						UTTAR PRADESH SUB-REGION			RAJASTHAN SUB-REGION
	FARIDABAD	GURGAON	ROHTAK	SONEPAT	PANIPAT	REWARI	MEERUT	GHAZIABAD	BULANDSHAHR	ALWAR
LAND(IN '000 HA) (1989-1990)										
Total Reporting Area	208	275	445	134	175	155	391.7	259.5	436.5	766.5
Gross Cropped Area	240	255	487	160	242	191	503.3	302.1	597.8	654.7
Net Irrigated Area	79	94	259	105	151	93	287.4	173.9	306.8	310.8
Forest Area	6	15	8	8	5	4	8	2.6	8.2	25.3
HUMAN RESOURCES (1991) LAKHS										
Population	14.77	11.46	18.09	7.55	8.33	6.23	34.48	27.04	28.5	14.4
Main Workers	4.24	3.18	5.3	2.21	2.41	1.5	9.79	7.36	7.58	4.07
% Main Workers to Total Popn.	28.7	27.77	29.29	29.27	28.93	24.07	28.39	27.21	26.59	28.26
Marginal Workers	0.24	0.49	0.38	0.11	0.12	0.23	0.73	0.81	0.67	1.31
LIVESTOCK RESOURCES ('000 NO.'S)(1988)										
Cattle Population	533	582	774	496	206	292	1076	140	1450	1419
Poultry Birds	106	1185	173	251	63	22	143	142	200	148
MINERALS PRODUCTION(1989-90)MT										
Silica Sand	266060	4390	NIL	NIL	NIL	NIL	NIL	NIL	NIL	
Sulphur					3662					
Copper Ore										27378
AGRICULTURAL PRODUCTION ('000 TONNES) (1989-90)										
Cereals										
Wheat	327	258	573	266	426	144	501.4	307.6	635.7	312.8
Bajra	26	54	47	51	196	66	43.5	49	221.3	130.4
Pulses	7.1	7.7	38.1	131	5	13	10.2	11.3	39.5	29
Oil Seeds	25.4	73.4	102.2	4	1	80.1	4	3	17.5	206
Sugarcane	37	5	126	39	39		9894.6	2973.8	2680.1	3
Cotton			17	1	1				0.1	
INDUSTRY DEVELOPMENT(1992-93)										
L & M Units (No.'s)	162	64	27	39	13	43	29	262	32	84
SSI Units (No.'s)	14286	14549	11598	8188	5886	778	7704	7595	5545	10514

Source : ORG ;(1994).

TABLE : 4

POTENTIAL INDUSTRIAL DEVELOPMENT IN THE CITIES OF N.C.R.

CITIES	POTENTIAL INDUSTRIAL ACTIVITIES	
	TYPES	MAJOR SECTOR
FARIDABAD-BALLABGARH	MACHINE TOOLS : Earthmovers & Tools,Hydraulic Jack AUTOMOBILE & PARTS : Two Wheelers,Light Vehicle,Pistons,Springs AGRICULTURE IMPLEMENTS & PARTS :- Tractor, Crushers Etc. COMMUNICATION & TRANSPORT SECTOR :- Printing Press,Tpt.Parts & Ancillary Units	DEMAND BASED INDUSTRY
	CONFECTIONERY ITEMS :- Bread/Biscuits	CONSUMER PRODUCT INDUSTRY
	GARMENT,LEATHER GOODS & MISC. :- Readymade Garments & Leather items. Ball Pens & Drinking Items. Rubber Products. Nickel Etc.	NON-DURABLE CONSUMER PRODUCT
GURGAON	Food & Allied Products. Dairy & Confectionery. Wood Based Furniture Fixtures.	RESOURCE BASED PRODUCTS
	Electronic Products. Computers,Accessories & Peripherals. Communication & Transportation Items.	DEMAND BASED PRODUCTS
	PVC Footwear. Chemicals & Paints Paper Products & Napkins. Plastic Products	NON-DURABLE CONSUMER PRODUCT
PANIPAT	HANDLOOM & TEXTILE UNITS :- Power Loom Products Spinnning & Weaving Products FOOD & AGRO-PROCESSING UNITS :- Rice,Dal,Flour Mills Sugarcane Crushing Units Sericulture,Mushroom,Floriculture Units Distillery Units DAIRY,POULTRY & ANIMAL PRODUCTS :- Milk Chilling Plant Chicken Nursery MACHINE & METAL UNITS :- Steel/metal Ancillary Units	SKILL BASED PRODUCTS
SONEPAT	Cattle/Poultry Feed Cold Storage,Flour Mill,Bone Mill Dehydrated Vegetables,Canning Of Mushrooms	RESOURCE BASED INDUSTRY
	Engineering Workshop,Agri.Implements Ice Cream,Tyres,Leather Goods,Sports Goods Plastic Goods,Electric Motors & Appliances	DEMAND BASED INDUSTRY
	Cycle Parts,Corrugated Boxes	ANCILLARY INDUSTRY

	Wax Coated Paper,Polishing Units Automobile Tyre/Tubes,Electroplating	
ROHTAK	AGRO BASED INDUSTRIES :- Sugar/Khandsari,Oil,Flour,Dal Mills Dehydrated Canned Vegetables & Fruits Cotton Spinning Mills ANIMAL RESOURCE BASED INDUSTRY :- Dairy & Milk Products,Leather Products	RESOURCE BASED INDUSTRY
	Nut/Bolt Making,Metal & Alloy Units Plywood Units,Polythene Granules Making Bulb/Tube,Bread Making,Agri. Implements Brick-Kilns,Wood Based &Chemical Prod. Units	DEMAND BASED INDUSTRY
GHAZIABAD	AGRO & DAIRY BASED UNITS ;- Bread/Confectionery,Milk Chilling Plants Dehydrated & Canned Vegetables & Fruits Ice Cream,Cheese And Beer	RESOURCE BASED INDUSTRY
	Machine Tools And Parts Electrical Appliances,Readymade Garments	DEMAND BASED INDUSTRY
	CHEMICAL & ALLIED DISTILLERY :- Industrial Alchol	NON-DURABLE CONSUMER INDUSTRY
HAPUR	AGRO & ALLIED PRODUCTS :- Flour Mills/Dal Mills,Veg. & Oil Mills Dehydrated Canned Vegetables & Fruits ANIMAL & LEATHER TANNING :- Leather Based Processing Units Hand Bag/Shoes Units	RESOURCE BASED INDUSTRY
MODINAGAR	AGRO BASED UNITS :- Sugarcane Processing Units Molasses & Distillery Units	RESOURCE BASED INDUSTRY
	CHEMICAL & FOUNDRY UNIT :- Cotton & Spinning Units	NON-DURABLE CONSUMER INDUSTRY
MURADNAGAR	Sugar Mills	
	Carpet Units	
PILKHUAN	Handlooms Printing of Cloths	
GARHMUKTESH	AGRO & DAIRY BASED :- Sugar Mills,Dairy & Milk Products Fruits & Vegetable Processing Units Furniture (Sarkanda Wood)	RESOURCE BASED INDUSTRY
MAWANA	AGRO BASED INDUSTRY :- Agro Processing Units,Sugar Mills Dairy & Milk Product Units	RESOURCE BASED INDUSTRY

NOIDA/ GREATER NOID	DOMESTIC TARIFF AREA MEDIUM & LIGHT ENGG. :- Machine Tools & Parts GARMENTS & TEXTILES :- Readymade Garments ELECTRICAL GOODS :- Domestic Appliances : Washing Machines Toasters/Irons Etc. ELECTRONIC GOODS AUTOMOBILES :- Heavy Vehicles HOSIERY & TEXTILE UNITS :- Socks,Gloves,Under Garments Etc.	DEMAND BASED INDUSTRY
	FOOD PRODUCTS :- Vegetable Processing Units Dehydrated Canned Vegetables & Fruits Beverages,Beers,Waffers & Noodles	RESOURCE BASED INDUSTRY
	EXPORT PROCESSING ZONE Electronic,Software,Hardware Communication,Jewellery,Garments Etc.	
ALWAR	Oil/Dal Mills,Confectionery Dehydrated Canned Vegetables & Fruits	RESOURCE BASED INDUSTRY
	News Print,Match Box,Match Splints Packing Boxes,Tissue Paper	FOREST RESOURCE BASED UNITS
	Dairy & Milk Products,Leather Products Sports Goods	ANIMAL RESOURCE BASED UNITS
	Baryte Produce Compounds Sulphate/Soda Ash/Carbonate Etc. Common Salt Fertilizer Industry Ammonium Phosphate Copper Based Units Lead/Zinc Based Units Asbestos/Mica Based Units Cement & Ceramic Based Units Textile Synthetic Yarn Units	MINERAL BASED UNITS

Source : ORG (1994)

- Non-conforming, obnoxious and polhising industries should be relocated outside Delhi and the DMA.
- The growth of large and medium scale industries should be restricted in the DMA towns in favour of their growth in the priority towns & units in the DMA may be permitted for a period of 10 years and thereafter the locational policy would be reviewed.
- There should be incentives for all industrial sectors in the priority cities comparable to those given for back ward areas.

5.2 **Proposed Mega Projects**

Several large environment - friendly projects in self-contained locations (urban-infrastructure wise) have been recently conceived in order to explore emerging overseas as well as national market and to decentralize Delhi.

- Textile Valley is a HUDA project over 642 areas of land located 70 kms from Delhi on Gurgaon - Alwar Road to accommodate 111 small and medium scale textile processing units.
- A Freight City has been proposed near Gurgaon along the lines of Frankfurt and Singapore models which may include power projects, express highways, tourism and sports complexes and food processing units.
- Tourism projects, which have been accorded industrial status are proposed especially along Delhi-Gurgaon-Alwar-

Jaipur portion of NH8 and around Sohna-Rewari-Alwar region.

- Software Technology Parks (STP) are being set up by the DOE as 100% export oriented schemes. One STP has been established in NOIDA. Another is on the way in Gurgaon.
- Electronic City for export oriented electronics and software development is being set up in Gurgaon.
- Electronics Hardware Technology Park (EHTP) is proposed in Gurgaon jointly by the HARTRON and the HUDA with the help of DOE.

CHAPTER 2

DEMOGRAPHIC PROFILE

Introduction:

Delhi has been a focal point of politics and administration for India from historical times. Modern Delhi is the ninth capital after Indraprastha, Mehrauli, Lalkot, Siri, Tughlaquabad, Firozabad, Shahjahanabad and New Delhi. Along with the changing status, Delhi's area has been redefined by each ruler. Today Delhi has grown so large, that it has not only encompassed all the capitals of the past, it even extends beyond them. The 1991 population of the Union Territory of Delhi (DUT) is 9,420,644, spread over an area of 1483 sq. kms.

Till 1941 Delhi's population was less than one million. But immediately after Independence, around 50 lakh refugees shifted to Delhi (NCR Plan) because of the partition. Between 1941-51, Delhi recorded a growth of 90 percent (Urban Environment Maps, 1994). To provide employment and livelihood to the new entrants, the government and the local administration encouraged setting up of industries, and wholesale and retail trade activities, all of which had a snowballing effect that was detrimental for the city (Review of Master Plan of Delhi; 1973). A total of 1.50 lakh migrants came to Delhi between 1971-81. As a result, the urban area of DUT spread to about 30 percent of its 1971 area. In 1981, 27 new census towns were added, which increased the area to 591.85 sq. kms. from an area of 446.26 sq. kms. in 1971. The 1991 census records 23 census towns for Delhi.

Industrial growth was given an impetus in the 1960s. It was once again reiterated in the 1980's, with the suggestion to locate obnoxious industries away from the city centre to the periphery to prevent pollution. This helped the population to spread to the neighbouring ring (DMA) towns that grew even faster than Delhi. Between 1951 and 1981 Delhi grew by 300 percent (NCR plan); whereas the growth of the ring towns in just one decade (between 1971-81) recorded a growth of 567 percent.

With the population growing at a phenomenal rate, and with the city expanding to contain the ever-increasing population, it was realised very early (in the history of Delhi's planning) that a comprehensive Master Plan of Delhi is essential, specially as Delhi was a centre of attraction for northern India.

The Delhi Development Authority was constituted under the Delhi Development Act of 1957 to formulate a Master Plan for the city. The first Master Plan of Delhi (1962) was a landmark in the history of planning in post-Independence India. The Plan adopted a *restrictive policy on employment generation* to cope with the migration, that was mostly from the adjoining states of U.P., Haryana and Rajasthan. It was decided that the Ministries of the Central government would be in DUT, while the public sector undertakings should be spread out to the surrounding areas. It was also decided that the non-nuisance small scale industries should be retained within the city, while the polluting industries should be encouraged to move out of DUT. This necessitated the demarcation

of the Delhi Metropolitan Area (DMA) that would include DUT, Faridabad-Ballabgarh complex, Ghaziabad-Loni complex, NOIDA controlled area, Gurgaon, Bahadurgarh and Kundli. The area would cover 3,182 sq.kms. and help to decongest Delhi.

Rapid population expansion alerted the government. Planners, even as far back as 1959, when the Master Plan was being prepared, became aware of the on-coming problems and recommended the formation of a National Capital Region Planning Board, by way of caution, to harmonise and balance the development of the region, which was ultimately set up in 1985 to formulate a Regional Plan for Delhi till 2001.

The Master Plan of Delhi had envisaged a population of 53 lakhs in 1981, and had assigned 46 lakhs for Delhi and 7 lakhs for the surrounding ring towns (i.e. DMA towns). But as the 1981 census recorded a population of 57.3 lakhs for DUT, it meant Delhi had an excess population of 11 lakhs as per the plan provisions. In other words, Delhi's population grew faster than what had been anticipated. Worse still, since the population of the ring towns grew by 567 percent during 1971-81, without much decline in Delhi's population, it was realised that the *polynodal pattern* of urbanisation which was being thought of, did not really help to check concentration of people within Delhi. In fact, people working in the ring towns preferred living in Delhi for better infrastructural facilities.

The outcome of this rapid growth was a shortage of infrastructural services (water, sewerage & garbage disposal, electricity, transportation and other basic services) by the prescribed standards, so that the social costs of agglomeration shot up (NCR Plan). The main objectives of the NCR Plan in 1988 were, therefore, to:

- relieve the capital of additional pressures;

- avoid adding new pressures onto the capital; and

- remodel the settlement pattern of the NCR to enable the towns to play their assigned roles.

The NCR Plan suggested a 4 tier structure of settlements with regional, sub-regional, service centres, and basic villages to solve all problems. It was also planned to organise the settlements functionally. The desirable population sizes suggested were -

1.	regional centres	-	300,000 and above
2.	sub-regional centres	-	.5 - 3.0 lakhs
3.	service centres	-	10,000 to 50,000
4.	basic villages	-	less than 10,000

The *regional centres* were considered to be the *priority towns* for the dispersal of population outside DMA. The towns identified were:

1. Meerut (Class I in 1991)
2. Hapur (Class I in 1991)
3. Bulandshahr (Class I in 1991)
4. Khurja
5. Panipat (Class I in 1991)
6. Rohtak (Class I in 1991)
7. Rewari
8. Palwal
9. Alwar (class I in 1991)

These towns were expected to accommodate Delhi-bound potential migrants by creating employment opportunities in secondary and tertiary sectors.

The *sub-regional* centres were to function as sub-divisional headquarters. In addition, they were also to serve as the first stage industrial centres with agro-economic and marketing facilities.

The *service centres* were to cater to the rural hinterland as agro-service centres, while the *villages* were to develop to provide day to day needs of the village clusters.

Over and above the 4 tier structure, suggestions for counter magnets were given, to be selected in consultation with the concerned State Governments. But these counter - magnets were advised to be located far enough to prevent daily commuting. It

was envisaged that these towns should have well established roots and inherent potentials to function as independent growth centres, have social and economic viability, nodality with respect to transportation network, and good quality physical linkages.

The counter-magnets were to play mutually complementary roles with the NCR in intercepting migratory flows from the less developed areas adjoining the NCR, and work as regional growth centres in their own setting, to balance the pattern of urbanisation.

The nodality considerations for selecting the counter magnets were :

- a range of 250-300 kms. from the NCR boundary, or 350-400 kms. from Delhi, representing 6 hours of travel time at the existing transportation conditions (without impairing its developmental autonomy & functional identity as regional growth centres as well). The NCR also suggested that the distance range could be extended with technology changes;

- the search zone for the counter magnets should be between 100-400 kms. of radius from Delhi, in the states of Haryana, Punjab, Rajasthan, Madhya Pradesh & Uttar Pradesh;

- they should also be spatially complementary to balance size, function and linkages; and

- the size of the countermagnets should be 3 lakhs and above to ensure an established service area and basic social and economic infrastructures.

Development of counter-magnets would require coordinated efforts of the States, the Centre and the NCRPB, and it was thought that location of these towns would help to guide migration.
The selected countermagnets, on the basis of population, distance, function and infrastructural parameters were:

Haryana

1. Hissar
2. Yamuna Nagar/Ambala/Karnal

M.P.

1. Gwalior

Punjab

1. Patiala
2. Bhatinda/Ludhiana

Rajasthan

1. Kota
2. Sikar/Ajmer

U.P.

1. Bareilly
2. Moradabad/Saharanpur/Allahabad

The consultants who were given the task to select these towns suggested that five cities should be selected from this list initially, one from each state. This would have to be done in coordination with the state's-development programmes.

The immediate counter-magnets were synchronized with the cardinal directions. They are (1) Hissar in Haryana (Westerly direction), (2) Patiala in Punjab (northerly direction), (3) Gwalior in M.P. (south-easterly direction, (4) Kota in Rajasthan (south-westerly direction) and (5) Bareilly in U.P. (easterly direction). It was decided that the counter-magnets would have specific action programmes for the first five years, which would have to be prepared by the State government/implementing agencies, indicating investment implications relating to development of physical & social infrastructures, economic activities such as industries, commerce & services, housing / environmental improvements etc. in the State sector, and development of transport (National Highways & Railways) & telecommunications in the Central Sector. The concerned State government should take steps to formulate a special programme to integrate state programmes to the countermagnets, and set apart special funds (revolving) for the purpose. In turn, the NCRPB would extend technical assistance and incorporate a separate budget head for helping the countermagnets. Monitoring, however, will have to be done by the Central government.

With an expansive plan, such as this (mentioned - above), the NCRPB has suggested monitoring of growth of Delhi and its surrounding till 2001. How far the plan has come to fruition after a decade, will be assessed from the existing population distribution pattern and growth, as a result of the developments that have taken place till now.

The NCR Components and Population Distribution

The NCR has an area of 30242 sq. kms. and a population of 2,59,16,892 (1991 census). The 4 major components of NCR are:

Chart 1

Components of NCR with Constituting Districts

Sub region	No.	Districts
1. NCT (DUT)	1	Delhi
2. Haryana	6	1. Faridabad 2. Gurgaon 3. Rohtak 4. Sonepat 5. Mahendragarh (Rewari & Bawal Tehsils) 6. Panipat
3. U.P.	3	1. Meerut 2. Ghaziabad 3. Bulandshahr
4. Rajasthan	1	Alwar (Alwar, Ramgarh, Behror, Mandawa, Kishangarh, Tijara Tehsils)

The Region encompasses a total of 11 districts with Mahendragarh of Haryana and Alwar of Rajasthan being not totally conterminous with the NCR boundary, as only portions of these districts have been included.

The breakup of the components with their areal and population contents indicate concentration of population in DUT, with the smallest area having the largest population. In all the other sub-regions, the population spreads over much larger areas, thereby reducing the density:

1. the Union Territory of Delhi (DUT), with 1483 sq. kms. occupying 4.90 percent of the total area of the Region, and containing 36.35 percent of the population;

2. the Haryana sub-region of 13,413 sq.kms. which is 44.35 percent of the NCR area holding 24.66 percent of the population;

3. the U.P. sub-region of 10853 sq. kms. constituting 35.88 percent of the region, and containing 34.73 percent of the population;

4. the Rajasthan sub-region of 4,493 sq.kms., occupying 14.85 percent of the NCR area and having 4.24 percent of the population.

Table 1
Share of NCR Constituents

Components	Area in sq.kms.	Percent share in NCR's area	Percent population to NCR 1981	Percent population to NCR 1991	Population Growth 1981-91	Percent share in the state area	Percent population of the state	
							1981	1991
DUT	1483	4.90	32.41	36.35	51.45	100.00	100.00	100.00
Haryana Sub-region	13413	44.35	25.74	24.66	29.35	30.33	19.91	38.82
UP Sub-region	10853	35.88	36.32	34.73	29.12	3.68	3.27	6.47
Rajasthan Sub-region	4493	14.85	5.52	4.24	3.77	1.31	1.61	2.50
NCR	30242	100.00	100.00	100.00	-	-	-	-

Source:

1. NIUA (1988); National Capital Region: A Perspective on Patterns and Processes of Urbanisation.
2. NEERI (1991); Carrying capacity Based Developmental Planning of National Capital Region: Interim Report, Nagpur.
3. Census of India, 1991.

FIG 1: **Population Distribution of NCR Components**

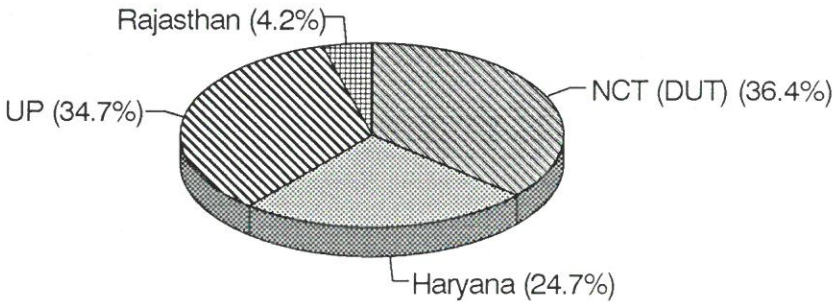


FIG 2: **Area Distribution of NCR Components**

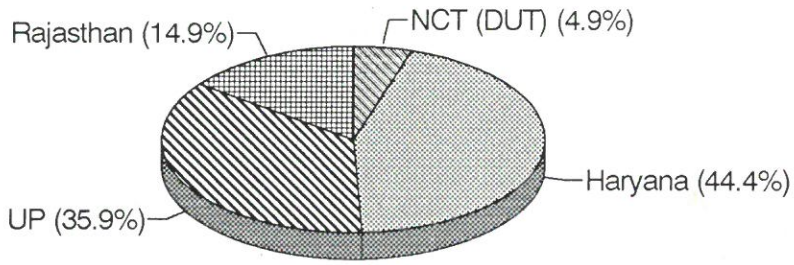


FIG3: **Population Distribution**
1991

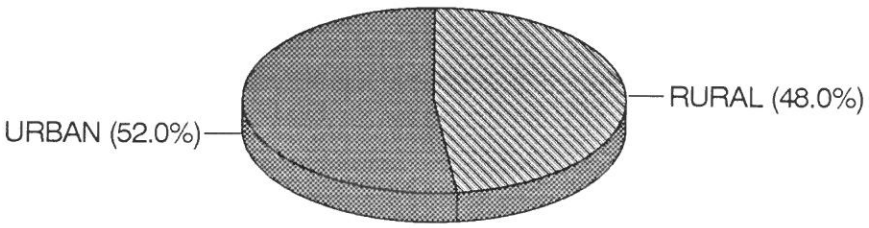
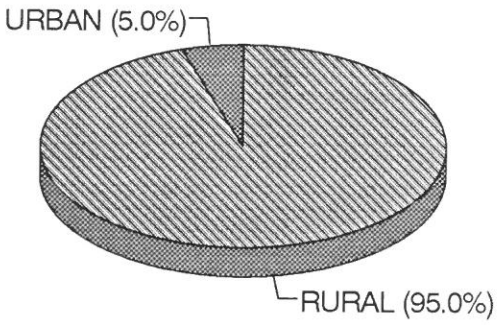


FIG4: **Area Distribution**



Of the total NCR area, 1498.9 sq. kms. (5%) is urban and 28743.1 sq.kms. (95%) rural (1981). The 1991 population contained in the areas are 1,36,49,531 (approx 52%) and 1,22,67,361 (approx 48%) respectively. That is, 52 percent of the population live in 5 percent urban area, and 48 percent of the population live in 95 percent rural area. The assigned urban population for 1991 by the NCRPB was 148.9 lakhs, which has not yet been attained; indicating a reduced growth of about 12 lakhs. But the number of urban settlements have increased from 94 (in 1981) to 107 (in 1991) indicating a change in employment and the way of life within the NCR (Moitra: 1995).

Going by the total 1991 assigned population of 254.1 lakhs, NCR's population has overshot its target by about 5 lakhs. At the same time there is a decline in the urban population by 12 lakhs. It means there is an increase of about 17 lakhs of rural population in the NCR between 1981-91. This excess rural population is actually concentrated on the periphery of large urban centres. Because of shortage of housing in urban areas, which otherwise offers employment, a section of the population work in urban areas, but live in rural areas close to the towns.

Table 2

National Capital Region: Distribution of Urban Area and Patterns of Urban Density by Subregion, 1961-81

Name of the sub-region	Urban area (in sq.kms.)			Percentage variation in urban area		Density of urban population			Density of total population		
	1961	1971	1981	1961-71	1971-81	1961	1971	1981	1961	1971	1981
Delhi	326.5	446.3	591.9	36.69	32.62	7726	8172	9745	1792	2738	4195
Haryana	99.6	140.9	365.2	45.46	159.98	4690	4854	3304	216	283	368
Rajasthan	44.8	61.6	121.6	37.5	97.4	1623	1803	1431	127	171	237
Uttar Pradesh	169.5	210.3	420.2	24.07	99.8	4594	5199	4638	405	502	642
NCR	640.4	859.1	1498.9	34.50	74.47	5743	6438	6070	347	466	635

Source: 1. NIUA (1988); NCR: A perspective on Patterns and Process of Urbanisation.

2. NEERI (1991); Carrying Capacity Based Developmental Planning of National Capital Region: Interim Report, Nagpur.

Distribution of **urban density** indicates ver high concentraion of population in the Delhi sub-region. Within the DUT there are three local bodies, and 23 census towns. The area, population and density distribution of the three local bodies are given in table 3.

Table 3
Growth of Population in Urban Delhi

Urban local body	Area (sq.kms.)	1971		1981		1991	
		Population	Population density (persons/sq. km.)	Population	Population Density (Persons/sq. kms.)	Population	Population density (persons/sq. kms.)
Delhi Municipal Corporation (Urban)	360.55	3287883	9119	4884234	13547	7174755*	19899
New Delhi Municipal Committee	42.74	301801	7061	273036	6388	294149*	6882
Delhi Cantonment Board	42.97	57339	1334	85166	1982	94326*	2195

* Provisional Population
Census of India 1981, Series 28, Delhi and Census of India (1991), Series 31, Delhi.
Source: NIUA (1994); Environmental Maps, New Delhi.

Whereas the cantonment is becoming dense very slowly, New Delhi's population density is controlled by restrictions on landuse and the built environment. It is therefore, only the MCD area that is growing in Delhi.

The rural-urban distribution of the population and area of DUT is as follows:

Table 4

Urban and Rural Population in Delhi Union Territory

	Year	Area (Sq.Km.)	Population	Population Density (Persons/sq. km.)
Urban Delhi	1981	591.9	5768200	9745
	1991	591.9	8471625	14313
Rural Delhi	1981	891.1	452206	507
	1991	891.1	949019	1065
Delhi Union Territory	1981	1483.0	6220406	4194
	1991	1483.0	9420644	6352

Census of India (1991), Paper 2 of 1992. Final Population Tables.
Source: NIUA (1994); Urban Environmental Maps.

Urban Delhi, as one can see in the table, is much more congested than DUT as a whole.

The Delhi Development Authority has divided the entire Union Territory into 15 divisions. Out of these 8 divisions form the urban area. In 1981 division 'A' (walled city area) had the maximum population density; while division 'F' (South Delhi Area) had the lowest density.

Table 5

Density Implications of the DDA 2001 Plan

District		Area (ha)	Master Plan Population	Master Plan Density	Population 1981	Population Density 1981 (per ha.)	DDA Holding Capacity	DDA Holding Capacity Density	DDA 2001 Population	DDA 2001 Density
Saturated	A. Old City	1159	322600	278	622207	537	420460	363	420460	363
Marginal Potential	B. Karol Bagh	2304	398200	173	267804	246	630000	273	619200	269
	C. Civil Line	3959	387685	98	530547	134	750800	190	712055	180
Higher Potential	D. New Delhi	6855	634100	93	496058	72	754658	110	703510	103
	E. Trans Yamuna	8797	969270	110	1028794	117	1789300	203	1638080	186
	F. South Delhi I	11958	827125	69	822200	69	1278425	107	1191840	100
	G. West Delhi I	11865	803175	68	868277	73	1489600	127	1369100	115
	H. Northwest Delhi	5677	920485	162	517687	91	1865270	329	1597900	281

Source: Banerjee (1994); Carrying Capacity Population Pressure and Infrastructure Stress: Toward a Methodology for Managing Regional Growth, NIUA, New Delhi.

As per the density assigned by DDA (1990), the old city is totally saturated. Karolbagh and Civil Lines have marginal potential for absorption and all other divisions have high potential to hold more. In the absence of 1991 population data for these divisions, discussions with DDA officials revealed that most of the divisions have reached their saturation point. However projected population density does not indicate so.

The population assigned by the Interim Development Plan of NCR for the Region as a whole, the DMA, and the DUT is as follows:

Table 6

(in lakhs)

Area	Population Assigned - 2001		
	Urban	Rural	Total
NCR	234	91	325
DMA	147	3	150
DUT	110	2	112

The **towns** of NCR can be categorised into Delhi Metropolitan Area (DMA) towns, the priority towns and the sub-regional towns. The 1991 population distribution of these towns indicate concentration in DMA.:-

Table 7
Distribution of Population in Town Groups within NCR (1991)

(Percent)

Year	DMA	Priority	Sub-regional
1991	73.20	14.53	12.40

The DMA towns can be further classified as DUT and other DMA towns such as Faridabad -Ballabhgarh complex, Gurgaon, Kundli, and Ghaziabad - Loni complex and NOIDA. The population distribution of the class I cities within the DMA shows that even though growth has been very high in the recent past, these towns still have not been able to draw away people from Delhi.

Table 8
Population Distribution of Class I Towns within DMA (1991)

Towns	Percent Population
Delhi	84.5
Faridabad	6.2
Ghaziabad	5.6
NOIDA	
Gurgaon	3.7

As already mentioned, Delhi has grown at an average rate of 50% per decade. If Delhi continues to grow at this rate the population would increase to 123,71,701. Which means Delhi's population will be 12,00,000 in excess of the assigned population. It also means that the other towns are not growing very fast to retard Delhi's growth.

If each individual class I town is considered, Gurgaon, NOIDA, Hapur, Bulandshahr - Khurja, Panipat, Rohtak, Alwar and Ghaziabad will be able to hold many more people by 2001, as there are wide gaps between the assigned population and the 1991 population. The Delhi Union Territory, Meerut and Faridabad - Ballabhgarh will not be able to absorb much.

Table 9
Population as proportion of assigned population for 1991 and 2001

(Population in lakhs)

Towns	Assigned - 2001 Population	1991 Census	% 1991 population to assigned population	2001 Projected Population	% to 2001 Projected Population
DUT	112	94.21	84.11	123.71	110.45
Faridabad-Ballabhgarh	10	6.14	61.40	11.53	115.30
Gurgaon	7	1.34	19.14	1.83	26.14
Ghaziabad-Loni	11	5.19	47.18	9.1	82.73
NOIDA	5.50	1.46	26.54	-	
Meerut	13	8.47	65.15	13.46	103.54
Hapur	6	1.46	24.33	2.08	34.67
Bulandshahr-Khurja	10	1.27	12.70	1.56	15.60
Panipat	5	1.91	38.20	2.65	53.00
Rohtak	5	2.15	43.00	.95	19.00
Alwar	5	2.11	42.2	3.02	60.40

Source: 1991 Census 2, NCR Regional Plan 2001.

Even by the projected population estimates of 2001, the above pattern will continue; except that DUT, Faridabad and Meerut would reach their saturation point.

The rank size distribution of the NCR towns indicates a primate position for Delhi. Its growth has not reduced. At the same time, Meerut, Faridabad and Ghaziabad is gaining more population. Even though the towns are expanding in population, they have not reached the rank-size equation vis-a-vis Delhi. So that as per the norms of a settlement system, there is scope for the other towns to grow and gain an optimal population in the settlement system.

FIG5: NATIONAL CAPITAL REGION: RANK-SIZE DISTRIBUTION OF CITIES

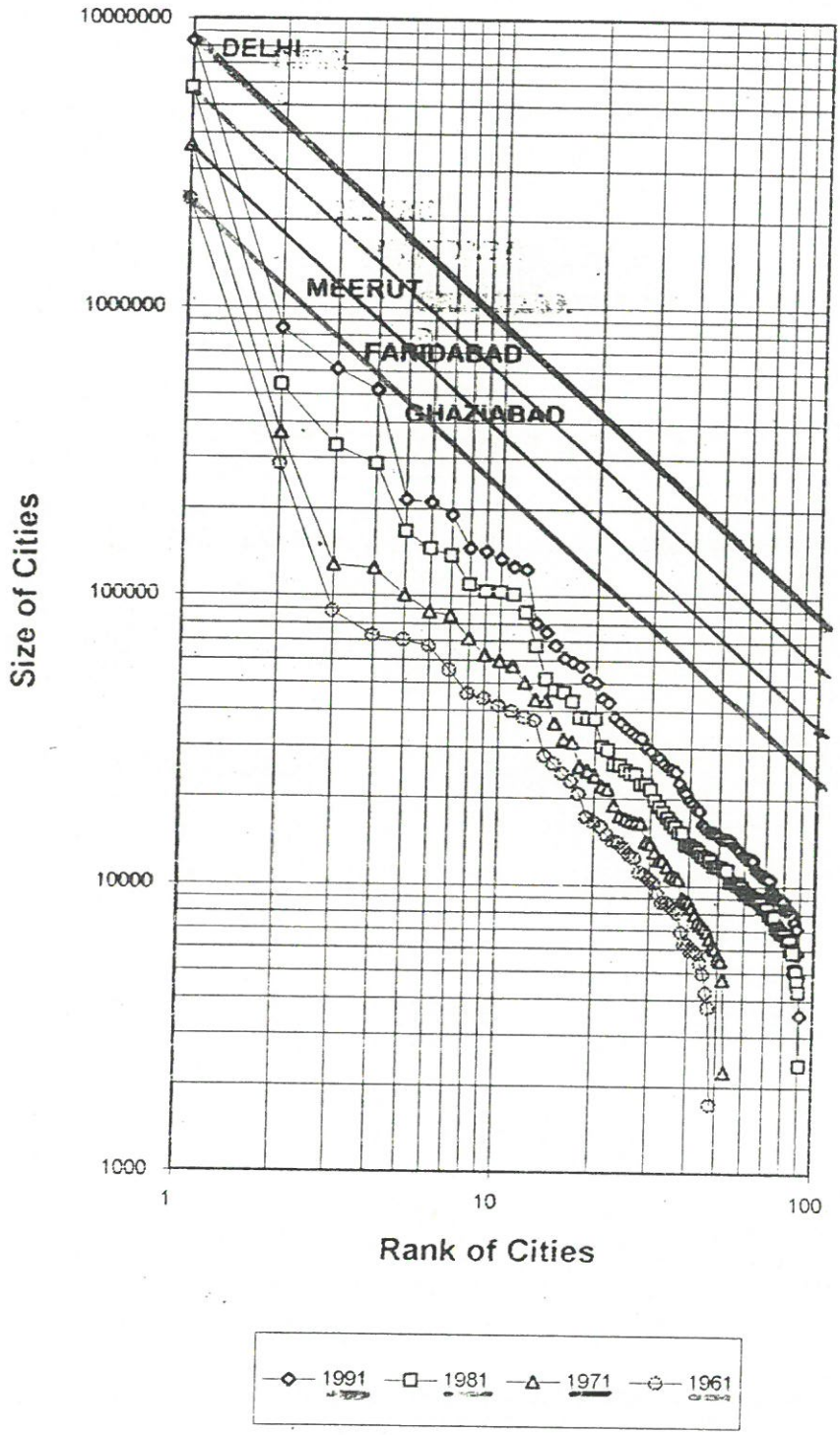


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Table 10

Projected population of Class I Towns

Town	Year wise projected population																			
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Meerut	889778	931637	975466	1021357	1069407	1119717	1172394	1227549	1285299	1345766	1409078	1475368	1544776	1617450	1693543	1773216	1856637	1943982	2035437	2131194
Ghaziabad	542198	574448	608616	644816	683170	723805	766856	812469	860794	911994	966239	1023711	1084601	1149112	1217461	1289875	1366597	1447882	1534001	1625243
Hapur	151506	156938	162565	168393	174431	180684	187163	193873	200824	208024	215482	223208	231211	239501	248087	256982	266196	275740	285626	295866
Noida*	146514	146514	146514	146514	146514	146514	146514	146514	146514	146514	146514	146514	146514	146514	146514	146514	146514	146514	146514	146514
Modinagar	127554	131978	136555	141291	146191	151261	156507	161935	167550	173361	179373	185594	192031	198691	205581	212711	220088	227721	235618	243789
Bulandshahr	129859	132573	135343	138171	141059	144006	147016	150088	153224	156426	159695	163032	166439	169917	173468	177093	180793	184571	188428	192366
Alwar	217971	226088	234506	243239	252296	261691	271435	281542	292026	302900	314179	325878	338013	350599	363654	377196	391241	405810	420921	436594
Rohtak	122620	119239	115952	112756	109647	106624	103685	100826	98047	95344	92715	90159	87674	85257	82906	80621	78398	76237	74135	72091
Sonipat	147928	152046	156278	160628	165099	169694	174418	179272	184262	189391	194663	200081	205651	211375	217258	223306	229521	235910	242477	249226
Gurgaon	139993	144226	148587	153080	157709	162478	167391	172452	177667	183039	188574	194276	200151	206203	212438	218862	225480	232298	239322	246559
Faridabad	657512	699870	744958	792950	844033	898408	956286	1017892	1083467	1153266	1227562	1306645	1390822	1480422	1575795	1677311	1785367	1900385	2022812	2153127
Delhi	8749461	9092802	9449617	9820434	10205802	10606292	11022498	11455037	11904549	12371701	12857184	13361719	13886052	14430960	14997252	15585766	16197374	16832982	17493533	18180004
Panipat	197561	204121	210899	217902	225138	232613	240337	248318	256563	265082	273885	282979	292375	302084	312114	322478	333186	344250	355681	367491

* 1981 population not available.

Table 11
Population Density Distribution Across Major Urban Areas

Core Area	Area sq.kms.	Population	Density Per ha.
NDMC	42.74	301297	70.49532
DMC	862.18	7206704	83.487
Delhi	904.92	7508001	82.96867
Faridabad	356.48	617717	17.32824
NOIDA	90.43	146514	16.201992
Ghaziabad MB	69.79	501097	71.80069
Gurgaon MC	24.13	135884	56.3233
DMA	540.83	1401212	25.90855
Priority towns			
Meerut MC	141.89	759778	53.12411
Sonepat MC	28.32	143922	50.81992
Panipat MC	20.82	191212	94.84054
Bulandshahr MB	12.33	124201	103.1638
Alwar MC	48.4	205086	42.37314
Hapur MB	14.2	146262	103.0014
Rohtak MC	28.38	216096	76.14376
Modinagar MB	14.00	101660	72.61429
NCR	308.34	1885217	61.14085

Total DMA population	4488889
Delhi as the norm (additional population)	3087677
NCR as the norm (additional population)	1897851

A closer look at the density of core towns (where the area is constant) provide very interesting details. As well known, the Delhi Union Territory consists of DMC, NDMC and the Cantonment.

But the major portion of the population live in DMC, which is the largest area, followed by NDMC, which is the garden-city of Delhi. Surprisingly enough, the density of NDMC (70 persons/ha.) is not very less than that of DMC (83 persons per hectare). The average density of Delhi (DMC & NDMC) is around 82 persons per hectare. There are only three towns (Panipat, Bulandshahr and Hapur) with density more than that of Delhi. However, Modinagar, Rohtak and Ghaziabad follow DMC very closely. The last three towns have densities more than that of NDMC.

Analysis indicates that the DMA towns have low average density, giving scope to hold more population in the future. The priority towns (Class I towns outside DMA) have higher density, where the scope to accommodate is less. In terms of absolute figures, an additional population of 30,87,677 lakhs can still be accommodated, if Delhi is taken as the norm. However, if the priority towns of NCR are taken as the norm, 18,97,851 more people can be included.

As seen earlier, if the assigned population is considered, practically all the towns should be able to hold more. Controversy arises in the case of Faridabad - Ballabgarh complex which has a low density of 17 persons per hectare, but has almost reached its assigned population.

The question is, how do we redistribute the population? Do we accommodate more people within Delhi and the DMA, or do we spread the population to the Priority towns? Any decision will depend upon

the status of the utilities and the infrastructure available in the priority towns. A reconaisance survey of the towns revealed that the position of the infrastructural set up is far from satisfactory.

The pattern that emerges from the present population distribution is:

- NCR's total population has overshot its assigned population by 5 lakhs;
- at the same time, there is a gap of 12 lakhs (less) in the assigned urban population;
- which means NCR's rural areas have an excess population of 17 lakhs;
- yet the number of towns have increased from 94(1981) to 107(1991);
- within Delhi, NDMC is not growing; and the cantonment has a marginal increase in population density;
- within MCD, the old city and Karol Bagh are saturated. All other areas, except Northwest Delhi have marginal capacity to hold more. Northwest Delhi is the only area which will be able to hold considerably more population;

- of the individual towns, Delhi, Faridabad and Meerut have reached their saturation by assigned population standards;

- but the population of Faridabad is only 17 persons/hectare and for Meerut the core area has 53 persons/hectare. Population density of MCD is around 83 persons/hectare, in comparison to Panipat (95/ha), Bulandshahr (103/ha) and Hapur (103/ha).

- even though Delhi is growing very fast and has overshot its assigned population, the distribution is not balanced;

- many low-income group workers are employed in Delhi and live in the rural-urban fringe of Delhi;

- people who are employed in the DMA towns often live in Delhi (the higher income groups) to avail of the higher order infrastructure;

- Faridabad's assigned population is very less and needs to be corrected to higher population standards;

- the priority towns (i.e. the class I), have not grown as per expectations. Hence more economic activities need to be induced to draw people to these towns. Also, more infrastructure and basic utilities are necessary in these towns.

- the rural-urban fringes of the Priority towns have not grown much;

- hence all the excess rural population is concentrated in Delhi's fringe area.

- which means employment opportunities are still more in Delhi than in the other towns, or that the employment opportunities of the other towns are not attractive enough;

- considering that the rural-urban fringe of Delhi is growing rapidly, it can be deducted that it is the unorganised/informal sector which is growing very fast to provide services to the population;

- which means, less educated and the low income groups are still moving towards Delhi in the hope of better employment.

Population Growth

After the sudden growth of population between 1941 and 1951 (after the partition), DUT has retained a steady growth of approximately 50 percent per decade.[1]

Table 12

Decadal Variation in Population of Delhi Union Territory

Year	Population	Decadal Variation	Percentage Decadal Growth
1901	405819	-	-

[1] Since planning for NCR had not begun in right earnest at that time, there is no detailed data on NCR. However, town data is available.

1911	413851	8032	1.98
1921	488452	74601	18.03
1931	636246	147794	30.26
1941	917939	281693	44.27
1951	1744072	826133	90.00
1961	2658612	914540	52.44
1971	4065698	1407086	52.93
1981	6220406	2154708	53.00
1991	9420644	3200238	51.45

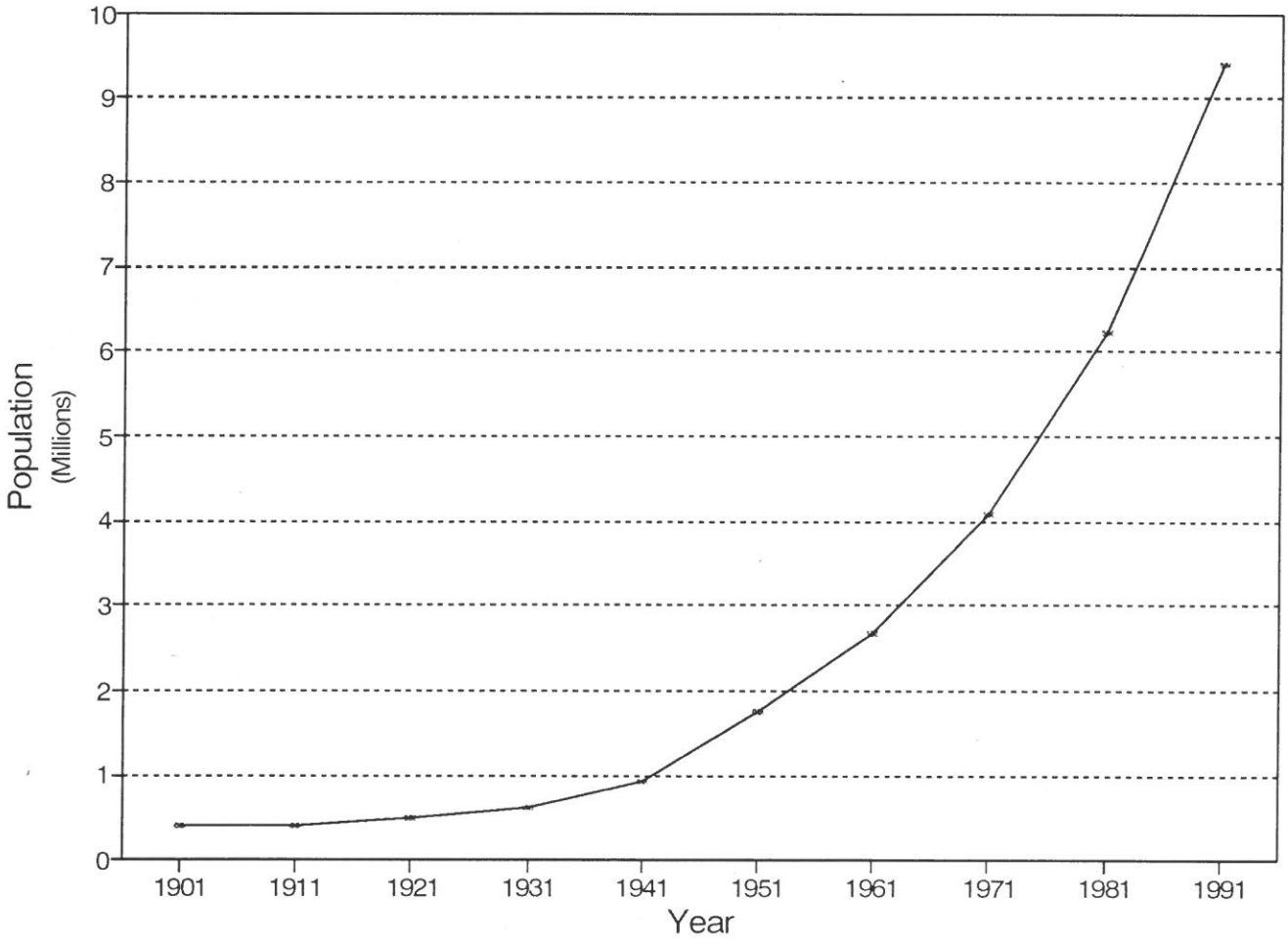
Census of India, 1991.

Source: NIUA (1994); Urban Environment Maps, New Delhi.

Urban population constitutes a major portion of the total population of the DUT. In 1981, the urban population was 92.73 per cent of the total population. In 1991 this share has been reduced to 89.93 percent (even though rural-urban bifurcation for NCR, as a whole is 48 percent and 52 percent respectively). Concentration of population in Delhi has already been indicated by the share of DUT's population in the NCR as a whole which was 36.35 percent in 1991.

As mentioned earlier, within the DMA, the share of DUT is 84.50 percent, indicating Delhi's primacy. In the NCR as a whole, the share of DMA is 73.20 percent (Table 7). Thus distribution figures point to a concentration in Delhi, which is gradually moving outward into the other DMA towns of Faridabad, Ghaziabad, NOIDA, and Gurgaon. These are the four major towns that are, at present, accommodating the *excess* population from Delhi. These

FIG 6: **Population Growth in Delhi**



towns put together are growing faster than DUT. While DUT grew by 51.45 percent between 1981-91, the DMA towns grew by 64.72 percent, and the priority towns by 45.78 percent. This indicates a rapid growth in the adjoining areas of Delhi, some of which is also in the neighbouring rural areas. However, Gurgaon did not grow much between 1981-91. Its growth has been very recent.

Table 13

Population Growth of NCR Towns (1981-91)

Towns	Percent population growth
DUT	51.45
DMA	64.72
Priority Towns	45.78

Source: SPA (1994); Study on Environment and ecology of the National Capital Region, new Delhi.

Of the individual towns, Loni has the highest decadal growth (256.38 percent), followed by NOIDA (248 percent), Ghaziabad (93.09 percent), Faridabad (86.7 percent) and Gurgaon (34.70 percent). Whereas Kundli, which is designated to be a future growth centre, has not yet attained an urban status (1991).

Table 14

Population and Growth of NCR Towns

Town	District	Population				Population Growth (decadal)		
		1961	1971	1981	1991	1961-71	1971-81	1981-91
Alwar	Alwar	72707	100378	145795	210146	38.06	45.25	44.14
Bulandshahr	Bulandshahr	44163	59505	103436	127201	34.74	73.83	22.98
Delhi UA	Delhi UT	2359408	3647023	5729283	8419084	54.57	57.09	46.95
Faridabad	Faridabad	10857	19644		617717	80.93	-	-
Ghaziabad UA	Ghaziabad	70438	127700	287170	511756	81.29	124.88	78.21
Gurgaon UA	Gurgaon	37868	57151	100877	135884	50.92	76.51	34.70
Hapur	Ghaziabad	55248	71266	102837	146262	28.99	44.30	42.23
Panipat	Karnal	67026	87981	137927	191212	31.26	56.77	38.63
Mahendragarh	Mahendragarh	9071	11496	14488		26.73	26.03	100.00
Modinagar					123279	-	-	-
Meerut UA	Meerut	283997	367754	536615	849799	29.49	45.92	58.36
Rohtak	Rohtak	88193	124755	166767	216096	41.46	33.68	29.58
Sonipat	Sonipat	45882	62393	109369	143922	35.99	75.29	31.59

Among the priority towns, Meerut has the highest growth (58.36 percent), followed by Rewari (46.12 percent), Alwar (44.14 percent) and Hapur (42.43 percent). The decadal growth of urban centres in 1981-91 is lower than those of 1971-81. The sudden spurt of growth in 1971-81 was actually incited by the new industrial policy, whereby many industries were set up around Delhi. It has been indicated by a study of the School of Planning and Architecture of Delhi that not only has DUT and its immediate neighbours registered a higher population growth than the national average, even the

growth of the priority towns have been very encouraging. Yet the growth is less than what was expected by the NCR Plan. The shortfall in the NCR's total urban population vis-a-vis the assigned population is to be welcomed. It indicates development of the rural-urban fringe. The SPA study has also analysed that urban growth has taken place along major transportation routes.

But even though growth trends point to growth of priority towns, DMA towns, and the rural-urban fringe, growth of Delhi as such is not drastically reduced. Also, the rapid growth of Delhi's fringe areas indicate the need for policy changes with regard to employment. It also hints at the low standards of infrastructure of the Priority or the neighbouring DMA towns. A near saturation condition of Faridabad, with such less population density urges the NCRPB to revise their population distribution plans.

Settlement Pattern:

Taking into account economic activities and the locational pull to be the most important factors of urban growth, the School of Planning and Architecture of Delhi has recently (1995) classified 83 urban settlements of 1981 and 99 urban settlements of 1991, based on population, workforce and connectivity, using the Planning Commission's formula (Appendix).

FIG 7: **Population Growth of NCR Towns**
(1981-91)

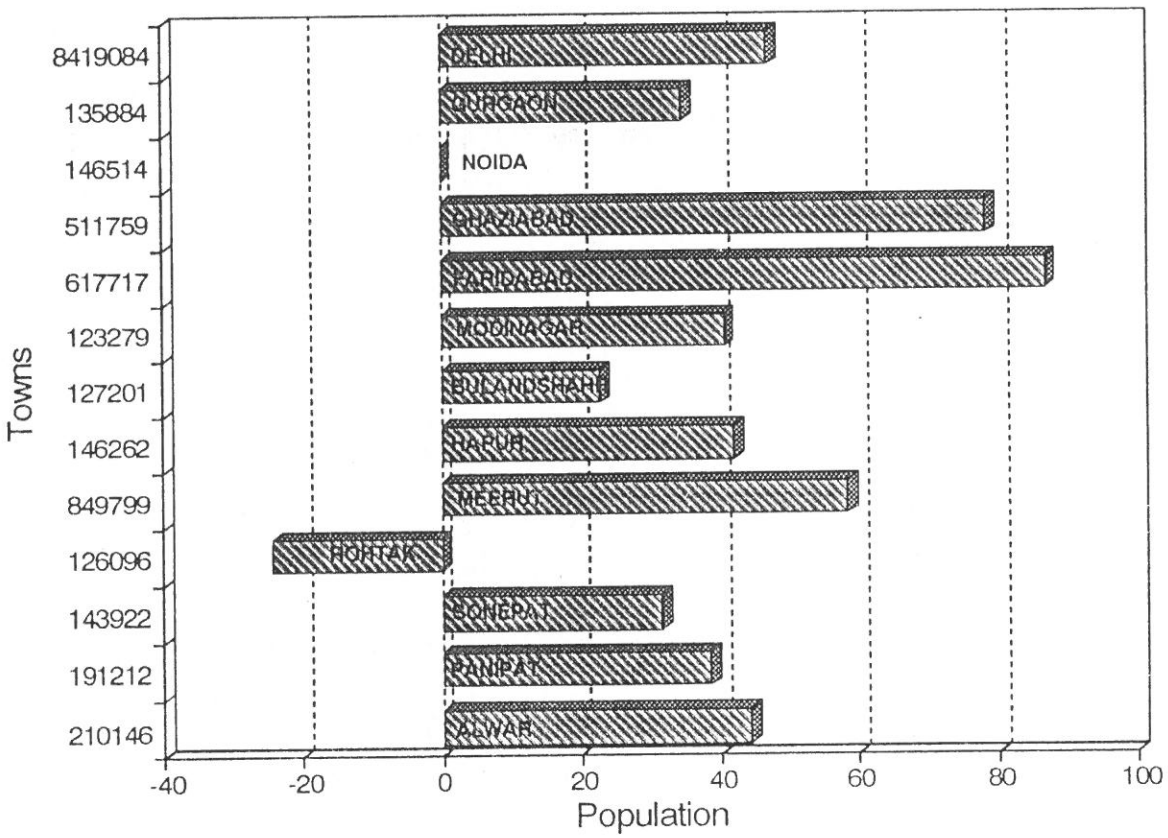


Chart 2

Order	1981	1991	Towns (1991)
I	3	4	Faridabad, Bhiwadi, Ghaziabad, Panipat
II	15	14	Rohtak, Meerut, Bulandshahr, Hapur, Alwar, Dharuhera (Panipat), Gurgaon, Bahadurgarh (DMA)
III	37	24	Muradnagar, Bosokar, Modinangar, Loni, Samalka, Sonepat
IV	28	40	
V	0	17	

Of the first order towns, Bhiwadi and Panipat have moved up by one step, while Rohtak has gone down by a step since 1981. All the first order towns have a strong industrial base and are very well connected. Bhiwadi in Rajasthan is a newly developed industrial township. Panipat also has a concentration of trade and commerce.

The second order settlements have six Priority towns, and two DMA towns. Except for Dharuhera, which is an industrial town, the other priority towns have a combination of industry, trade and commerce. Hapur and Dharuhera also have a substantial concentration of workforce in the primary sector. Rohtak's decline is due to a shift in the non-agricultural workforce from 96.01 percent to 91.76 percent, and a decline in the population growth rate, indicating outmigration.

Settlements like Aggarwal Mandi, Hailey Mandi, Ganaur and Jhajjar have declined from Second to Third and Fourth Order. The major contributing factor to this decline is a drastic decrease in the population growth of the previous two decades which means, these towns are *feeble receptors of growth impulses.* In many of these towns high growth was a one-time phenomena from sudden introduction of economic activities.

The third Order settlements have lower workforce participation rates and lower population growth potentials for development. They need to be studied carefully before considering them for development.

The Fourth and the Fifth Order Settlements are generally the class IV and Class V towns (by population size). Spatial distributions of the towns point to more lower order towns in UP than in Haryana. Also, connectivity with higher order settlements is better in Haryana than in UP. Rajasthan reveals an interesting characteristic of rural-urban linkages, as the proportion of rural is quite high in this sub-region (SPA:1995).

Table 15
Functional Organization of Settlements: 1981

Order	Uttar Pradesh	Haryana	Rajasthan	Total
I	1	2	-	3
II	6	8	1	15
III	23	13	1	37
IV	24	4	-	28
Total	54	27	2	83

Source: SPA Study, 1995.

Table 16

Functional Organisation of Settlements: 1991

Order	Uttar Pradesh	Haryana	Rajasthan	Total
I	1	2	1	4
II	7	6	1	14
III	13	9	2	24
IV	26	13	1	40
V	16	1		17
Total	63	31	5	99

Source: SPA Study, 1995.

In UP during 1971-81, 47 out of 54 towns were in Third and Fourth Orders, and only 7 in first and second orders. There is a spread along the transport arteries, so that corridor developments are taking place viz.

- Ghaziabad - Hapur - Garhmukteshwar (NH 4)
- Ghaziabad - Bulandshahr (State Highway)
- Ghaziabad - Meerut (state Highway)

Infact, all the first and second order towns, are along highways. In Rajasthan, poor connectivity is the cause of slow growth.

Results from a study on **migration** done by NIUA (1986) indicate that migration to Delhi is mostly for employment. The study which covers a sample of 5,059 household from six NCR towns revealed that the larger cities such as Panipat, Meerut and Alwar had larger proportions of migrants from outside NCR, than from within. Which means, these towns could possibly be made into growth centres through induced employment. Urban to urban migration was more in the larger cities, for better employment. While rural to urban migration was in quest for employment. The survey also showed that it is the poor that migrated from the rural areas.

Appendix

(XI - Minimum)/ (Maximum - Minimum)

Where,

- Xi denotes the value of a particular observation
- Minimum refers to the minimum value from all observations
- Maximum refers to the maximum value from all observations

The summation of weightages assigned to each parameters for all the urban settlements have then been grouped into five categories by using standard Deviation (from mean). Thus, five orders of settlements have been identified for 1981 and 1991 urban settlements. These categories are:-

Mean - 2 SD	0.709
Mean - SD	1.611
Mean -	2.513
Mean + ST	3.415
Mean + 2 SD	4.318
Mean + 3 SD	5.220

These categories have been computed for 1991 data and have been super imposed for 1981 data so as to arrive at a comparable data to analyse shifts in the functional hierarchy.

CHAPTER 4

LAND ENVIRONMENT IN NCR

1. Land is both economic and ecological resource for a region and its availability, quality, utilization and management provides a key to the supporting capacity dimension of the region. Further, the assimilative capacity of the land environment, as it relates specifically to the bio - productivity of the soil has bearing on the utilization and management of the regional land. A broad integrative view of land environment of an urban region should define land not just as a physical entity described in terms of its spatial dimension and topography but should incorporate all natural and man-made resources associated with land, specifically, soil, minerals, water biota, human settlements, agriculture etc. as well as the system of human management of land. Our focus here is, however, on urban land that is, the supportive capacity of NCR's land environment to sustain urbanization and urban activities, with particular reference to development of its major urban centres (Class I cities).

2. **Land classification and use across NCR**

Comprising of four sub-region of NCT Delhi, U.P., Haryana and Rajasthan the National Capital Region of Delhi extends over a total area of 2995223 hectares (according to DTRL)*. The Haryana sub-region comprising six districts to Panipat, Sonipat, Rohtak, Rewari, Faridabad and Gurgaon, constitute the single largest physical entity with 44.62% (1336178) of NCR's

land area, followed by U.P. sub-region sharing 36.48% (1092613 ha) of the region's land. While the above two constitute over 71% of the total land of NCR, NCT Delhi's share is a meagre 4.92%(147487 ha) and Rajasthan sub-region comprising part of Alwar district constitute 13.98%(418945 ha).

The land classification system developed through recent top sheets of DTRL(1993)*(See Table 1) differ from the one adopted in the Regional Plan 2001 of NCR (1987) (see Table 2). Also, there is a minor difference in the total land area of NCR as derived from these two sources. Furtherman, the land records data differ for data based on satellite imageries in respect of three land classes i.e. "Forest; "Barren Land" and "Cultivated Land". Satellite imageries indicate that forests lands have depleted further from the what was shown under land records while both barren and cultivated lands have increased, with no change in other land categories.

Thus agricultural encroachment upon forest lands as well as denudation of forests resulting in barrenness are likely.

In summary, the following salient features in respect of different landuses and their distribution pattern across the region may be highlighted.

1

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[1]* Source: School of Planning and Architecture, Delhi (1994). A study on Ecology & Environment of National Capital Region. Draft Final Report (Regional Plan 2001,

TABLE : 1

LAND ENVIRONMENT ACCROSS NATIONAL CAPITAL REGION

Sl. No.	District Name	Tehsil Name	Total Area area Ha	Settlement ment %age	Road/Rail rail %age	Water Canal canal %age	Agriculture culture %age	Forest %age	Waste Land land %age	Rocky %age	Water Logged logged %age	
1	2	3	4	5	6	7	8	9	10	11	12	
	UP SUB REGION											
1.	Meerut	Meerut	90080	12.01	1.71	0.82	84.83	0.44	0.19	-	-	
2.		Mawana	107900	3.74	1.18	0.89	87.66	1.98	3.31	0.00	12.40	
3.		Sardhana	89820	4.70	0.76	0.92	92.00	1.39	0.23	0.00	0.00	
4.		Baghpat	105160	4.86	1.21	1.70	89.00	0.92	2.31	0.00	0.00	
	Sub total		391770	6.16	1.21	1.10	88.35	1.21	1.63	0.00	3.42	
5.	Ghaziabad	Ghaziabad	75620	33.63	1.42	1.33	61.15	0.35	2.12	0.00	0.00	
6.		Hapur	79560	3.78	0.92	0.43	92.99	1.00	0.81	0.00	0.00	
7.		Dadri	61900	12.86	1.12	0.80	78.00	5.14	2.08	0.00	0.00	
8.		Garhmukte Shwar	44400	4.57	1.84	1.02	83.59	1.14	7.84	0.00	0.00	
	Sub total		261480	14.70	1.27	0.88	78.64	1.82	2.68	0.00	0.00	
9.	Bulandshahr	Khurja	116170	3.10	1.07	1.13	91.46	2.27	0.97	0.00	0.00	
10.		Sikandrabad	64223	2.68	1.22	0.53	91.33	2.23	2.01	0.00	0.00	
11.		Bulandshahar	122170	5.18	1.33	0.54	92.14	0.36	0.45	0.00	0.00	
12.		Anupshahr	136800	4.21	2.19	1.65	86.19	1.47	4.29	0.00	0.00	
	Sub total		439363	3.96	1.51	1.04	89.99	1.48	2.01	0.00	0.00	
	Total Area Sub-Region		1092613	7.32	1.35	1.02	86.89	1.47	2.03	0.00	1.22	
	HARYANA SUB-REGION											
1.	Panipat	Panipat	123570	2.83	1.35	1.06	85.75	2.47	6.54	0.00	0.00	
2.	Sonipat	Gohana	90030	1.98	0.79	0.55	91.69	0.32	4.67	0.00	0.00	
3.		Sonipat	129350	3.60	1.44	1.55	87.50	1.27	4.64	0.00	0.00	
	Sub total		219380	2.94	1.17	1.14	88.22	0.88	4.65	0.00	0.00	
4.	Rohtak	Rohtak	168410	3.22	0.88	0.63	84.56	0.68	8.83	0.00	0.00	
5.		Jhajjar	161410	1.76	1.28	0.50	88.89	0.94	6.67	0.00	0.00	
6.		Bahadurgarh	58050	4.40	1.22	0.39	81.53	0.73	11.73	0.00	0.00	
	Sub total			2.78	1.10	0.54	85.93	0.80	8.35	0.00	0.00	
7.	Gurgaon	Gurgaon	124670	5.20	0.94	0.14	75.60	0.48	7.43	10.20	0.00	0.00
8.		Nuh	64750	2.17	0.70	0.75	80.65	0.42	7.07	8.24	0.00	0.00
9.		Firozpur Zhir	81170	1.88	0.83	0.02	84.33	0.67	9.02	3.25	0.00	
	Sub total		270590	3.48	0.85	0.25	79.43	0.52	7.82	7.65	0.00	
10.	Faridabad	Faridabd	76980	9.92	2.09	1.35	79.55	1.57	1.42	4.45	0.00	
11.		Hathin	35044	2.02	1.08	0.22	9.33	1.59	1.75	0.00	0.00	
12.		Palwal	99854	2.57	0.97	1.10	90.98	0.33	4.05	0.00	0.00	
	Sub total		212558	5.14	1.39	1.04	73.15	0.99	2.71	1.61	0.00	
	Total area sub-region		1211938	3.38	1.13	0.73	82.81	0.95	6.39	1.99	0.00	
	NCT DELHI											
	NCT Delhi	NCT Delhi	147487	49.06	2.23	1.52	38.74	0.57	2.96	4.92	0.00	
	RAJASTHAN SUB-REGION											
1.	Alwar	Behror	50305	1.45	0.94	0.61	81.33	1.07	5.26	9.34	0.00	
		Tuara	190790	1.72	0.89	1.29	78.41	0.06	5.80	11.83	0.00	
		Alwar	168250	2.55	0.87	0.49	66.46	0.89	2.11	25.63	0.00	
	Sub total		418945	2.02	0.89	0.89	73.97	0.52	4.25	17.47	0.00	
	Total Area Sub-Region		786985	1.08	0.47	0.47	39.39	0.27	2.26	9.31	0.00	
	Grand total		3238053	6.23	1.09	0.80	71.56	0.94	3.76	3.23	0.41	

Source : SPA, New Delhi (1994).

TABLE : 2
SUB-REGIONWISE DISTRIBUTION OF LANDUSES IN N.C.R. (1986-1987)

LANDUSE	DELHI (%AGE)	HARYANA (%AGE)	RAJASTHAN (%AGE)	UTTAR PRADESH (%A	TOTAL N.C.R.
Misc.Tree Crops	24	-	1.9	74.1	4740
Forest	2.2	52.1	15.2	30.5	65222
Barren Land	13.2	24.7	39.8	22.3	141677
Water Bodies	4	42.9	28.9	24.2	8323
Cultivated Land	3.7	45.9	13.1	37.3	2392118
Culturable Waste	1.5	41.8	12.2	44.5	57484
P.Pasture & Grazing Lan	3	45	42.3	9.7	26648
Non-Agri. Use	24.2	43.3	5.9	33.7	296509

Source : Regional Plan 2001-National Capital Region

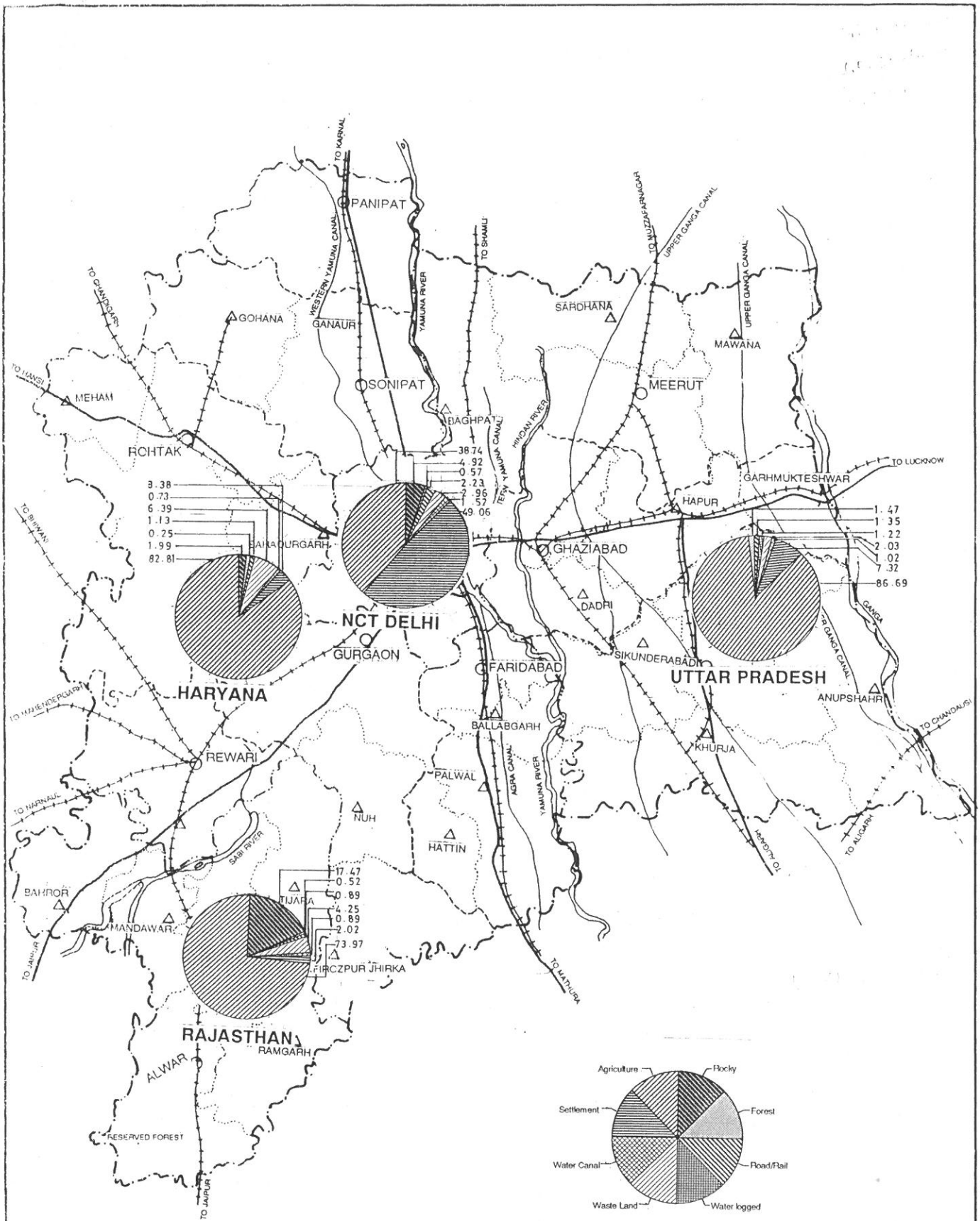

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FIG.1
LAND USE DISTRIBUTION NCR & SUB-REGIONS

Scale
5 0 5 10 20 kms

N

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NEW DELHI

FIG. 2
LAND USE DISTRIBUTION
TEHSILS

Scale
5 0 5 10 20 kms

N

2. **Agricultural land** constitute about 81% of NCR's total land resource (Table 1). Apparently, this use includes not only "cultivated land" but also " permanent pasture and other grazing land" and "Land under Miscellaneous tree crops' of the other classification system (see Table 2) which together match the above percentage figure. Haryana and U.P. sub-regions enjoy the major share (43.3% and 40.86% respectively) of such lands under production while NCT Delhi's share is only 2.46%; 13.37% of this land is in Rajasthan sub-region. However, within NCT Delhi, agricultural land constitute about 39% of its total land area which is not insignificant considering the areas urbanized nature. Although no specific analysis on the quality of such agricultural land is available, the studies on land irrigability and dominant problems and potential soils of Delhi territory (NEERI,1994) indicate that non-irrigable lands constitute only a minor proportion of Delhi's land and the largest share of land has fine or coarse loamy soils with good agricultural potential. Presently, cereals and vegetables constitute the major types of crops in Delhi.

Bulandshahr is the richest among districts of NCR in term of land area under agriculture, followed closely by Meerut in U.P., Rohtak in Haryana and Alwar in Rajasthan. Panipat, Faridabad and Sonipat of Haryana have relatively small agricultural land resource. The inequitable distribution of agricultural land is evident further when the tehsil level

data are analyzed. Tuara of Alwar district and Jhajjar and Rohtak of Rohtak district have large concentrations of agricultural land while it is scarce in Hathin tahsil of Faridabad and very low in Garhmuhteswar of Ghaziabad and Behror of Alwar.

2.2 **Forest land** is the most scarce among land resources of NCR constituting a meagre 1.07% of its total area (according to DTRL data). U.P. sub-region shares serve than half (52.36%)of the forests with Haryana sharing another 37.82%. Bulandsharhr is the richest district also in term of forest land followed by Ghaziabad and Meerut. Forests constitute respectively 1.48%, 1.82% and 1.21% of the total areas of these districts. Gurgaon, apart from Delhi, has the least forest area. Forest land in scarce in Tuara tehsil of Alwar, Ghaziabad tehsil of Ghaziabad district, Nuh of Gurgaon and Gohana of Sonipat. Dadri of Ghaziabad in the richest among tehsils, followed by Khurja of Bulandshahr. Most forests in the region are of dry deciduous and hill types.

2.3 **Urbanized Land** includes settlement areas and area under Road/Rail (See Table 1) while Water bodies, including canals, have been put under a separate category, even though some of these flow through urbanized areas of the region. Only 8.27% of NCR has been shown under settlements and transportation systems, but sporadic small habitation possibly spread also across agricultural lands as well as "waste" or "waterlogged"

lands. "Land put to non-agricultural use" in the other classification system (see Table 2) may roughly correspond to area under settlements and road/rail. The largest concentration of urbanized land use is obviously found in NCT Delhi where 51.29% of the total land falls under settlements and road/rail whereas it ranges between 2.91% in Rajasthan sub-region and 8.67% in U.P. sub-region. Among all other districts, Ghaziabad has the highest proportion of urbanized land (15.97%) and Alwar has the lowest (2.91%). Rohtak, Sonepat, Panipat and Gurgaon districts of Haryana also have low porporation of urbanized lands (respectively 3.88%, 4.11%, 4.18% and 4.33%) compared to Faridabad district of Haryana (6.53%) and Meerut (7.37%) and Bulandshahr (5.47%) of U.P. Comparison of further micro-level distribution pattern of urbanized land (across tehsils) clearly indicate the role of large towns and cities in the relative concentration of urbanized lands across the region. Eleven tehsils containing the 12 class I cities of NCR constitute over 62% of the total urbanized land of the region (excluding NCT Delhi). The tehsils which have very low amounts of lands under settlements and road/rail are: Hathin (1107 Ha;3.1%) in Faridabad district, Behror in Alwar district (1216 Ha;2.39%), Firozpur Zhir in Gurgaon district (2199 Ha;2.71%) and Sikandrabad in Bulandshahr district (2505 Ha;3.9%).

District and Tehsilwise Urbanise Land-Man Ratios are shown in TABLE 3 and Figures 3-4.

2.4 The DTRL imagery based land classification system (Table 1)

Table : 3

DISTRICTWISE URBANIZED LAND-MAN RATIOS ACROSS N.C.R.

DISTRICT	POPULATION 1991	AREA HA	AREA/1000 POPULATION	SETTLEMENT(H RAIL/ROAD(HA)	SETTLEMENT+ RL/RD/1000POPLN
PANIPAT	831754	123570	148.56	5165.22	6.21
SONIPAT	744450	219380	294.68	9013.14	12.1
ROHTAK	1780166	385870	216.76	14958.03	8.4
FARIDABAD	1466393	212558	144.95	13888.3	9.47
GURGAON	1128905	270590	239.69	11712.77	10.37
REWARI	623443	126210	202.44	7761.92	12.45
ALWAR	2286704	418945	183.21	12185.3	5.32
MEERUT	3430398	391770	114.2	28888.21	8.42
GHAZIABAD	2755494	261480	94.89	41743.79	15.15
BULANDSHAHR	2826427	439363	155.44	24057.46	8.51
DELHI	9370745	147487	15.73	75646.08	8.07

Source : Census of India (1991)

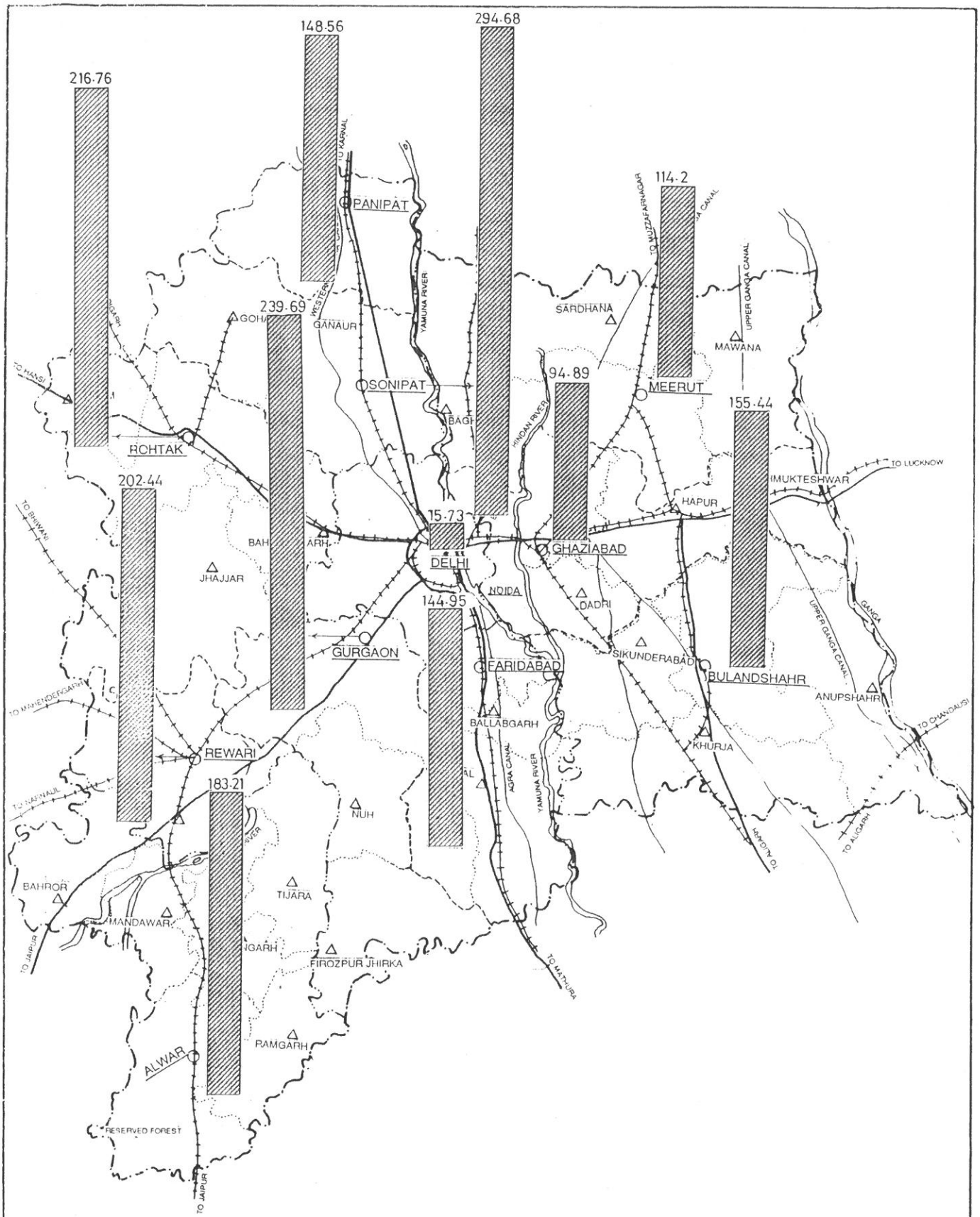

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FIG.3
DISTRICT-WISE LAND-MAN RATIO
(HA/1000 POPULATION)

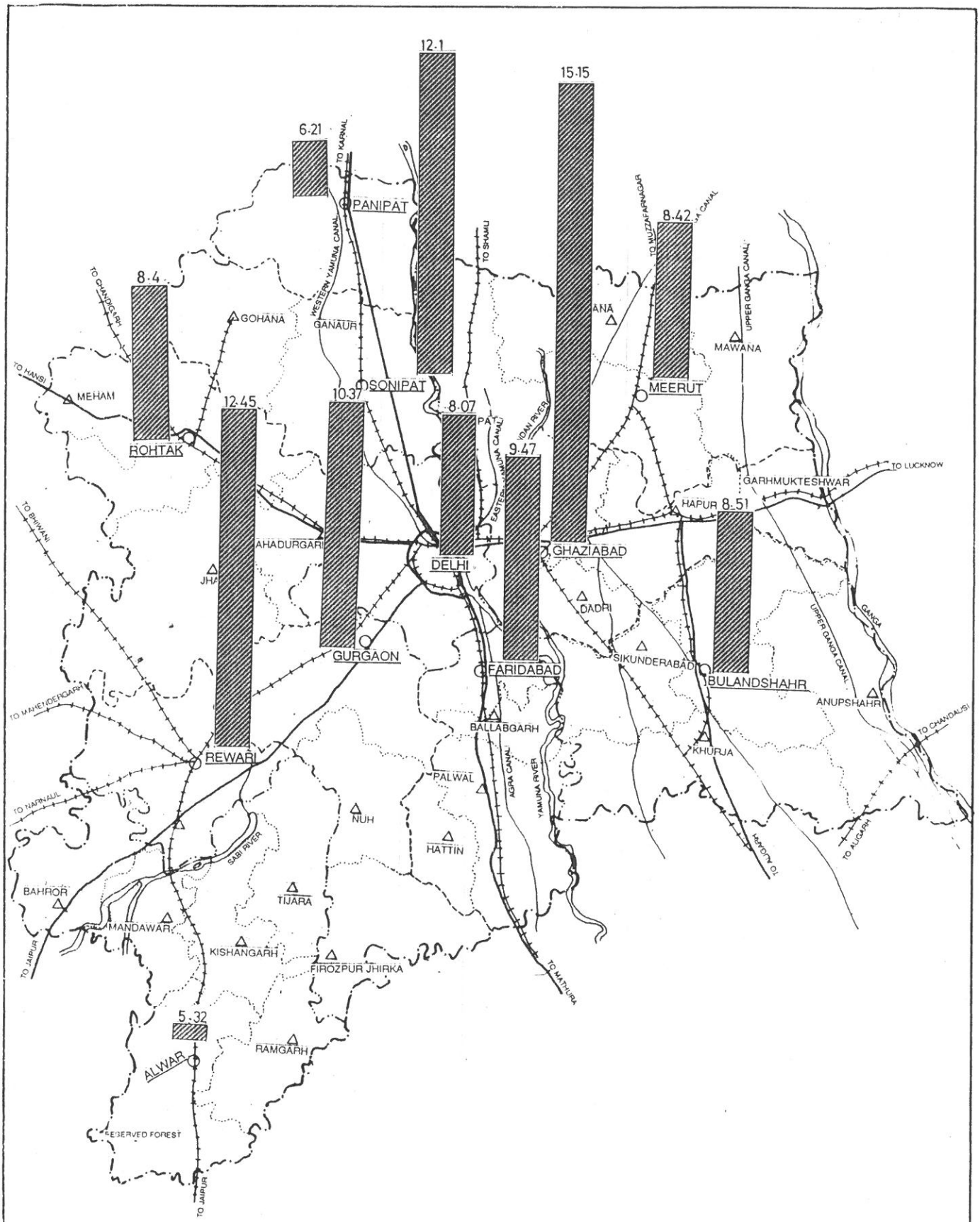
12.1
15.15
6.21
8.4
8.42
12.45
10.37
8.07
9.47
8.51
5.32
PANIPAT
SONIPAT
MEERUT
ROHTAK
REWARI
GURGAON
DELHI
FARIDABAD
GHAZIABAD
HAPUR
BULANDSHAHR
GARHMUKTESHWAR
GOHANA
GANAUR
MEHAM
MAWANA
AHADURGARI
DADRI
SIKUNDERABAD
ANUPSHAHR
BALLABGARH
PALWAL
NUH
HATTIN
TIJARA
BAHROR
MANDAWAR
KISHANGARH
FIROZPUR JHIRKA
RAMGARH
ALWAR
KHURJA
WESTERN YAMUNA CANAL
EASTERN YAMUNA CANAL
UPPER GANGA CANAL
AGRA CANAL
YAMUNA RIVER
SABI RIVER
GANGA
HINDON RIVER
TO KARNAL
TO SHAMLI
TO MUZAFFARNAGAR
TO CHANDIGARH
TO HANSI
TO BHIWANI
TO MAHENDERGARH
TO NARNAUL
TO JAIPUR
TO LUCKNOW
TO ALIGARH
TO MATHURA
RESERVED FOREST
LEGEND
BOUNDARY
N.C.R
STATE
DISTRICT
TEHSIL
PHYSICAL FEATURES
RIVERS
CANALS
HEADQUATAR
DISTRICT
TEHSIL
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FIG.1
DISTRICT-WISE URBANISED
LAND-MAN RATIO
SETTLEMENT+RD./RL. AREA: Ha/1000Pop
Scale
5 0 5 10 20 kms
N

provides three distinct land classes, namely, "waste land","Rocky" and " waterlogged" land which together constitute 8.35% of NCR's land area. While there is no information on the use of such lands, some form of use, like cultivation or habitation may be assumed, for the land area far exceeds the "barren" category of the other classification (Table 2). Furthermore, the so-called "waste land" has not been defined. The other classification system qualifies waste land in term of "culturable waste" which presumably can be reclaimed in future for expansion of agricultural activities.

In any case, barren lands should be examined for their relative suitabilities for competing land uses in future, especially, urbanization, cultivation and afforestation; for the proportion of such land in NCR is not insignificant. In NCT Delhi alone as high as 18,707 have been "barren" in 1986-'87 (Table 2) constituting 12.68% of its total land area. However, the discrepencies between the two land classification system data (see Table 1 and 2) interestingly suggest that there must have been already large-scale encroachment of urbanization between 1986-87 and 1993 not only upon the barren land, but also upon forest and agricultural lands. While there have been 11% increase in the areas and "settlement" and "roads" in 1993 from the "land put to non- agricultural use" in 1986-87 their have been a concommitant decline in the total area under "forest", agricultural uses (including "pasture and grazing, miscellaneous tree crops and cultivated land) and

barren land ("waste " and "rocky" lands) in Delhi. Yet in 1993, nearly 3% of the total land remain under "waste" land category and another nearly 5% under " rocky" lands, some of which are potential areas for urban expansion.

In comparison, Haryana and U.P. sub-region recorded only 2.62% and 2.89% respectively, under barren land category (Table 2). The relatively high percentage of barren land in Rajasthan (13.47%) is due to large concentration of "rocky" lands in this sub-region (see Table 1). While district land tehsil level data on "barren" lands are not available, such detailed distribution patterns are available for "waste","rocky" and "waterlogged" lands from the DTRL imagery based land classification (Table 1).

Apart from Delhi and the tehsils of Alwar, rocky land and present only in the tehsils of Gurgaon district, expecially Gurgaon tehsil and in the Faridabad tehsil of this district. Waterlogged lands are found only in Mawana tehsil of Meerut district in the entire NCR (Table 1). However, the geomorphological maps prepared by NEERI (1994) indicate some saline marshes along the north-eastern boundary of Alwar district and a few dispersed waterlogged areas in the central part of Ghaziabad district. In U.P. sub-region, waste land area is well distributed across different districts but its concentration is highest in Anupshahr tehsil of Bulandshahr district and lowest in Meerut tehsil of this district.

Haryana has much larger wasteland area and most of it is located in Rohtak and Gurgaon districts, especially in Rohtak, Jhajjar and Gurgaon tehsils. In Rajasthan where waste land area is less than that of the above two sub-region, most of it is concentrated in Tuara tehsil.

3. Urban Land Resource across NCR

3.1 Land-Man Ratio in Major Cities

The existing status of gross land areas available across the 13 class I cities (including Delhi) of NCR, in relation to their population sizes is shown in Table 4 . The average land-man ratio of class I cities of NCR is 18.64 hectares per 1000 persons; but variations are evident across these cities as well as across different parts of NCR. Delhi's land-man ratio falls between the above average for all class I cities of the region which indicates the relatively high population perssure on urban land in Delhi. Nevertheless, Delhi is better off in term of urban land resource than several cities, especially the outlying "priority" towns of Bulandshahr, Hapur, Panipat and Rohtak. These are old congested settlements with typically unplanned organic urban structure (see Figures in Transportaion Chapter) and having very little expansion and new land developments. Alwar and Meerut however, are "priority" cities that have better urban land-man ratio than most other cities.

Interestingly, the average land-man ratio of cities in the

TABLE : 4

LAND MAN RATIO IN THE MAJOR CITIES OF N.C.R.

CITY/REGION	AREA IN SQ. KMS.	POPULATION (1991)	LAND MAN RATIO
NCT Delhi	1486.3	9421000	15.78
D.M.A. Cities	574	1551907	36.99
Ghaziabad U.A.	74.64	511759	14.58
Noida C.T.	90.43	146514	61.72
Faridabad C.A.	356.48	613828	58.07
Gurgaon U.A.	24.13	135884	17.76
Sonipat M.C.	28.32	143922	19.67
Rest N.C.R. Cities	332.39	1863993	17.83
Bulandshahr	12.33	127201	9.69
Hapur M.B.	14.2	146262	9.71
Meerut U.A.	177.58	849799	20.89
Modinagar U.A.	20.95	123279	16.99
Panipat M.C.	20.82	191212	10.89
Rohtak M.C.	28.38	216096	13.13
Alwar M.C.	58.13	210146	27.66
TOTAL NCR CITIES	2392.69	12836900	18.64

Source : Census of India (1991)

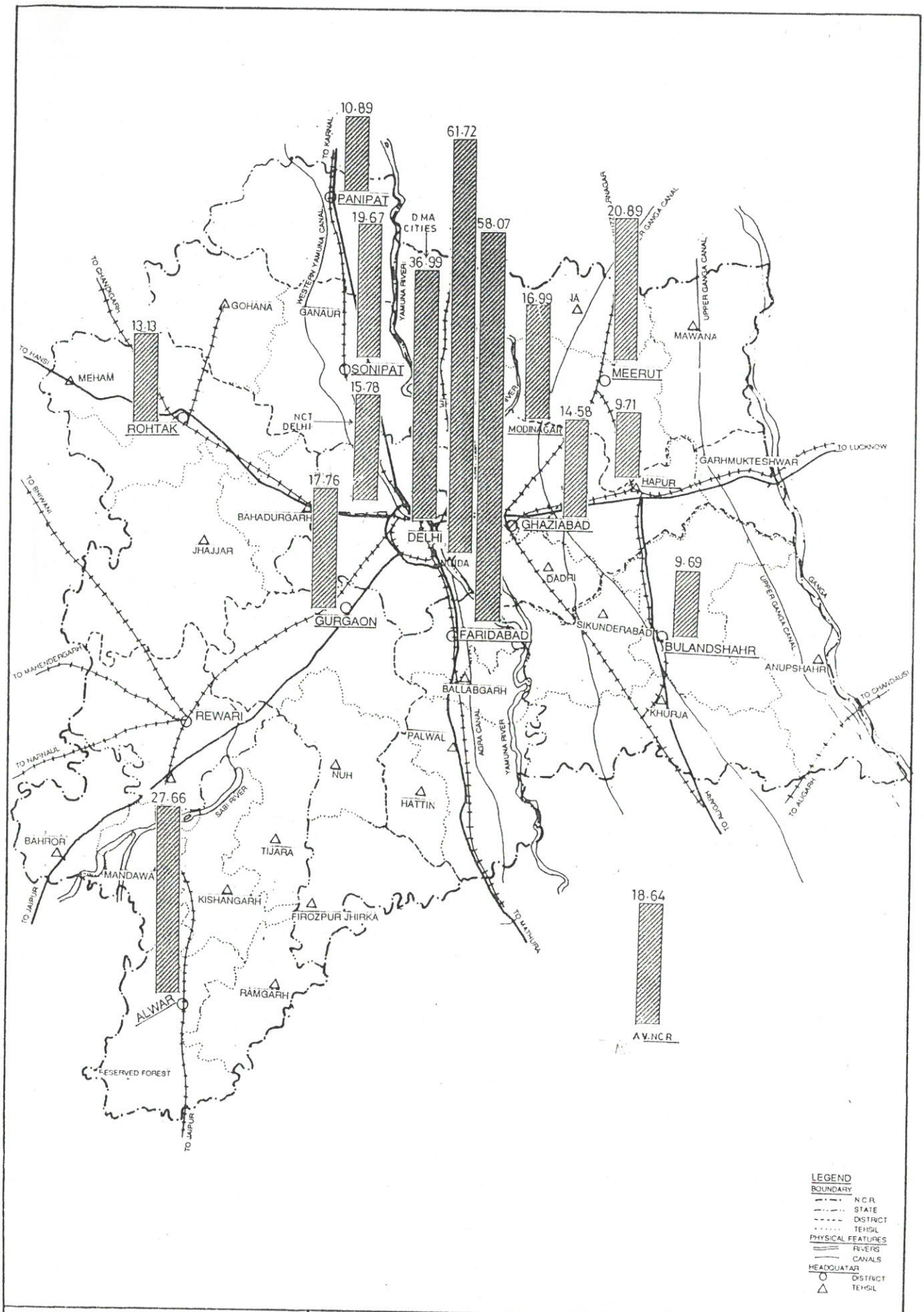

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FIG-5:
CITY LAND-MAN RATIO
HA./1000 POPULATION

D.M.A. far exceeds that of the cities of rest NCR, i.e. the "priority" cities. While the two planned cities of Noida and Faridabad provide the largest urban land resource among cities of the D.M.A., even sonepat and Gurgaon have better land-man ratio than most outlying cities of the region. Although Ghaziabad which is amongst the old settlement of NCR has relatively less land-man ratio, extensive new land development projects in both industrial and housing sectors are fast booming across the adjacent Shahibabad. Therefore, in term of the relative availability of developed land resources, the D.M.A. cities around Delhi, especially Noida and Faridabad, may be able to absorb almost twice as much future population than the outlying cities of the region, with the possible exception of Alwar and Meerut.

3.2 Intensities of Land Utilization with in Major Cities

The intensities of use of urban lands have been measured through gross densities of the cities, densities of their different census components and residential densities. The pattern of population density distribution (gross) across the major cities of NCR indicate considerable variations among them (Table 5). All the "priority" cities proposed by the NCR Regional Plan-2001, with the exception of Alwar and Meerut, have higher gross densities than the NCT Delhi. Especially, the old cities of Bulandshahr, Hapur and Panipat show considerably higher intensities of land utilization than NCT Delhi. In contrast, all the DMA cities, except Ghaziabad,

has lower densities than NCR Delhi, indicating that they may be able to absorb much higher population pressure in the future than the so-called "priority" cities. The densities of the planned cities of Noida and Faridabad are especially low.

Incidentally, the NCR regional Plan -2001 prescribes densities of 125 p.p.ha for Ghaziabad, Noida, Faridabad, Gurgaon, Meerut, Bulandshahr and Panipat and 110 p.p.ha for Hapur, Rohtak and Alwar, while no recommendations have been given for Sonepat and Modinagar. On the basis of such density norms, most cities have capacities to hold additional population within their existing urban land areas. But, these capacities across the cities vary from the insignificant or very low of 6.79%, 21.17%, 36.11% and 44.46%, respectively for Hapur, Bulandshahr, panipat and Rohtak to the very high of 671.51% and 625.90%, respectively for Noida and Faridabad. Alwar and Meerut have relatively moderate capacities of 204.28% and 161.21% respectively (Table 5). Furthermore, assuming the same density of 12500 persons per square kms. (as prescribed for most cities in the NCR Regional Plan) for Sonepat and Modinagar, the five DMA cities of Faridabad , Noida, Ghaziabad, Gurgaon and Sonipat will be able to accommodate an additional population of 56.23 million approximately (86% of which will be contained in Faridabad and Noida taken together) which will be more than two and a half times the additional population the six outlying cities will be able to accommodate, (which will be 21.40 million,

TABLE : 5

EXISTING DENSITIES AND ADDITIONAL HOLDING CAPACITIES OF CITIES IN N.C.R.

CITIES	GROSS DENSITY	ADDITIONAL POPULATION HOLDING CAPACITY 1991-200 WITHIN EXISTING URBAN AREAS		
		NCR PLAN PROPOSED GROSS DENSITY 2001	ADDITIONAL POPULATION 2001	%AGE INCREAS 1991-2001
Sonepat	5081.99	12500	210078	145.97
Rohtak	7614.37	11000	96084	44.46
Gurgaon	5631.33	12500	165741	121.97
Alwar	3615.1	11000	429284	204.28
Meerut	4785.44	12500	1369951	161.21
Ghaziabad	6856.36	12500	421241	82.31
Hapur	10300.14	11000	9938	6.79
Modinagar	5884.43	12500	138596	112.43
Noida	1620.19	12500	983861	671.51
Bulandshahr	10316.38	12500	26924	21.17
Faridabad	1712.91	12500	3841922	625.9
Panipat	9184.05	12500	69038	36.11
Delhi NCT	6338.59			

Source : 1. NCR Regional Plan 2001.
2. City Master Plans.

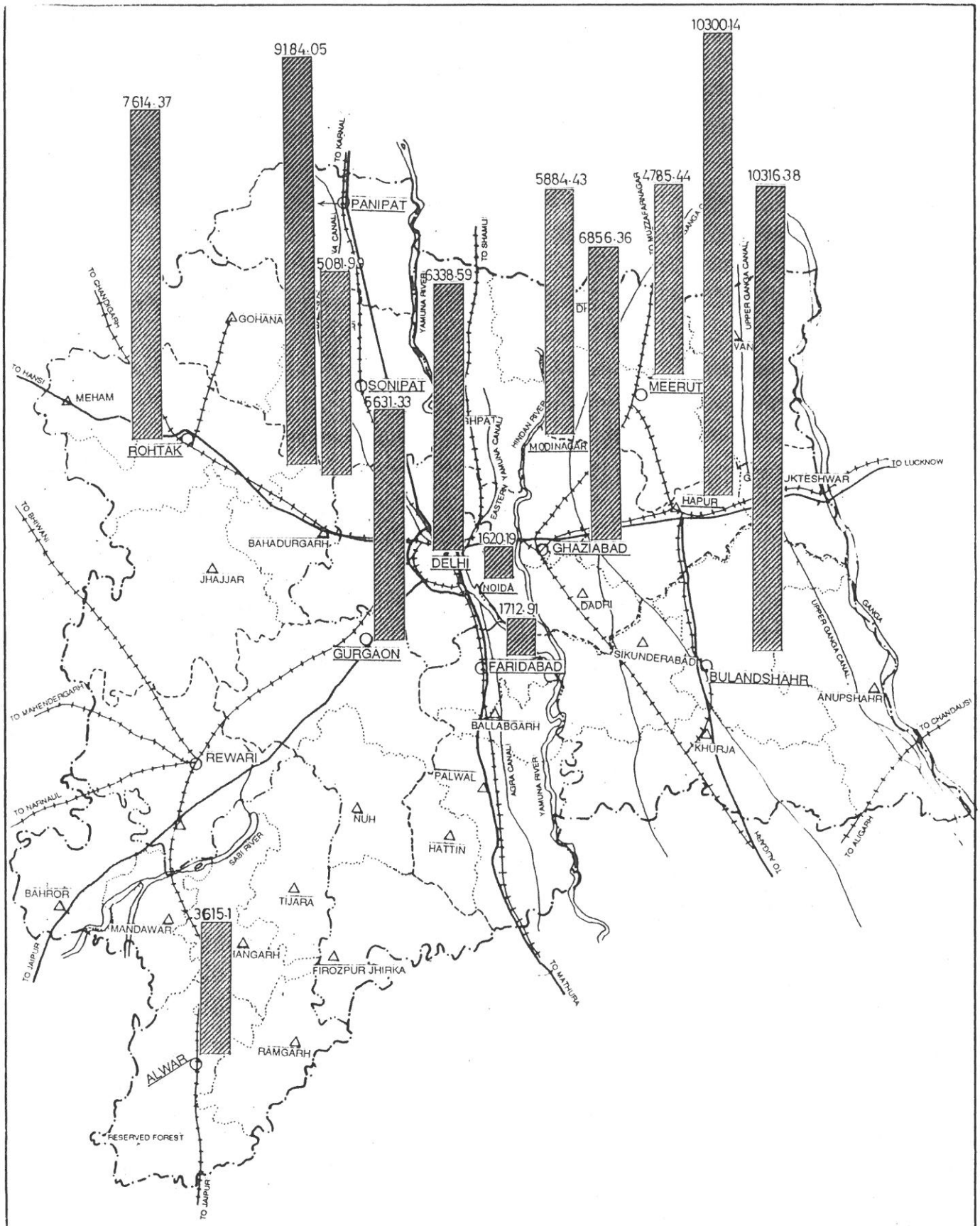

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FIG.6
GROSS DENSITY IN CITIES
1000'PERSONS/HA.

Scale:
5 0 5 10 20 kms

N

approximately). Among these latter cities, again, Meerut and Alwar together need to absorb over 84% of this additional population.

A further break-up of the land areas, population and densities of the different components across these cities (see Table 6) may provide interesting insights into the land utilization patterns within them. Although the density of urban Delhi rises considerably (12361.2 p p sq km) when the rural areas of NCT Delhi are excluded, the intensity of use of urban land has a highly skewed distribution, tending almost towards an 'inverted -U ' curve, with its central core comprising of NDMC having a density of 7049.53 p.p.sq.km. which rises to 16717.4 p.p.sq.km. for the surrounding DMC area and even higher for the several small peripheral census towns , viz Babarpur, Sultan pur, Tigri, Nasirpur, Gokal pur, and Jaffarabad (Table 6). Within the MCD area, again, there is a sharp variation in densities ranging from 170000 p.p. sq.km. in some parts of the walled city of old Delhi to less than 5000 p.p.sq.km. in some parts of south Delhi. The rural periphery of NCT Delhi has an average density of only 1189.75 p.p.sq.km. Thus the wide variation of densities is reflected in their high value of co-efficient of variation (108 per cent)(see footnote,p.24)

Interestingly, according to DDA's own calculations, the urban area (excluding cantonmentand census towns) a holding capacity of approximately 9 million population (Table 7) which is

TABLE : 6

CENSUS COMPONENTWISE DENSITIES OF N.C.R. TOWNS

CITIES AND COMPONENT	AREA (HA)	POPULATION	DENSITY
Meerut U.A.	177.56	849799	4785.44
Meerut M.C.	141.89	753776	5312.41
Meerut Cantt.	35.69	96021	2690.42
Ghaziabad U.A.	74.64	511759	6856.36
Ghaziabad M.B.	63.79	454156	7119.55
Razapur C.T.	6	46941	7823.5
Noida C.T.	90.43	146514	1620.19
Modinagar U.A.	20.95	123279	5664.44
Modinagar M.B.	14	101660	7261.43
D'Bad Budhsana C.T.	4	13509	3377.25
Bisokhar C.T.	2.95	8110	2749.15
Bulandshahr M.B.	12.33	127201	10316.36
Hapur M.B.	14.2	146262	10300.14
Alwar U.A.	50.13	210146	3615.1
Alwar M.C.	46.4	205088	4237.31
Itarna O.G.	9.73	5060	520.04
Rohtak M.C.	28.38	216096	7614.38
Panipat M.C.	20.82	191212	9184.05
Sonipat M.C.	28.32	143922	5081.99
Gurgaon U.A.	24.13	135884	5631.33
Gurgaon M.C.	15.33	121486	7924.72
Gurgaon(Rural) C.T.	8.8	14396	1636.14
Faridabad C.A.	356.48	617717	1732.82
Delhi U.A.	624.28	8419084	13486.04
N.D.M.C.	42.74	301297	7049.53
Delhi Cantt.	42.97	94393	2196.72
D.M.C.	431.09	7206704	16717.4
Census Towns	107.48	816690	7598.52
Total Urban (NCT)	685.34	8471625	12361.2
Total Rural (NCT)	797.66	949019	1189.75

Source : Census of India (1991)

about 20% higher than the 1991 population figure. Evidently, the census towns and the contonment areas, with their much lower population densities (see Table 6) may augment much further Delhi's population holding capacity.

Unlike Delhi Urban Agglomeration which constitute a large number of different census units, other cities of NCR are more or less integrated census urban areas. However, sharp density variation may be found among the different census units within several urban agglomeration. Important among them are Meerut where the density of the corporation area is about twice that of the contonent area which constitute a significant land area in city; Ghaziabad where the density of the railway colony in less than one-third of that of the Municipal Board area and Modinagar where both Bisokhar and Begumebad census towns have significantly less densities than that of the Municipal Board area.

In general, the intensities of land utilization within urban agglomerations, especially Delhi, are highly unbalanced. The existence of large institutional housing areas such as contonments, railway colonies, etc., is a significant contributor to the scewed density distribution pattern across

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[3] * Dopant, V and Mitra A 1994. Population Distribution, Growth and Socio-economic special patterns in Delhi, paper for 13th European Conference of Modern South Asian Studies, Toriouse, France.

Table : 7
DENSITY IMPLICATIONS OF THE DDA 2001 PLAN

Division	Area	Population (1981)	Population (1991)	DDA Holding Capacity
A. Old City	1159	622207	NDMC =	420460
B. Karol Bagh	2304	567804	301297	630000
C. Civil Lines	3959	530547	DMC =	750800
D. New Delhi	6855	496058	7206704	754658
E. Trans Yamuna	8797	1028794		1789300
F. South Delhi	11958	822200		1278425
G. West Delhi	11865	868277		1489600
H. North West Delhi	5677	517687		1865270
Total	52574	5453574	7508001	8978513

Additional Holding Capacity = 14,70,512
(1991 Pop.- DDA Hold. Cap.)

Additional Holding Capacity in % = 19.58

Source : DDA (1990): Master Plan Delhi 2001

many cities. In Delhi, furthermore, the situation is unique also with the presence of very sparsely populated Lutyen's "New Delhi" on one hand and the intensily occupied "Old Delhi" on the other.

3.3 Trends in Urban Population Densities

The decadal percentage veriation in densities of individual cities (see Table 8) does not provide a rational picture of densification trends of NCR cities, since there has been increase in the census urban area boundaries at different points of time. This has resulted in negative change in urban densities in several cities in different census years. However, the recent trends (1981 to 1991) indicate that densification has been high in Ghaziabad, moerately high in Panipat and low or negative in rest cities. Alwar is a special case where sharp density increase have been the result of sharp increase in between 1971-81 and decrease between 1981-91 of the consus defined urban area. At the same time, the two old cities of Hapur and Bulandshehr in U.P. sub-region have been consistently more densely populated than all other cities. Although these two cities, especially Hapur show negative trends in density recently (1981-91), their densities are still highest among the cities. Meerut had the highest population density in 1971 which primarily reflected the population of the congested old city core; but over the last two decades, newly developed planned settlements have come up all around in consonance with its Master Plan, which has

TABLE : 8

GROWTH RATES IN THE DENSITY OF N.C.R. TOWNS

CITIES	1961-1971	1971-1981	1981-1991
Panipat	32.39	42.02	38.65
Sonipat	72.16	75.29	0.7
Gurgaon	49.02	55.92	3.13
Faridabad	12.56	3.08	7.71
Rohtak	41.33	29.25	0.59
Meerut		65.39	27.88
Ghaziabad			60.94
Bulandshaher			6.35
Modinagar			22.09
Hapur		44.42	41.61
Noida			
Delhi		19.26	26.83
Alwar	52.7	26.53	98.4

Source : 1. Census of India (1991)
2. City Master Plans.

Figure : 7

G. Rates of Density in Haryana Sub-Reg.

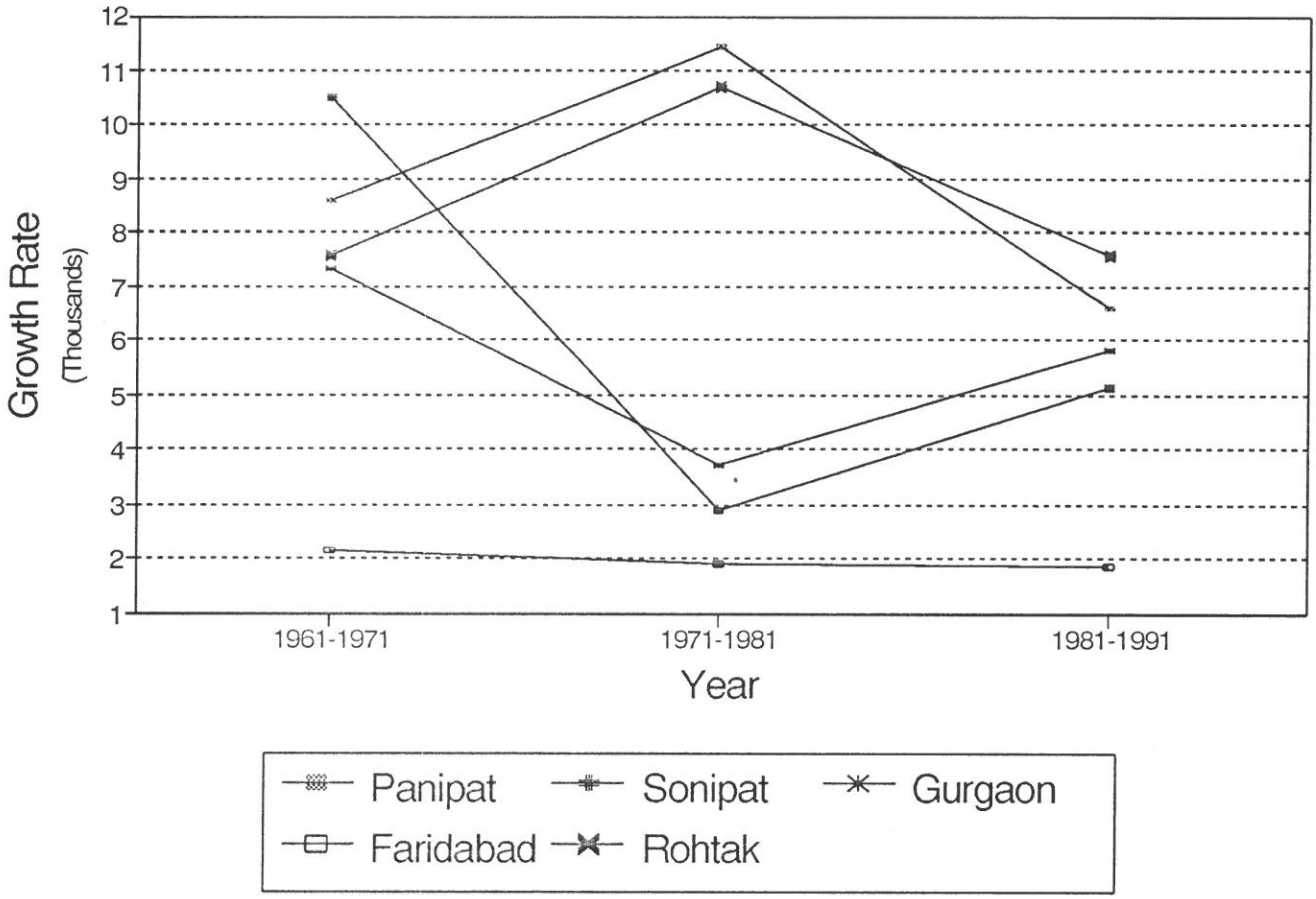


Figure : 8

G. Rates of Density in U.P Sub-Region.

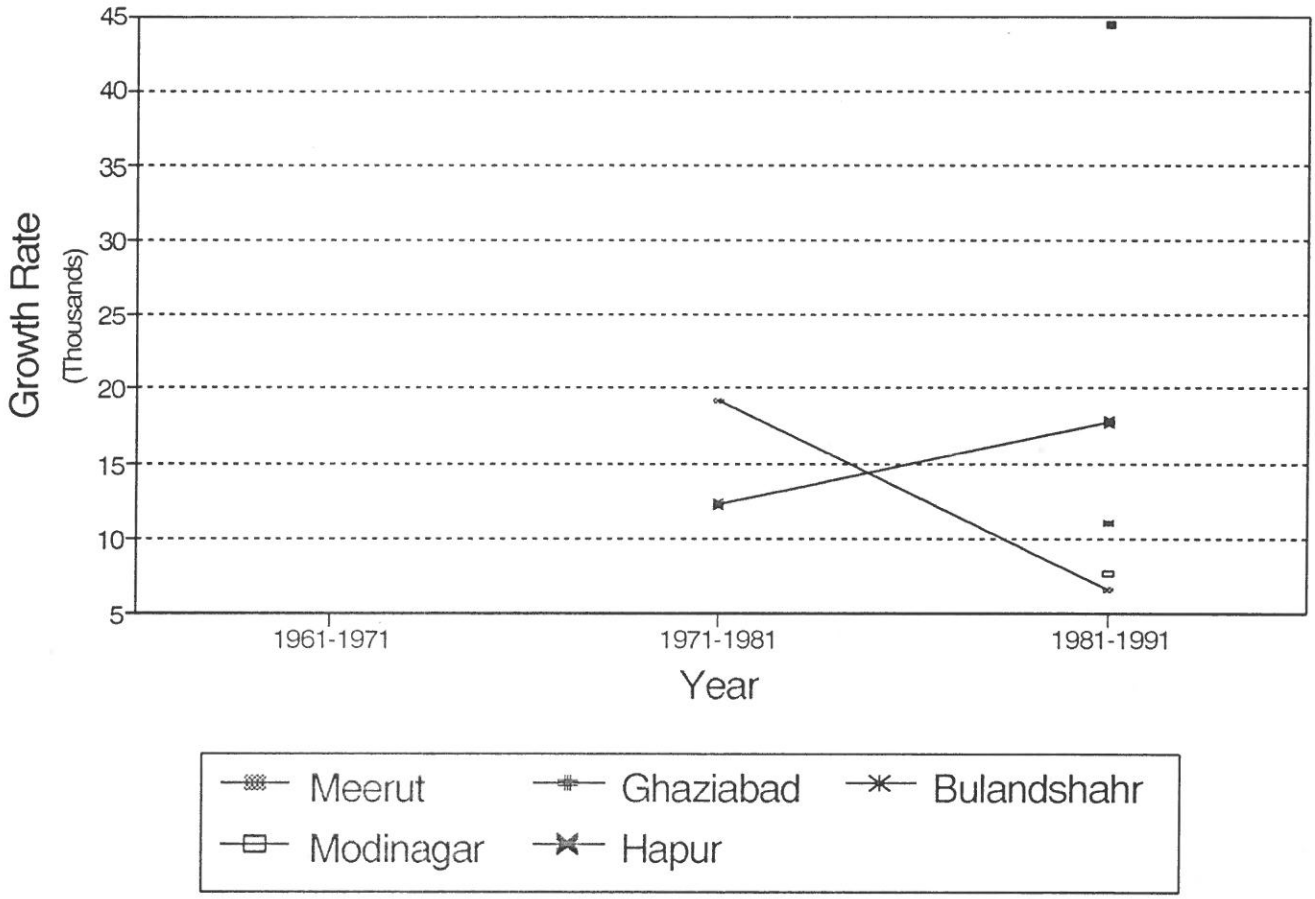
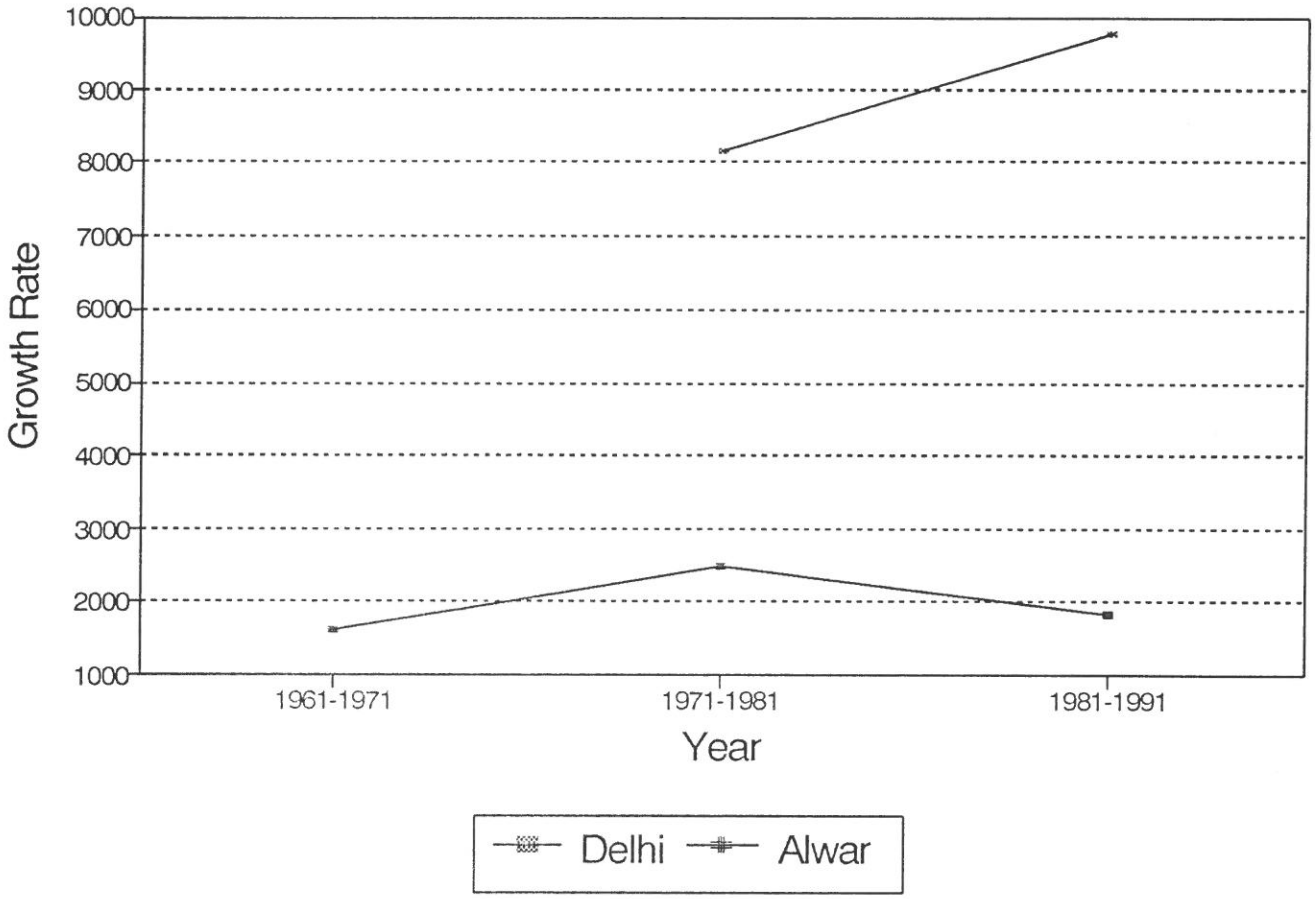


Figure : 9

G. Rates of Density in Delhi & Alwar



resulted in a sharp decrease in its gross population density. The densities of the two other densely populated cities, i.e., Panipat and Rohtak have also come down considerably between 1971 and 1991 but they are still more densely populated than most other cities. The population densities of Faridabad and Alwar have been consistantly low. Interestingly in Sonepat, where the population density was higher that of other cities in 1961, the density came down sheply in 1971 (due to a five fold increase of census urban boundary) and rose sharply in 1981 while in recent times, density appears to have more or less stabilised. Apparently therefore, the two DMA cities of Noida and Faridabad have the highest prospects of further denstification in future, in relative terms, whereas the other DMA towns like Ghaziabad and Gurgaon has relatively much less prospect. Similarly, among "priority cities", Alwar and Meerut have relatively greater prospect for densification than the rest cities.

The population density of urban Delhi has grown at a steadier rate than other cities of NCR and most recent trend (1981 to 1991) indicates a faster rate of densification than before. Even then, this recent rate of density increase is lower than those of Ghaziabad and Panipat.

3.4 Landuses and Vacant Land Availability within Major cities

Unlike those for sub-region and tehsils of NCR, the available information on urban landuses are highly sporadic. Data on existing landuses for several cities have been obtained from available master plan reports prepared by respective Town

TABLE : 9

LAND USE IN THE TOWNS OF N.C.R.

TOWNS	YEAR	RESI. %	COMM. %	IND. %	TPT. %	PUBLIC S.PUB. %	GOVT. OFFICE	GOVT. LAND %	PUBLIC UTILITY	WATER BODIES	OPEN SPACE %	SPECIAL ZONE %	OTHERS %	AGRI. %	ORCHAR %	BUNDS OR DAM	CREAMA ION GRN	VACANT LAND %	REC.USE %	TOTAL HA
PANIPAT	1984	29.86	4.5	10.45	10.18	3.78				0.8	3.55							36.88		2082
ROHTAK																				
SONEPAT																				
FARIDABAD																				
GURGAON																				
MEERUT	1968	29.9	1.3	2.3		2.9							9					53.7		1997.2
GHAZIABA	1984	48.05	0.73	29.56	7.61	1.18			0.83		0.56	2.23*						9.25		6496.25
BULANDSH	1989	35.9	1.5	3.2	15.5	5.4	3		1.4	1.3	7.6			14.4	9.4	0.6	0.5			939
NOIDA	1995	42.15	4.92	30.23	13.6	3.43					5.66									2683
MODINAGAR																				
HAPUR	1994	33.3	3.1	5.7	8.8	3.4					1.3							44.3		1429
DELHI																				
ALWAR	1988	23.4	2.1	22.3	6.4	5.4		0.2				32.7*		3.5				2.8	1.2	3610

Source : City Master Plans.

Planning Offices of cities and a few consultants reports which have been prepared at different points of time for the different cities. The landuse classification system is not uniform across these reports. Nevertheless, Table 9 prepared from these different sources may provide some indication of the distribution of urban lands urban various major uses. Prospects for future densification of these cities should be viewed against, among other factors, the availability of vacant land resources within these cities. In Meerut, a 1968 survey of existing landuse as well as a 1990 existing landuse map by the Town Planning Department indicate large amount of vacant land within the urban limit. Apparently, however, this is on account of the extension of the Municipal limit far beyond the built-up area of the city and the vacant land consists primarily of agricultural fields orchards and village areas subsequently proposed for urban growth. There is no seperate record of vacant land availability within the city's built up area. Similarly in Panipat and Hapur, the large amount of vacant lands recorded within their municipal boundaries are due to recent reclassification of their municipal limits which contain agriculture lands and other rural uses. In other words, there is no seperate record of truly vacant or unused land as distinct from agricultural or rural uses. Neither there is any record of the quality of such agricultural lands to help determine the relative need for conservation vis-a-vis allowing urban encroachment in future. In Ghaziabad furthermore, this large amount of vacant

land is primarily low lying riperian land along Hindon River. The two planned cities of Noida and Faridabad, however, are the major exceptions where large amounts of land subdivisions within the serviced developed limits of the cities are still lying vacant, i.e. unoccoupied.

3.5 Urban Land Prices

Land price data for the NCR cities (See Table 10) may reflect the supply-demand situation for urban land across them, in terms of both land availability and the quality i.e., the level of land development. The land aquisition and developments costs as well as land price data for different cities, as shown here, however, do not differentiate between public and private development costs, which are usually substantial. In Delhi, for instance, the land prices for residential plots in the DLF Qutab Enclave (1990) ranged between Rs. 50.58 and Rs. 174.82 lakhs per acre, whereas the proposed predetermined rates for 1993-94 for residential plots in Dwarka project of the DDA ranged between Rs.25.13 and Rs.75.35 lakhs per acre*.

Nevertheless, a comparison among the cities interestingly reveals that, with the exception of Rohtak and Alwar, residential land prices are lower in the "priority" than the DMA towns which might

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4* Public-Private Partnership in the Delivery of Serviced Land in Delhi, by NIUA (1995).

Table 10

PRICING AND DEVELOPMENT COST OF LAND IN DIFFERENT CITIES OF N.C.R.

CITY	COST OF LAND ACQUISITION RS.LAKH/ACRE	COST OF LAND DEVELOPMENT RS.LAKH/ACRE	LAND PRICE RESIDENTIAL RS./SQ.MTR.	INDUSTRIAL RS./SQ.MTR.
UTTAR PRADESH				
Noida	4.04	8.09	1200	Phase I - 500 Phase II - 400 Phase III - 600
Bulandshahr	2.8 to 8.09	12 to 14	700	
Khurja	2.8 to 18.2	12 to 14	700	500 to 900
Meerut	1.61 to 4.81	4.07	700 to 1000	
Ghaziabad	4.39	14.66	1200	
Hapur	NA	NA	800	
HARYANA				
Bahadurgarh	3.5	4.0 to 6.0	600 to 700	
Kundli	4	12	NA	700
Palwal	12.14	32.37	400 to 500	
Rewari	1.24 to 2.0	10	600 to 700	
Dharuhera	1.5	10	500 to 600	
Panipat	NA	NA	NA	
Rohtak	9.7	NA	1000 to 1500	
Gurgaon	4.0 to 6.0	7.59	1000 to 1100	780
Faridabad	3.0 to 5.0	9.0 to 10.0	1000	400 to 500
RAJASTHAN				
Alwar	4.0 to 5.0	7	500 to 2000	3000 to 3500

Source : N.C.R. Economy And Its Industrial Development Potential;ORG(1994)

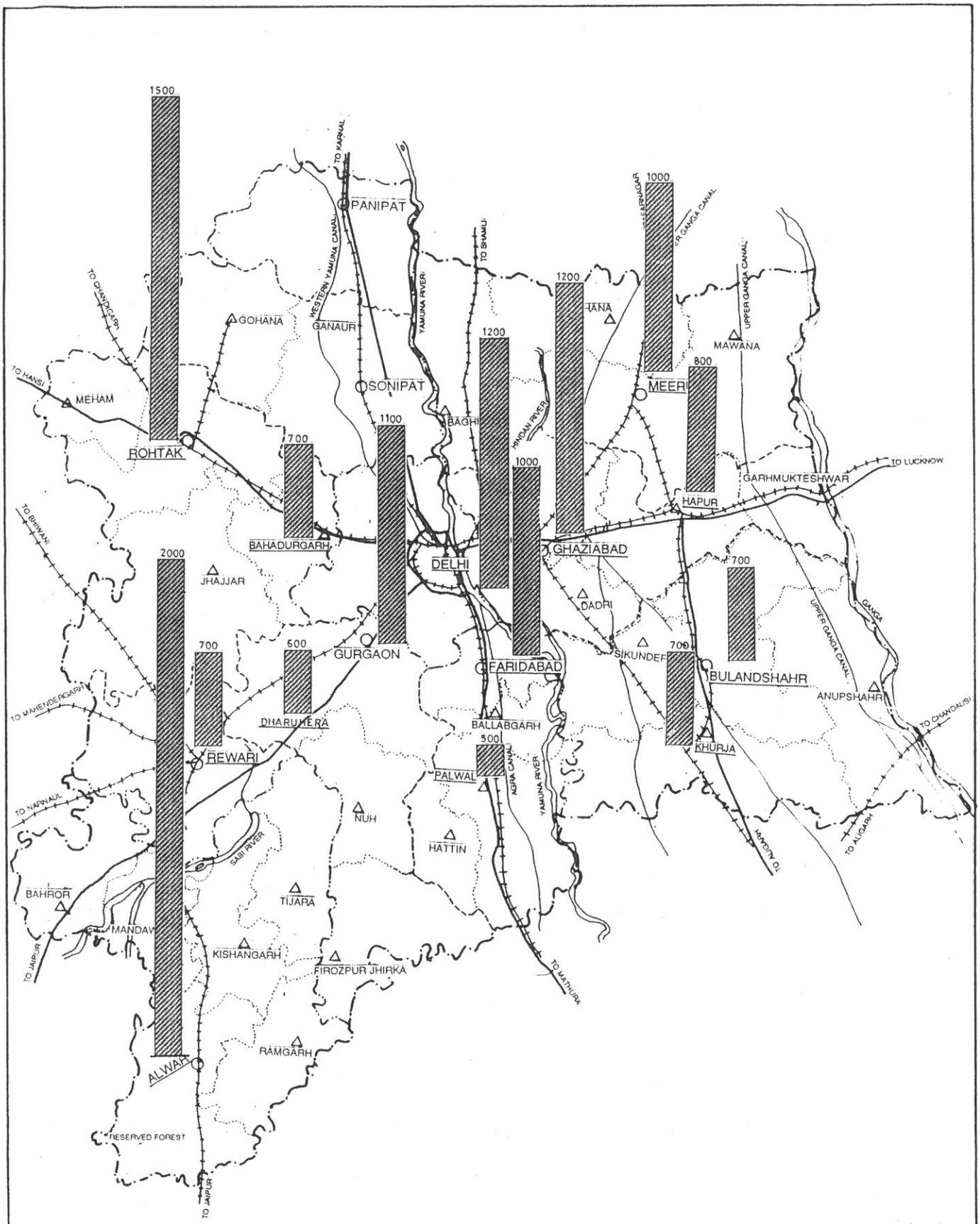

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FIG.10
RESIDENTIAL LAND PRICE IN CITIES (RS/SQ.MTR.)

Scale: 5 0 5 10 20 kms

N

reflect the relatively higher demand for residential landuses across then latter cities. In the U.P. Sub-region, the land prices in Noida and Ghaziabad are much higher than those of other cities, even that of the growing city of Meerut. In the outlying cities of Bulandshehr and Khurja the land price is low despite the high costs of land aquisition and development. While high aquisition costs may reflect land scarcity, low land prices may reflect low demand.

A similar situation is likely for Hapur, but information on cost are not available for this city. The low aquisition cost in Noida may be due to the low compensation rate for public aquisition. In Haryana, the land price is much higher in the DMA cities of Gurgaon and Faridabad than in most of the outlying cities, despite the fact that aquisition and development costs in many of the latter cities (viz Palwal) are higher.

3.6 Land Resources for Urban Expansion Surrounding Major Cities

Explorations into the prospects of horizontal expansion of the major growth centres of NCR in the future need to take into account the various constraints as well as potentials associated with the available land resources surrounding these cities, namely, landform, natural drainge and other land features, conservation of agricultrual land, water and other nutural resources, nearby ground and surface water prospects,

existing structure, linkages and desirable directions of growth of the cities, scope for extension of existing service networks in term of roads, water supply, sewerage and drainge, town network etc and the urbanizable limits as envisaged in the proposed development plans of these cities.

The development plans i.e., the Regional Plan 2001 for NCR as well as the Development Proposals prepared by the respective State Town Planning offices for individual cities, envisage additional land requirements for the expansion of these cities between 1991 and 2001, with the notable exceptions for three cities (Faridabad C.A., Meerut and Alwar) which apparently have surplus lands within their existing urban limits to meet the projected demands for urban growth (see Table 10).

The projected land requirements under the Regional Plan 2001 of NCR reflect the Plans' objective of providing impetus for growth of the outlying "priority" cities to decentralise Delhi. While the recent development plans of individual cities (such as for Panipat and Hapur) take into account the "assigned population" for these cities in 2001, as suggested in the Regional Plan, generally, most plans consider the growth trends and the needs of their respective cities alone in projecting their future land requirements.

Both Faridabad and Meerut already have large surplus lands within their existing legal urban limits -respectively, 77% and 38% more than their projected land requirements; but these surpluses reflect two contrasting pictures of the nature of such land resource. In the case of Meerut, its recently

TABLE : 11
ADDITIONAL LAND REQUIREMENTS PROPOSED IN DEVELOPMENT PLANS

CITIES	EXISTING URBAN AREA 1991 (Ha)	PROPOSED LAND AREA - 2001		ADDITIONAL LAND REQUIREMENT WITH % INCREASE FROM 1991	
		TOWN PLANNING DEPT. (Ha)	R. PLAN 2001 NCR (Ha)	TOWN PLANNIN DEPT. (Ha)	R. PLAN 2001 NCR (Ha)
Panipat	2082	4000	4000	1918 92.12	1918 92.12
Hapur	1420	4091	4901	2671 188.1	3481 245.14
Bulandshaher	1233	2867.01	4000	1634 132.52	2767 224.49
Ghaziabad	7464	8897.6	8800	1434 19.21	1336 17.9
Meerut	17758	9466.41	12400		5358 30.17
Rohtak	2838	4560	4545	1722 60.68	1707 60.15
Gurgaon	2413	9372	5600	6959 288.4	3187 132.08
Faridabad	35648	15678.75	8000		27648 -77.56
Alwar	5813		4545		1268 -21.81
Noida	2683	7790	4400	5107 190.34	1090 32.93
Modinagar	2095				
Sonipat	2832				
Delhi U.A.	62428	68777		6349 10.17	

Source :1. Town Planning Departments
2. National Capital Region Planning Board

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FIG. II
ADDITIONAL LAND REQUIREMENT
DEVELOPMENT PLANS
(Thousands Ha.)

Scale
5 0 5 10 20 kms

N

extended large urban boundary includes extensive agricultural lands and rural areas as sporadic "leap frog" growths of recent residental and industrial areas have occured beyond the older built-up core; whereas much of the surplus lands in Faridabad C.A. represent unoccupied lands within the planned New Industrial Town (N.I.T.) and the urban growth here is more of less a continuous, although heterogeneous one.

At the other end of the scale, large demands for additional lands for future urban expension have been posed for several cities, especially Gurgaon, Noida and Delhi. Although the projected additional land requirements for Hapur, Bulandshahr, Panipat, etc. are smaller in absolute terms, these additional lands represent 90-200% of their respective existing urban limits.

4. Conclusions

Carrying Capacities of different parts of NCR with regard to their land resources to support future urban uses should be viewed in relative rather than absolute terms, since there is no definate way to deliniate absolute standards in respect of various indicators, such as densities, land-man ratios in cities, holding capacities, etc. Although Delhi has the highest density figure as well as lower land-man raios than may other potential growth centres across the region, existing density distribution pattern across the metropolies indicate sufficient scope for redensification of the core as well as of the city. Furthermore, NCT Delhi has a large ament of "Waste"

and rocky lands, significant portion of which should be explored for their potential to absorb urban uses.

Among the rest potential growth centres of the region, the older cities, especially, Bulandshahr, Hapur and Panipat suffer from high densities and low urban land-man ratios as well as low supply of potential urbanisable land around them. Alwar is the only large outlying centre having a low density and a large potential urbanisable land, although the quality of this land resource (may be predominently hilly) needs further assessment. The planned urban centres near around Delhi, especially NOIDA and Faridabad apear to have the largest growth potential in term of land resources, with their existing low densities and large additional holding capacities.

CHAPTER 5

TRANSPORTATION AND COMMUNICATION

1. Introduction

Transportation system of a region is a vital infrastructure resource to support the economic development and settlement system growth across the region. This chapter presents an analysis of the carrying capacity of NCR's existing transportatin system in respect of it various key indicators. Depending on the available information, the analysis has been carried out at different spatial levels, i.e., for the entire region, sub region and districts of the region as well as for its major urban centres.

The hierachical distribution pattern of road and rail networks of NCR will identify the physical coverage and extent of transportation facilities across the region as well as the relative accessibilities of various existing and potential growth centres. The relative accessibilities and nodalities of the major cities have studied in further details in term of travel time matrix. Analysis of regional bus facilities and regional bus trips generated across these cities indicate further their interlinkages and relative accessibilities and nodalities. Network capacities have been studied in term of these lane capacities, ROWs ad apparent congestons or bottlenecks aloy the major high and the charted capacities of major rail sections. Analysis of the lengths and densities of road networks indicates the relative accessibilities of different districts as well as the major urban centres. A

detailed study of road network patterns (through maps) within these cities provide insights of their capacities to support their internal movements.

Apart from the analysis of road and rail network capacities and accessibilities across the region, the study has highlighted various stresses on the existing transportation system through analysis of traffic volumes along major regional road and rail corridors, densities and growth of motor vehicles on road, densities and growth of road accidents in the major cities and anticipated pollution load of the regional road network.

2. Regional Highway and Railway Network Patterns

2.1 Both passenger and goods movements within the NCR are road and rail based. The Indira Gandhi International Airport of Delhi and the small airport at Hindon (near Meerut) in U.P. State have little role in the regional movement system. Delhi is the hub in term of both the rail and the major highway networks in the region.

2.2 Existing Highway Network

Nine major radial corridors and seven orbital links constitute the main frame of highway network of NCR. Of these nine radial routes that form the backbone of regional road traffic movement, the following six converge directly to Delhi (See Regional Transportation Network Map):

1. Delhi-Sonepat-Panipat (NH1)
2. Delhi-Faridabad-Palwal-Hodal (NH2)

3. Delhi-Gurgaon-Bawal-Bahror(NH8)

4. Delhi-Bahadurgarh-Rohtak-Maham(NH10)

5. Delhi-Ghaziabad -Hapur-Garhmukteswar (NH24)

6. Delhi-Loni-Baghpat-Baraut(SH57);

While the following rest three connects Delhi via closly located Ghaziabad and Gurgaon:

7. Delhi-Ghaziabad-Meerut(NH24-SH45)

8. Delhi-Ghaziabad-Bulandshahr(NH24-SH22)

9. Delhi-Gurgaon-Sohna-Alwar (NH8-SH13)

The seven orbital links are :

1. Baraut-Panipat (District Roads)

2. Panipat-Gohana-Rohtak (SH16)

3. Rohtak-Jhajjar-Rewari (SH15)

4. Rewari-Sohana-Palwal(SH12-SH18-SH29)

5. Palwal-Khurja (District Roads)

6. Bulandshahr-Hapur-Meerut(SH18-SH10)

7. Meerut-Baghpat (District Road)

It is apparent however that all the links in the above network system are not of similar levels of hierarchy. While the first five radial corridors converging into Delhi are National Highways the last one is primarily a state highway and the rest are national or state highways at their different stretches. Among the orbitals, three are state highways while the others are district roads.

2.3 **Existing Railway Network**

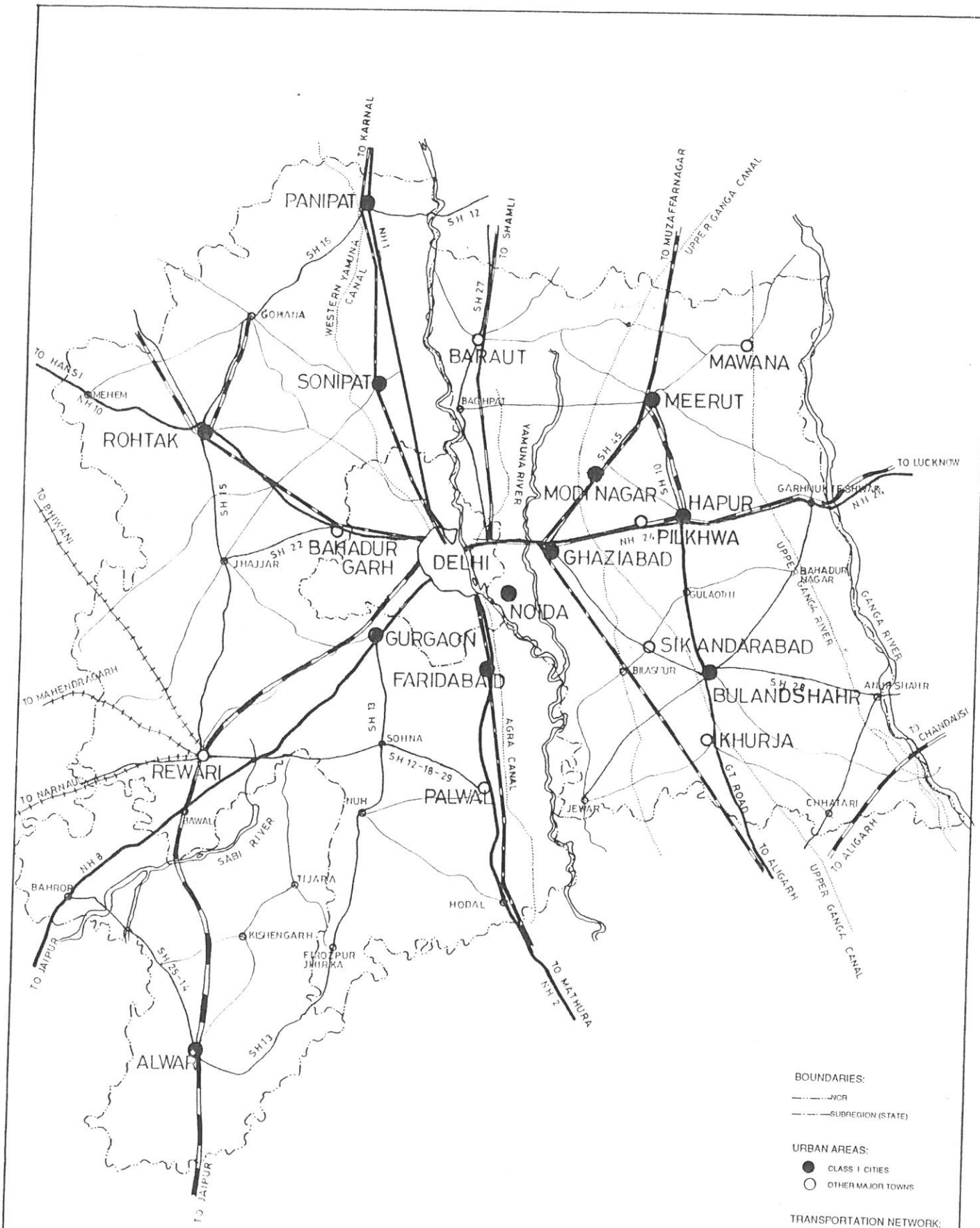

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FIG. 1
REGIONAL TRANSPORTATION NETWORK

Scale
5 0 5 10 20
kms.

N

The railway network similarly constitute radial routes coverging into Delhi as well as orbital links. The network constituting both broad and meter guages, cover northern, central and western railway zones and five divisions.

The following radial corridors converge directly into Delhi:

1. Delhi-Rohtak (Broad guage)
2. Delhi-Sonepat-Panipat (Broad guage)
3. Delhi-Samli (Broad guage)
4. Delhi-Ghaziabad-Hapur (Broad guage)
5. Delhi-Faridabad-Palwal (Broad guage)
6. Delhi-Gurgaon-Rewari-Alwar (Broad guage)

Besides two other corridors converge into Delhi via Ghaziabad:

7. Delhi-Ghaziabad-Meerut (Broad guage)
8. Delhi-Ghaziabad-Khurja (Broad guage)

The important orbital railway routes in NCR include

1. Panipat-Rohtak (to Bhiwani) (Broad guage)
2. Meerut-Hapur (Broad guage)
3. Hapur-Bulandshahr-Khurja (Broad guage); and

the two specially identified by pass lines, namely, the Goods Avoiding Line (GAL) and the Delhi Avoiding Line (DAL) are used essentially to avoid Delhi and/or New Delhi stations in freight movement between yards i.e., between Ghaziabad and Tughlakabad and to provide direct passage from these two major yards into the Delhi-Ambala-Kalka section as well as to serve as an intra-city ring railway route for local passengers.

3. Existing Network Capacities and Accessibility Across NCR

3.1 Highway Capacities

The NH-1 linking Delhi with Sonepat and Panipat has 4 -lane dual carriage way upto Sonepat and 2-lane carriage way between Sonepat and Panipat excepting built up areas, with R.O.W. ranging between 45 and 9owM. The road has good to very good riding quality with no major constraints or bottlenecks.

The NH-2 linkage to Faridabad from Delhi is a heavily trafficked road passing through fully developed section. It has a 4-lane dual carriageway upto 37 Kms from Delhi beyond which it has 2 lanes R.O.W. varying from 26-60 M., but there is heavy encroachment of lorries, stalls and hawkers in Faridabad and congestion near Badarpur.

NH_8 linking Gurgaon with Delhi has 4-lane dual carriageway (2-lanes beyond Gurgaon) with 45-60M R.O.W., no major bottleneck and very good riding quality.

NH-10 linking Rohtak with Delhi has 4-lanes upto Bahadurgarh with 2-lanes beyond with R.O.W. 25-60M. Although it has good riding quality there is bottleneck in Bahadurgarh and little R.O.W. expansion possibility upto that town.

NH-24 linking Ghaziabad and Hapur with Delhi is heavily trafficked expecially upto Ghaziabad, although it has 4-lane dual carriage upto this city and 2-lane beyond it, R.O.W. varies from 25-54M and widening is possible. It has fair to good riding quality.

Most state Highways are of single lane or intermediate lane except for the busy corridors of Ghaziabad-Meerut and Ghaziabad-Bulandshahr Sections which are of 2-4 lanes.

However, the SH-22 linking Bulandshahr with Ghaziabad has no major constraints or bottlenecks and has service road in Sikandarabad while the SH-45 to Meerut from Ghaziabad is continuously developed with limited open areas and is one of the most heavily trafficked State Highways. But both roads have good to very good riding qualities. No significant information is available to date for the other State Highways.

3.2 Road Accessibility of Different Parts of NCR

Table 1 shows the extents of road network and the densities of the network in relation to areas and population of the Districts. The density of pucca roads in the district vary considerably across the region-Alwar having the lowest road density of 0.22 Kms of pucca roads per sq.mm. of area, whereas in Ghaziabad road density rises to 0.75 Kms per sq.mm. of the district. Similarly, the percentages of district land areas devoted to road and rail also varies considerably across the region.

As may be apparant from both the Table and the Map, Rajasthan sub region is relatively poorly served by road networks, compared to the other sub-regions. The NCT Delhi appears to be most endowed, followed by Haryana and U.P. Sub-regions. The only national highway of Rajasthan sub-region (NH-8: Delhi-Jaipur) passes through the extreme north-western corner of the district touching Behror (Class IV town). The two state highways- SH25 and SH13-help to connect Alwar city, the most important centre of the region, with the rest of NCR.

TABLE : 1

ROAD NETWORK IN DIFFERENT DISTRICTS OF NCR

DISTRICTS	POPULATION	AREA	TOTAL LENGTH OF PAVED ROADS (Km)	ROAD DENSITY IN KM/SQ.KM	KM / 1000 Popn.	% LAND UNDER ROAD/RAIL
U.P. Sub-Region						
Bulandshaher	2849859	4353	1920	0.44	0.67	1.51
Ghaziabad	2755000	2590	1930	0.75	0.7	1.27
Meerut	N.A.	N.A.	N.A.	N.A.	N.A.	1.21
Sub Total	5604859	6943	3850	1.19	1.37	3.99
Haryana Sub-Region						
Sonipat	754866	1385	1018	0.47	1.35	1.44
Faridabad	1477240	2105	1147	0.53	0.78	1.39
Rohtak	1808606	4411	1593	0.36	0.88	1.1
Gurgaon	1146090	2760	1547	0.56	1.35	0.85
Panipat	833501	1754				
Sub Total	6020303	12415	5305	1.92	4.36	4.78
Rajasthan Sub-Region						
Alwar	2296580	8380	1846	0.22	0.8	0.89
Sub Total	2296580	8380	1846	0.22	0.8	0.89
NCT Delhi	9420644	1483	19084	12.86	2.025	2.23
Total NCR	23342386	29221	30085	16.19	8.555	11.89

Source : District Statistical Hand Books

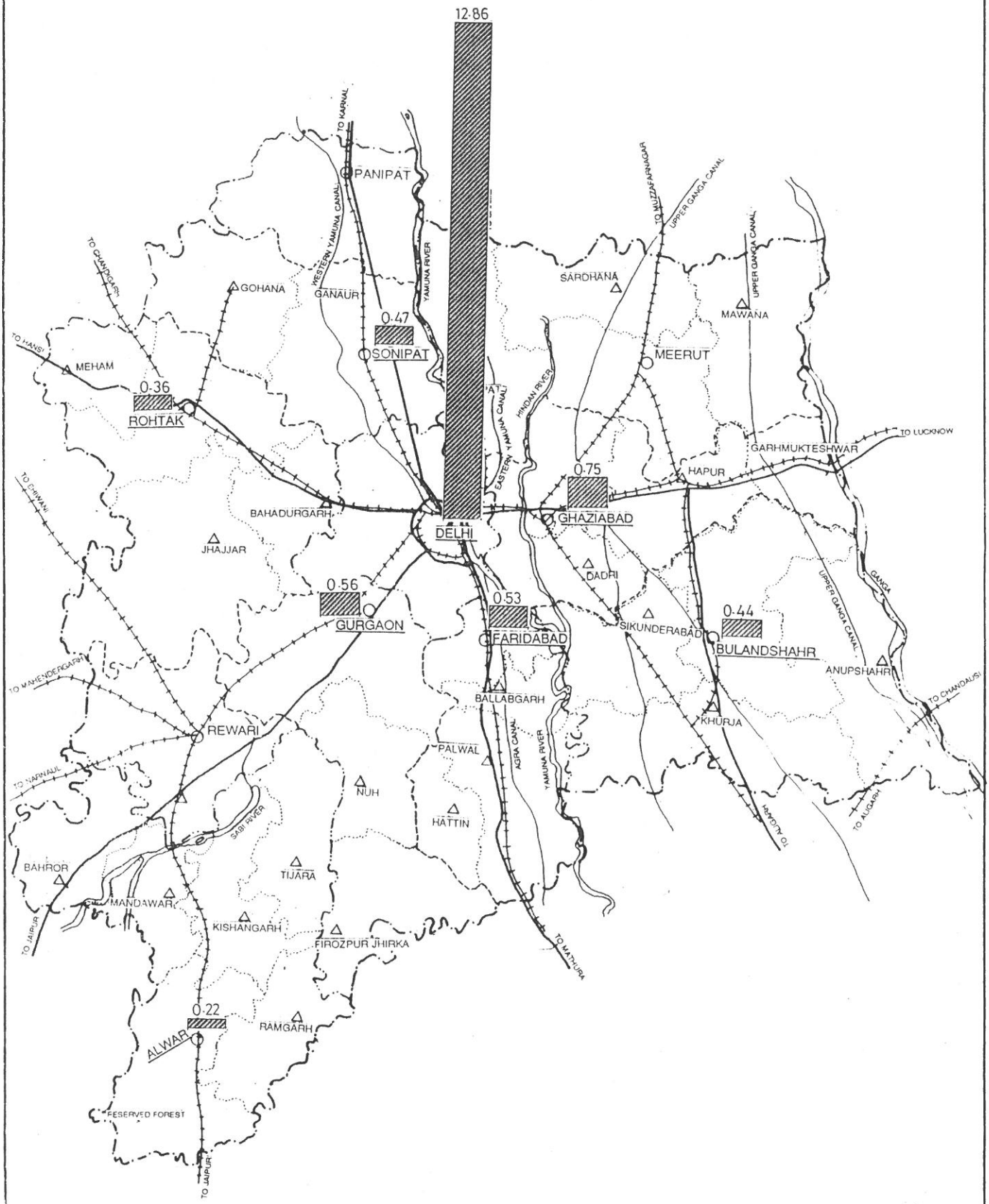

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FIG.2
DISTRICT ROAD DENSITY
(KM./SQ.KM.)

Scale
5 0 5 10 20 kms

N

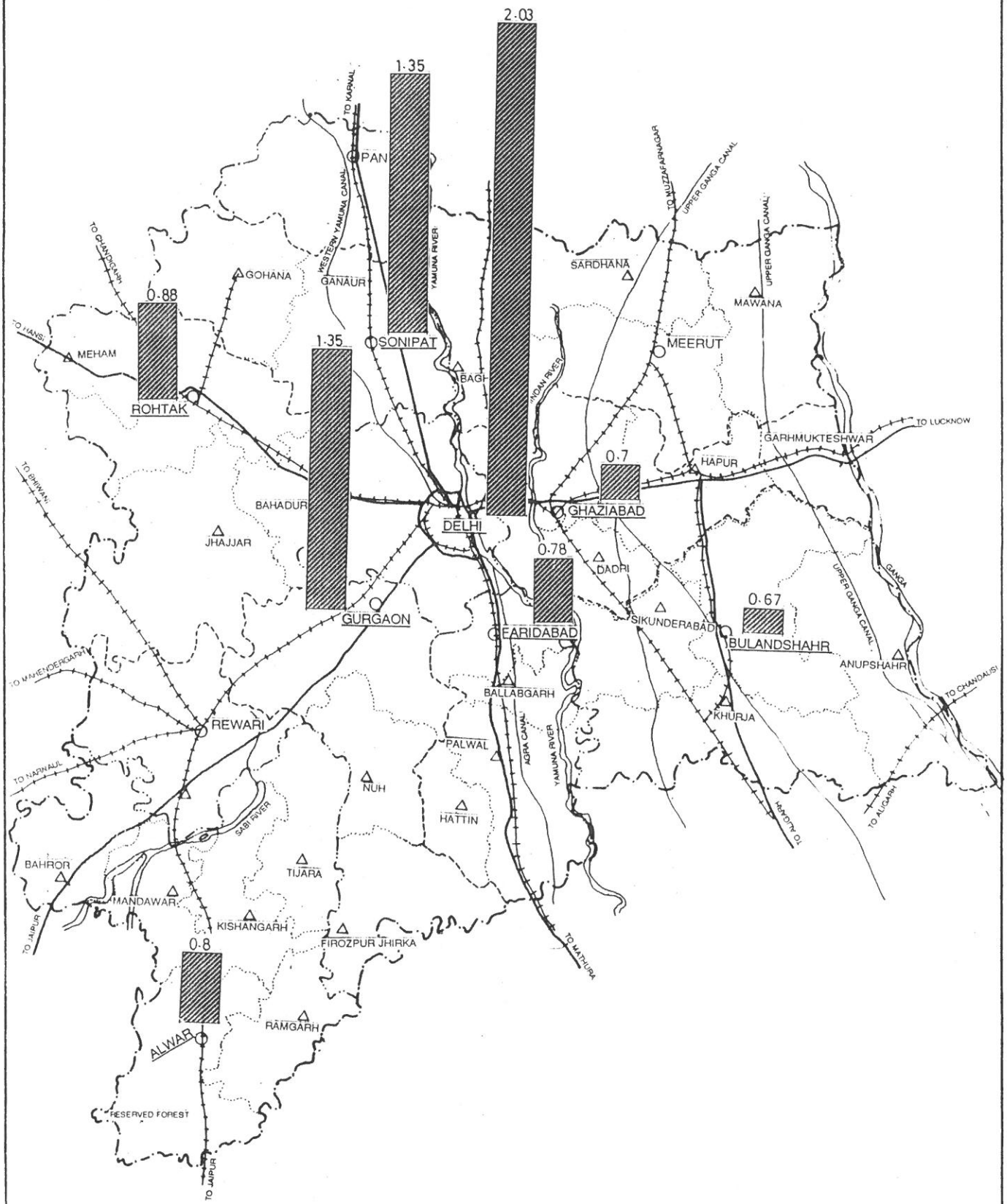

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FIG. 3
DISTRICT ROAD DENSITY (KM./1000 POP.)

Scale
5 0 5 10 20 kms

N

The latter connect Alwar to Delhi via Gurgaon. The other Highway SH-14-which connects Alwar with Bharatpur has a minor role within the NCR. Difficult terrain condition of this sub-region as well as sparse settlement growth are factors related to the low level of accessibility of Rajasthan Sub-region.

Haryana sub-region in served by four national highways interconnecting some of its major urban centres as well as connecting them with Delhi. They are NH-8 connecting Gurgaon with Delhi, NH-10 connecting Rohtak with Delhi and passing through Bahadurgarh a Class II town, NH-1 connecting Panipat, Sonipat and Delhi and NH-1 connecting Faridabad and Palwal (an important class III town) with Delhi. The state highway network is also vastly extensive compared to Rajasthan sub-region which help to interconnect the class I cities and other major towns of this sub region as well as to connect them with some centres and major towns of U.P. sub-region. Important links in this network include SH-16 connecting Rohtak and Panipat via Gohana (class II town), SH-11 connecting Gohana and sonipat, SH-15 connecting Rohtak and Rewari as well as Gurgaon (through SH-15A via Jhajjar- a class II town), SH-18 connecting Rohtak and Sonipat, SH-13 from Gurgaon to Alwar via Sohana (class IV) and Ferozpur (class IV), SH-26 connecting Rewari and Gurgoan via Palandi (class IV), SH-28 connecting Rewari and Palwal and the inter-state expressway connecting Faridabad with Noida and Ghaziabad cities of U.P. Besides, a district road connects Panipat with Baraut in U.P. with further district road links to the city of Meerut as well as

to Baghpat in U.P. sub region.

In U.P. NH-24 passes through the heart of the sub-region inter-linking class I cities of Ghaziabad and Hapur and a few other large centres, viz Pilkhua and Gurumukteswar with Delhi. The G.T. Road connects NH-24 at Ghaziabad and runs south wards connecting Dadri, Sikkandarabad (Class III) Bulandshahr and Khurja (Class II). Other important regional roads include the northern radial corridor emanating from Delhi connecting Loni, Baghpat and Baraut, SH-45 connecting Ghaziabad, Modinagar and Meerut, SH-10 connecting Meerut and Hapur, SH-18 connecting Hapur and Bulandshahr, the district road between Meerut and Baghpat as well as other district roads connecting the class I cities of Meerut, Hapur and Bulandshahr with their surrounding other urban settlements.

3.3 Regional Road Accessibility: Nodality of Class I Cities of NCR

The nodality individual class I cities of NCR is studied in terms of their relative highway linkages with Delhi as well as other cities of the NCR (See Table 2) and their average time accessibility for road travel (see Table 3).

Alwar has the weakest nodality among the class I cities of NCR with least inter-connection with other major regional cities and with no direct national highway link to Delhi. In the eastern part of NCR, specifically in U.P. sub-region, Ghaziabad appears to be the strongst node with direct highway link to eight other major cities of NCR, followed by Meerut and Hapur. Although, Meerut does not enjoy a direct national

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September, 1995

Table 2.

HIGHWAY LINKAGES OF DIFFERENT CLASS I CITIES OF NCR

City	Highway Connections	Linkage with to Other cities of NCR
U.P. Sub - Region		
1. Bulandshaher	SH - 22	Ghaziabad - Delhi (via NH - 24)
	SH - 18	Hapurt - Meerut (via SH - 10), Khurja
2. Ghaziabad	NH - 24	Delhi, Noida, Hapur
	SH - 22	Bulandshaher - Khurja (via SH - 18)
	SH - 45	Modinagar, Meerut
	Faridabad Expressway	Noida - Faridabad (via Shahibad/ NH - 24)
3. Hapur	NH - 24	Ghaziabad, Delhi, Outside NCR (to Murabad)
	SH - 10	Meerut
	SH - 18	Bulandshaher, Khurja
4. Meerut	SH - 45	Ghaziabad - Delhi (via NH - 24) Modinagar
	SH - 10	Hapur - Bulandshaher, Khurja (via SH - 18)
	District Roads	Baraut - Panipat
	SH -	Outside NCR (Roorkie)
	District Roads	Baghpat - Sonepat
5. Modinagar	SH - 45	Ghaziabad - Delhi (via NH - 24), Meerut
6. Noida	NH - 24	Delhi, Ghaziabad
	Faridabad Expreeway	Faridabad
Haryana Sub - Region		
7. Faridabad	NH - 2	
	Faridabad Expressway	Delhi, Outside NCR to Mathura Noida, Ghaziabad (via Shahibad/ NH - 24)
8. Gurgaon	NH - 8	Delhi - outside NCR to Jaipur
	SH - 13	Alwar
	SH - 26	Rewari
9. Rohtak	NH - 10	Delhi, outside NCR to Hansi
	SH - 16	Panipat, outside NCR to Bhiwani
	SH - 15	Rewari
	SH - 18	Sonepat
10. Sonipat	NH - 1	Delhi, Panipat
	SH - 18	Rohtak
		Baghpat - Meerut
11. Panipat	NH - 1	Sonipat, Delhi, outside NCR to Karnal
	SH - 16	Rohtak
	District Roads	Baraut - Meerut
Rajasthan Sub - Region		
12. Alwar	SH - 13	Gurgaon - Delhi (via NH - 18)
	SH - 25	Bhiwadi - Rewari (via SH - 28)
	SH - 14	outswide NCR to bharatpur
NCT Delhi	NH - 1	Sonipat, Panipat
	NH - 2	Faridabad
	NH - 8	Gurgaon - Alwar (via SH - 13)
	NH - 10	Rohtak
	NH - 24	Ghaziabad, Hapaur, Meerut (via SH - 45)
		Bulandshaher (via SH - 22)
	SH - 57	Baghpat - Baraut

Source : ORG (1988); RITES (1992); SPA (1993)

highway link to Delhi like Ghaziabad, some district roads help to link it with cities of Haryana sub-region, i.e. Panipat on the north and Sonipat (and Rohtak via Sonepat) on the west, Meerut has also direct highway links with major cities outside NCR. Both Modinagar and Noida have much less direct links to other class I cities of NCR than the above nodes.

On the west, i.e. in Haryana sub-region, Sonipat, Panipat and Rohtak appear to have similar nodality in term of direct link to other major regional cities. The former two have links with Meerut, ableit through district roads. Gurgaon and Faridabad has relectively less direct links with other major regional centres.

The Time Accessibility ranking of each of these class I cities of NCR has been worked out seperately on the basis of (1) its travel time requirement (by car) to or from Delhi and (2) the cummulative time requirement (by car) to travel between the city and all other class I cities (excluding Delhi) of the region (see Table 3). Ghaziabad has the highest time accessibility for road travel with respect to both Delhi and other NCR cities, followed by Noida and Gurgaon in that order. While Faridabad has greater time accessibility to /from Delhi than Hapur and Modinagar, the latter two are better accessible to/from other NCR cities. While Meerut, Bulandshahr, Sonipat and Rohtak appear to be middle-ranking cities in term of time accessibility, Panipat requires considerably more time to reach than the above. Alwar clearly suffers from the worst accessibility problem. Although there appears to be an

TABLE 3

Table : TIME ACCESSIBILITY ON ROADS OF CITIES IN SOME OF TRAVEL BY CAR TO/FROM DELHI AND OTHER NCR CITIES*

CITY	DISTANCE TO DELHI (Kms)	TRAVEL TIM BY CAR TO DELHI	CUMULATIVE DISTANCE TO ALL OTHER CLASS I CITIES	CUMALATIVE TRAVEL BY CAR TIME TO ALL OTHER CITIES (MIN.)
Ghaziabad	24	24	760	801
Noida	14	20	828	889
Faridabad	26	34	934	1001
Gurgaon	22	31	887	972
Meerut	78	75	1167	1201
Hapur/ Rest NCR Bulandshaher	51	49	942	977
Khurja	75	72	1175	1223
Panipat	98	110	1479	1583
Rohtak	72	83	1210	1382
Alwar	149	154	2104	2189
Sonipat/ rest NCR	67	83	1182	1352
Modinagar	48	47	952	985

Source : ORG (1994)

* based on Distance and Travel Time Matrices

TABLE : 4
DISTANCE MATRIX (Kms.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. DUT		24	14	26	22	30	28	78	51	75	69	98	72	81	149	63	48	44	58	167
2. Ghaziabad/ Loni			32	46	46	54	51	54	27	61	79	121	96	105	173	90	24	68	82	191
3. Noida				34	36	44	42	86	59	83	63	112	86	95	163	81	56	58	72	181
4. Faridabad/ Ballabhgarh					43	56	54	100	73	97	33	124	98	102	166	93	70	61	84	193
5. Gurgaon						46	49	100	73	97	50	119	88	59	127	88	70	22	74	183
6. Bahadurgarh							43	108	81	105	89	110	42	76	173	82	78	68	28	137
7. Kundli								105	78	102	87	70	85	108	176	39	75	71	71	180
8. Meerut									38	63	133	175	150	159	227	144	30	122	136	245
9. Hapur/ Rest of NCR										33	106	148	123	132	200	117	51	95	109	218
10. Bulandshahar/Khurja											83	172	147	156	216	141	75	111	133	242
11. Palwal												157	131	73	133	126	103	28	117	226
12. Panipat													68	148	246	49	145	141	100	163
13. Rohtak														84	184	50	120	110	32	95
14. Rewari															104	130	129	45	48	175
15. Alwar																215	197	105	152	279
16. Sonepat/ Rest of NCR																	114	110	82	145
17. Modinagar																		82	106	215
18. Sohana/ Rest of NCR																			93	205
19. Jhajjar/ Rest of NCR																				127

Source : ORG (1988); IIT

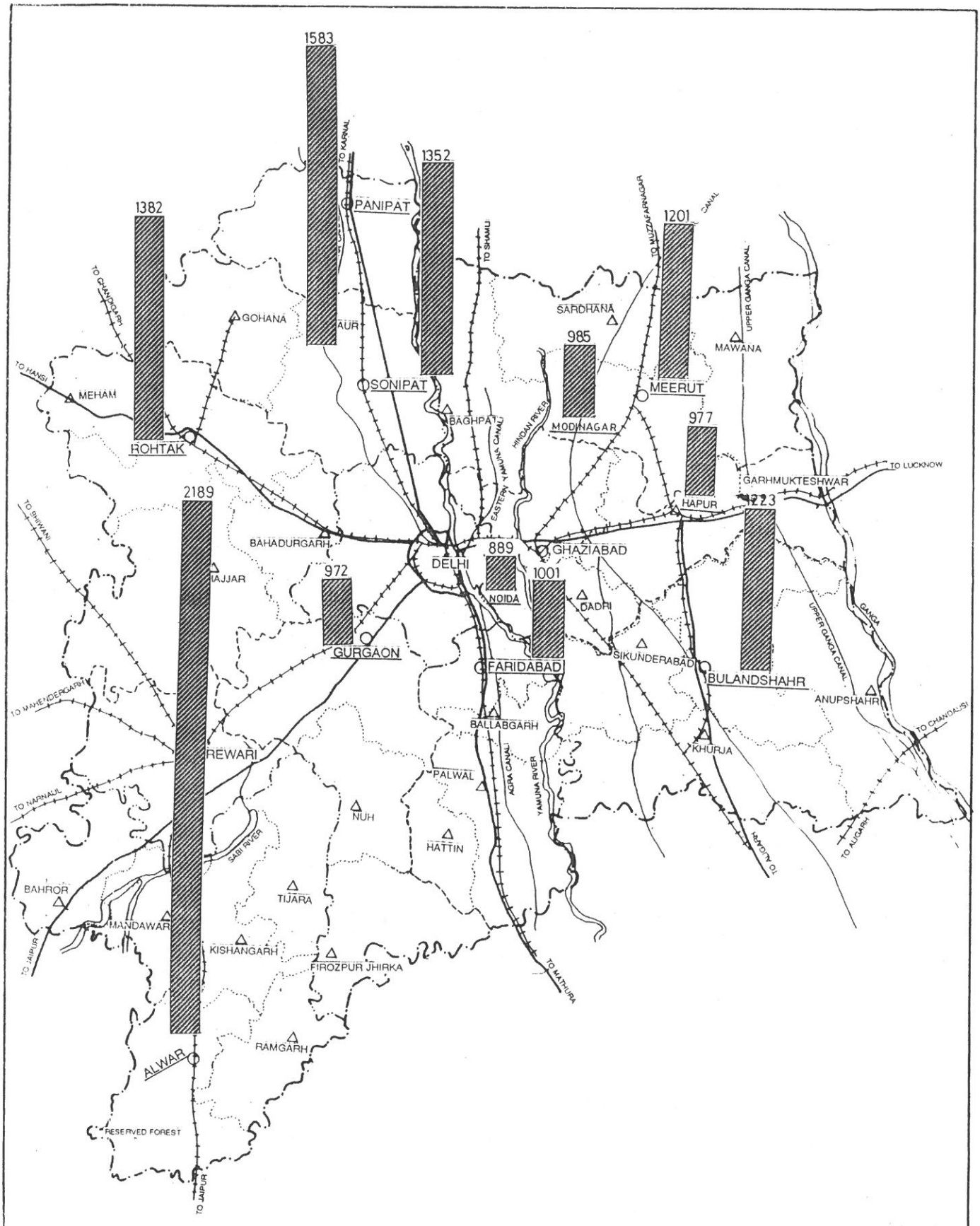

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FIG. 4
CUMULATIVE TRAVEL TIME
(CAR TO OTHER CITIES) MINUTES

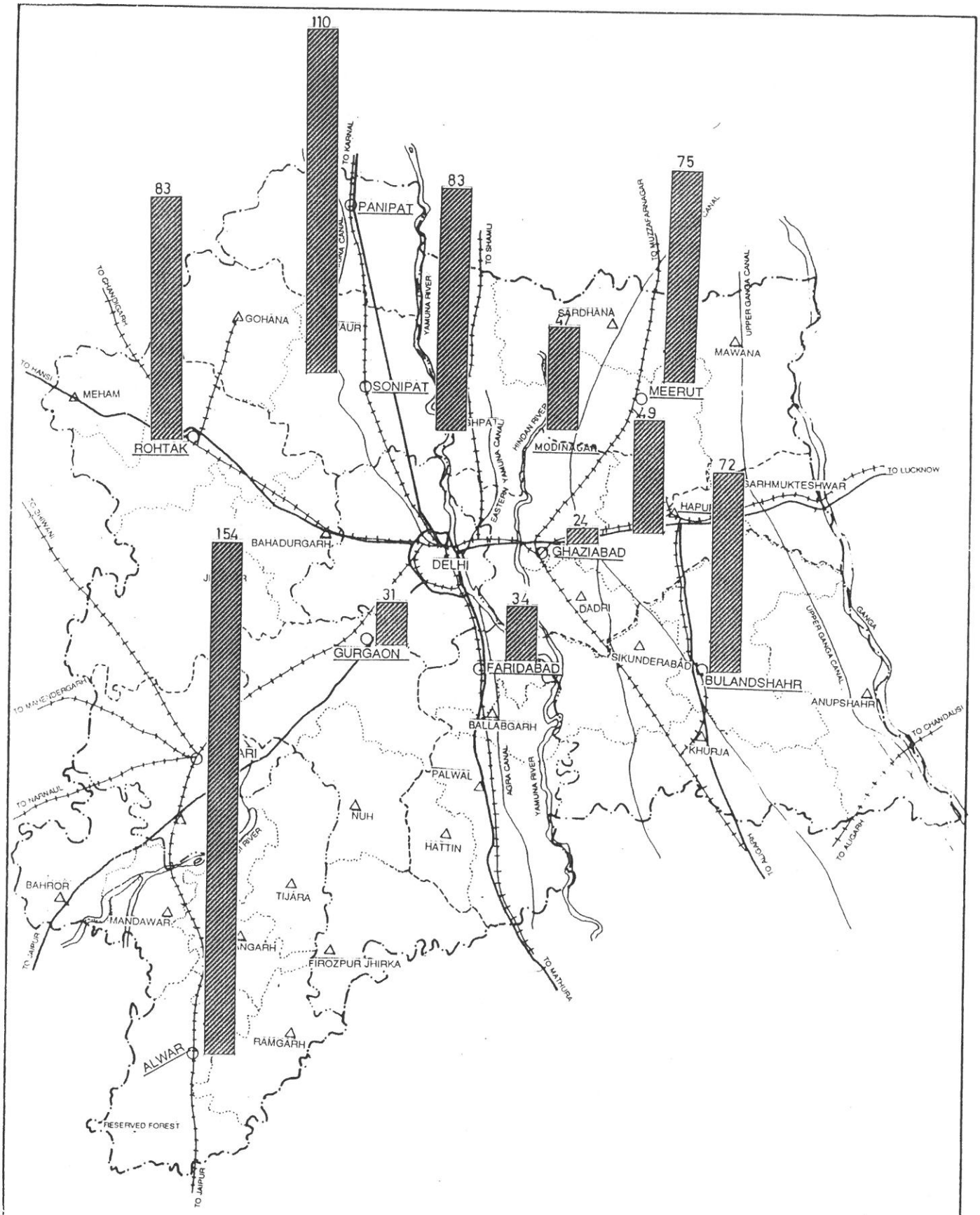

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FIG.5
TRAVEL TIME BY CAR TO DELHI
MINUTES

Scale
5 0 5 10 20 kms

N

obvious correlation between distance and travel time, the time accessibility ranks do not exactly correspond to the relative proxmities of the cities especially from Delhi which may reflect variations in average journey speeds of the different roads connecting there cities. In general, the DMA towns like Ghaziabad, Noida, Gurgaon and to some extent Faridabad are better accessible both from Delhi and from other cities of NCR than the outlying "priority" cities of the region, expecially Alwar, Panipat and Rohtak.

3.4 Railway Accessibilty and Capacity Across NCR

All class I cities, except Noida, has railway access; and they are served by broad gauge lines. Alwar has limited railway accessibility since it is served by a single track, with double track only in the Delhi-Rewari section. Among the NCR 0cities, Faridabad appears to have the highest level of railway access from Delhi as it is the only class I city served by three broad gauge lines, while Ghaziabad, Gurgaon, Panipat, Rohtak and Sonipat are served by double broad guage lines and Bulandshahr (?), Hapur, Meerut and Modinagar are served by single broad guage lines.

In terms of railway nodality of individual class I cities of NCR, Ghaziabad appears to be the strongest by virtue of its existing and potential railway links to Delhi as well as other major cities of the region. It has direct links to Delhi, Meerut, Hapur and Khurja and is linked also to Rohtak, Sonipat and panipat either via Delhi or via the G.A.L.-D.A.L.

byepassing loops. Faridabad follows as another strong railway node having direct link to Delhi as well as potential links to Ghaziabad (via G.A.L.), Meerut, Hapur and Khurja (via Ghaziabad) and Rohtak, Sonipat and Panipat (via Delhi/D.A.L.) Panipat, Rohtak, Hapur and Meerut are moderately strong railway nodes. The first two has direct links with Delhi as well as interconnection between them. Although Meerut is linked to Delhi via Ghaziabad it has direct link to Hapur and to Bulandshahr via Hapur. While Alwar is clearly the weakest railway node with meter guage connection to Gurgaon and Rewari. Bulandshahr is also relatively weak with no direct link to Delhi.

3.4.1 Railway Line Capacities

The chartered capacities and utilization of the capacities for different sections of NCR railway network is shown in TABLE (5). It reveals that line capacities of sections are reaching saturation level (80% capacity utilization) and several sections are over-utilising their capacities. They are Delhi-Bahadurgarh connecting Rohtak, Delhi-Azadpur-Sonipat-Panipat. Delhi-Gurgaon, Muradnagar-Meerut connecting Modinagar and Meerut and Delhi-Ghaziabad section (over unitized). Thus the railway accessibilities of most NCR towns, especially Ghaziabad, Gurgaon, Sonipat, Rohtak and Meerut appear to be fast getting congested. Delhi-Faridabad section is the only major one among the main railway corridors

Table 5
Railway Line Capacity

Sections	Class I Cities Connected	Charyered capacity (trans)	% capacity utilisation	Passenger volume (each way)	Railway plans	
					Length (km)	Passengers (one way)
Ghaziabad-Muradnagar	Ghaziabad	37up 37dn	60.8;45.1	11;12	17.79	
Muradnagar-Meerut	Modinagar,Meerut	27up 19dn	80;82.6	1.1;12	29.5	
Delhi-Sabjimandi	Delhi	14.5	86.8	7	2.77	
Subjimandi-Delhi Azadpur	-	37	77	19.5	6.13	
Delhi Azadpur-Panipat	Sonipat,Panipat	37	87	19.5	79.39	
Shakurbasti-Rohtak	Rohtak	38	75.5	14	59.72	
New Delhi-Sabjimandi	New Delhi	12	147.5	12.5	3.91	
Delhi-New Delhi	Delhi,New Delhi	37	82.8	15.5	3.14	
Shakurbasti-Ghaziabad	Dehi,Ghaziabad	90	193.7	55.5	6.72	
Delhi-Delhi Kishanganj	Delhi	25.5	83.5	13	2.95	
New Delhi-Delhi Kishanganj	New Delhi	20	41	0.5	4.32	
Delhi Kishanganj-Dayabasti	-	38	98.7	19.5	2.94	
Dehi-Ghaziabad	Delhi,Ghaziabad	97.5	106.5	59.5(15821)		26318
Delhi-Sonipat	Delhi,Sonipat	46	22.5	80.2(10529)		17596
Delhi-Faridabad	Delhi,Faridabad	95	35	71.8(8845)		15757
Delhi-Gurgaon	Delhi-Gurgaon	33	21	99.7(3492)		6383
Delhi-Rewari-Alwar(M.C.)	Delhi,Gurgaon,Alwar				157	
Delhi-Ghaziabad-Hapur(B.C.)	Delhi,Ghaziabad,Hapur					

Source: ORG NCR Trans population Study (1988), Rites Report on LPT in Delhi.

emanating from Delhi where capacity has been under-utilized to date. Most line capacities in and around Delhi have exceeded their saturation limits straining the accessibility of all NCR towns to and from Delhi. Especially under strain are the New Delhi-Subzimandi and Shakur Basti-Ghaziabad sections which are being utilized far above their capacities.

3.4.2 **Terminal Capacities**

More than 50% of the total rail passengers of NCR use the three terminals of Delhi. Delhi and New Delhi Railway Stations are the most congested terminals of the region and saturated already in terms of their passenger handling capacity as well as line capacity.

4. Regional Bus Facility Across NCR

4.1 Bus transportation system has an important role in the inter-city passenger movements across NCR and dominate particularly the movement between DMA towns and Delhi with approximately 42% of their total passenger trips occuring in buses. Five major state transport undertakings, namely, DTC, UPSRTC, STP, STH and RSRTC dominate the service while private agencies are also increasing their roles, especially in Delhi. DTC performs both inter-city (to and fro Delhi) and inter-city bus trips.

4.2 Regional Bus Services in Different Class I Cities

Table 6 shows the levels of daily bus trips, places (inside and outside NCR) directly connected by bus service, the total

TABLE 6

REGIONAL BUS SERVICE IN THE CLASS I CITIES OF NCR

City/Station	Total No. of Bus trips per day	Places connected directly by bus routes (i)Major cities in NCR (ii) Major places outside NCR (iii) Remaining places	Total Bus Elect	Bus Station Area and Other Facilities
1) Ghaziabad	725	(i) Delhi, Meerut, Modinagar, Sikandrabad, Bulandshahr, Hapur, Khurja, Pilkhua (ii) Moradabad, Muzzafarnagar, Aligarh, Sharanpur, Hardwar (iii) Hathras, Wodinagar, Suvana, NTCPC, Ghaziabad Industrial Area.	76	Bus Station =10495sq.yd Sahibabad work shop = 291.4 ha Facilities=Enquiry Public Announcement System, Passanger Waiting, Drinking Water, Toilet
2) Modinagar	192	(i) Hapur (ii) Aligarh (iii) Dholari, Sewal, Khindorwa, Biklawa Patla	30	Bus Station Facilities:Enquiry Passenger Waiting Hall, Drinking Water, Toilet No workshop
3) Hapur	292	(i) Delhi, Meerut, Bulandshahr, Garmukteshwar, Modinagar (ii) Lucknow, Shahranpur, Etwah, Moradabad, Sitapur (iii) Barachi, Sewana, Bahalurgara, Kathor, Harroda, Badyana	67	BusStation=3,000sq. yd Workshop=3,000 sq.yd. Facilities: Enquiry Passenger Waiting Hall, Time Table, Drinking Water, Toilet

4) Bulandshahr	199	(i) Delhi, Meerut, Ghaziabad, Hapur, Khanpur (ii) Kanpur, Aligarh, Agra, Ajmer, Saharanpur (iii) Kasganj, Mohana, Anupshahr, Narova, Bibinagar, Truwana, Daulatpur	79	Bus Station=6,000 sq.yd Workshop=3,000 sq.yd. Facilities: Enquiry, Time Table, Passenger Waiting Hall, Drinking Water, Toilet
5) Meerut a) Sohrabgate Depot	385	(i) Delhi, Faridabad, Bulandshahr, Ghaziabad (ii) Bareilly, Pilibhit, Agra, Etawah, Mathura, Firozabad, Lucknow, Kanpur, Sultanpur, Gonda, Aligarh, Muradabad, Budaun (iii) Lakhimpur, Haldwani, Kotdwar, Kharkhawda, Keena Nagar, Balda, Samediya, Laliyal, Mahelwala, Satkai, Jodha, Garh, Jododa, Muzafarpur	144	Bus Station=8,154 sq.yd. Bus Station=10,495 sq. yd. Facilities: Enquiry, Public Announcement System, Passenger Waiting Hall, Drinking Water, Toilet
b) Bhaishali Depot	599	(i) Delhi, Ghaziabad, Alwar, Hastinapur (ii) Karnal, Kota, Hardwar, Dehradun, Shimla, Chandigarh, Ludhiana, Bijnor, Etawah, Ajmer, Muzaffarnagar (iii) Palla, Dholadi, Dinkauli, Lohadda, Rasulpur, Barot, Shamli, Satwai, Karnawal, Sardhana, Bhamur Radhna, Jwela garh Khera, Kotdwar, Kila, Panchhitgarh, Shitash, Pindora, Pushkar	183	Bus Station=61606 sq.yd Facilities: Drinking Water, Toilet, Waiting Hall, P.A. System Guides, Telephone, T.V. Cycle Stand, Rickshaw Stand

5) Meerut a) Sohrabgate Depot	385	(i) Delhi, Faridabad, Bulandshahr, Ghaziabad (ii) Bareilly, Pilibhit, Agra, Etawah, Mathura, Firozabad, Lucknow, Kanpur, Sultanpur, Gonda, Aligarh, Muradabad, Budaun (iii) Lakhimpur, Haldwani, Kotdwar, Kharkhawda, Keena Nagar, Balda, Samediya, Laliyal, Mahelwala, Satkai, Jodha, Garh, Jododa, Muzafarpur	144	Bus Station=8,154 sq.yd. Bus Station=10,495 sq. yd. Facilities: Enquiry, Public Announcement System, Passenger Waiting Hall, Drinking Water, Toilet
b) Bhaishali Depot	599	(i) Delhi, Ghaziabad, Alwar, Hastinapur (ii) Karnal, Kota, Hardwar, Dehradun, Shimla, Chandigarh, Ludhiana, Bijnor, Etawah, Ajmer, Muzaffarnagar (iii) Palla, Dholadi, Dinkauli, Lohadda, Rasulpur, Barot, Shamli, Satwai, Karnawal, Sardhana, Bhamur Radhna, Jwela garh Khera, Kotdwar, Kila, Panchhitgarh, Shitash, Pindora, Pushkar	183	Bus Station=61606 sq.yd Facilities: Drinking Water, Toilet, Waiting Hall, P.A. System Guides, Telephone, T.V. Cycle Stand, Rickshaw Stand

6) Alwar a) Depot 'A'	200	(i) Delhi, Meerut (ii) Hardwar, Mathura, Aligarh, Agra, Firozabad, Jaipur, Bharatpur, Hisar (iii) Narayanpur, Dausa, Balaji, Pratapnagar, Bandikui, Lalsor, Basely, Behror, Kheirli, Bayana, Mahavirji, Laxmangarh, Gangapur, Malakhera Gardi, Bootoli, Godli, Mandower, Rajgarh, Govindgarh, Rai, Dholagarh, Kherthal	N.A.	N.A.
b) Depot 'B'	197	(i) Delhi, Meerut, Panipat, Rewari (ii) Firozabad, Bikaner, Jaipur, Jodhpur, Bharatpur, Ganganagar, Pali (iii) Mubarkpur, Neekatu, Tonk, Dausa, ajabgarh, Pratapgarh, Narainpur, Karana, Shahjahanpur, Bhiwadi, Mandawer, Bhatabda Behror, Kherthal, Kotakallin, Rainpur, Golakabar, Esmilepur, Kishangarh,Shanagari	N.A.	N.A.

7) Delhi (DTC Bus Service)	4001	(i) Ballabgarh, Faridabad, Bahadurgarh, Faruknagar, Badli, Gurgaon, Panipat, Rewari, Sonipat, Rohtak, Dadri, Palwal, Hodal, Alwar, Bulandshahr, Ghaziabad, Baghpat (ii) Hissar, Jind, Kaithal, Yamunanagar, Hamirpur, Kullu, Simla, Sujanpur, Jammu, Katra, Gwalior, Amritsar, Bhatinda, Chandigarh, Hosiarpur, Julladhar, Kapurthala, Ludhiana, Patiala, Pathankot, Ajmer, Bharatpur, Bikaner, Bhiwani, Dholpur, Ganganagar, Jaipur, Jhunjhun, Jodhpur, Kota, Pilani, Aligarh, Agra, Hatrai, Bijnore, Dehradhun, Etali, Etawa, Firozabad, Farrukkabad, Garh, Haldwani, Hastinapur, Haridwar, Kanpur, Lucknow, Mathura, Moradabad, Muzzafarnagar, Nainital, Rishikesh, Sahabad, Rai Barrielly, Shaharanpur, Pilibhit, Rampur, Hardoi (iii) Aliganj, Jewar, Vilthora, Vikasnagar, Vrindavan, Tamakpur, Sambhal, Sikohabad, Sahaswan, Ratoi, Rudrapur, Ram Nagar, Rupana, Nazibabad, Lakhimpur, Kotdwar, Kakripur, Kasganj, Khurja, Kalagarh, Babrola, Behjoi, Bewsar, Anoopshahr, Kosi, Ayodhya, Sawai, Sahpur, Udaipur, Nagona, Makvana, Mabriji, Derbi, Churu, Chittorgarh, Mori, Anoopgarh, Moga, Talwara, Sangroor, Macluwara, Maler Kojala, Dhuri, Bela, Banga, Nalagarh, Chamba, Chintpurni, Baijwaru, Badchal, Dever Khanna, Doulatabad, Gubhana, Sonouli, Charkhi, Ganour Mandi, Kalka, Chandu, Palandi, Saffido, Jhajjar, Gohana, Pehwa, Mohindargarh, Kharkoda, Kaithal	883	

8) Rohtak	451	(i) Delhi, Panipat, Sonipat, Gurgaon (ii) Chandigarh, Hardwar, Dehradhun, Gwalior, Agra, Bikaner, Lucknow, Haldwani, Ajmer, Kota, Patiala, Amritsar, Hisar, Ludhiana,Nainthal, Jind, Ganganagar (iii) Fazilka, Anupgarh, Mahavirji, Firozpur, Vrindawan, Hanumangarh, Panchkoi, Pilani, Jhajjar	197	Bus Station: 3.5 Acres Workshop=8.75 Acres Facilities:Toiets Bathrooms, Water Cooler, Tubewell, Telephone, Waiting Hall, Cycle Stand
9) Gurgaon	555+279= 834 (Local Trips 2 Rural Short distance)	(i) Delhi, Rewari, Hodal, Dadri, Rohtak, Pataudi, Bawal, Alwar, Sohna, Ballabgarh, Bahadurgarh, Tijora (ii) Chandigarh, Manali, Simla, Agra, Yamuna Nagar, Gwalior, Hisar, Agra, Kapurthala, Haridwar, Udaipur, Aligarh, Mathura, Jaipur (iii) Sikri, Bhandni, Dabwali, Narwara Beri, Nandbai, Singora, Sangrur, Panchkula, Manesar	235	Bus Stand Area:6 acres Workshop:5-1/2 acres Facilities: Cycle/Scootar Stand, Water Cooler, Restaurant, Telephone
10) Sonipat	1070	(i) Delhi, Bulandshahr, Panipat, Bhagpat, Alwar, Rohtak, Gohana, Gurgaon, Bahadurgarh, Baraut, Hodal, Dadri, Maham (ii) Gwalior, Agra, Mathura, Aligarh, Hardwar, Bharatpur, Jaipur, Shimla, Chandigarh, Pathankot, Jallandhar, Ludhiana, Sirsa, Hisar, Bhiwani, Ambala, Yamunanagar, Kurukshetra, Karnal, Jind (iii) Sujanpur, Kalka, Karnal, Neharkhodi, Roorki, Awali, Hasangarh, Shivpuri, Shamli, Pushkar, Balaji, Manali, Badani, Tohari, Jawahara, Saupeda, Mehandipur, Rital, Kharkhoda, Julana	255	Bus Stand:1.5 Acres Parking: 1.5 Acres Workshop: 2 Acres Gohana B.S.:5 Acres Workshop: 2 Acres Facilities: Bathroom, Drinking Water, Water Cooler, Fan, Cycle Stand, Parking Space.

11)	746	(i) Gohana, Rohtak, Dadri, Rewari, Baraut, Sonipat, Samalkha, Meerut, Hodal, Delhi (ii) Bhiwani, Jind, Hisar, Sirsa, Karnal, Yamuna Nagar, Ambala, Kurukshetra, Haridwar, Sharanpur, Dehradun, Barelli, Jaipur, Ajmer, Karnal, Amritsar, Patiala, Ludhiana (iii) Jawahar, Narwar, Adampur, Asand, Goli, Khodi, Bharana, Bharsat, Yamunapul, Easrana, Jhatana, Sanoli, Pilani.	131	Bus Stand & Workshop: Approx 2 Acres.

Source: Field Survey

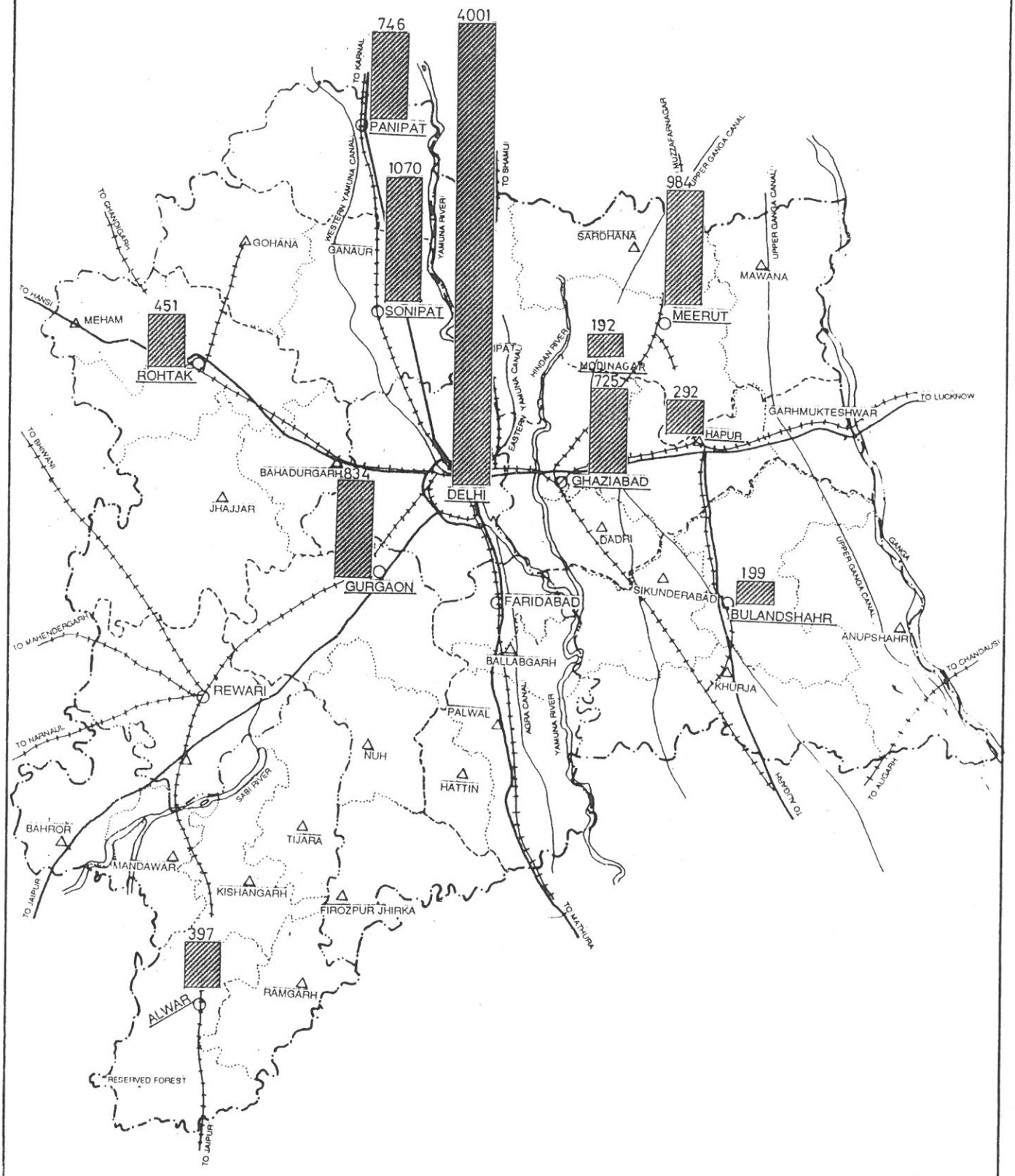

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FIG.6
DAILY REGIONAL BUS TRIPS
NO.'S

Scale
5 0 5 10 20 kms

N

fleet strength and the areas and facilities of bus terminals, for the Class I cities ofNCR. Furthermore the ORG (1987) estimated the daily bus trips and the bus passenger trips to and from these cities (Table 5).

As expected, Delhi is the hub of regional bus services, not only for the NCR but also for a much wider catchment area stretching to other parts of the component states of U.P., Haryana and Rajasthan as well as to M.P., Punjab, Himachal Pradesh and Jammu and Kashmir. Although only the DTC interstate bus services have been observed here (there are other state transport as well as private bus services operating through Delhi), the daily bus trips from Delhi far exceeds those from other Class I cities. Leaving aside Delhi, Meerut appears to be the strongst node for regional services in NCR. Its catchment area transcends beyond the U.P. State connecting it with Rajasthan and a few places of Punjab, Haryana and Himachal Pradesh. However, inter-sub regional bus links within NCR are generally poor, except for connection between Meerut and Alwar and in between the latter and Panipat. The bus transport system amply reflects the Delhi focussed regional road network and absence of orbital network interconnecting the major cities.

Furthermore, the difference between DMA cities (with the exception of Ghaziabad) and the outlying priority towns may be interesting to note. The former cities hardly act as regional bus nodes as their bus movements are confined to connection with Delhi alone while the latter provide much wider bus

TABLE NO. 7

ESTIMATED BUS TRIPS PER DAY AND AVERAGE PASSENGER DENSITY PER TRIP

	TOTAL BUS TRIPS	TOTAL PASSENGER TRIPS	AV.PASSENGER DENSITY PER TRIP
Ghaziabad	1489	68508	46.01
Delhi	668	34913	52.26
Meerut	218	9809	45
Bulandshahr	96	4512	47
Meerut	1680	71734	42.7
Delhi	326	13456	41.28
Rest of N.C.R.	326	14000	42.94
Ghaziabad	218	9809	45
Rohtak	861	44187	51.32
Rest of N.C.R.	275	13445	48.89
Sonepat	80	3695	46.19
Delhi	59	2592	43.93
Gurgaon	881	38731	43.96
Delhi	603	27053	44.86
		e	
Sonepat	184	7931	43.1
Delhi	115	4631	40.27
Panipat	33	1557	47.18
Panipat	240	11050	46.04
Delhi	107	4576	42.77
Rohtak	55	3167	57.58
Sonepat	33	1557	47.18
Noida	1547	64002	41.37
Delhi	1447	61021	42.17
Faridabad	1002	39122	39.04
Delhi	904	35557	39.33
Hapur	431	19796	46.13
Meerut	142	6308	44.42
Rest of N.C.R.	62	3205	51.69
Bulandshahr	883	44672	50.59
Delhi	301	14734	48.95
Meerut	130	7387	56.82
Rest of N.C.R.	179	7392	41.3
Alwar	380	14391	37.87
Rest of N.C.R.	149	5653	37.94
Delhi	45	1918	42.62

Source : ORG & IIT Kanpur ; 1988

services connecting them with different parts of NCR and in some cases also outside it. Again, the U.P. sub-region appears to be better endowed than Haryana, especially through Meerut and Ghaziabad. In Haryana suh-region, Rohtak is a far superior regional bus node to Panipat, Sonipat, Faridabad and Gurgaon. Alwar is the only sub-regional bus node in the Rajasthan part of NCR.

4.3 Bus Terminal Facilities

Delhi has large inter-state bus terminal, but the facilities are fast getting congested. However, the terminal is primarly for long distance passenger trips within and outside NCR and relatively much less for travel to and fro the nearby DMA cities. As one study indicates (Rites, 1992) the terminal caters for only 3.6% of the total passenger trips for Noida, 9.30% for Ghaziabad-Loni, 21.78% for Faridabad-Bulandshahr, 14.80% for Gurgaon and 79.28% for Sonipat.

Properly designed bus terminal facilities are either inadequate or are no-existent in many other cities of NCR. Among the DMA cities, Noida may represent the worst case with no designed bus terminals facility, although the estimated number of bus trips, especially to and from Delhi in among the highest in the region (Table 3). The two terminal in Sector 6 and Sector 37 operate through on-street parking and boarding/alighting with no parking, bus bays or other terminal facilities. On the other hand, each of the other DMA towns has some designed terminal facilities although the relative

adequacies vary. Ghaziabad has the largest bus station among them with additional workshop facilities in Sahibabad. According to a RITES study (1992) Faridabad C.A. has a large amount of land alloted for bus terminal facilities, especially in Ballabgarh and the smaller Faridabad terminus in adequate for 2001. Further, Gurgaon terminal area is inadequate and should be shifted to another larger location with the existing site to be continued for Depot use only, whereas Sonipat terminal may be adequate if the depot is relocated (RITES 1992). Among the outlying prioirty cities, Meerut has two bus depot of which Bhaisali Depot is the largest in the region, in tune with its regional importance as a bus node with catchement area spreading far beyond NCR. Alwar also has two bus stations although the area availability is yet unknown. In comparison, bus stations are small and inadequate in Rohtak, Hapur and panipat. In Hapur, the bus station is old and located in the congested part of the city. Panipat requires a properly designed station, according to the NCR Board Proposal (TCS, 1994).

5. Road Networks within Class I Cities of NCR

This section provides an overview of the road network patterns, the extents and capacities of road networks and the intracity modes of travel for individual class I cities of NCR.

5.1 Urban Road Patterns

The road network patterns of individual cities are shown in

Maps. It may be apperent from these figures that the national and state highways passing through these cities form significant parts of the arterial road systems within most cities. Highways and regional roads apparently have the most extensive role for intra-city movements in Meerut, Ghaziabad, Panipat and Modinagar where these roads constitute very large proportions of the urban arterial road networks. The pattern is typical of the so called "Organic growth" of these cities. Historically, urban growth had occured at the nodes or intersections of these regional roads which provided greatest accessibility to their central functions and then spreaded outwards along these major routes.

Of these cities, Meerut clearly displays a "radio-centric" pattern where regional roads from different directions culminate into the city centre; whereas the fan-shged urban form of Ghaziabad emerges dues to the highways leading to Meerut, Hapur and Bulandshahr fanning out from the G.T. Road section with its only bridge over Hindon River. Panipat is a combination of linear and radial road pattern with NH-1 forming the single long north-south artery along which different district roads intersecting at different points. Although Moninagar is a relatively new and planned rather than organise growth, the SH-45 from Delhi to Meerut acts as the single major artery as the city, takes a narrow linear form, stretching along this highway. Also, in Rohtak, Bulandshahr and Sonipat regional roads provide the major access and connectivity accross the cities. In Rohtak especially the NH-

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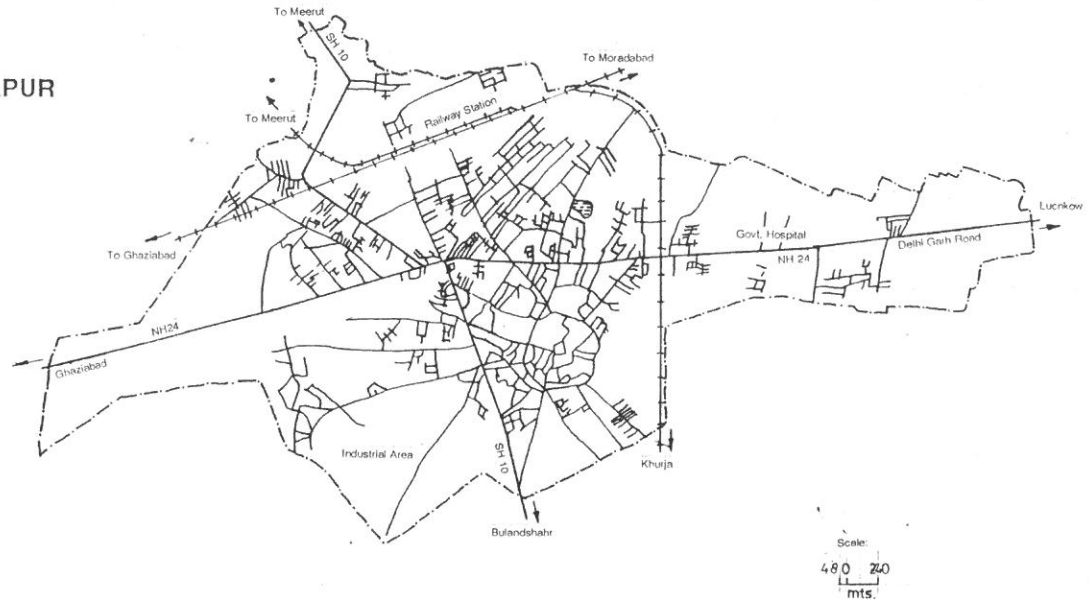
FIG 7

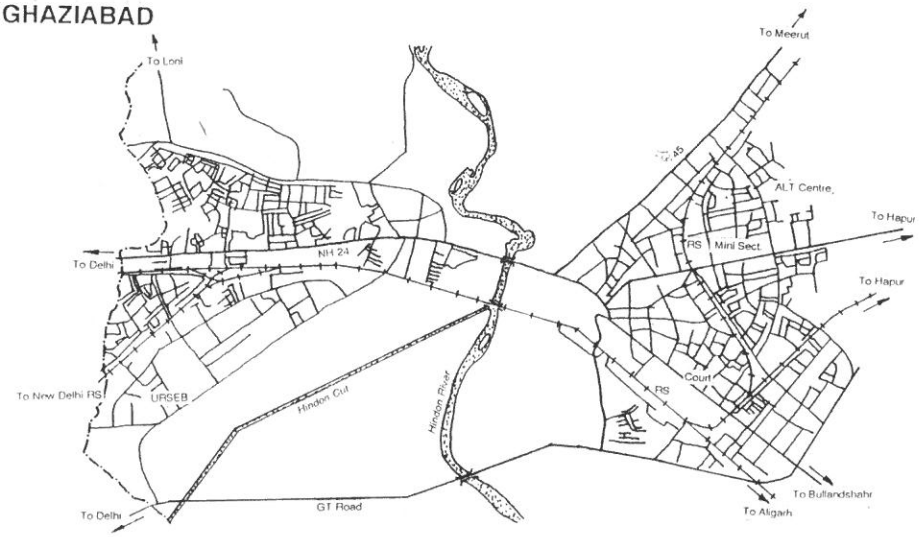
ROAD PATTERN IN NCR CITIES — DELHI AND RAJASTHAN SUB REGION

N

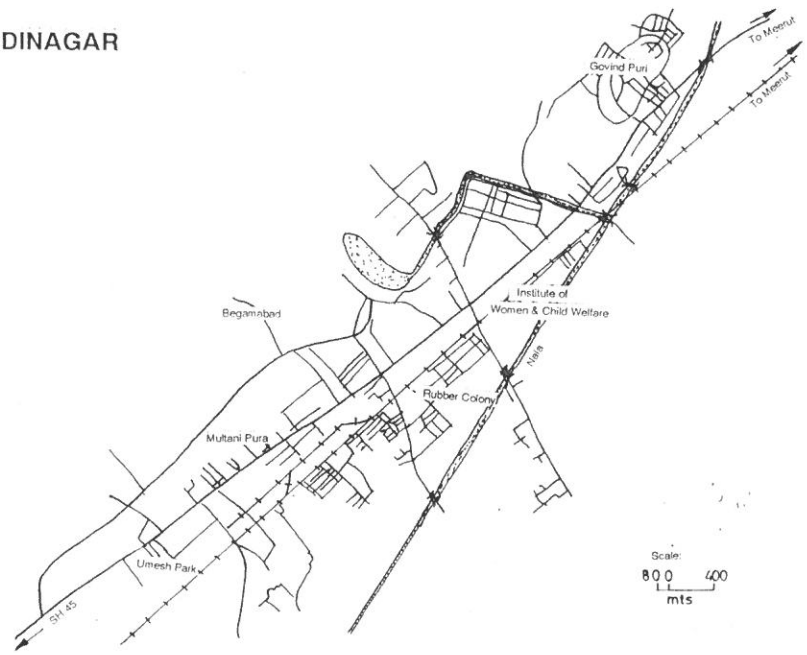
HAPUR



GHAZIABAD



MODINAGAR



LEGEND

- MUNICIPAL BOUNDARY
- MAJOR ROADS
- OTHER ROADS
- WATER BODY
- RAILWAY LINE

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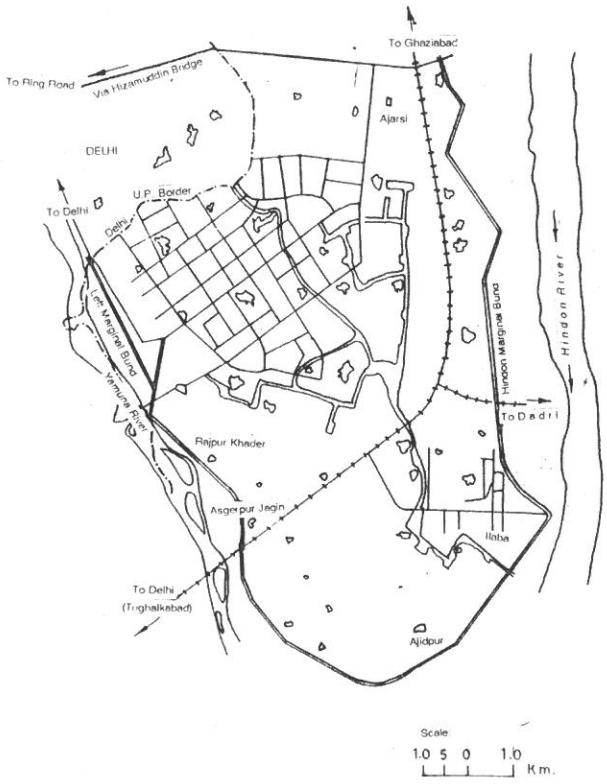
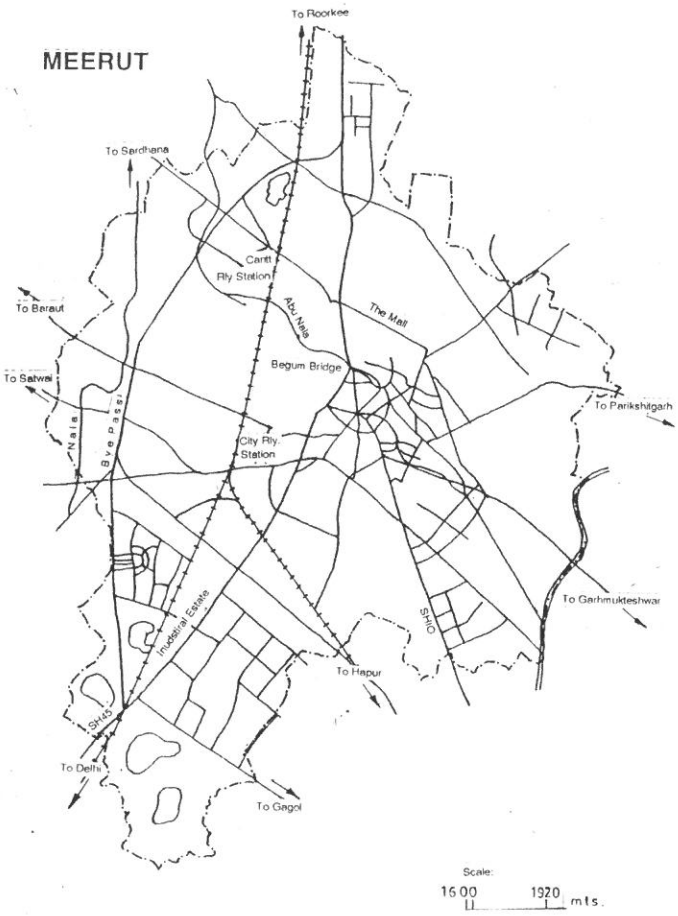
FIG.8
ROAD PATTERN IN NCR CITIES — U.P. SUB REGION

N

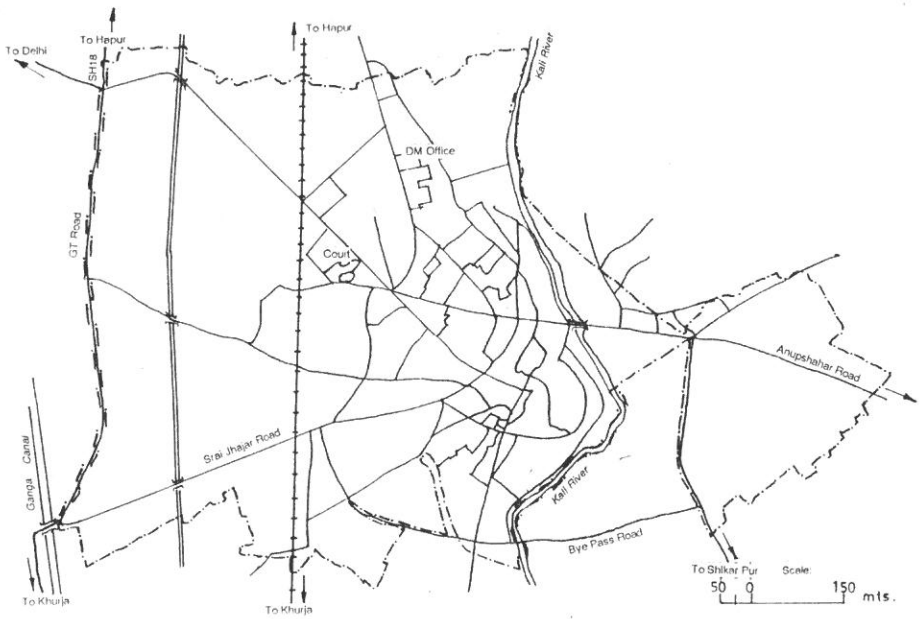
NOIDA



MEERUT



BULANDSHAHR



LEGEND

- MUNICIPAL BOUNDARY
- MAJOR ROADS
- OTHER ROADS
- WATER BODY
- RAILWAY LINE

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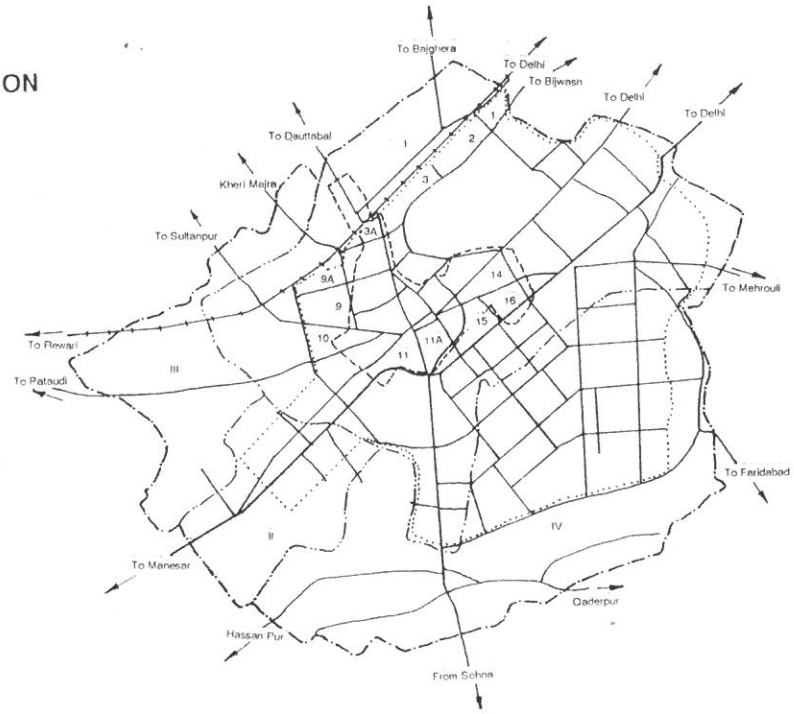
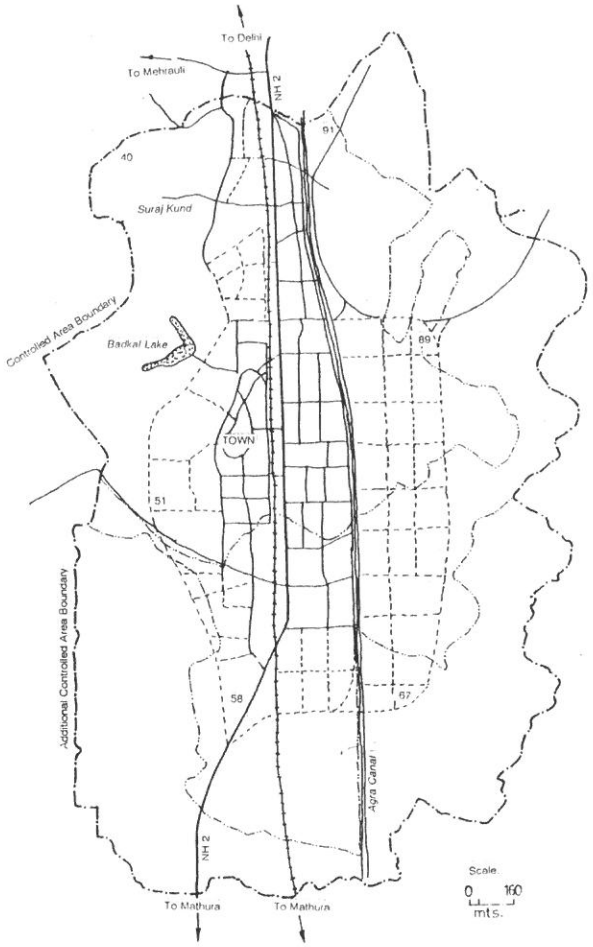
ROAD PATTERN IN NCR CITIES — U.P. SUB REGION

N

GURGAON



FARIDABAD



LEGEND

- MUNICIPAL BOUNDARY
- MAJOR ROADS
- OTHER ROADS
- WATER BODY
- RAILWAY LINE

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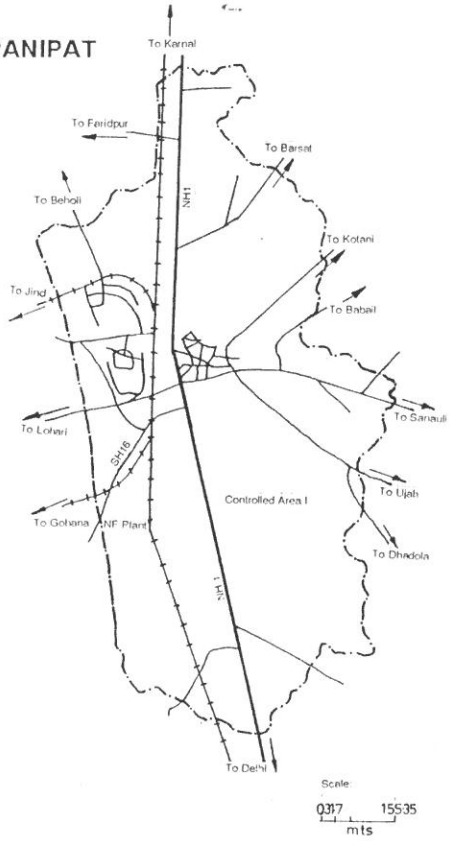
FIG. 9

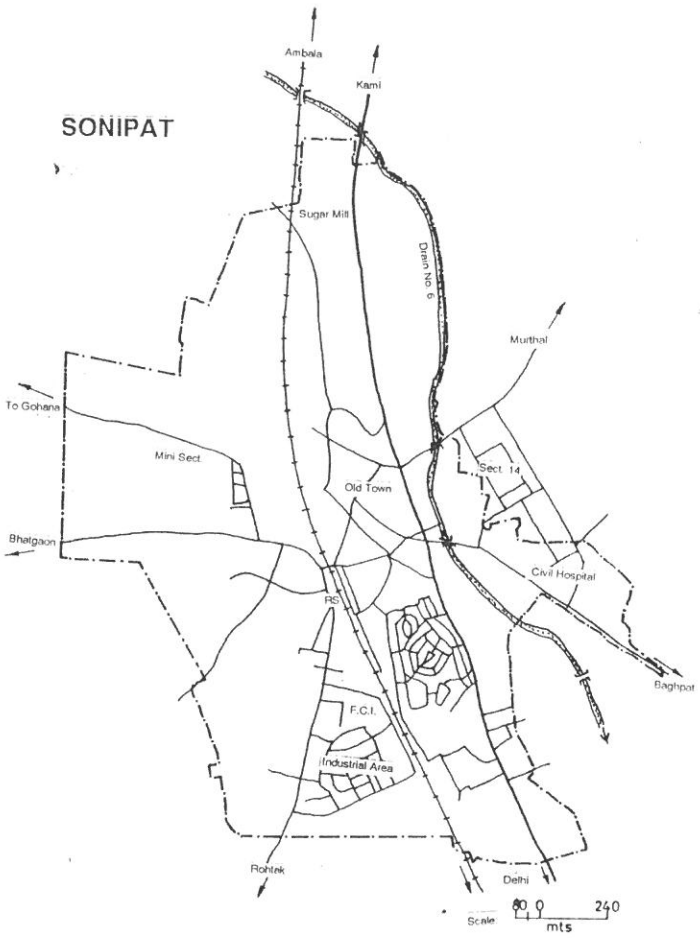
ROAD PATTERN IN NCR CITIES — HARYANA SUB REGION

N

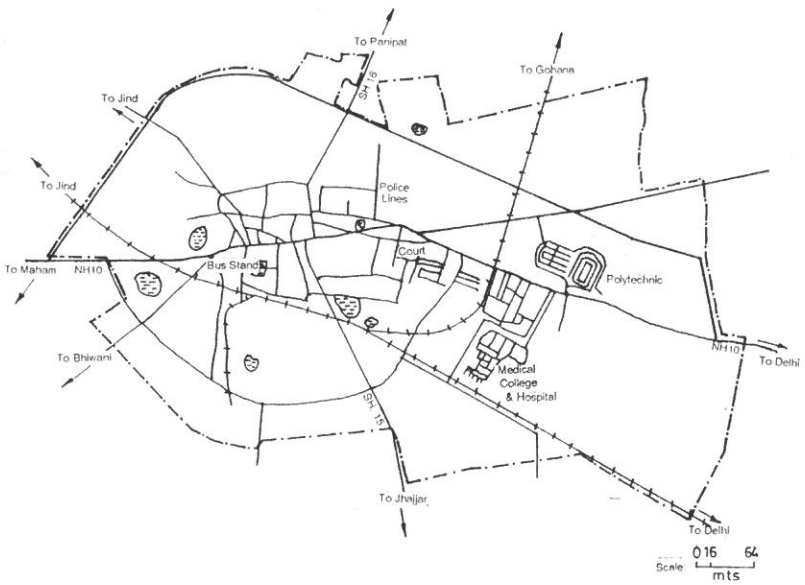
PANIPAT



SONIPAT



ROHTAK



LEGEND

- MUNICIPAL BOUNDARY
- MAJOR ROADS
- OTHER ROADS
- WATER BODY
- RAILWAY LINE

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ROAD PATTERN IN NCR CITIES — HARYANA SUB REGION

N

10 and their bypasses and several state roads are its prime arteries. In Bulandshahr, regional roads and arterials connecting to the G.T. Road or the SH_18 become arteries for urban movement. While there are dense road networks within some parts of Sonipat, especially within the old city, the model town and the industrial area, it is the regional roads from Baghpat, Rohtak, Murthal and Kundli that provide the connectivity across the entire settlement. Hapur has an extensive organic pattern of intracity road network, but it major north-south and east-west arterials are again formed by highways. The intrinsic feature of the urban networks of the above old cities in that their capacities suffer due to the mixture of regional and intracity traffic. The high incidence of slow moving vehiclor movement in their intracity traffic components aggrevates this situation.

In contrast, Noida, Faridabad and Gurgaon are typical cases of so-called planned development where extensive urban road networks have been laid out in grid-iron pattern which provide connectivity across these cities and the role of highways in intra-urban movements are relatively low. In Faridabad, however, NH-2 is the key north-south artery as the city has stretched in linear fashion along this highway and the planned lateral growth, especially on the east of Agra canal is yet to nature.

5.2 Capacities and Densities of Urban Road Networks

Table 8 indicates the densities of urban road network in the

major cities of NCR in terms of both the area and the population size of these cities. Clearly, Delhi is far superior to other cities, in term of density of roads in relation to city size, Noida follows. Hapur and Bulandshahr are however exceptional cases, for although their road densities are high in relation to their areas, the areas are very small and their road geometry is distinctly unplanned and not conducive to high speed movements. Further, the high road density in Hapur may be attributed to the dense but unplanned network of local roads rather than its arterials. Panipat and Alwar represent the work cases of urban road network development in relection of city size. Ghaziabad also has poor road network especially in relation to its population size. The two largest cities of the region (leaving aside Delhi), i.e. Meerut and Faridabad have moderate road densities. However, Faridabad may be distinctly superior to Meerut in terms of capacity of the road network, since the road network here is modern and planned with little encroachments on the right of ways and is cornducive to high speed movement. While an extensive highway network caters to the urban movement in Meerut and provide accessibility to its central area, it suffers from narrow width, heavy encroachment, poor geometry and surface conditions and extreme congestion with mixed traffic especially in peak hours. Such problems, however, may be generalised across other old cities of the NCR. The development plan of Meerut (U.P. Town and Country Planning Department) proposed large-scale R.O.W.

TABLE : 8

ROAD LENGTHS AND DENSITIES OF ROAD NETWORKS IN CLASS I CITIES OF NCR

CITIES	ROAD LENGTH (Kms)	AREA (SQ.Kms)	POPULATION	ROAD DENSITY (Km/Sq.Km)	ROAD DENSITY (Km/1000 Popn.)
Gurgaon U.A.	210.8	24.13	135884	8.74	1.55
Rohtak M.C.	150	28.38	216096	5.28	0.69
Alwar U.A.	190	58.13	210146	3.27	0.9
Delhi U.A.	19803	624.28	8419084	31.72	2.35
Faridabad FCA	901.2	178.24	617717	5.05	1.45
Sonepat M.C.	63.1	28.32	143922	2.95	0.43
Panipat M.C.	188	20.82	191212	9.02	0.98

Source : District Census, 1991

Bulandshahar M.C.	209.41	12.32	144126	16.99	1.45
Ghaziabad M.C.	240.96	63.76	446325	3.78	0.54
Hapur M.C.	154.63	5.83	128147	26.52	1.21
Meerut M.C.	730.1	141.94	540879	5.14	1.35

Source :NIUA, 1986-87

Noida C.T.	400	22	146514	18.18	2.73

Source : Field Survey, 1995

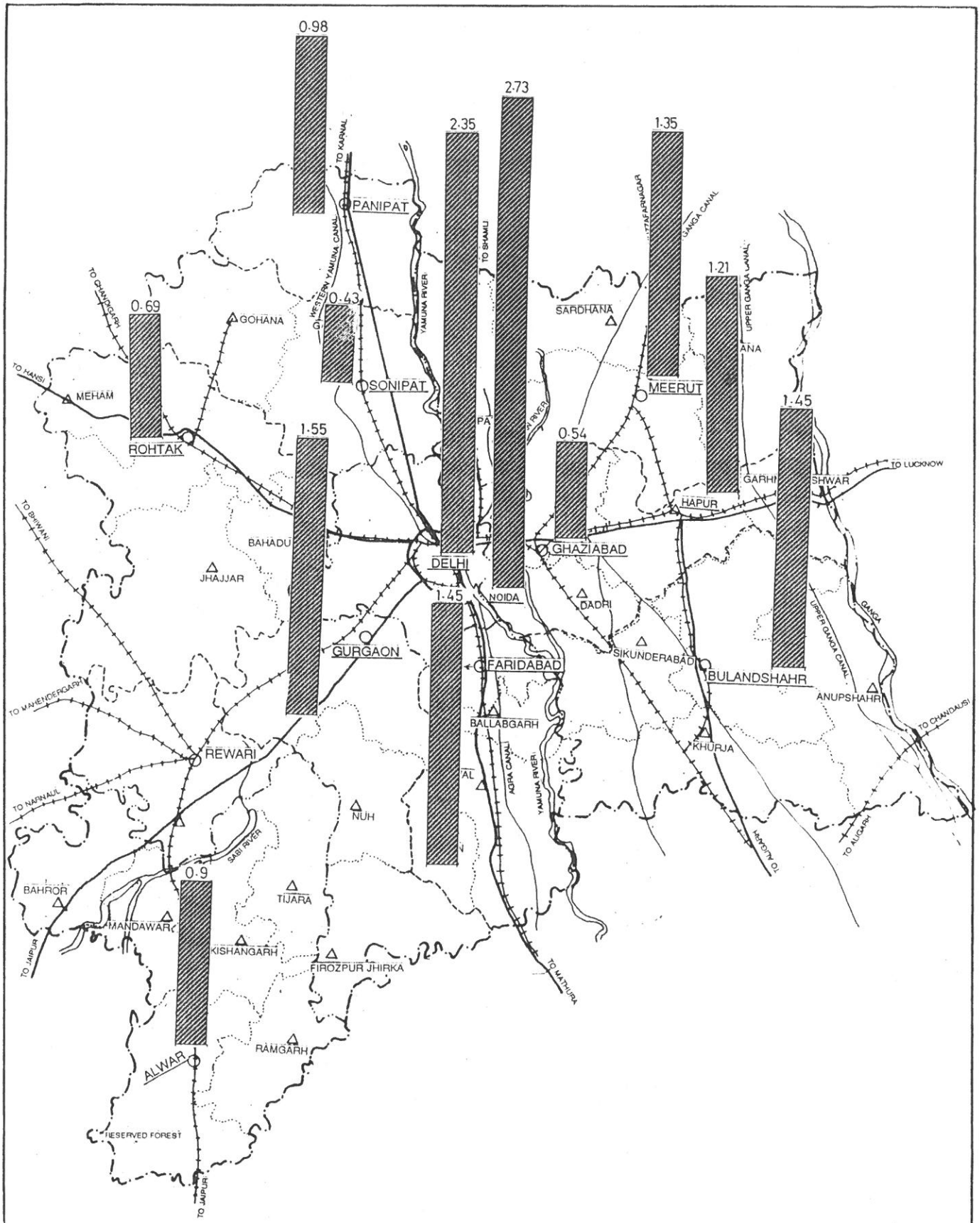

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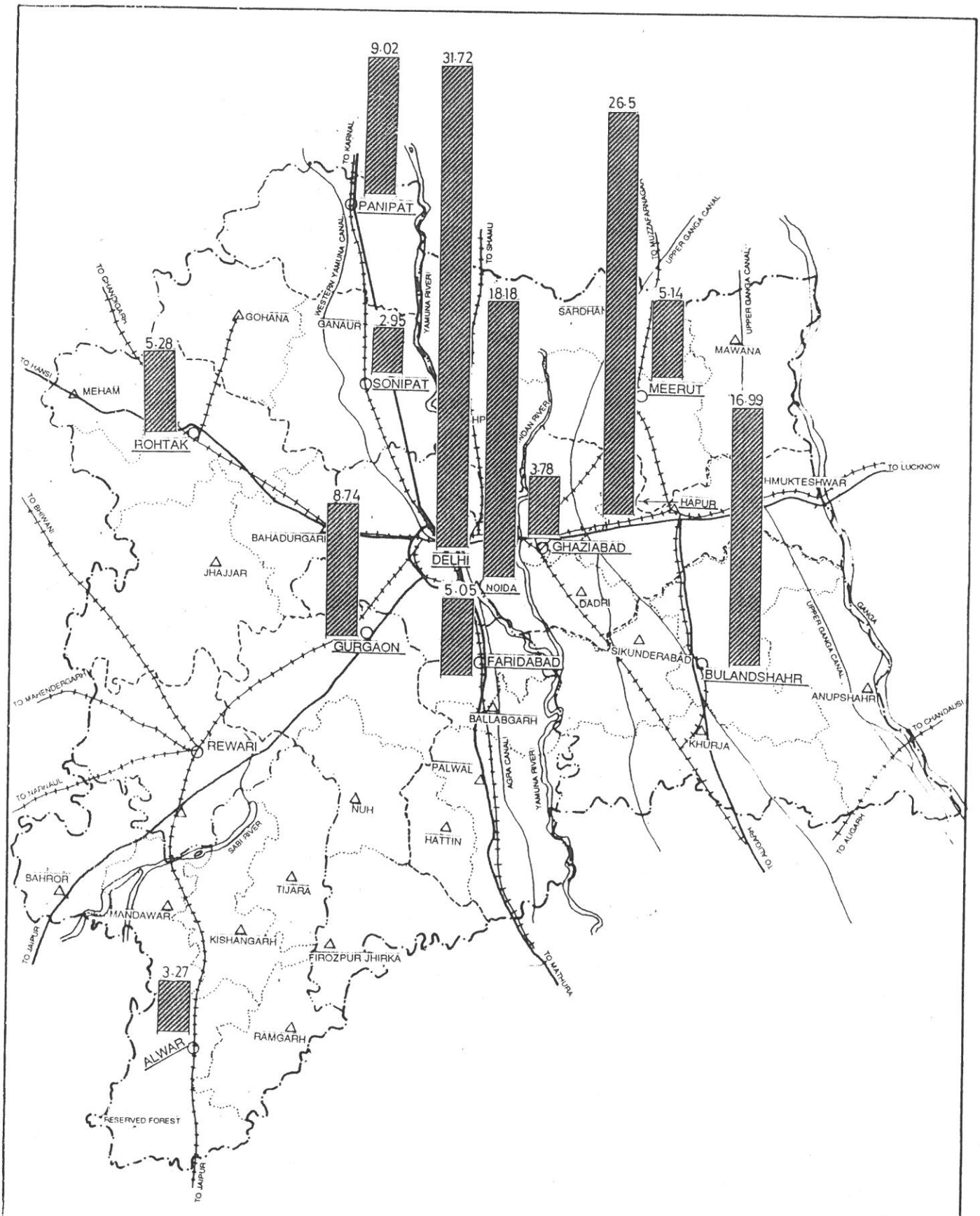
FIG. 10
CITY ROAD DENSITY
(KM./1000 POP.)

Scale
5 0 5 10 20 kms

N



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FIG·11
CITY ROAD DENSITY
(KM./SQ. KM.)

widening of these highways within the city for capacity augmentation which may require land acquistion and demolition of structures. It is apparent from the road network patterns and the data on road densities of cities that most outlying "priority" cities of NCR suffer from either poor road densities (viz. Alwar and Panipat) or low capacities of their old road system constituting poor road geometry (viz Hapur, Bulandshahr) or both (viz Meerut, Rohtak). In contrast, DMA cities like Noida, Gurgaon and Faridabad have both high to moderate density of road networks and relatively modern, high capacity road system. Although the road system of Sonipat is relatively old, it is moderately dense. Ghaziabad may be the sole exception in DMA where the road network is both old and of low density, especially when compared to its large population size.

6. Stress on Transportation Infrastructure

6.1 Traffic Volumes along major Road Corridors

The daily vehicular traffic volumes for the two years of 1987 and 1991, the peak hour volume (1991) and the average daily passenger trips along the major road corridors of NCR are shown in Table 9. The Delhi-Faridabad (NH-2), Delhi-Noida and Delhi-Ghaziabad (NH-24) are the busiest routes where both daily and peak hour vehicular volumes are appreciably higher than those along other regional roads. Passenger trips are also much higher along Delhi-Ghaziabad and Delhi-Noida than other sections. However, they are relatively much less along

Table 8

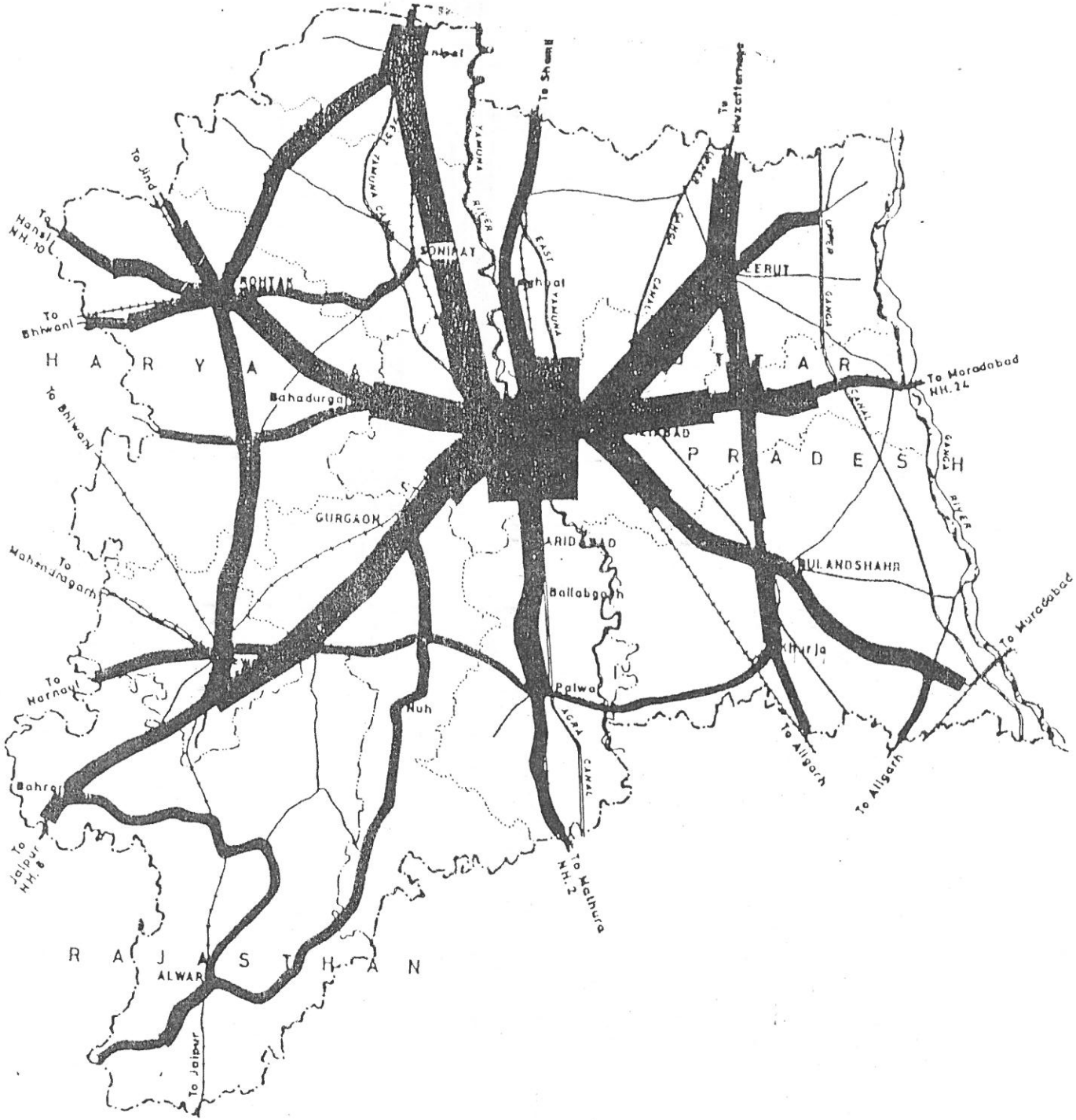
Major Corridor	Traffic Volume (1987)	Traffic Volume (1991)	Annual Growth Rate (%)	Peak Hr. Flow (%)	Average Passenger Trips
Delhi - Faridabad (NH - 2)	30316	31740	3.2	2594 8.17	60838
Delhi - Gurgaon (NH - 8)	14995	17025	4.7	1679 9.88	71487
Delhi - Bhadurgarh (NH - 10)	6974	11672	13.7	883 7.5	64564
Delhi -Panipat (Sonipat)(NH-1)	8302	12254	10.22	677 5.5	71528
Delhi - Baghpat	7901	-		-	
Delhi - Ghaziabad (NH - 24)	42751	50709	4.05	2848 9.7	174381
Delhi - Noida	20307	30481	10.68	2758 9.08	169581
Ghaziabad - Meerut	11245	-			
Ghaziabad - Hapur (NH - 24)	6871	7697	2.58	540 7.01	51488
Ghaziabad - Bulandshaher	9019	-			
Gurgaon - Sohna - Alwar	2187	-			
Gurgaon - Behror	6670	-			

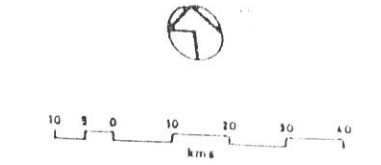
Source: RITES (1992)
ORG (1987)

Delhi-Faridabad corridor which may indicate the predominance of goods traffic in the total vehicular volume along their route. Further bus passenger trips constitute, respectively 81% and 73% of the total passenger trips on Delhi-Ghaziabad and Delhi-Noida routes, indicating very large homework relationships between Delhi and these two DMA cities.

The Delhi-focussed traffic movement in NCR is apparent from the Traffic Volume Map (ORG, 1987) which shows that the volume between Delhi and other major cities fall appreciably with their distances from Delhi. There is a very heavy concentration of traffic volume within the DUT which falls sharply beyond a distance of 10-15 Kms from Delhi. The drop is shrapest along the southern direction, i.e. along NH-2 beyond Faridabad and the least towards Meerut. Among the "priority cities" Meerut appears to have the highest traffic volume to and fro Delhi, via Ghaziabad, which is followed by Panipat, whereas traffic volume is least between Alwar and Delhi.

Collating the above information on traffic volume with those on capacities of various highway routes, discussed earlier (see Section 2.1), it may be said that among the national highways, NH-2 upto Faridabad and NH-24 linking Ghaziabad and Hapur with Delhi are under relatively greater stress than the others. Although NH-24 has 4-lane dual carriageway upto Ghaziabad its capacity drops to half beyond Ghaziabad whe reas the traffic volume continue to be very high beyond this city. comparatively, NH-1 upto Panipat and NH-8 appear to be under





LEGEND

- National capital region boundary
- State boundary
- District boundary
- National highway
- State highway
- Other road
- Railway broad gauge
- Railway metre gauge

TRAFFIC INTENSITY (IN PCUS)

4000 10000 20000

FIG. 12.

TRAFFIC VOLUME

Source : ORG-IIT (1987)

much less stress. Similarly, NH-10 is also under less stress once bottlenecks near Bahadurgarh are removed. Although little information are available on the capacity of the state highways, SH-45 linking Ghaziabad and Meerut appear to be under stress, especially with bottlenecks near Modinagar and other towns.

6.2 Concentrations of Registered Motor Vehicles

Table 9 present districtwise total number of registered motor vehicles on road and their numbers in terms of per unit population and per unit road lengths of these districts. Although the 1991 census population has been considered, a rough comparison is possible among the districts except for Alwar. Further, a comparative assessment of the priority and DMA cities is also possible indirectly, since these cities are likely to carry the major share of vehicular population of the districts. Ghaziabad district, however, contains the four class I cities of Ghaziabad, Noida, Hapur and Modinagar, whereas in Bulandshahr, Khurja is an important class II town. In other districts, urban areas are very small compared to their respective headquarter cities.

Delhi has the highest concentration of Motor Vehicles (in relation to population size) which is about two-and-a-half times higher than its next rival, Faridabad and 18 times that of Bulandshahr which has the lowest concentration. However, motor vehicle volume in relation to available road networks appear to be higher in Faridabad than in Delhi which clearly indicates the superiority of Delhi in terms of road network.

Table 10

NUMBER OF MOTOR VEHICLES ON ROAD

District	Total No. of M. Vehicles	Population	Total Road Length	No. of MV per 1000 Population	Total MV per Km Road Length
Haryana * Sub - Region					
Panipat	35757	833501	1031	42.89	34.68
Sonipat	31521	754866	786	41.75	40.1
Rohtak	52311	1808606	2016	28.92	25.94
Faridabad	126648	1477240	1187	85.74	106.69
Gurgaon	33786	1146090	1686	29.47	20.03
U.P. ** Sub-Region					
Ghaziabad	38289	2703933	1930	14.16	19.83
Bulandshahr	33413	2849859	1920	11.72	17.4
Meerut	130307	3447912		37.79	
Rajasthan # Sub-Region					
Alwar	27226	2296580	1846	11.87	14.74
NCT Delhi ##					
Delhi	1962988	9420644	21564	208.37	91.03

Source : Field Survey ,1995; Statistical Year Books ; Delhi Quartrly Digest Of Economics & Statistical.

Note :
* As on 1992-93
** As on 1991-92
# As on 1986-87
As on 31.8.92

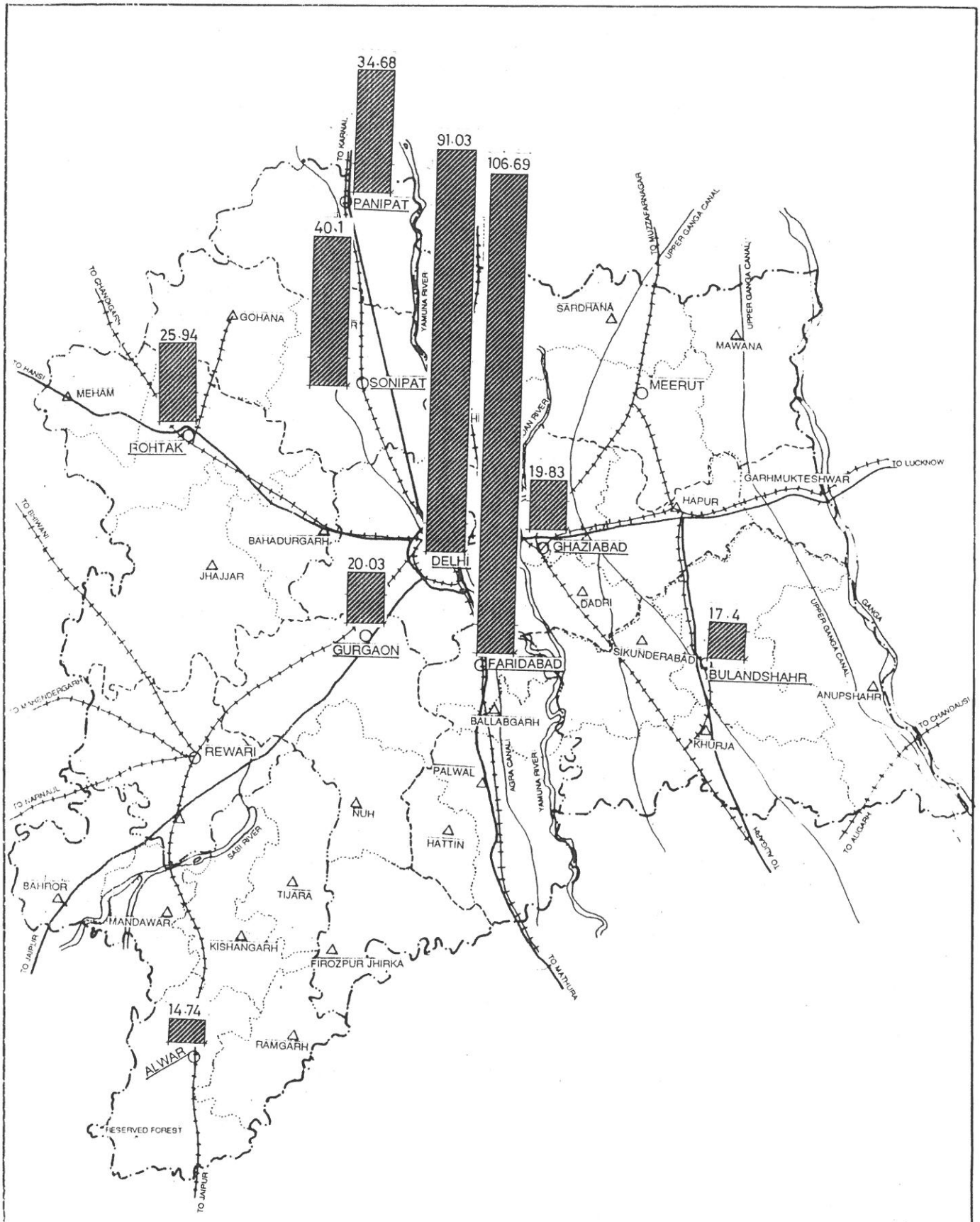


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FIG.13
DISTRICT VEHICLE DENSITY
(NO./KM. ROAD)

Scale :
5 0 5 10 20 kms

N

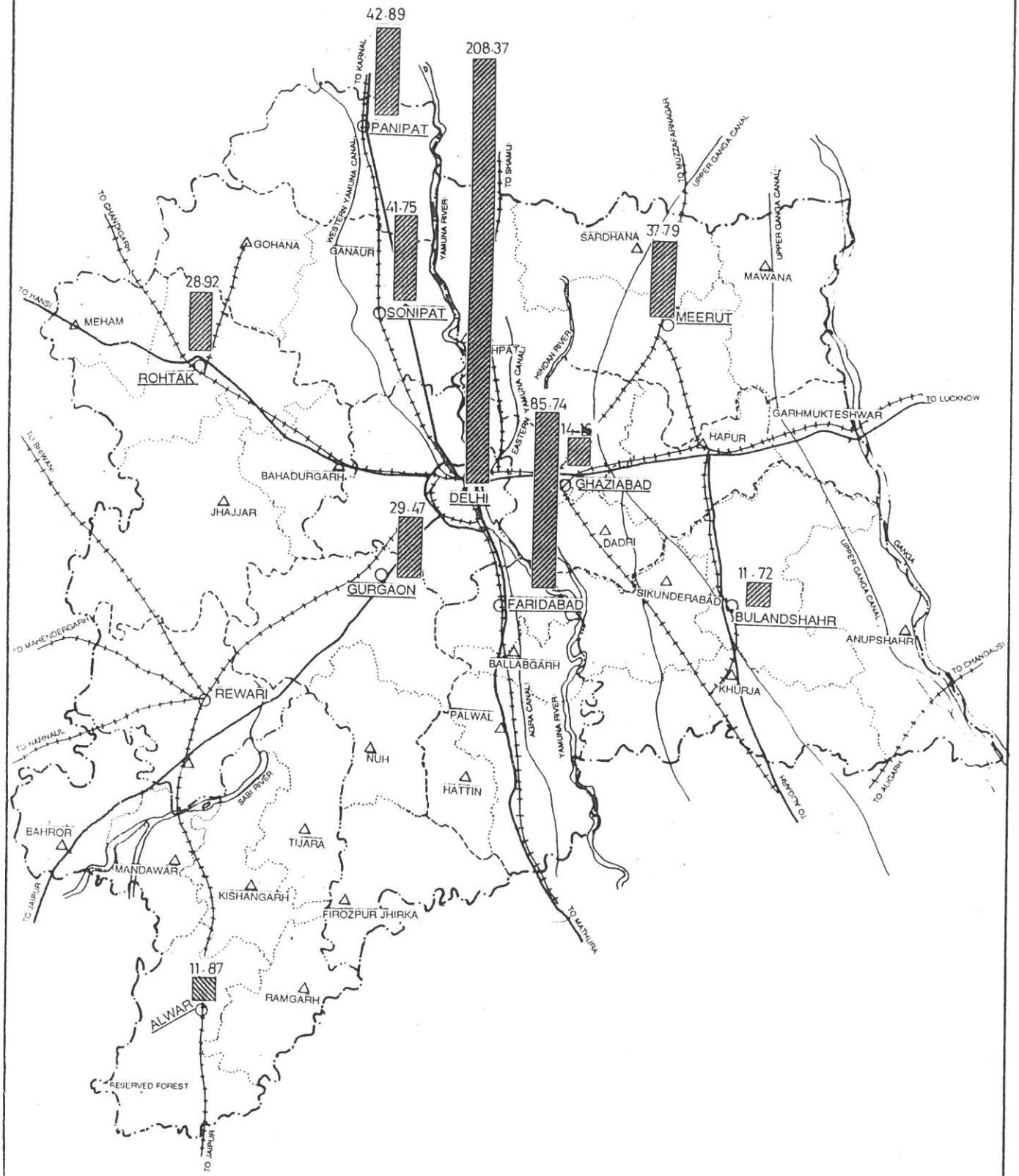

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FIG. 14.
DISTRICT VEHICLE DENSITY
(NO./1000 POP.)

Scale :
5 0 5 10 20 kms

N

Table 11

Number of different Types of Motor Vehicles on Road

District	Auto-cycles/ Motor-cycles/ Scooters	Auto-rickshaws	Tempo/ Minibus	Jeeps	Private motor cars	Taxies	Other public service vehicles	Goods vehicles	Tractors	Miscellaneous	Total
HARYANA *											
Panipat	13486	137		162	941	7	338	1502	7784	42	24399
Sonipat	11645	306		331	831	1	1144	2686	10392	10	27346
Rohtak	14047	869		518	345	3	1091	4225	18614	-	39712
Faridabad	44963	1039		480	3305	3	272	3062	2497	-	55621
Gurgaon	7102	325		304	1415	-	547	2906	2797	-	15401
UTTAR PRADESH **											
Ghaziabad	42171		821	963	2378	39	913	1550	7587	257	56679
Bulandshahr	20167				736	410	757	2748	11894	286	36998
Meerut	78442		1131	90	6909	126	1571	5820	47819	126	142034
RAJASTHAN #											
Alwar	13711				1557 &	292		1995	8942	72	27226
NCT Delhi ##											
Delhi	1317180		67128	440166	10694	20201	107629				1962998

Source : Delhi Quarterly Digest of Economics & Statistics ; District Stastical Hand Books ; Field Survey.

Note :
* As on 1989-90
** As on Dec'94.
# As on 1986-87
As on 31.8.92
& Include Jeeps

Meerut has the highest vehicular population among the districts outside Delhi, but its concentration in relation to population size is smaller than those of Faridabad, Panipat and Sonipat. the vehicular populations in the rest district are distinctly smaller than those of the above three districts and also, there is apparently no significant differences among them, excepting Rohtak where vehicles are higher in numbers, but when compared to the larger population size and extent of road network in this district, the vehicle concentration is less than those of many districts. In Ghaziabad, Bulandshahr and Alwar, however, vehicular volumes in relation to both their respective road lengths and population are considerably lower than all other districts. Furthermore, the average vehicular population within the city is likely to be lowest in Ghaziabad district, since the total volume is distributed across four major cities in this district.

6.3 Growth of Registered Vehicles

Table 12 and Figures (Graphs) attempt to indicate how the volumes of registered vehicles have increased over time in the different districts of NCR. In Delhi, the growth rate of motor vehicles peaked during the second part of last decade (1984-1987) and then slowed down substantially in the beginning of this decade. The annual increase between '91-'92 and '92-'93 was only 2.03% during the three years between 1989-'90 and 1992-'93 motor vehicles numbers increased at an average annual rate of 7.8% which was lowest among all the districts for which data have been available for the

Table 12

GROWTH OF REGISTERED MOTOR VEHICLES

District	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95
Delhi	561768	648531	724495	814803	924905	1075486	1250755	1415931	1590502	1764558	1923787	1962998	-	-
% Increase		15.44	11.71	12.46	13.51	16.28	16.29	13.2	12.32	10.94	9.02	2.03		
Panipat									24399			35757		
% Increase										Avg. Annual Growth 15.51				
Sonipat									27346			31521		
% Increase										Avg. Annual Growth 5.08				
Rohtak									39712			52311		
% Increase										Avg. Annual Growth 10.97				
Faridabad									55621			126648		
% Increase										Avg. Annual Growth 42.56				
Gurgaon									15401			33786		
% Increase										Avg. Annual Growth 39.79				
Ghaziabad												38319	50177	56679
% Increase													30.94	12.95
Meerut												129123	134668	141308
% Increase													4.29	4.93
Bulandshaher												33413	36938	40071
% Increase													10.54	8.48
Alwar		15961	18658	21232	24190	27226								
% Increase			16.89	13.79	13.93	12.55								

Source : District Statistical Hand Books

FIG. 15

Growth of Registered Motor Vehicles
Haryana Sub-Region

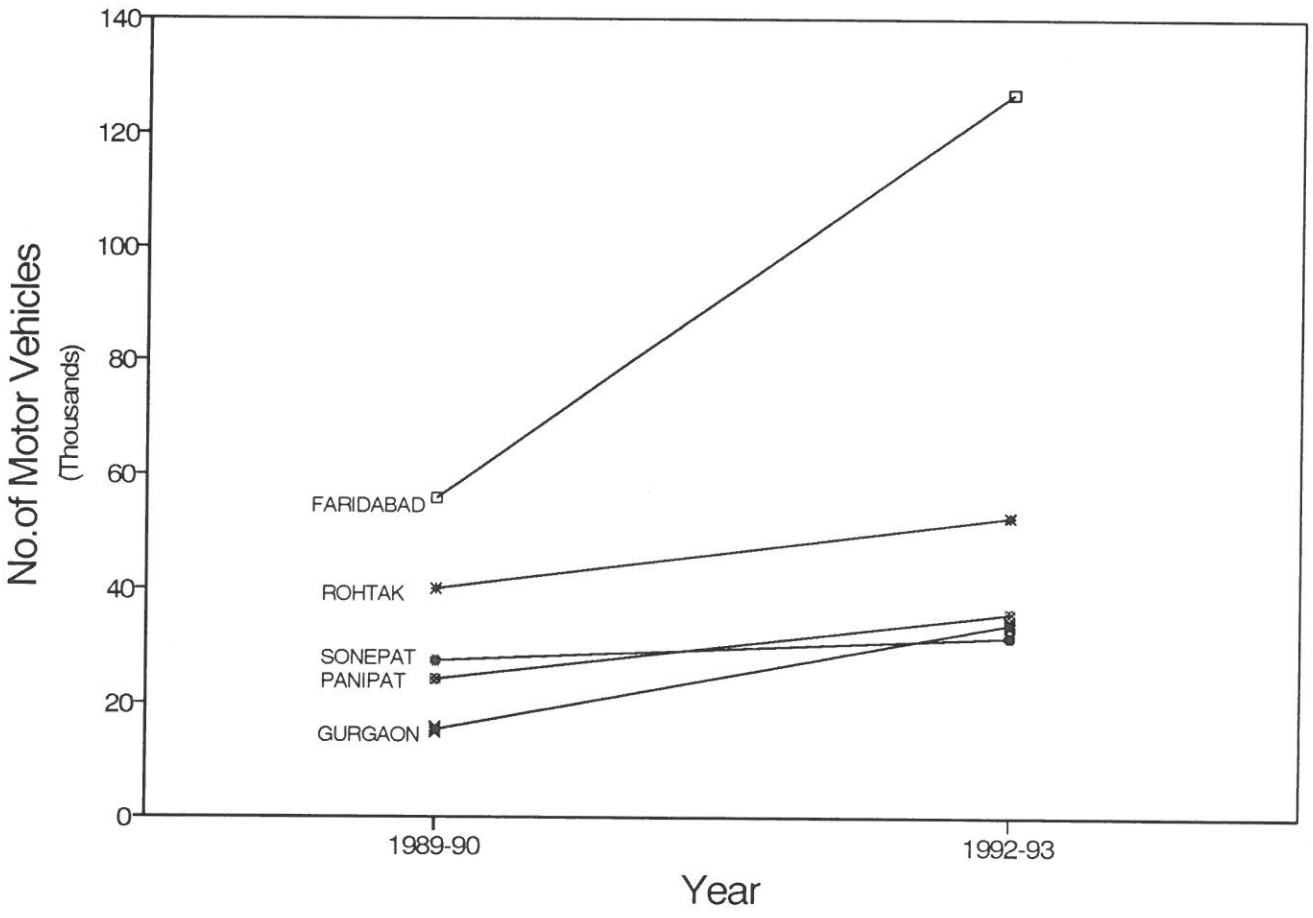


FIG - 16

Growth of Registered Motor Vehicles
U.P. Sub-Region

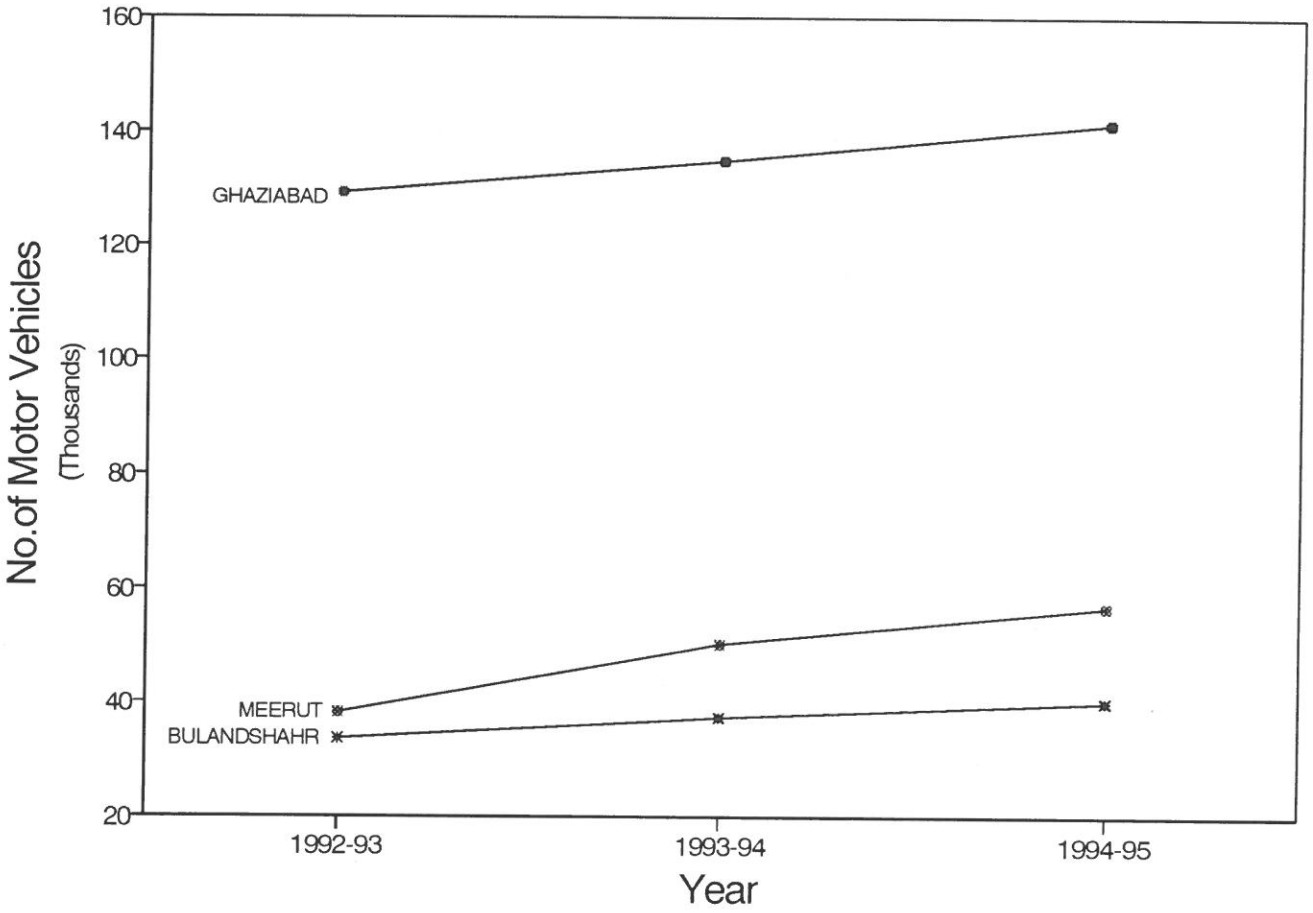


FIG.17

Growth of Registered Motor Vehicles
Alwar

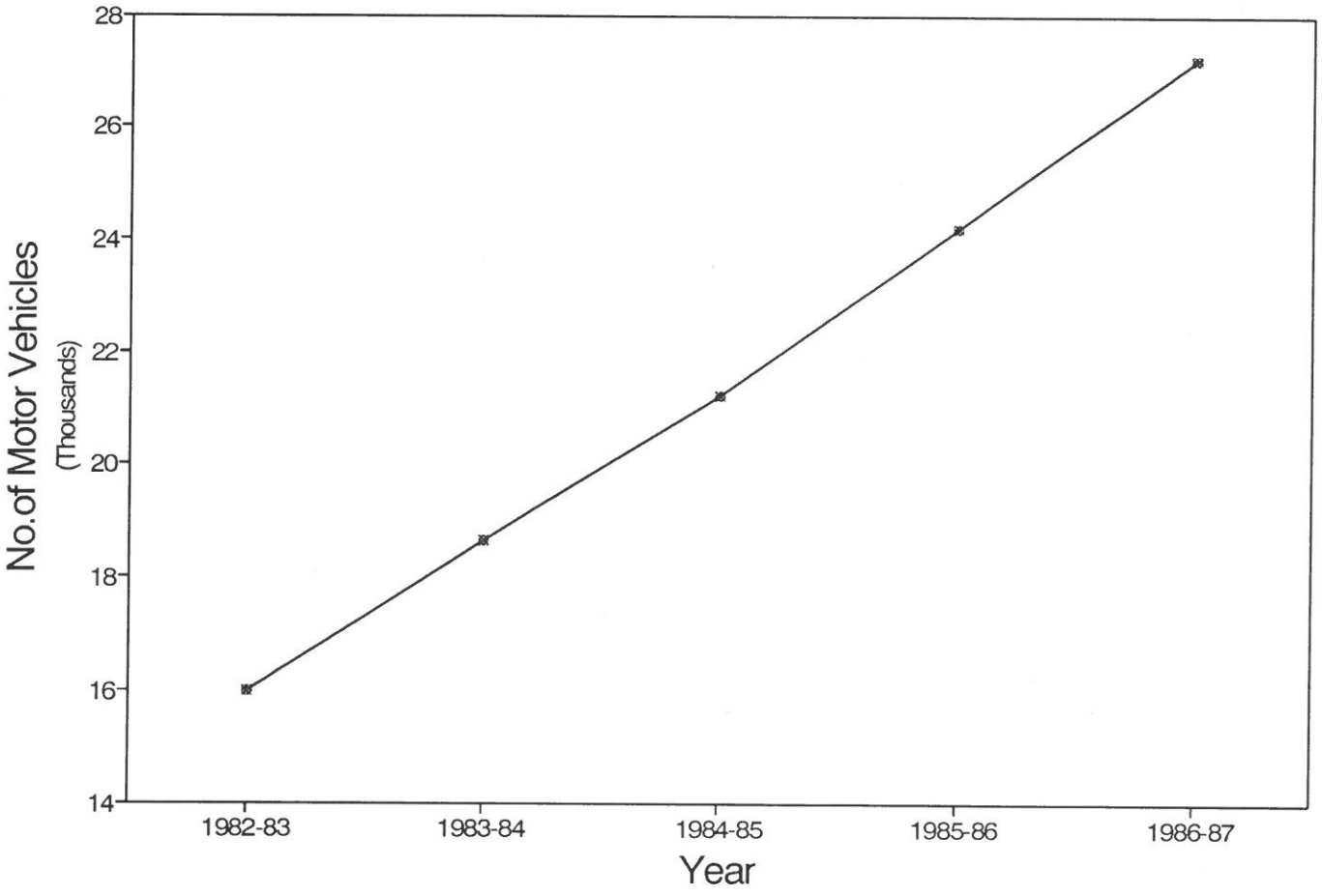
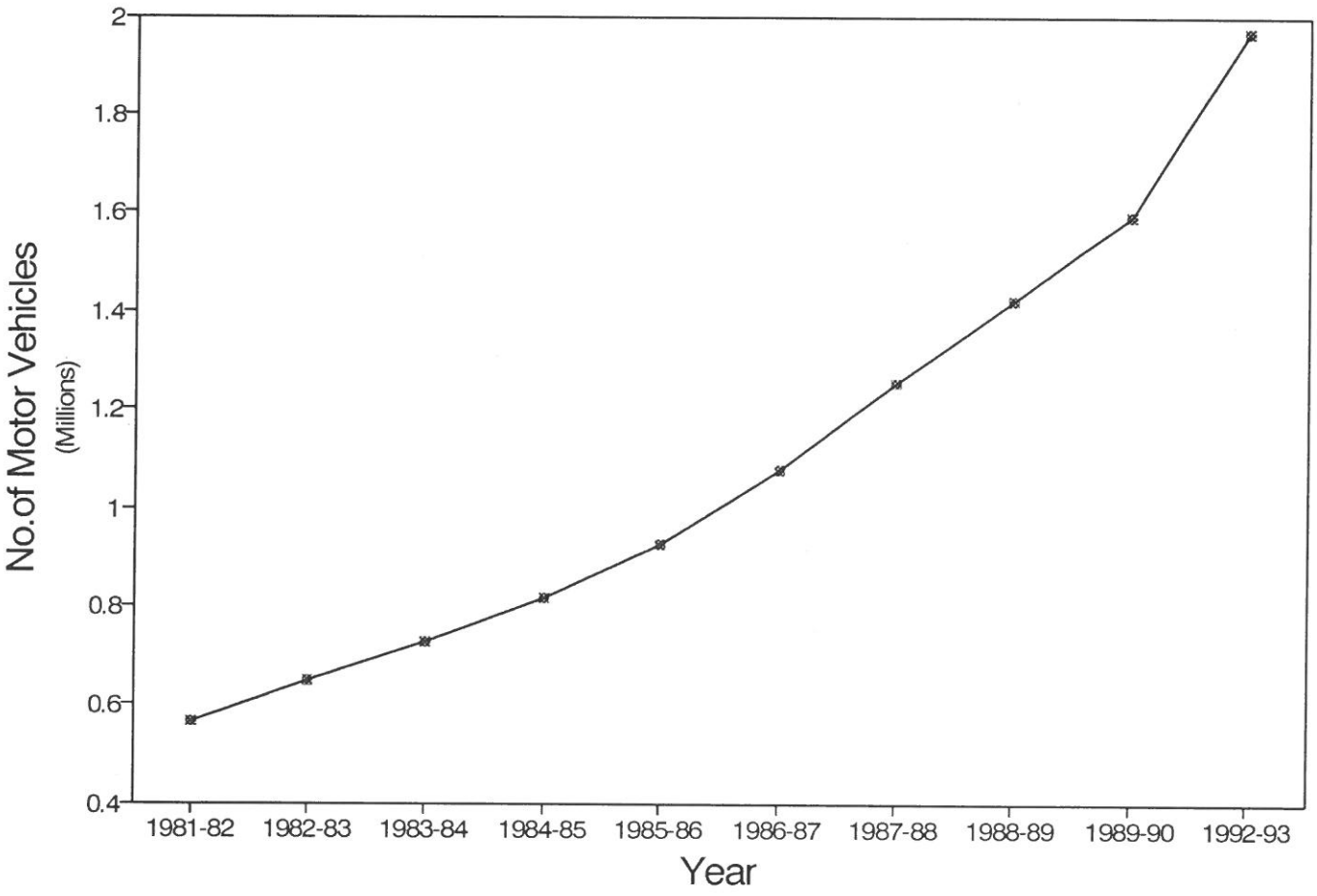


FIG. 18

Growth of Registered Motor Vehicles Delhi



corresponding period, except Sonipat where the increase was 5.09%.

Apparently, Faridabad and Gurgaon are the two districts where motor vehicles are increasing at the fastest rate. Faridabad is distinct in terms of both the large volume of registered vehicle in the district and its annual increase. At the other end of the scale, Meerut and Sonipat are the districts where such increase have been the least. Meerut however, has larger vehicle volume than other districts except Delhi.

6.4 Traffic Accidents in Cities

Time series data on annual accident rates of several cities indicate that traffic accidents have been growing streadly in all cities. Traffic accidents are much higher in number in Delhi than other cities. But, taking into account the population size of NCR cities, Delhi's accident rate per unit population in comparable with that of Panipat or Noida. Further, the average annual increase of traffic accidents in Delhi in much lower than those of most other cities. The U.P. cities as well as Alwar could not be considered due to lack of information. Also, the number of road accident deaths per unit population in Delhi is comparable with those of Gurgaon and Faridabad. Next to Delhi, Faridabad has the largest number of traffic accidents among cities and the accident rate in also moderately high, in relation to population size. But the average annual increase in traffic accidents appear to be slower here than in most other cities, especially panipat, Rohtak and Noida. Interestingly the rate of road accidents

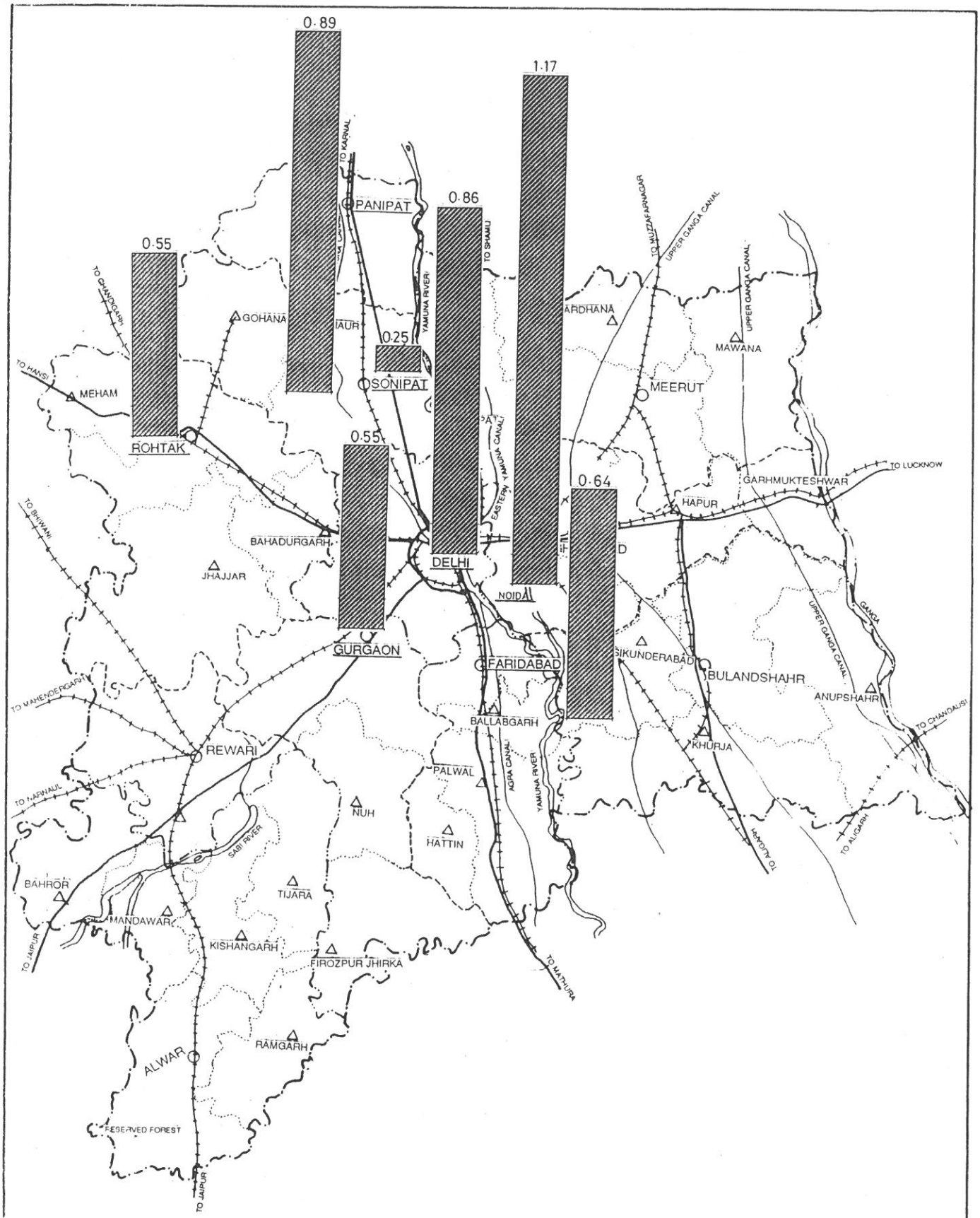


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FIG. 19
ACCIDENT RATE IN CITIES
(NO./1000 POP.)

Scale
5 0 5 10 20 kms

N

Table 13

Growth of Road Accidents

City	1990			1991			1992			1993			1994			Total Accdients per 1000 Population	Accdient Deaths per 1000 Population	Average Annual Increase
	Total	Fatal	No. of Persons Killed	Total	Fatal	No. of Persons Killed	Total	Fatal	No. of Persons Killed	Total	Fatal	No. of Persons Killed	Total	Fatal	No. of Persons Killed			
Sonepat	38	14	14	36	10	12	50	13	15	44	13	14	40	13	17	0.25	0.08	
Panipat	67	9	21	161	29	20	176	24	29	189	19	19	186	26	24	0.89	0.1	3.135
Gurgaon	76	15	19	75	23	30	82	19	24	105	26	26	126	32	40	0.55	0.22	38.85
Rohtak	39	6	20	119	24	27	125	32	39	128	40	46	88	32	36	0.55	0.12	14.01
Faridabad	340	92		394	109		344	89		420	98					0.64	0.18	181.67
Noida							171	63		235	101		252	84		1.17		9.18
Alwar																		7.23
Delhi	7701		1849	8070		1924	2038									0.86	0.2	

Source : Field Survey (1995)

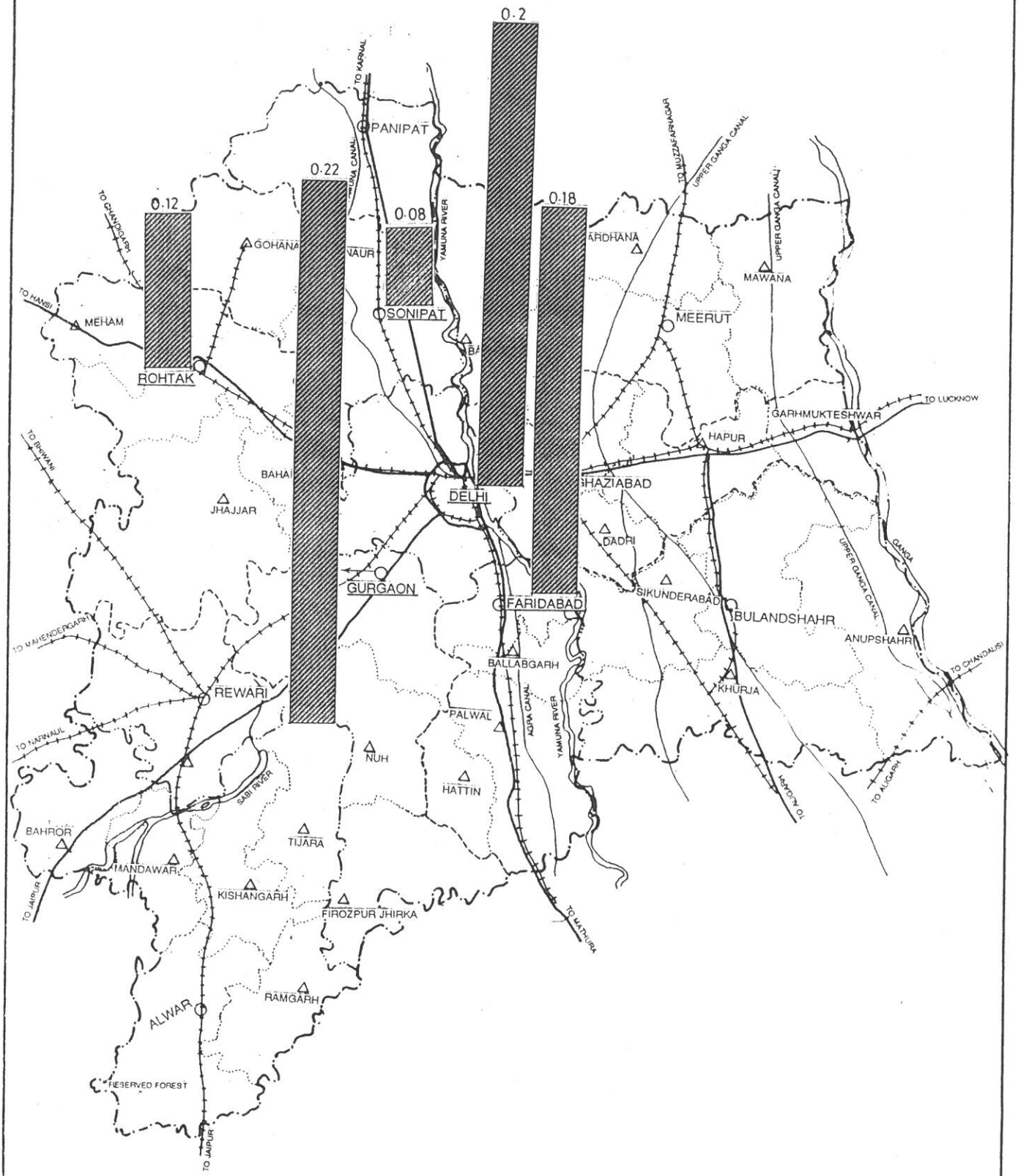

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FIG. 20
ACCIDENT DEATH IN CITIES
(NO./1000 POP.)

Scale
5 0 5 10 20 kms

N

FIG 2.1

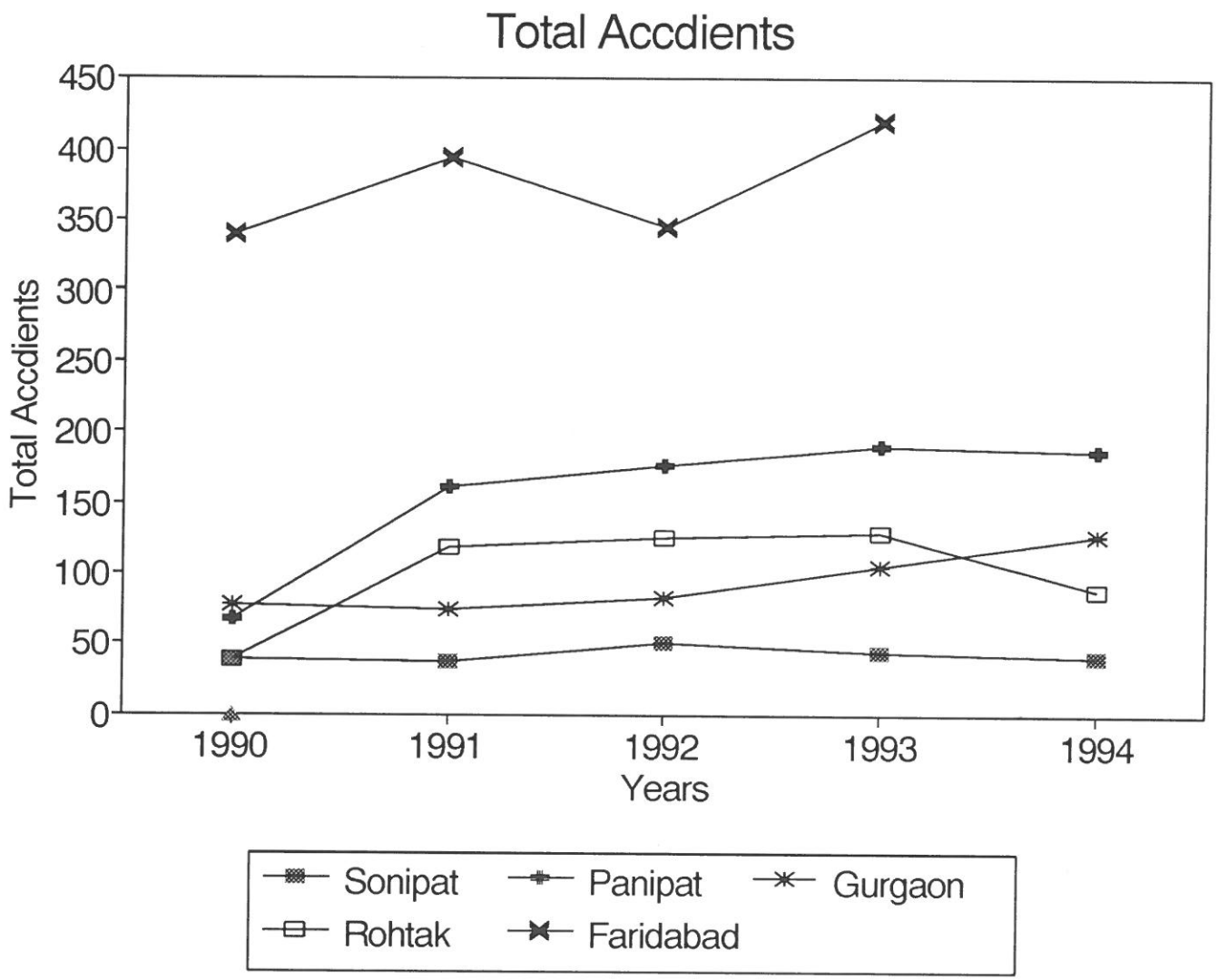
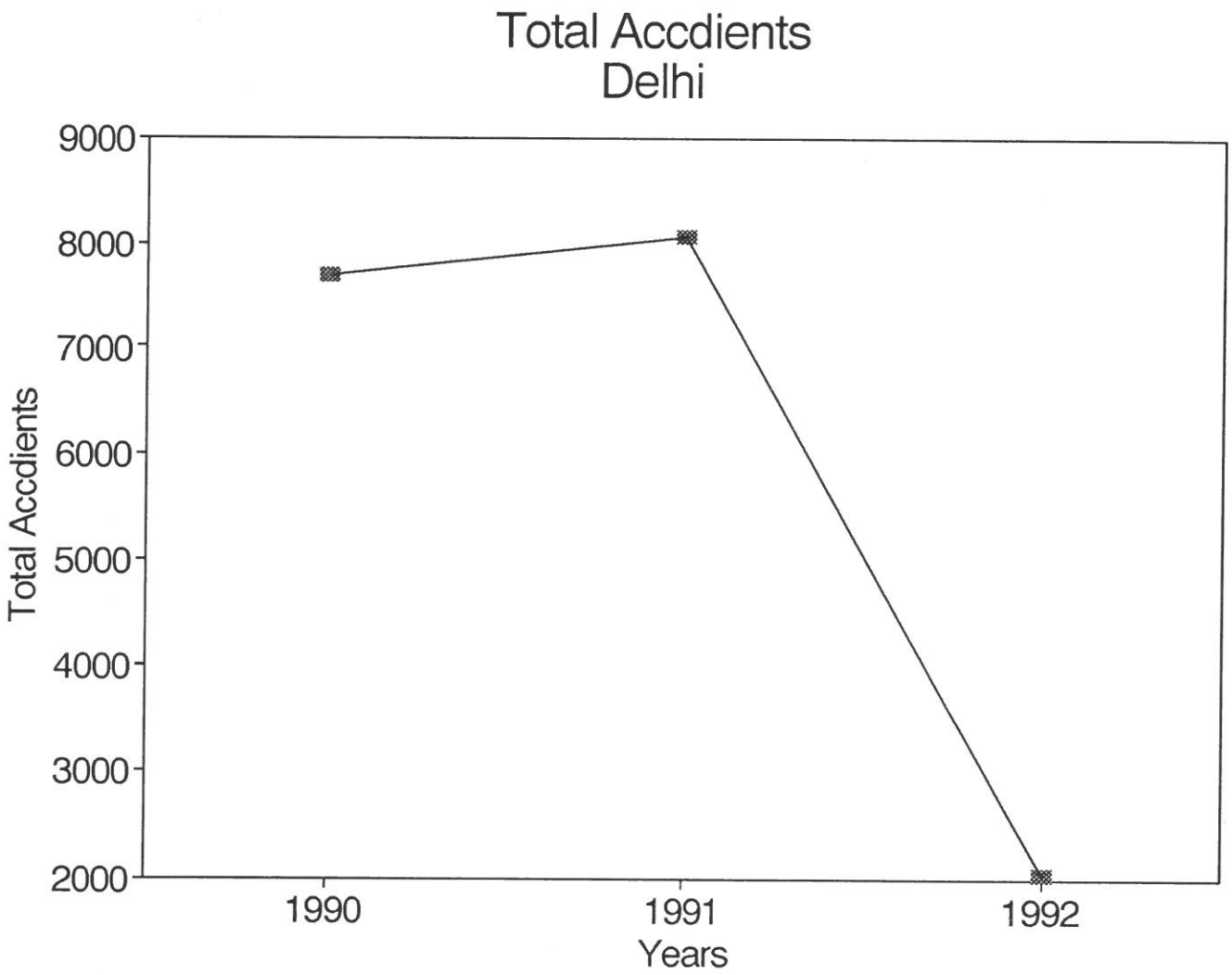

Total Accdients
Total Accdients
450
400
350
300
250
200
150
100
50
0
1990
1991
1992
1993
1994
Years
Sonipat
Panipat
Gurgaon
Rohtak
Faridabad

FIG.22


Total Accdients
Delhi
9000
8000
7000
6000
5000
4000
3000
2000
Total Accdients
1990
1991
1992
Years

(per 1000 persons) has hardly any relationship with the density of road network (in terms of per 1000 persons) in the city (r=0.09), while it has a weak relationship with the motor vehicle concentration (per 1000 person) in the district (r=0.31). Thus Delhi and Panipat has almost similar accidents rates while the road network in far more extensive in the former. Although information on the capacities of relatively modern networks of Delhi, Noida, Faridabad and Gurgaon are likely to have superior capacities to those of the older networks, for instance, the average width of the 74.11 Kms (1993-94) of Municipal roads ranges between 10-20 feet only. Therefore, a combination of factor, primary, growth of motor vehicle, road geometry or network pattern, road capacities and traffic management may be responsible for the growth of road accidents in the cities.

6.5 Environmental Pollution due to Transportation

Studies of environmental pollution due to transportation across NCR have been minimal. However, according to a recent estimate[1] of projected air pollutants, (in 2001) for existing road network of NCR, there will be large concentrations of Carbon Mono-Oxide followed by concentration of nutrites of oxygen and hydrocarbon, whereas the concentration of lead, sulfar di-oxide and total suspendended particulate are likely to be low (see Table 14).

---

[1] Source: Delhi School of Planning and Architecture (1994) Study on Environment & Economy of the National Capital Region Draft, Final Report.

TABLE 14

Estimated Projected Concentration of Different Type of Air Pollution for the Existing Road Network of NCR (for year 2001)

CO	NOX	HC	SO2	TSP	PB	TOTAL
358.2748	100.5750	63.29825	14.60732	2.636230	0.152547	539.544

Source: Delhi School of Planning and Architecture (1994) Study on Environment & Economy of the National Capital Region Draft, Final Report.

Neeri[2] has reported on the emissions of different pollutions from "line sources" across different parts (grids) of NCR. Delhi area peaks in the emissions of all kinds of pollutants which far exceed these from any other parts of the regions. Comparing among the rest grids containing other major cities, Ghaziabad area appear to be the largest line source of pollution while the pollution patential of other areas appear to be significantly less. However, while Faridabad areas emits highest CO and HC pollutants than the rest grids, Sonipat area emits t he highest SO_2 among them.

7. **Communication Facilities in Cities of NCR**

Telephone densities across cities of NCR are shown in Table 3.3.3.5a. Table 3.3.3.5b shows the levels of postal and telephone facilities in Delhi and the cities of Haryana. Leaving aside Delhi, Faridabad and Ghaziabad have the highest levels of telephone communication and the population densities

[2] NEERI (1994) Carrying Capacity based Development Planning of National Capital Region , Interim Report.

TABLE 15

TELECOMMUNICATION IN NCR

Town	No. of Connections	Waiting List	Population per Telephone	Waitlisted Application per 100 Pop.
I. Delhi	769000	317000	13	340
II. Uttar Pradesh				
i) Ghaziabad	27500	5000	19	9
ii) Noida	12200	5000	14	34
iii) Hapur	3000	1500	49	10
iv) Bulandshahr	1600	500	79	4
v) Khurja	2500	300	32	4
vi) Meerut	19500	7000	44	8
III. Haryana				
i) Bahadurgarh	2400	1700	28	30
ii) Kundli	290	NA	17	
iii) Palwal	1300	300	42	5
iv) Rewari	2300	1000	33	12
v) Dharuhera	200		55	
vi) Panipat	4700	5300	38	28
vii) Rohtak	7300	18000	27	83
viii) Gurgaon	5000	14000	27	103
ix) Faridabad	27000	10000	23	16
IV. Rajasthan				
i) Alwar	4400	3500	48	17
ii) Bhiwadi	2650	150	15	

Source : ORG (1994): National Capital Regions Economy and its Industrial Development Potential

TABLE : 16

COMMUNICATION FACILITIES

City/Region	Postal facilities			Telephones	
	Post offices	Telegraph offices	Post boxes	Telephones	Public call offices
Faridabad C.A.	30	3	121	5005	72
Gurgaon U.A.	90	1	32	2500	10
Panipat M.C.	14	1	100	3786	16
Rohtak M.C.	16	3	54	3097	42
Sonipat M.C.	13	7	80	1725	26

Source : Municipal Year Books.

per telephone are also relatively low in these cities. Delhi has the least population density per telephone. Telephone facilities appear to be in much higher stress in the priority cities of Bulandshahr, Hapur, Alwar and Meerut than the DMA cities of Noida, Ghaziabad, Faridabad and Gurgaon.

CHAPTER 6

SHELTER

1. Housing and related social ameniting across the cities constitute important resource base that determine their carrying capacities to almost future population as well as economic growth. Apart from being a basic social resource, housing stock and their potential future supply (along with land and other infrastructure) may serve as a determina for attracting future industrial growth across these cities. Depending primarily on census information, this chapter analysis several key indicators of shelter conditions, specifically the existing stock and shortage across cities, housing conditions, recency rate and the extent of slum conditions. It also provides a comparative view of various educational, health, vary letter infrastructure is available at the rate of supply of housing stock for the individual cities.

2. **Existing Housing Shortage**

Housing census 1991 provides information on the numbers of households and residential/partly residential census houses for the cities of NCR from which the index of housing shortage across then cities have been computed (TABLE 1). With the exception of four cities, the index is lower than the all India average urban housing index of 980, which indicates the severity of urban housing shortage across NCR. Bulandshahr, among these cities, faces the worst housing shortage problem and the average household size (which is indicative of the

TABLE 1

Households, Houses and Shortage of Houses (Housing Stock) NCR Town: 1991

Towns/Cities	No. of Household	No. of Houses	Index of Housing Shortage to total households*	Av. of Household size
Meerut	131476	123957	943	6.46
Ghaziabad	96536	88696	919	5.30
Alwar	36882	36490	989	5.69
Rohtak	36475	35574	975	5.92
Panipat	34569	34508	998	5.53
Sonepat	25722	25632	996	5.59
Gurgaon	24680	24623	998	5.50
Faridabad	133180	128470	965	4.63
Delhi	1690233	1619467	958	4.98
Noida	33459	32281	965	4.37
Modinagar	22270	21656	972	5.53
Bulandshahr	19883	17533	882	6.39
Hapur	21327	20051	940	6.85

Source: Census, 1991

* No. of residential/partly residential house per 1000 households.

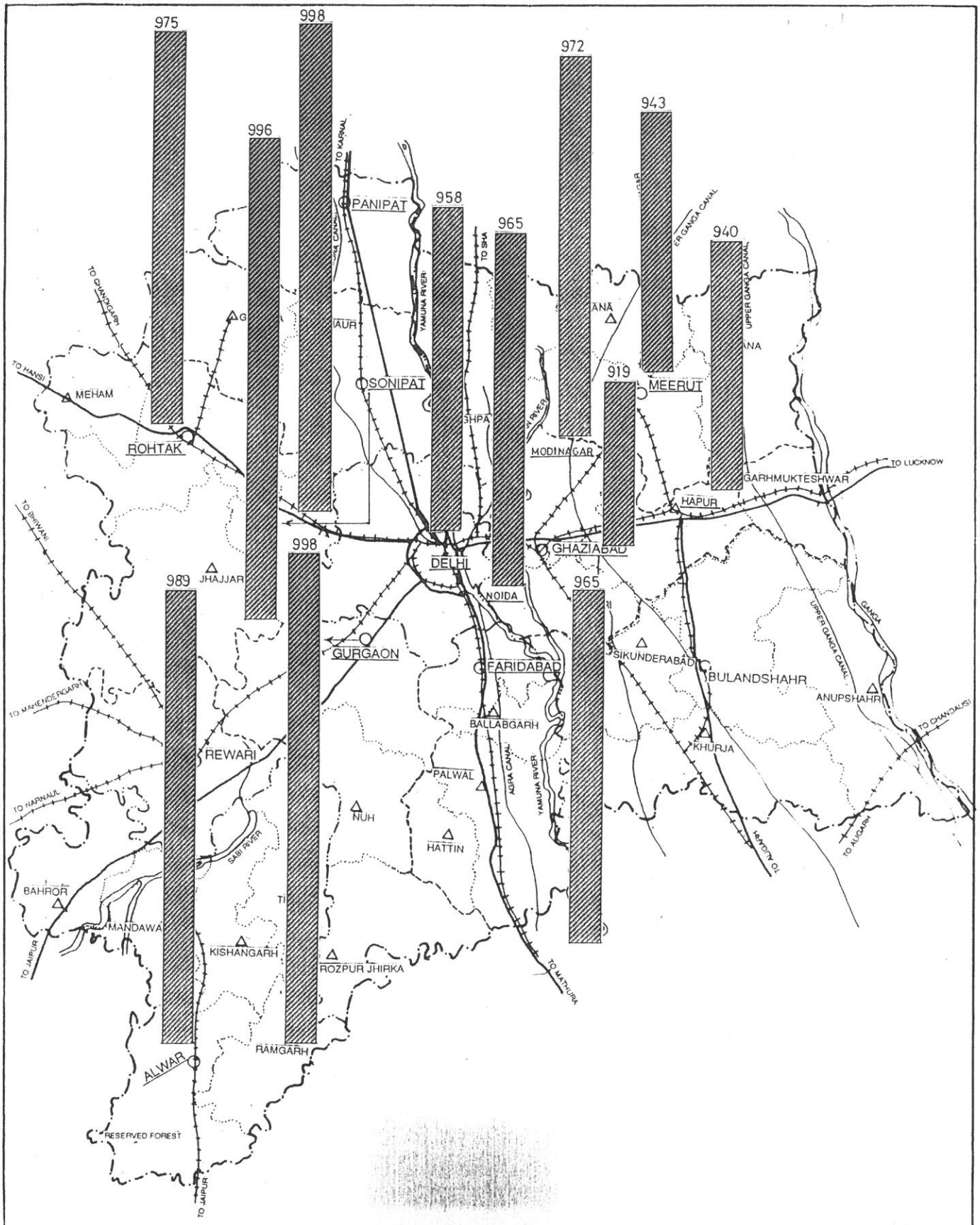


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FIG.1
HOUSING INDEX IN CITIES
NO. OF CENSUS HOUSES/1000 H.H.'S

occupancy rate) is also very high; Ghaziabad, Hapur and Meerut follows. On the other hand, housing shortage appear to be marginal in the case of the three Haryana cities of Gurgaon, Panipat and Sonepat. Delhi's situation lies in between the above two sets of cities, but the average household size in Delhi is lower than all cities except Noida and Faridabad.

3. **Quality of Housing Stock**

TABLE 2 shows the distribution of "Pucca" and "other" (Kutchha and Semi-pucca) houses indicating the quality of the total housing stock in these cities. The proporation of pucca houses in the housing stock is highest in Alwar, Rajasthan (93%) which is due to the prevalence in the use of stone, as building material. On the other hand, pucca housing constitute only 43% of the total stock in Bulandshahr which substantiate further the worst housing situation here among all the cities. Interesting to note that the population of pucca houses are greater in the DMA cities of Gurgaon, Ghaziabad, Noida and Faridabad than in the outlying priority cities of Panipat, Rohtak, Hapur and Meerut. Sonepat too has a relatively low stock of pucca housing. Furthermore, Delhi's quality of housing stock is better than that of other cities except Gurgaon and Alwar.

4. **Slums**

Although authentic information on slum housing in the individual cities are hard to come by, interview with municipal officials as well as a few reports on housing situation in the individual cities reveal some idea on the

Table 2

Housing Condition in NCR Cities
1991

Cities	Total Cencus Houses	Pucca Houses	Other houses (Kutcha/Semi Pucca)
Panipat	51630	32835	18795
%		63.59	36.41
Sonepat	37340	24230	13110
%		64.89	35.11
Rohtak	53665	38975	14690
%		72.62	27.38
Gurgaon	33770	31805	1965
%		94.41	5.59
Faridabad	171960	140790	31170
%		81.87	18.13
Bulandshaher	717490	224545	292945
%		43.39	56.61
Ghaziabad	131225	112930	18295
%		86.05	13.95
Hapur	28065	21610	6455
%		76.99	23.01
Meerut	178315	141265	37050
%		79.22	20.78
Noida	49470	40650	8820
%		82.17	17.83
Modinagar			
%			
Alwar	51360	47650	3710
%		92.77	7.23
Delhi	2446143	2115743	330400
%		86.49	13.51

Source : Census,1991

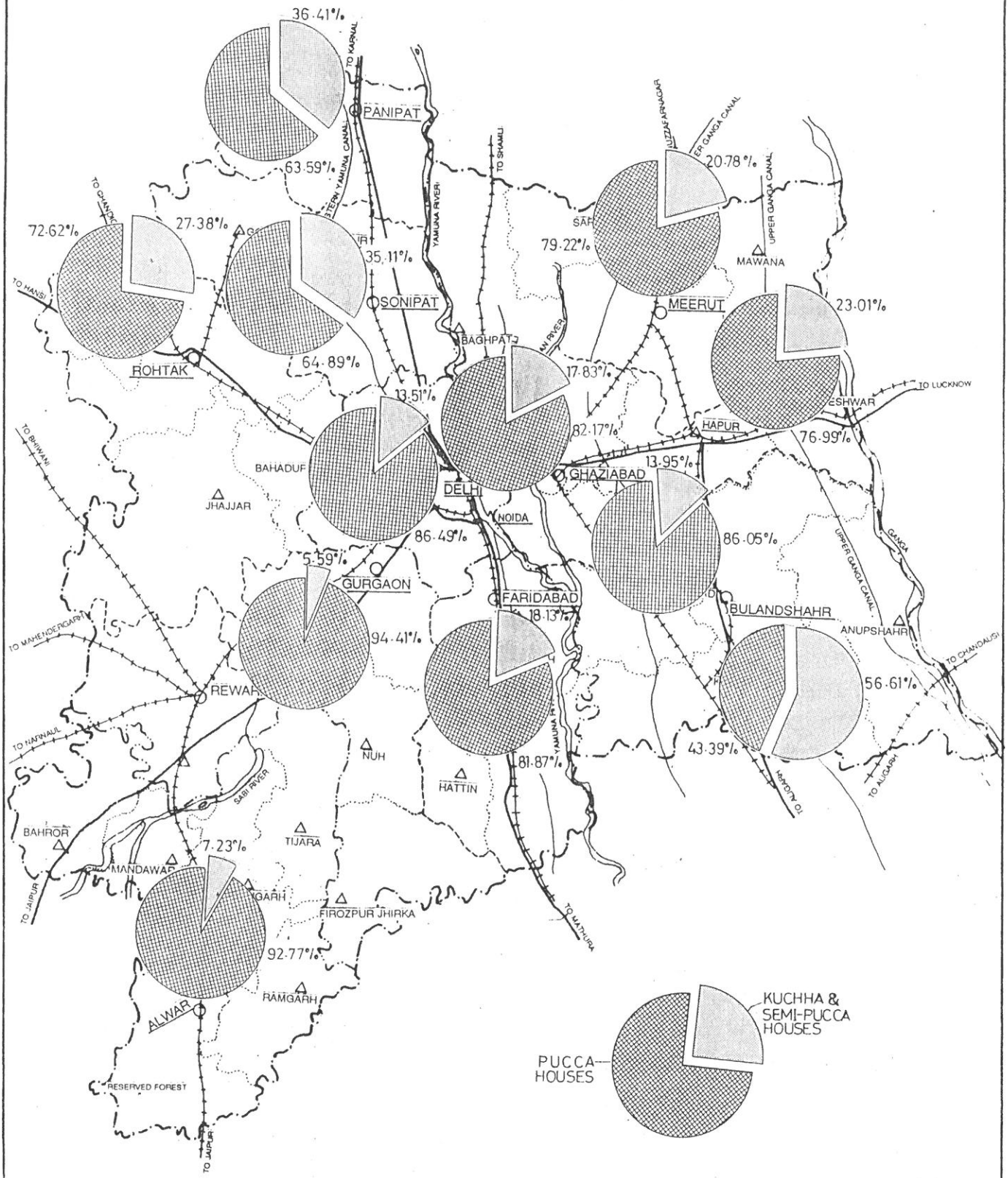

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FIG. 2

HOUSING CONDITION IN CITIES

Scale
5 0 5 10 20 kms

N

extent of slum population across class I cities of NCR (see TABLE 3). The proportion of total municipal population living in slum condition appear to be very high in Bulandshahr (>67%) and moderately high in Sonepat (37.5%), Modinagar (35%) and Hapur. Panipat and Meerut appear to have the lowest percentage of population in slums, whereas this proportion is relatively low also in Delhi (21.4%), Rohtak (23.6%), Faridabad (24.3%) and Gurgaon (25.9%). Information of slum population are not available for Noida and Alwar.

5. **Vacancy Rate**

The vacancy rates in the total census houses across different class I cities are shown in Table 4 Which may indicate the relative prospects of additional supply in their future housing markets. Although there may be various causes for vacancy in the existing housing stock, existing tenancy regulations often discourage house owners to supply unused stock in the rental market, leading to high vacancy.

The official records of vacant housing vary sharply across NCR. Interestingly, Delhi has the highest vacancy rate in existing housing stock among all cities. About 2.94 lakh houses remained vacant in 1991. Ghaziabad, Sonepat and Rohtak also have high vacancy rates that range between 10% and 12%. However, the vacant stocks are very low in Sonepat and Rohtak compared to that in Ghaziabad. The very low vacancy rate in the new city of Noida may porably be due to high demand as well as owner occupancy. Although the vacancy rate is relatively low also in Bulandshahr, its existing vacant stock

TABLE : 3
SLUMS AND SQUATTER HOUSING ACROSS N.C.R. CITIES

CITY	NO.OF SLUMS/ SQUATTER AREA	SLUM/SQUATTER POPULATION	%AGE OF TOTAL POPULATION	NO. OF SLUMS/ SQUATTER UNITS	OCCUPANCY RATE IN SLUM/SQUATTER (POPULATION/UNIT)
Bulandshahr(1995)	28	85326	67.08	5940	14.36
Hapur (1993)	28	46557	31.83	7133	6.53
Modinagar (1993)		35516	34.93	4894	7.26
Meerut Squatters (1992)		16200	1.92	3000	5.4
Meerut Municipal Villages (1992)		134818	15.93	18987	7.1
Faridabad (1995)	64	150000	24.28	30000	5
Gurgaon (1994)	14	31448	85.89	6454	4.87
Sonepat (1994)	26	54010	37.53	9946	5.43
Rohtak	28	51027	23.61	8448	6.04
Panipat(1994)	28	31403	16.42	5355	5.86
Alwar (1992)				2500	
Delhi (1991)		1800000	21.38		

Sources :
1. Municipality (N.I.U.A. Field Survey)
2. School of Planning And Architecture, New Delhi,1992 ; Housing Situation Study and Strategy:Meerut (U.P.)
3. Faridabad UBSP office (for F.C.A.)
4. Society For Development Studies,New Delhi,1992;Housing Development Strategy for Alwar
5. Census of India,1991;District Census Handbook,District Delhi.

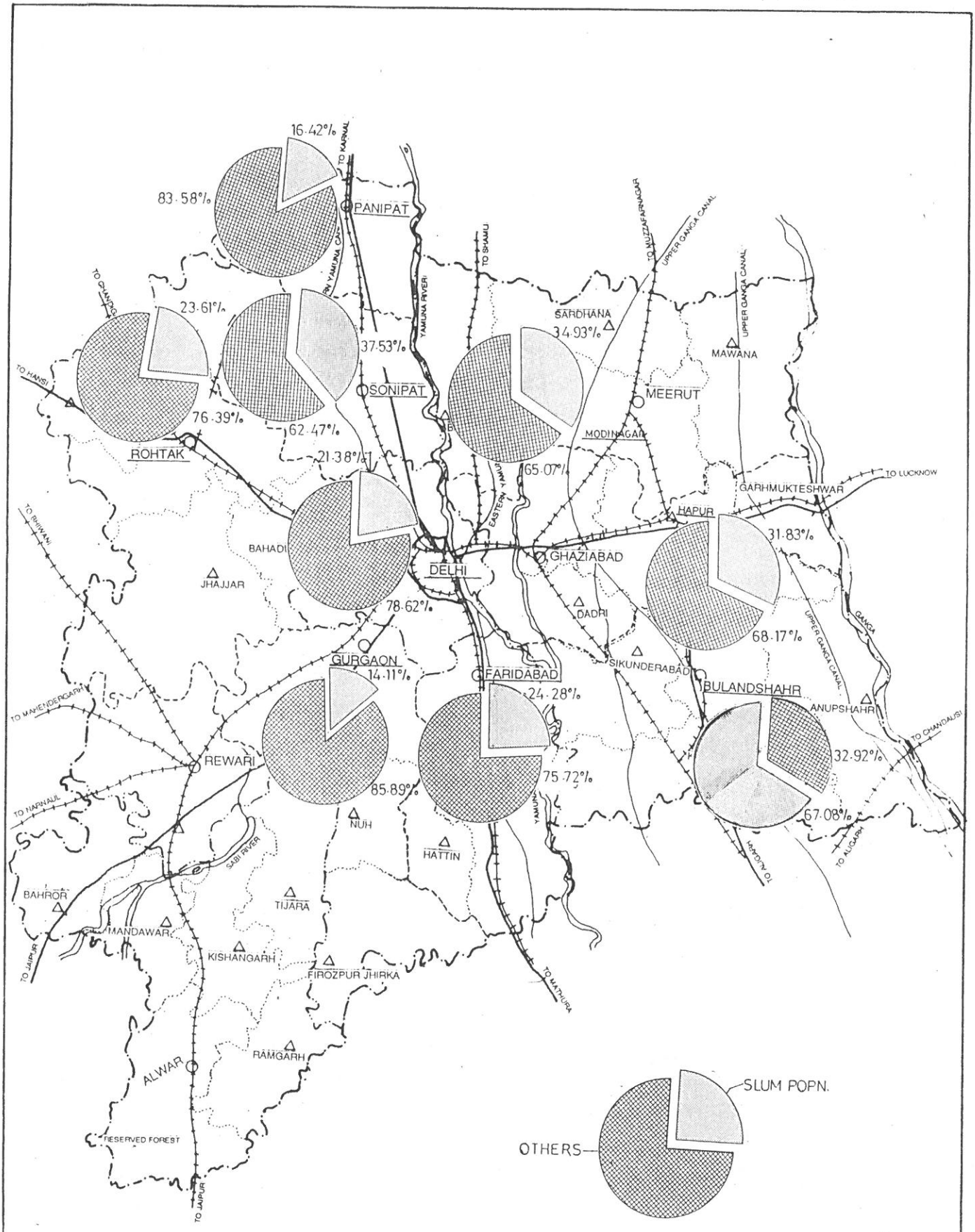

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FIG.3
SLUM POPULATION
(% IN CITIES)

Scale
5 0 5 10 20 kms

N

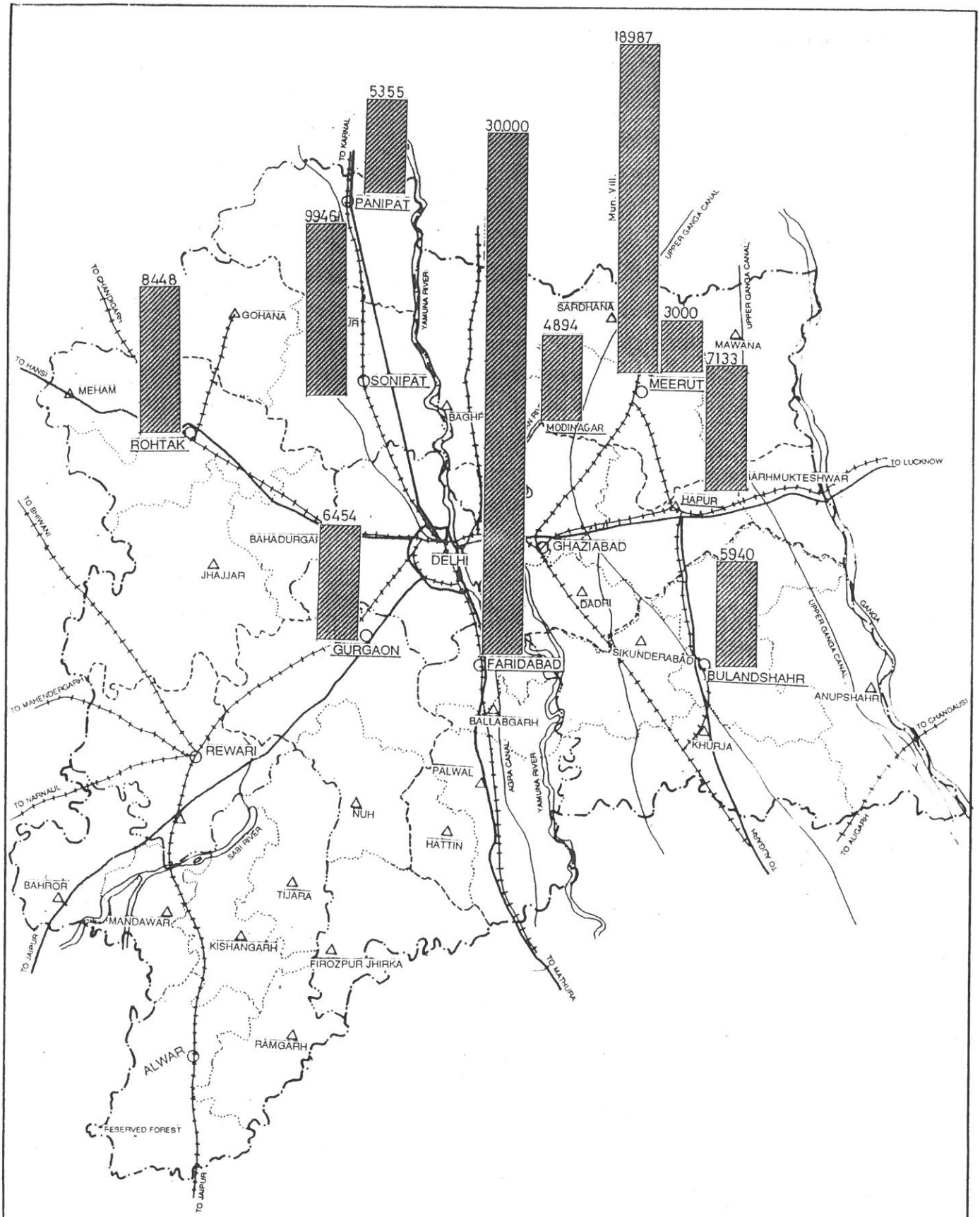

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FIG. 4
NO. OF SLUMS & SQUATTER UNITS NO.'S

in the highest among cities of NCR, excepting Delhi. However, the habitability of much of this stock may be suspect across these old cities. Meerut and Faridabad are the two other cities having large stocks of vacant houses-ranging between 13 and 17 thousands.

6. **Social Infrastructure or Amenties**

The levels of educational, health and recreational facilities available across NCR cities (Delhi, Haryana and Rajasthan sub-region) are shown in Figures 6-11 . Apparently the status of individual cities in term of various social amenities vary considerably according to the types of facilities. However, Rohtak clearly stands out superior to most other cities in term of the densities of higher level educational facilities, viz general and vocational/profesional institutions as well as densities of medical beds available in the cities. In Delhi, the density of college facilities is significantly lower than those of Haryana cities (except Faridabad) and Alwar, while that of professional/vocational institutions is slightly better. However, the density of medical beds in Delhi is better than in Panipat, Gurgaon, Sonepat and Faridabad. Considering school educations both Delhi and Sonipat are much superior to the rest of above cities, in terms of density of secondary school than the rest. Interestingly, Panipat and Faridabad appear to stand out as the worst cases in terms of all levels of school and college facilities. They are also inferior to most of the rest cities in terms of density of medical beds. Panipat appears to be the worst case also in

Table 8

Census Houses and Vacant Census Houses in NCR Towns
1991

City	Total Census Houses	Vacant Census Houses	%
Bulandshaher	517490	28570	5.52
Ghaziabad	131225	15560	11.85
Hapur	28065	1755	6.25
Meerut	178315	16615	9.31
Noida	49470	7905	1.48
Modinagar	N.A.	N.A.	N.A.
Alwar	51360	4415	8.59
Sonepat	37340	4215	11.28
Faridabad	171960	13345	7.76
Gurgaon	33770	2945	8.72
Rohtak	53665	5725	10.66
Paniapt	51630	4720	9.14
Delhi	2446143	293677	12

Source : Census,1991

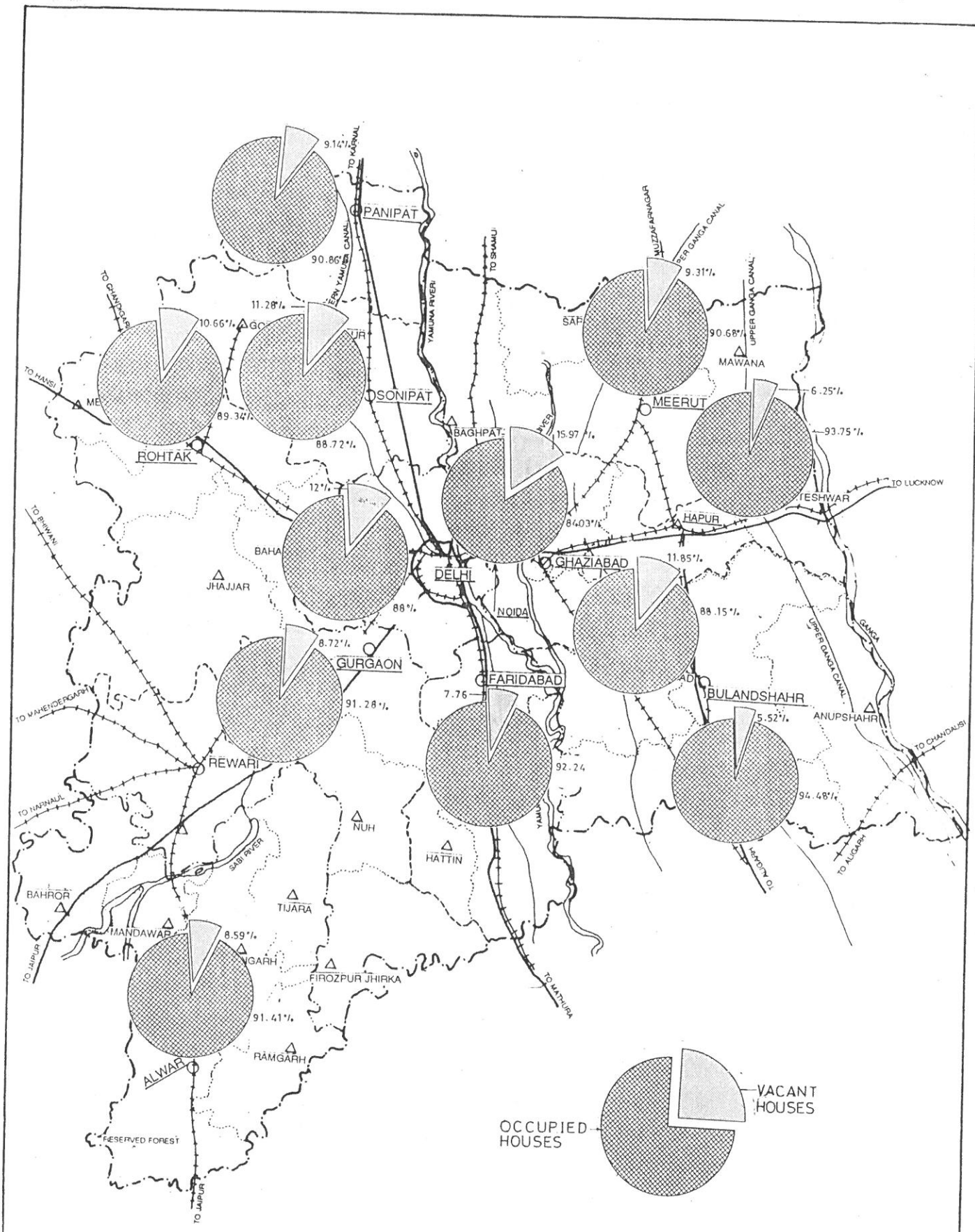

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FIG. 5
VACANT HOUSES IN CITIES

Scale
5 0 5 10 20 kms

N

terms of the range and densities of recreational and cultural facilities available across the cities and Delhi tends to follow in this respect.

The levels of recreational /cultural facilities in terms of especially, public libraries, cinema and drama or community halls appear to be high in Rohtak, Sonepat and Gurgaon compared to the rest cities. Although Delhi has a large number of specialised recreational facilities like stadia, other cultural facilities appear to be low in proportion to the city's population size.

Although it has not been possible to draw a complete comparative profile across NCR cities in the absence of recent information on UP sub-region towns, 1981 consus data tend to indicate that the number of hospitals per unit population was much higher in Bulandshahr than other U.P. and Haryana cities, while the density of schools where higher in Hapur than the other U.P. and Haryana cities (except Rohtak).

7. **Conclusions**

Apparently, the shelter condition of Delhi is no worse off than other cities of NCR, especially the old outlying cities of U.P. and Haryana, in term of housing stock, condition of housing and the extent of slums in cities. Furthermore, the growth of slums in Delhi which had been occuring over the past few decades, primarily due to migration of population is likely to slow down in future with the recent higher rate of

TABLE : 5
EDUCATIONAL FACILITIES

City	Schools						General Colleges		Voc./ Other Inst.	
	No.of Primary Schools	Schools per 1000 Population	No.of Secondary Schools	Schools per 1000 Population	No.of H.Sec. Schools	Schools per 1000 Population	No. of Colleges	Colleges per Lakh Population	No. of Colleges	Colleges per Lakh Population
Delhi	1824	0.21	2496	0.29	729	0.08	53	0.62	121	1.44
Rohtak	53	0.24	65	0.30	12	0.05	10	4.62	12	5.50
Panipat	30	0.15	31	0.16	6	0.03	3	1.56	-	
Gurgaon	35	0.28	55	0.45	7	0.05	2	1.64	6	3.14
Sonipat	25	0.17	63	0.43	12	0.08	4	2.77	2	1.65
Faridabad	82	0.13	134	0.21	25	0.04	4	0.64	1	0.69
Alwar	72	0.35	51	0.24	10	0.04	4	1.95	3	1.46

Source :District Census Handbooks,1991

TABLE : 6
MEDICAL FACILITIES

City	HOSPITALS		Dispensaries		Other Medical Facilities		Total No. of Beds	
	No.of Hospitals	Hospitals per Lakh Population	No.of Dispensaries	Dispensaries per Lakh Population	No.of M.facilities	Facilities per Lakh Population	No.of Beds	Beds per Lakh Population
Delhi	78	0.92	508	6.03	234	2.77	17120	2.03
Rohtak	8	3.70	3	1.38	5	2.31	1436	6.64
Panipat	3	1.56	2	1.04	4	2.09	195	1.01
Gurgaon	4	3.29	6	4.93	6	4.93	151	1.24
Sonipat	1	0.69	3	2.08	3	2.08	132	0.91
Faridabad	3	0.48	24	3.88	4	0.64	474	0.76
Alwar	5	2.43	8	3.90	3	1.46	523	2.55

Source :District Census Handbooks,1991

TABLE : 7
RECREATIONAL AND CULTURAL FACILITIES

City	Stadiam		Cinema		Drama/Community Hall		Pub.Library/Reading Room	
	No.of Stadiams	Stadiams Per Lakh Population	No.of Cinema Halls	Cinema Halls per Lakh Population	No.of Halls	Halls per Lakh Population	Nos.	Per Lakh Population
Delhi	10	0.11	88	1.04	146	1.73	214	2.54
HARYANA STATE								
Rohtak			9	4.16	5	2.23	11	5.09
Panipat			1	0.52			2	1.04
Gurgaon	1	0.82	5	4.11	6	4.93	6	4.93
Sonepat			6	4.16	4	2.77	14	9.72
Faridabad	1	0.16	10	1.61	10	1.61	14	2.26
RAJASTHAN STATE								
Alwar	2	0.97	5	2.43	4	1.95	4	1.95

Source :District Census Handbooks,1991

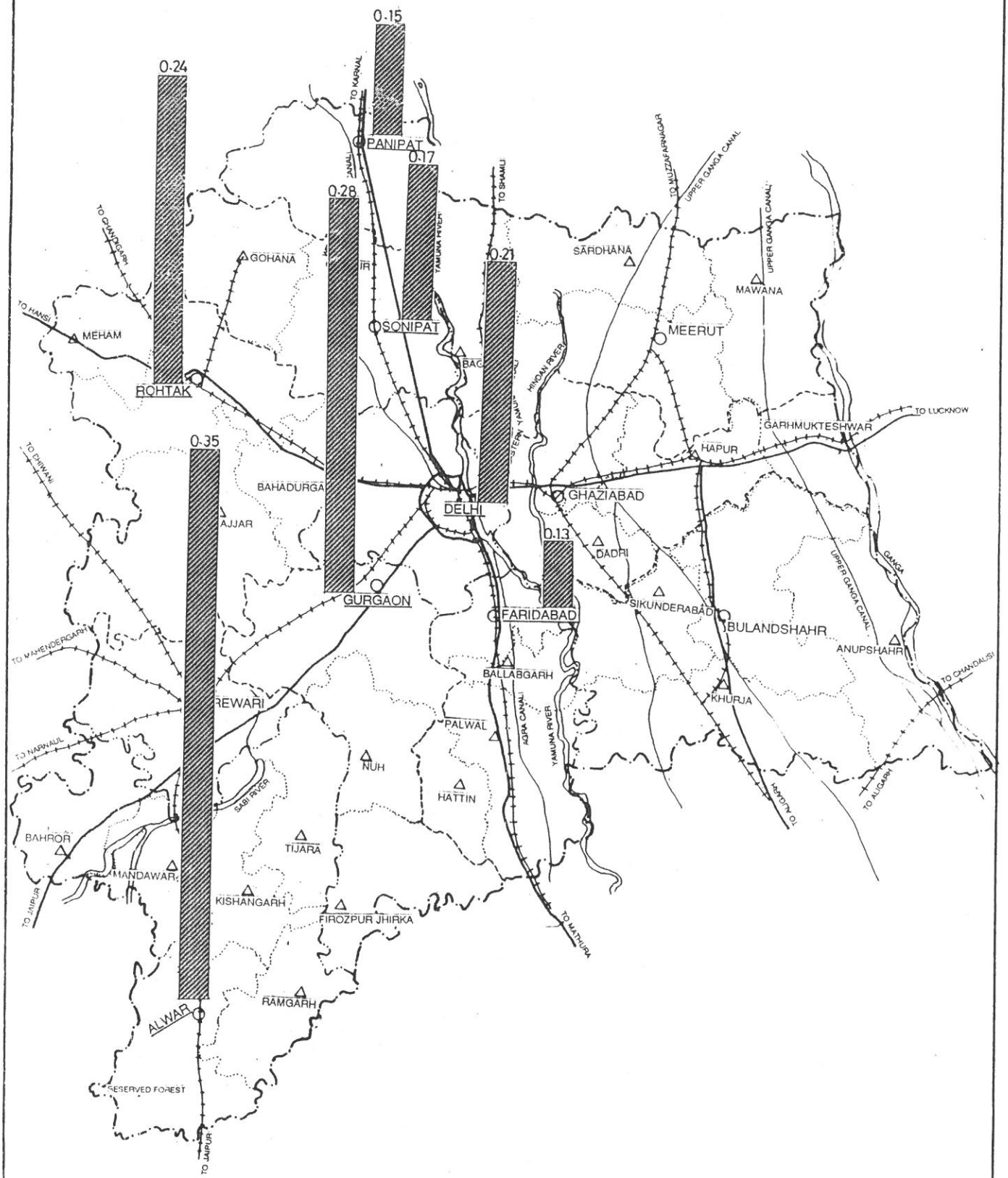

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FIG. 6
EDUCATIONAL FACILITIES
(PRIMARY SCHOOLS/1000 POP.)

Scale
5 0 5 10 20 kms

N

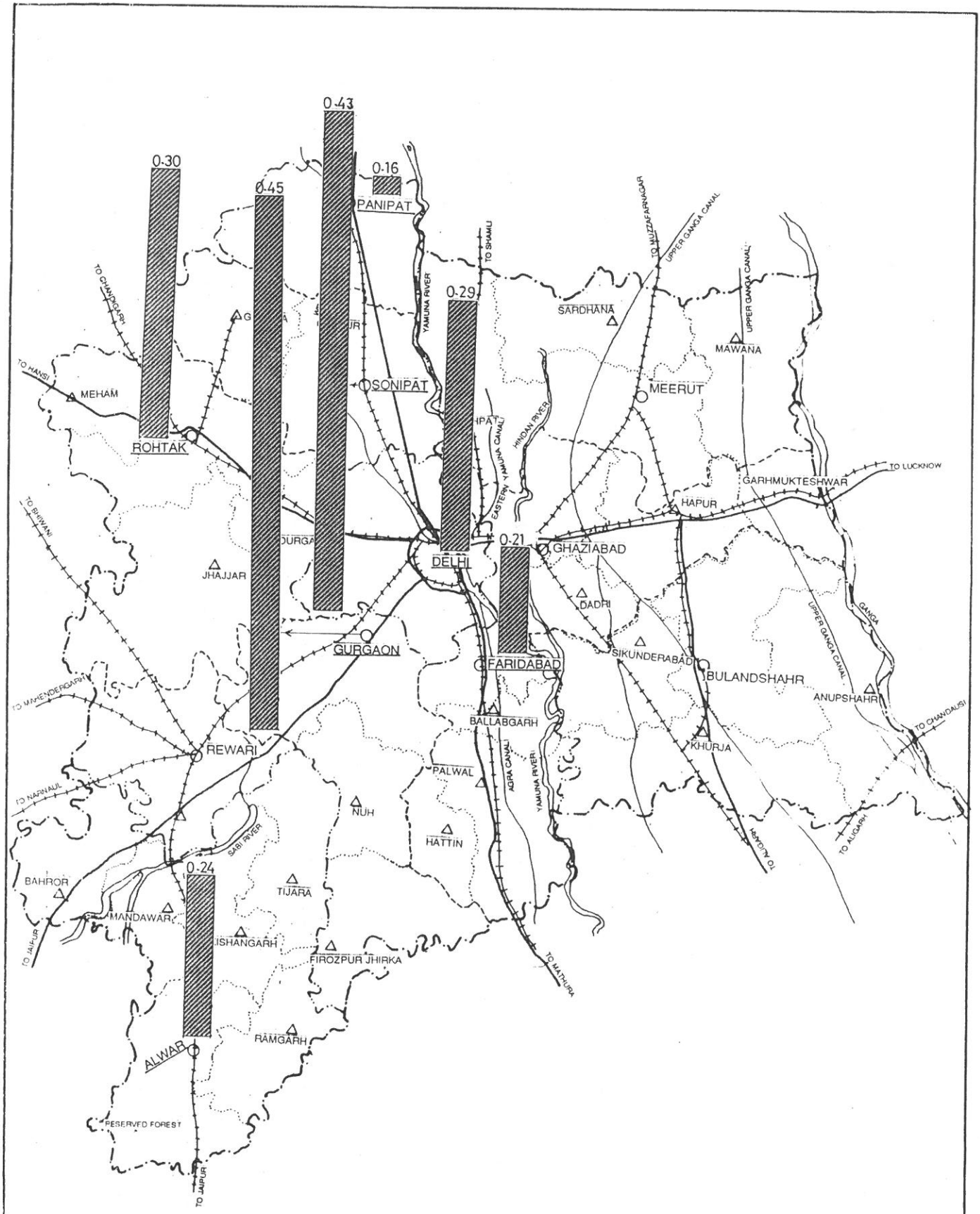

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FIG.7
EDUCATIONAL FACILITIES
(SEC.SCHOOLS/1000 POP.)

Scale
5 0 5 10 20 kms

N

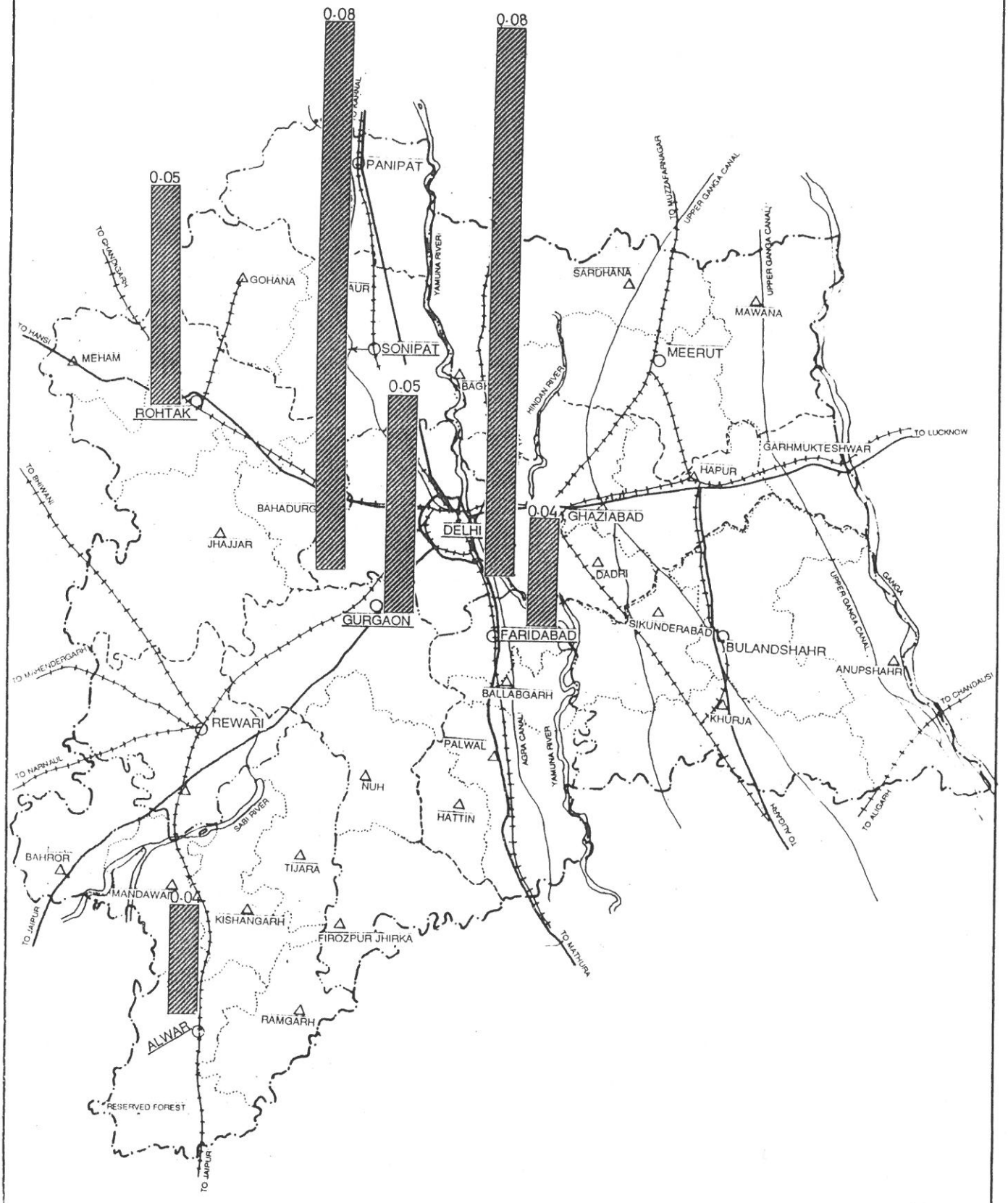

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FIG.9
EDUCATIONAL FACILITIES
(HIGH SEC.-SCHOOLS/1000 POP.)

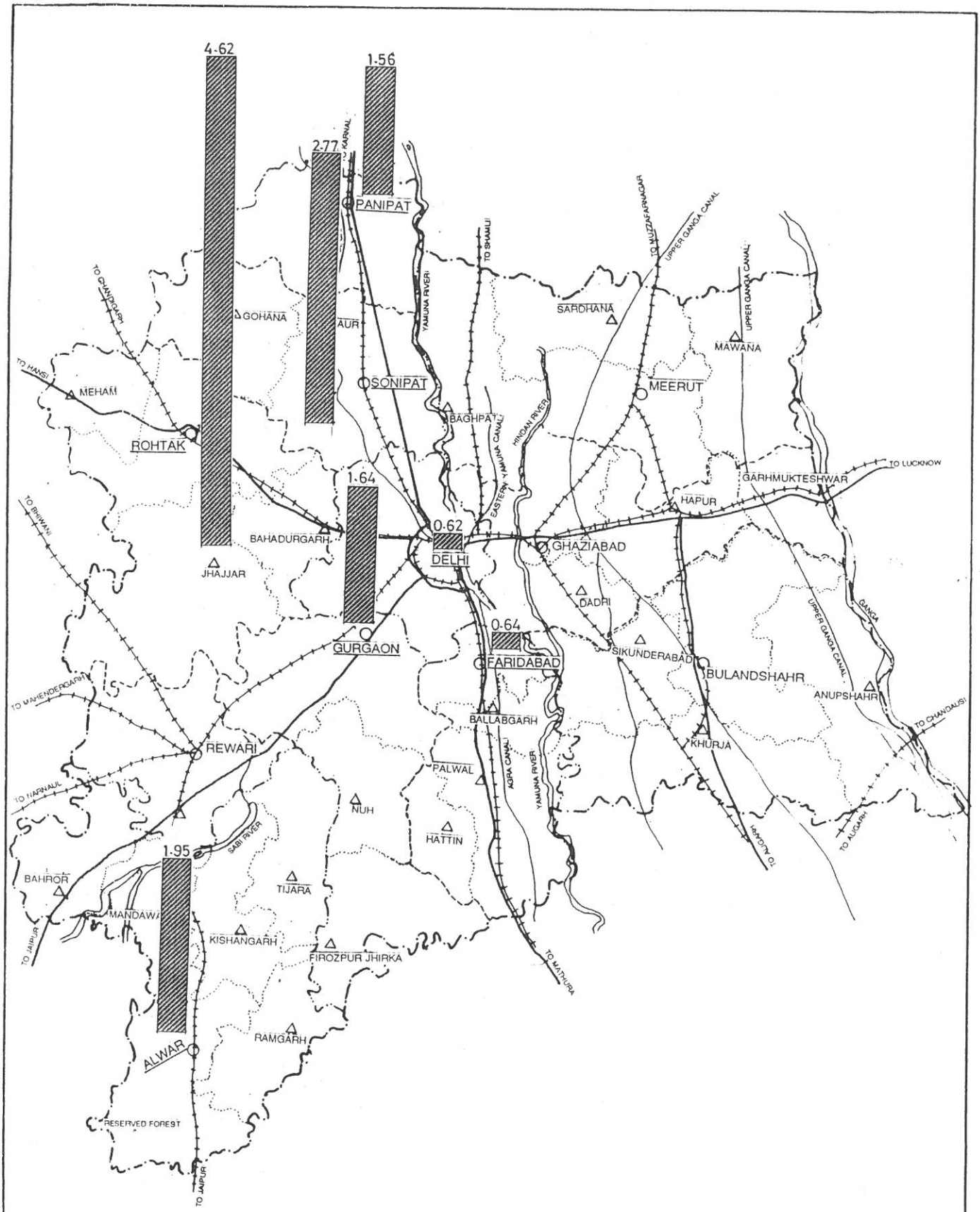

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FIG.9
EDUCATIONAL FACILITIES
(COLLEGES/LAKH POP.)

Scale
5 0 5 10 20 kms

N

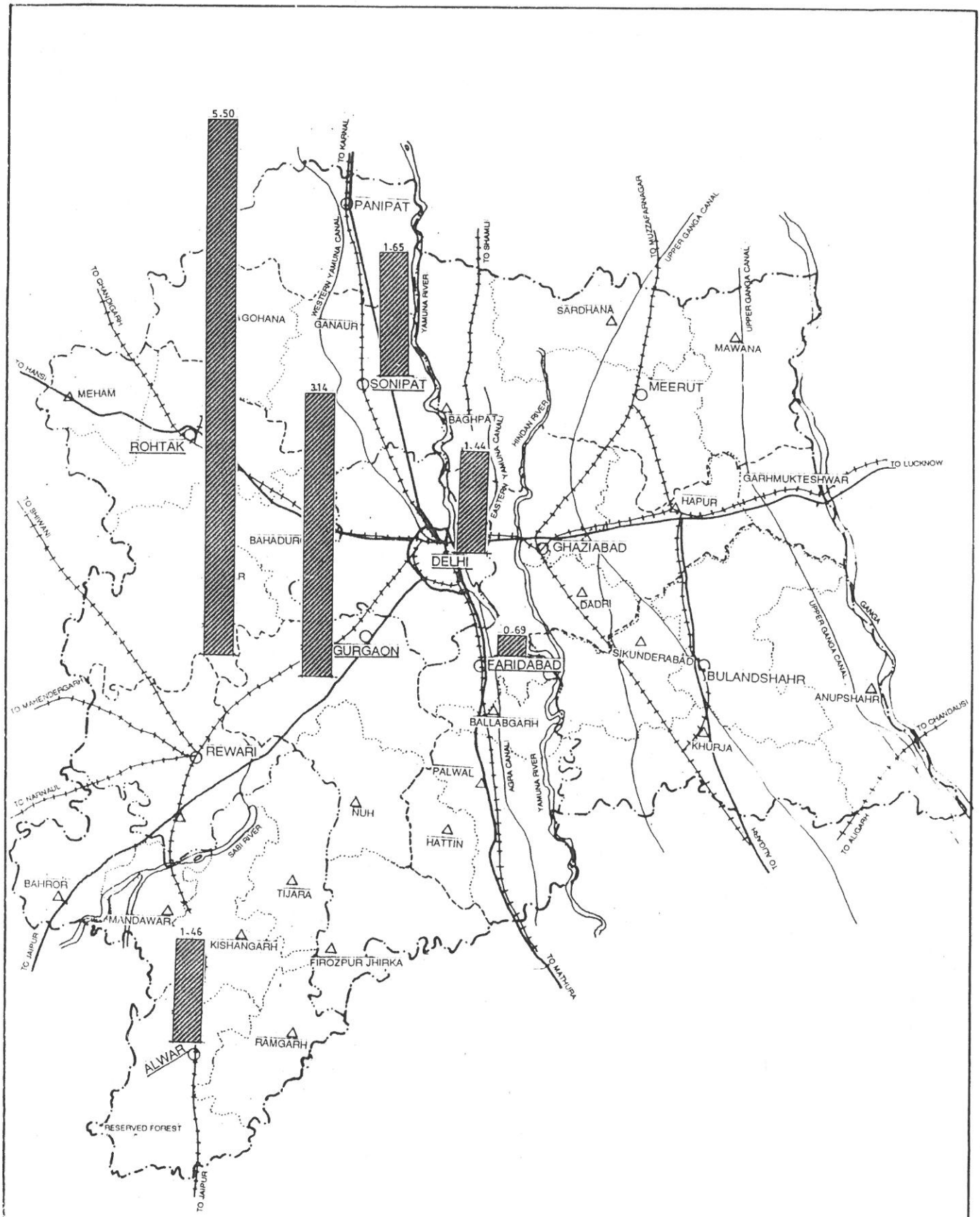

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FIG.10.
EDUCATIONAL FACILITIES
(VOC. COLLEGES/LAKH POP.)

Scale
5 0 5 10 20 kms

N

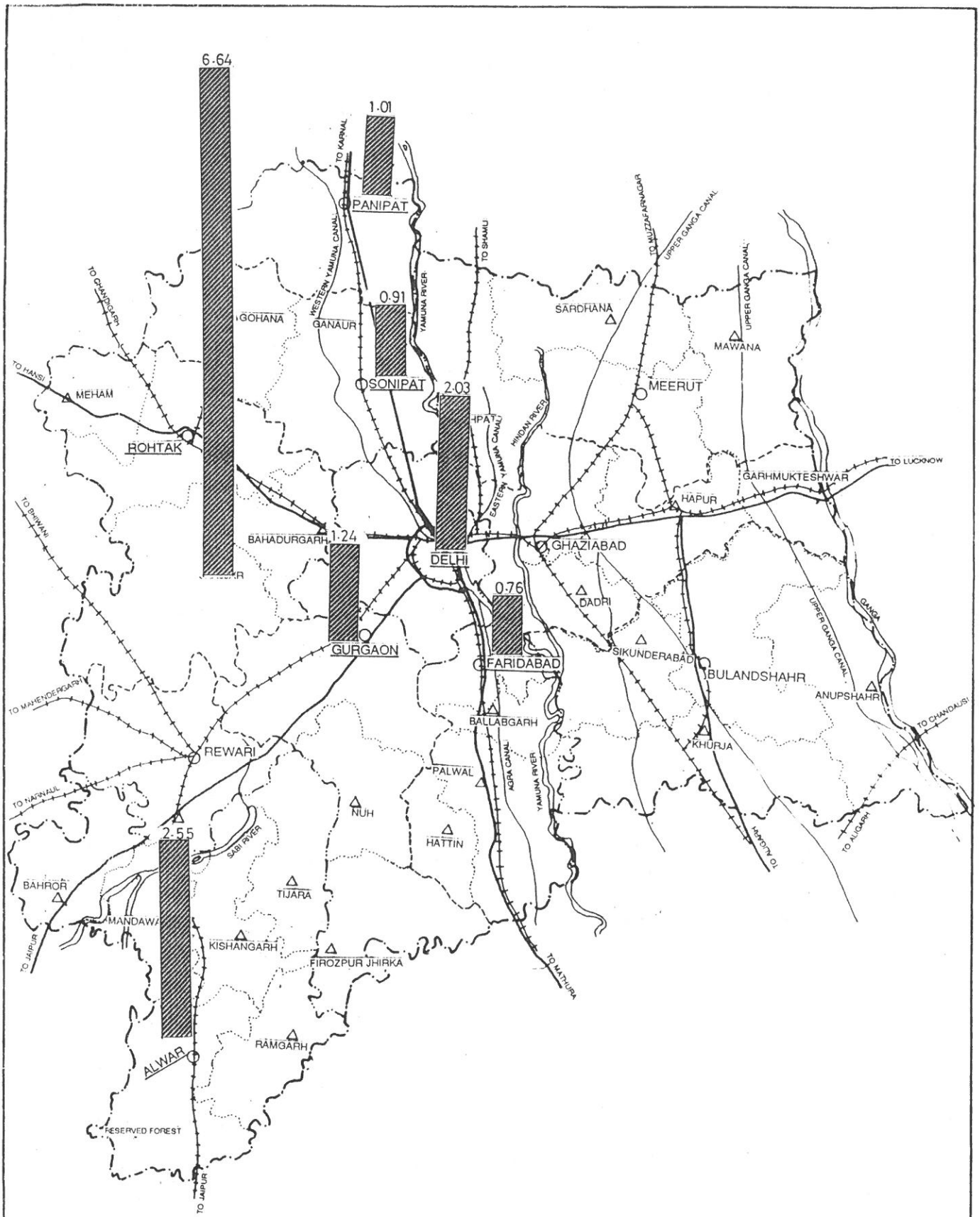

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FIG II
MEDICAL FACILITIES
(NO. OF BEDS/LAKH POP.)

Scale
5 0 5 10 20 kms

N

growth of cities in the DMA and gradual reduction in migration rate. One recent estimate of the need-supply gap in Delhi(NIUA, 1995: Review of Master Plan of Delhi-2001) presents significantly less alarming picture than the housing requirements prepared center in the MPD-2001.

Nevertheless, supply-demand gap in housing is a contentious issue for the NCR as a whole and for its large growth centres in particular which should be looked upon urgently. In the absence of supply information for individual cities it is not possible to present a comparative picture of supply situation. But, as some studies on urban housing tend to indicate (viz NIUA, 1995, SPA, 1992: Meerut Housing Study)in public sector dependence an housing supply, such as supply through DDA, State Housing Boards, Development Authorities and other local agencies may be grossly inadequate and large-scale private sector investment in housing supply should be mobilized across the large cities. There should be ways and means to mobilize private investments especially in the low-income group and EWS housing and slum improvement schemes.

CHAPTER 7

ENERGY

Power

Power is a vital input for economic development. It is used in all spheres of activities -- industries, railways and communications, trade and commerce, agriculture and even in day to day living (domestic). In fact, use of power is a good measure of the level of development of any region or city.

A quick recapitulation of population distribution of the NCR will remind us that Delhi, which has the least area (4.9%), contains the largest share of population (36.4%), followed by U.P. sub-region with 35.9% area and 34.7% of NCR's population, Haryana with 44.4 % area and 24.7 % population and Rajasthan with 14.9% area and 4.2 % population. In these sub-regions the distribution of medium and large scale (which is a large consumer of power) industries indicates a restricted growth in DUT, and a concentration in U.P. and Haryana. The latter also has a very large number of SSI units.

The three major consumers of power are the domestic, industrial, and the commercial sectors. As population increases, domestic and commercial consumption increases. The latter indicates developments of tertiary activities within a city/area. Industry on the other hand is a strong indicator of secondary activities and productivity of an area.

The pattern of power consumption in the NCR indicates less consumption in the industrial sector of DUT, and more consumption in its domestic sector. In comparison, the industrial sectors of U.P., Haryana and Rajasthan consume larger proportions of their total use. Except for Rajasthan, where expansion is taking place in the tertiary sector, U.P. and Haryana maintain almost the same pattern over the years, with a slight increase in the domestic sector and a little decline in the tertiary sector.

Table 1
Sectoral Power Consumption by Sub-Regions

Sub-region	1989-90 (Provisional)			1994-95 (Estimated)			Total MKW	% to total
	Domestic %	Industrial %	Others %	Domestic %	Industrial %	Others %		
Delhi	37.36	24.40	38.24	39.41	25.91	34.68	12214	48.38
Haryana	19.35	41.19	39.46	23.60	43.24	33.16	4901	19.41
UP	9.72	43.66	46.62	12.56	52.83	34.61	6529	25.86
Rajasthan	5.12	81.60	13.28	4.27	77.26	18.47	1601	6.34
Total	24.57	35.64	39.79	26.48	40.17	33.35	25245	100.00

Source: CEA (1992); Power Requirement of the NCR upto 1999-2000, New Delhi.

Judging by the age old concept of a widening tertiary base with urban development, it can be said, that except for DUT, the other sub-regions have not yet reached a mature stage of development, as use od electricity in the tertiary sector is less than the use in the industrial sector. There is, therefore, a need for more power supply in these regions for further development. Given the industrial location policy of the NCR, the existing pattern will remain, if the NCRPB continues to focus on development of industries in the U.P. and Haryana sub-region.

The per capita power consumption for the NCR as a whole has been 380 Kwh in 1985-86 and 606 Kwh in 1989-90. The corresponding figures for Delhi were 502 Kwh and 869 kwh, which is much above the regional figures. It is understood that Delhi is consuming more electricity because of population concentration. But industrial development also requires plenty of energy. So that, if the ring towns and the priority towns are to improve their economic activities, to absorb more people, more power should be supplied to these towns. The 1994-95 per capita consumption estimates for NCR is 879 kwh and for 1999-2000 it is 1215 kwh.

The NCR falls within three state grids of Haryana, Rajasthan and U.P., all being part of the Northern grid. The provisional installed generating capacity of the Northern Region for 1991-92 was 20458 MW, out of which Haryana had 882 MW (4.3%), U.P. had 5599 MW (27%), Rajasthan had 1185 MW (5.8%) and Delhi had 614 MW (3.0%). The NCR is only a portion of these states put together. The areal and population distribution in comparison to the share of the installed power generation capacity will indicate the need for power in the sub-regions.

Table 2

Distribution of Area, Population and Power in the NCR

Sub-region	% area to NCR	% population to NCR	% Power capacity to the Norther grid for the states	% share of sub-region in the state area	% share of 1991 population to the state	Installed capacity by proportionate area (MW)	Installed capacity by proportionate population (MW)
DUT	4.9	36.4	3.0	100.0	100.0	614.00	614.00
Haryana	44.4	24.7	4.3	30.33	38.82	267.51	342.39
UP	35.9	34.7	27.4	3.68	6.47	206.08	362.32
Rajasthan	14.9	4.2	5.8	1.31	2.50	15.52	29.62

The two sub-regions with high proportion of population vis-a-vis the state are DUT and Haryana. In fact, the whole of Delhi is included in the NCR. Since the objective of the NCR plan is to divert population from Delhi, Haryana would be a major receiver. The likelihood of Haryana to absorb more population in the future (given the road links and the industrial developments taking place) will create a large demand for power. U.P.'s growth may get redistributed in some of its other important cities areas. Since U.P. is a large state, it is quite likely that less importance will be given to NCR as far as the interest of the state goes. Rajasthan will grow if other infrastructures improve. Hence, power generation/distribution may depend on the state priorities.

The capacity additions in the Northern region for the Eighth (1992-97) and Ninth (1997-2002) plans are assessed to be 12420 MW and 13925 MW. This would mean an increase of 60.71 % during the Eighth plan. The Ninth Plan additions would work out to 42.35 % of the Eighth Plan position. In other words, there would be a decline

in capacity building as the region reaches its assigned population; for requirements would already have been met.

Based on the above capacity addition programme, the anticipated power supply position by the end of the Eighth Plan and the Ninth Plan for the Northern Region would be:-

Table 3
Power Supply Position

Energy Supply	**1996-97**	**2001-2002**
Peak deficit (-) Surplus (+) MW %	-5658/ -23.3%	-6654/ -19.0%
Energy deficit (-) Surplus (+) MW%	-5163/ -4.0%	+2137/ +1.1%

Source: CEA (1992); Power Requiremtn of the NCR upto 1999 - 2000, New Delhi.

The total requirement of the Northern Region would be met by the year 2001-2002.

Meanwhile, there will be an increased need for transmission and distribution infrastructure. It is also expected that power requirements for the various growth centres should be met by the concerned State Electricity Boards by giving priority to NCR developments. Timely completion of the existing and future power generation schemes should, therefore, have to be aimed at.

Table 4
Forecast for future power requirements

State	Actuals		Provisional	Estimated	
	1987-88	1988-89	1989-90	1994-95	1999-2000
A. Energy Requirement (MKwh)					
Delhi	6099	6720	7687	12214	18104
Haryana	2163	2506	2755	4901	8000
U.P.	3323	3497	4000	6529	10445
Rajasthan	516	617	685	1601	3221
Total	12101	13340	15127	25245	39770
B. Peak Load MW					
Delhi	1044	1107	1350	2145	3179
Haryana	403	477	522	919	1490
U.P.	632	667	763	1244	1971
Rajasthan	98	117	130	305	608
Total	2177	2368	2765	4613	7248

Town Analysis:

The total demand and supply of electricity in the towns will give an idea of the capacity of the towns, and the sources that supply electricity.

Table 5

Demand and Supply in Class I Towns

(in MU)

Towns	Supply (1993-94)	Demand (1993-94)	Gap	% supplied
Delhi	7996 (92-93)	NA		100.00
NDMC	756		0	100.00
Ghaziabad	7596	8010	414	95.00
Faridabad	11210	13676	2466	82.00
Gurgaon	12050	12662	612	95.00
NOIDA	37153	37184	31	100.00
Meerut	30983	57783	26800	54.00
Bulandshahr	2397	2636	239	91.00
Hapur	4178	5014	836	83.00
Modinagar	22771	24093	1322	95.00
Panipat	16042	20057	4015	80.00
Sonepat	10000	13508	3508	74.00
Rohtak	13758	15134	1376	91.00

This analysis from primary data does not indicate any pattern. Townwise figures indicate acute shortage of supply in Meerut and considerable shortages in Sonepat, Panipat, Hapur and Faridabad. Delhi, Faridabad, Panipat, Sonepat and Rohtak get power from the grid, and at the same time generate power. The UP towns get power totally from the grid. The present position indicates a need to generate power over and above the contribution from the grid. The proportion of power supply, by source, in the individual towns is given below:

Table 6
Proportion of Electricity Supplied from Different Sources

(in %)

Town	From Power Plant	From Grid	Total
Delhi	21.6	78.4	100.00
Faridabad	28.6	71.4	100.00
Ghaziabad	-	100.00	100.00
NOIDA	-	100.00	100.00
Gurgaon	N.R.	N.R.	N.R.
Meerut	-	100.00	100.00
Hapur	-	100.00	100.00
Modinagar	-	100.00	100.00
Bulandshahr	-	100.00	100.00
Panipat	35.0	65.0	100.00
Sonepat	25.4	74.6	100.00
Rohtak	33.2	66.8	100.0

Response to demand projections were poor. In Delhi the demand-supply gap will be (+) 126 MW by 2000 (as per the 14th power survey). But in 2009 it will be (-) 2003 MW. The supply will depend on the availability of power from the centrally sponsored projects. In Bulandshahr, the figures would be (-) 607 MW for 2001 and (-) 1572 MW for 2011. Hapur will have (-) 1128 MW and (-) 1354 MW respectively. Modinagar will have (-)5465 MW and (-) 8197 MW respectively. The figures for Panipat, Sonepat and Rohtak are also negative. Hence, as demand increases with population, supply will decline, unless concerted efforts are made.

The maximum demand (as assessed by the 14th power survey) in Delhi will be 3179 MW in 1999-2000. This can be met by the

arrangements already done by DESU. But the demand for the year 2010, which will be 5660 MW, will face a deficit of 2003 MW. DESU will have to, therefore, either search for new sources, or gear up their existing sources (details in Annexure). Similar details will have to be worked out for each and every town.

Table 7

Demand - Supply Gap of Selected Towns

(in MW)

Towns	Demand-Supply gap 2001	Demand - Supply gap 2011
Delhi	(+) 126	(-) 2003
Bulandshahr	(-) 607	(-) 1572
Hapur	(-) 1128	(-) 1354
Modinagar	(-) 5465	(-) 8197
Panipat	(-) 6684	(-) 6078
Sonepat	(-) 4943	(-) 3577
Rohtak	(-) 4200	(-) 6000

As of now many towns have regular load-shedding (which indicates demand for higher peak load). These are Meerut, Hapur, Modinagar, Panipat, Sonepat, Rohtak. Of late even Faridabad has begun having load-shedding, though the other DMA towns, NOIDA and Gurgaon, have no load-shedding (there has been no response from Ghaziabad and Bulandshahr). Delhi does not have regular load-shedding, but as and when it is required. It also varies among the intra-city areas.

The categorywise consumer connection pattern indicates maximum connection in the domestic sector, followed by commercial and industrial.

Table 8
Pattern of Connection 1993-94

(Percentages)

Town	Domestic	Commercial	Industrial	Street Lighting	Other	Total
Delhi	83.7	11.5	4.7	0.1	0.0	100.0
Faridabad	79.5	9.2	4.7	0.1	6.5	100.00
Gurgaon	78.9	14.0	3.8	0.1	3.2	100.00
Ghaziabad	82.7	13.3	3.2	0.0	0.8	100.00
NOIDA	87.8	11.00	0.8	0.00	0.4	100.00
Meerut	69.7	23.5	2.9	0.1	3.8	100.00
Bulandshahr	77.3	17.5	2.9	0.0	2.3	100.00
Hapur	80.0	14.2	5.5	0.2	0.1	100.00
Modinagar	81.1	8.5	2.5	0.1	7.9	100.00
Panipat	66.6	28.2	5.1	0.0	0.0	100.00
Sonepat	79.7	17.3	2.7	0.0	0.3	100.00
Rohtak	75.3	21.9	2.8	0.0	0.0	100.00

However, such figures do not indicate the consumption pattern of electricity. The number of domestic connections indicate, to a certain extent, the population pressure and the demand in the domestic sector.

Table 9
Power Supply to Households

Towns	Domestic connections (93-94)	No. of Households (1991)	Ratio of domestic connections to Households	Slum Population (1995)	Average Slum Households	Slum household as % to total household
Delhi (MCD)	1533935	1441348	0.9	1800000	360000	25.00
Faridabad	54332	133180	2.5	150000	3000	22.52
Gurgaon	46451	24680	0.5	31448	6290	25.49
Ghaziabad	84372	96536	1.1	-	-	-
NOIDA	38366	33459	0.9	-	-	-
Meerut	79654	131476	1.7	134818	26964	20.51
Bulandshahr	13744	19883	1.4	85326	17065	85.83
Hapur	17235	21327	1.5	46557	9311	43.66
Modinagar	30005	22270	0.7	35516	7103	31.89
Panipat	31846	34569	1.1	31403	6281	18.17
Sonepat	31857	25722	0.8	54010	10802	42.00
Rohtak	43817	36475	0.8	51027	10205	27.98

The categorywise consumption pattern indicates larger portion of the supply being consumed by industries in the DMA towns. Gurgaon, however, has a large proportion consumed by the domestic sector as well. Less consumption of electricity in this category in Meerut hints at less use of electricity for the large number of SSI units of Meerut.

Table 10
Consumption Pattern for 1993-94

Town	Domestic		Commercial		Industrial		Total
	MKW	%	MKW	%	MKW	%	MKW
Delhi							
Faridabad	2050	18.3	987	8.8	6131	54.7	11210
Gurgaon	5480	45.5	830	6.9	4150	34.4	12050
Ghaziabad	10410	13.7	278	3.7	6020	79.3	7596
NOIDA	6316	17.0	1128	3.0	20310	55.7	37153
Meerut	9875	31.9	8255	26.6	6391	20.6	30983
Bulandshahr	782	32.6	245	10.2	1212	50.6	2397
Hapur	999	23.9	352	8.4	2533	60.6	4178
Modinagar	2993	13.1	326	1.4	13222	58.1	16042
Panipat	5243	32.7	1295	8.1	9251	57.7	16042
Sonepat	4375	43.8	547	5.5	4408	441	10000
Rohtak	7638	55.5	1944	14.1	4080	29.7	13758

The proportion of tariff collected gives an idea of how efficiently cost recovery is managed

The efficiency of the system is judged by the T & D losses. Townwise data explains why in some towns the demand-supply gap is large, or actual use is less. Avoiding T & D losses might help to overcome shortages.

Percentage T & D loss

Meerut	-	39.04
Ghaziabad	-	19.75
Bulandshahr	-	03.26
Hapur	-	09.09
Modinagar	-	19.75
NOIDA	-	08.10
Panipat	-	20.00
Sonipat	-	18.00
Rohtak	-	20.00
Gurgaon	-	N.R.
Faridabad	-	10.00

In Delhi the T & D losses are roughly 20%. The price of electricity is 182 paise/ unit for L.T. supply and 160 paise/ unit for H.T. (11 kv) supply. The per capita consumption norms (1991-92) are 271.4 kwh for domestic, 151.81 kwh for commercial, 150.39 kwh for industrial and 154.30 kwh for street lighting and others. The average total consumption norm is 727.90 kwh.

The NDMC buys electricity from DESU. The rates are 1.65 paise/kwh for 11 kv. The total electricity bought is 756 MW from the 220 kv Northern Grid, through DESU's transmission system. In NDMC the T & D losses are less than 7%.

DESU has classified the consumers in each district into nine groups, called cycles. Cycles 1 to 8 are billed once in two months; while the consumers in cycle 9 are billed every month.

Table 11

Proportion of Tariff Collection: 1993-94

(Rs.lakh)

Town	Demand	Collection	Percent Collected
Delhi	-	837(crores)	-
Faridabad	NR	NR	-
Gurgaon	165	175	106.4
Ghaziabad	NR	14074	-
NOIDA	102 (crores)	102 (crores)	100.00
Meerut	4338	3846	88.7
Bulandshahr	416	315	75.7
Hapur	169	138	82.0
Modinagar	4074	3634	89.2
Panipat	1977	1932	97.8
Sonepat	1251	999	79.8
Rohtak	1754	1738	99.1

Energy:

A study of energy conservation in Delhi, by TERI has come out with very interesting facts about Delhi's energy consumption pattern. For example, energy consumption has shown an increasing trend with rise in household income. This may be due to the use of domestic electrical appliances. End use analysis indicates that 47% is consumed by cooking, 17% by

lighting, 10% by space heating, 5% by water heating, 1% by space cooling and 17% miscellaneous. In lower income categories, space heating is not done. In the higher income category energy used in cooking declines, while that for cooling increases.

The study mentioned that the share of electricity in the domestic sector between 1975-76 to 1991-92 increased from 32% to 41%. During the same period the LPG sales increased from 34 thousand tonnes to 205 thousand tonnes (with an annual growth of 16%). Kerosene sale increased from 75 to 237 thousand tonnes (recording an annual growth of 4%) during the same period.

Table 12

Total Energy Demand in the Domestic Sector of Delhi in 2001

Income Class	Annual per-capita consumption in 1989			Population Distn. %	Population in Delhi Million	Annual total energy demand in 2001			
	LPG Kg	Ker. Kg	Elec. Kwh			LPG '000t	Ker. '000t	Elec. GWh 10^9	Total kCal
I	5.57	32.71	160.96	17	1.70	9.48	55.66	273.91	928
II	10.90	20.01	287.58	38	3.80	41.46	76.10	1093.90	2195
III	27.06	10.71	481.07	38	3.80	102.93	40.73	1829.89	3117
IV	39.50	1.98	652.43	7	0.70	27.68	1.39	457.16	707
All together				100	10.01	181.55	173.88	3654.85	6947

Source: TERI (1994); Energy Conservation Plan for Delhi.

Energy in the transport sector is met by petrol (motor spirit) and diesel oil. To understand the energy consumption in the transportation sector, travel demand in a city needs to be analysed. Urban travel demand depends on three important factors - volume of passenger trips, and size and economic structure of the city. It is also influenced by the length of the trip, which in turn depends on the landuse pattern of the city. Demand for transport is characterised by increasing trip lengths and traffic densities that increase the use of energy through growth of the number of vehicles. Growth of transportation is also estimated by the increase in motor vehicles.

Table 13

Growth and Composition of Motor Vehicles in Delhi

(in thousands)

Vehicle type	1986	1987	1988	1989	1990	1991	Annual growth rate in percent	
							1971-91	1986-91
Cars/Jeeps	202905	241851	279708	332761	383610	427743	10.18	16.09
Motor cycles/ Scooters	746619	867908	978698	1082802	1191186	1294066	13.16	11.63
Auto Rickshaws	40713	45546	51700	57761	62007	65829	9.45	10.09
Taxis	8772	8919	9094	9422	10026	10426	4.77	3.52
Buses	14617	15363	16319	17481	18651	19671	9.39	6.12
Goods vehicles	61860	71168	80412	89568	99078	106052	10.18	11.38
Total	1075486	1250755	1415931	1589795	17645558	1923787	11.87	12.33

Source: TERI (1994); Energy Conservation Plan for Delhi.

Delhi has the largest number of motor vehicles (1.92 million in 1991) among the four metropolitan cities. Various surveys have revealed that residential location, and to a lesser extent income, decides the choice of mode for travel. Hence, trip rate, trip length, modal choice and the like, are important determinants of energy demand for the transportation sector.

Projected Number and Composition of motor vehicles in Delhi during 2001

Table 14

Proportion of Vehicles in Delhi by Types

Vehicle Type	Number of vehicles	% composition
Cars/Jeeps	992156	15.57
Motor cycles/Scooters	4861152	76.28
Auto rickshaws	167022	2.62
Taxis	16877	0.26
Buses	53142	0.83
Goods Vehicles	282767	4.44
Total	6373116	100

Source: Teri (1994); Energy Conservation Plan of Delhi.

The table below is an indicator of the demand for energy for motor vehicles in Delhi. There is a distinct rise in the use of both the fuels from 1983-84.

Table 15
Consumption of Petrol and Diesel in Delhi

Year	Petrol ($10^{3}t$)	High speed diesel ($10^{3}t$)
1973-74	118.60	157.81
1974-75	100.50	187.20
1975-76	99.70	205.40
1976-77	105.30	218.20
1977-78	114.65	263.60
1978-79	124.00	309.00
1980-81	133.00	377.00
1983-84	171.00	449.00
1984-85	187.00	474.00
1985-86	205.00	530.00
1986-87	233.00	621.00
1987-88	260.00	741.00
1988-89	293.00	665.00
1989-90	330.00	718.00
1990-91	344.00	732.00
1991-92	355.00	747.00
1992-93	363.00	810.00
2000-01 (estimated)	670.28	1851.22
Annual growth (%) 1973-74 to 1980-81	1.65	13.25
Annual growth (%) 1980-81 to 1992-93	9.77	14.60

Table 16
Energy Demand for Passenger Transportation in Delhi during 2001

Vehicle type	Energy source	Number of motor vehicles in 2001	Average norms per vehicle as assumed in previous table				Total travel demand (10^9pkm)	Energy demand in 2001	
			Occupancy (passengers)	Vehicle utilisation (km/yr)	Energy consumption (km/lit)	Operating energy intensity (km/lit)		(10^6 lit)	(10^3t)
Cars/Jeeps	Petrol	744117	2.6	9855.00	12	31.20	19.07	611.11	427.77
Cars/Jeeps	Diesel	248039	2.6	9855.00	12	31.20	6.36	203.70	173.15
Motor cycles/ scooters	Petrol	4861152	1.5	4927.50	45	67.50	35.93	532.30	372.61
Auto rickshaws	Petrol	167022	1.76	33488.75	25	44.00	9.84	223.73	156.61
Taxis	Petrol	12657	1.57	31025.00	9	14.13	0.62	43.63	30.54
Taxis	Diesel	4219	1.57	31025.00	9	14.13	0.21	14.54	12.36
Buses	Diesel	53142	44.72	82500.00	3.5	156.52	196.06	1252.64	1064.74
							Total Petrol Total Diesel	1410.77 1470.89	987.54 1250.25

Source: TERI (1994); Energy Conservation Plan for Delhi.

In the commercial sector energy consumption pattern is decided by the plinth area. Urbanisation leads to commercial growth, which in turn demands electricity. The average electricity consumption is the highest in textile shops, followed by those dealing in building materials, restaurants and auto parts. The total annual demand of electricity for lighting in Delhi shops is estimated at 963.92 GWh for 1991. This figure works out to approximately 10.65% of the total electricity supply for the city (Teri: 1994).

Energy consumed in industries are coal, coke, firewood, charcoal, aviation and motor spirit, diesel oil and fuel oils. While the use of all the other oils are on the decrease, electricity consumption is also on the increase.

Concluding Remarks:

Use of energy is a function of population size and economic activities. The size of population directly influences domestic consumption the quantity of fuel used for intra-city transportation and commercial use of energy. Economic activities, on the other hand, influences the quantity of power used in the industries. Infrastructure such as railways use plenty of energy as well. Goods transportation is yet another major consumer of energy. A closer look at the population, economic activities, transportation etc. will help to assess the demand of energy -- which then will have to be produced and distributed. However, to assess the demand, so that the need can be met with supply, detailed data is required.

Appendix

'DELHI ELECTRIC SUPPLY UNDERTAKING'

Statement Indicating Demand/Availability of Power in Delhi During VIII, IX & Xth Plans

Description	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
1. Maximum demand as power survey (MW)	2145	2334	2532	2739	2955	3179	3411	3650	3894	4143	4395	4649	4905	5159	5412	5660
2. Availability of Power																
2.1 DESU's own sources at IP Stn./RPH/GTs	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450
2.2 BTPS	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
2.3 Waste heat recovery unit	-	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
2.4 Combined cycle project at Bawana	-	-	450	450	450	450	450	450	450	450	450	450	450	450	450	450
Sub-total (2)	950	1502	1502	1502	1502	1502	1502	1502	1502	1502	1502	1502	1502	1502	1502	1502
3. Allocated Share in central stations																
3.1 Baira-suil	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
3.2 Singrauli	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
3.3 Salal-I (H)	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
3.4 NCR(T)	756	756	756	756	756	756	756	756	756	756	756	756	756	756	756	756
3.5 Tanakpur (H)	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
3.6 Rihand	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
3.7 Napp (N)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
3.8 Anta (G)	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
3.9 Auriya (G)	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
3.10 Dadri (GT)	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90

Description		1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
3.11	Salal-II(H)	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38
3.12	Unchahar-I & II	45	45	45	90	90	90	90	90	90	90	90	90	90	90	90	90
3.13	Chamira (H)	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
3.14	Rapp-III (N)	-	-	-	-	-	47	47	47	47	47	47	47	47	47	47	47
3.15	URI (H)	-	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
3.16	Dulhati	-	-	-	-	40	40	40	40	40	40	40	40	40	40	40	40
3.17	Faridabad (CT)	-	-	-	-	82	82	82	82	82	82	82	82	82	82	82	82
3.18	Tehri	-	-	-	-	-	79	79	79	79	79	79	79	79	79	79	79
3.19	Rihand (STPS)	-	-	-	-	-	108	108	108	108	108	108	108	108	108	108	108
3.20	Nathpajhari	-	-	-	-	-	-	118	118	118	118	118	118	118	118	118	118
3.21	Parbati Hydro	-	-	-	-	-	-	-	-	-	120	120	120	120	120	120	120
Sub Total (3)		1466	1516	1561	1561	1730	1717	2035	2035	2035	2155	2155	2155	2155	2155	2155	2155
Total Availability (2 + 3)		2416	2568	3063	3232	3419	3537	3537	3537	3537	3657	3657	3657	3657	3657	3657	3657
Deficit/surplus (1 - 4)		+271	+234	+531	+324	+277	+240	+126	-113	-357	-486	-738	-992	-1248	-1509	-1755	-2003

CHAPTER 8

RELATIVE CARRYING CAPACITIES OF GROWTH CENTRES ACROSS THE NCR

1 Within the limitations of the available information base, it has not been possible to date to measure all the above outlined carrying capacity indicators.* Also, a complete comparison among the cities in term of the measured indicators has not been possible to date due to non-availability of some information for several cities. Nevertheless, a fair assessment of the relative carrying capacities and growth potential of major cities of NCR may be provided through the Table 1 . This profile of carrying capacities of the major urban centres may be examined in the context of various planning goals or objectives as discussed,* specifically the goals of the Regional Plan - 2001 of the NCR.[1]

2 An interesting point that may emerge from this comparative analysis relates to the relative carrying capacities of Delhi vis-a-vis the other centres where growth has been invisaged for the purpose of decentralisation of the capital city. Delhi appears to have superior carrying capacities to many of these envisaged growth centres in respect of several indicators.

2.1 In terms of land resources:

- The potential urbanisable land availability in NCT. Delhi is far greater than those in the entire tehsils around most cities, excepting Alwar, Gurgaon and Rohtak.

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[1] * See CHAPTER 1

RELATIVE CARRYING CAPACITIES OF CLASS-I CITIES: A COMPARATIVE EVALUATION OF VARIOUS INDICES

INDICES	NCT DELHI	U.P. SUB-REGION					HARYANA SUB-REGION			RAJASTHAN SUB-REGION		
		NOIDA	GHAZIABAD	BULANDSHAHR	HAPUR	MODINAGAR	MEERUT	FARIDABAD	GURGAON	SONIPAT	PANIPAT	ROHTAK	ALWAR
DEMOGRAPHY													
1. Population	8471625 (NCT Urban)	146514 (Noida C.T.)	511759 (Ghaz.U.A.)	127201 (Bshr.M.B.)	146232 (Hapur M.B.)	123279 (M.ngr.U.A.)	849759 (Meerut U.A.)	617717 (F.bad C.A.)	135884 (G'gaon U.A.)	143922 (S'pat M.C.)	191212 (P'pat M.C.)	216936 (Rtak Mc-C.)	210146 ('(Alwar U.A.)
2. Density													
a. Gross Density	12361.20	1620.19	6856.36	10316.36	10000.14	5664.44	4785.44	1732.82	5631.33	5081.99	9184.05	7614.38	3615.10
b. Without Rural and Institutional Housing	14320.57	1620.19	7180.07	10316.36	10000.14	5664.44	5312.41		7924.72	5081.99	9184.05	7614.38	4237.31
3. Population Growth Rate													
ECONOMY													
4. Industrial development Prospect	LOW	VERY HIGH	MODERATE/ HIGH	LOW	LOW	MODERATE	MODERATE	HIGH	VERY HIGH	MODERATE	MODERATE	MODERATE	ALWAR
INFRASTRUCTURE													
A. URBAN LAND RESOURCE													
5. Potential Urbanizable Land in Tehsil (Ha) ("waste" & "rocky" lands)	11621.98		1603.14	549.77	648.22		171.22	4517.57	21979.32	6001.84	8081.48	14877.05	48355.04
6. District wise Urban Land-Man Ratio(settlement+transportation land Hectares/1000 persons)	8.07		15.15	8.51			8.42	9.47	10.37	12.1	6.21	8.4	5.32
7. City Land-Man Ratio (Hectares/1000 persons)	15.78	61.72	14.58	9.69	9.71	16.99	20.89	58.07	17.76	19.67	10.89	13.13	27.66
8. Additional Holding Capacities (1991-2001) (As per Regional Plan Density Norm)		983861 671.51%	421241 82.31%	26924 21.17%	9938 6.79%	136593 112.43%	1368651 161.21%	3841922 625.90%	165741 121.97%	210078 145.97%	69038 36.11%	96084 44.46%	429284 204.28%
9. Urban Land Price Residsential (Rs./Sq.Mt.)		1200	1200	700	800		850	1000	1050			1250	1250
B. TRANSPORTATION													
10. Access Time (Minutes by Car)													
a. To Delhi		20	24	72	49	47	75	34	31	83	110	83	154
b. Other NCR Cities(cum.tv)		889	801	1223	977	985	1201	1001	972	1352	1583	1382	2189
11. Nodality	HIGHEST	HIGH	HIGH	LOW	MODERATE	MODERATE	MODERATE	HIGH	MODERATE	MODERATE	LOW	LOW	LOWEST
12. Regional Bus Service (No. of Daily Trips)	4001*		725	199	292	192	984		834	1070	746	451	397
13. District Road Density													
a. K.mrs./Sq.Km.	12.86		0.75	0.44				0.53	0.56	0.47		0.38	0.22
b. K.mrs./1000 Persons	2.03		0.7	0.67				0.78	1.35	1.35		0.88	0.8
14. City Road Density													
a. K.mrs./Sq.K.mrs.		18.18	3.78	18.99	26.52		5.14	5.05	8.74	2.95	9.02	5.38	3.27
b. K.mrs./1000 Persons		2.73	0.54	1.45	1.21		1.35	1.45	1.55	0.43	0.98	0.69	0.9
15. District Motor Vehicle Density													
a. No./K.m.Road	91.03		19.83	17.4				106.09	20.03	40.1	34.68	25.94	14.74
b. No/1000 Persons	208.37		14.16	11.72			37.79	85.74	29.47	41.75	42.89	28.92	11.87
16. Traffic Accident Rate (Total/1000 Persons)	0.86	1.17						0.64	0.55	0.25	0.89	0.55	
C. SHELTER													
17. Housing Shortage Index	958	965	919	882	940	972	943	965	968	966	968	975	969
18. Housing Condition- % Pucca Houses	86.49	82.17	86.05	43.39	76.99		79.22	81.87	94.41	64.89	63.59	72.62	92.77
19. Slums - % Population	21.38			67.08	31.83	34.93	17.85	24.28	25.89	37.53	16.42	23.61	
D. SOCIAL AMENITIES													
20. Pr. School/1000 pop.	0.21							0.13	0.28	0.17	0.15	0.24	0.35
21. Sc. School/1000 Pop.	0.29							0.21	0.45	0.43	0.16	0.3	0.24
22. HS School/10,000 pop.	0.8							0.4	0.5	0.8	0.3	0.5	0.4
23.Gen. Colleges/lakh Pop.	0.62							0.64	1.64	2.77	1.56	4.62	1.95
24. Other Inst./lakh pop.	1.44							0.69	3.14	1.65	0	5.5	1.46
25. Cultural Fac./Lakh Pop.													
26. Medical Beds/Lakh Pop.	2.03							0.76	1.24	0.91	1.01	6.64	2.55
E. WATER SUPPLY													
27. Ground Water Resource Balanct Potential in Dist. MCM/Y	-60.33		309.11	471.05			792	243.86	75.47	314.38	-19.2	543.52	170.2
28. Water Supply Coverage													
a. Area		100%	100%	75%	80%		85%	80%	90%		65%	60%	75%
b. Population		100%	100%	65%	75%		75%	90%	90%		75%	80%	70%
29. Per Capita Supply (lpcd)		488	152	182	7		102	147	135		128	105	86
30. Proposals/Schemes		YES	YES	NIL	NIL		YES	YES	YES	NIL	NIL	NIL	YES
E. SANITATION													
31. Sewerage Coverage Area MLD		100	70		15		40	60	40		60	40	
Population		100	85		15		47	70	40		25	40	
32. Sewage Treatment		80MGD	NIL	NO UGD	AGRIC.DISP		NIL	NIL	NIL		NIL	NIL	NO UGD
33. Solid Waste Collection/Population (gms.)		477	573	39	171		285	243	147		131	116	0.37
34. Proposals/Schemes		NIL	NIL	NIL	PUMPING		PUMPING RENEWAL		NEW 30 MGD		NEW 30 MLD	NIL	NIL
F. POWER													
35. Consumption (District)	7687		1924	872			1264	958	279	282	609	309	685
36. Peak Demand (District)	1350		421	175			241	192	56	53	118	68	130
37. Blackouts/Restrictions		YES 5 HRS.	5 HRS.	4 HRS.			3 HRS. 4 HRS.		NO		3 HRS. IND.	YES	4 HRS.SEASONAL
G. TELECOMMUNICATION													
38. Telephone Use Density	13	14	19	79	49		44	23	27		38	27	48
INSTITUTIONAL CAPACITY													
39. Municip. Income per Capita	4788.65 383.22		81.49	94.05	75.65			204.82	128.4	133.65	142.22	118.16	121.98
POLLUTION STRESS													
40. Local Air Pollution	Mod.High	Moderate	High	Low	Low		Moderate Low	Moderate	Low	High	Low	Moderate Low	Low

*only DTC buses

Even in Alwar and to some extent Gurgaon, much of these unused rocky/waste lands may be actually hilly lands which may either pose barrier to urban growth or may be able to accommodate only very low density growth.

- The land-man ratio of Delhi, U.A. is more than those across the so-called "priority" towns of the Regional Plan, with the exception of Meerut and Alwar.

2.2 In the trasnportation and communication sectors:

- Delhi enjoys the highest nodality among cities of the region, being in the hub of the Delhi focussed highway and railway networks in the region. Pancity in orbital links in the network as well as Delhi's primacy and nodality has; however, increased the volume of traffic and congestion over time in the various highway approaches to and fro other centres.
- But at the same time, the frequency of regional bus service generated in Delhi is far greater than those from all other major cities.
- Furthermore, no other cities in the region can match anywhere near the amounts of road densities Delhi enjoys.

The stresses in the urban transportation and communication infrastructure capacity in Delhi compared to other centres are particularly in term of the high vehicular densities in relation to both population size and the extent of road network, the high traffic accident rate and the low density of telephone facilities. Interestingly, however, the accident rate in Delhi is less than those of the DMA city of Noida and the priority city of Panipat.

2.3 In term of housing situation:

- Delhi ranks sixth among the 13 cities in terms of housing index (indicative of housing shortage) and is better off than the priority cities of Bulandshahr, Hapur and Meerut and the DMA city of Ghaziabad.
- Slum condition in terms of the percentage of population living in notified slums is far worse in the priority and other outlying cities of Bulandshahr, Hapur , Modinagar, Sonipat and Rohtak as well as in the DMA cities of Gurgaon and Faridabad than in Delhi. In other words, the proportion of slum population in Delhi is among the least across the cities (information on Noida, Ghaziabad and Alwar are not available).
- Also, the general housing condition, in terms of the proportion of "pucca" houses in the available stock is better in Delhi than in most other cities.
- The relative levels of various social amenities are not comparable in the absence of current information for all the U.P. Cities. However, on account of its primacy, Delhi enjoys a wider range of higher level or specialised educational and cultural facilities than most cities. The density of medical beds is also higher than others, excepting Rohtak and Alwar.

2.4 In term of Water Supply:

Sanitation:

Power/Energy:

Institutional Capacity:

2.5 Delhi's local air pollution stress in term of the level of different pollutants emmitted from the area, point and line sources is moderately high compared to other urban areas. It is however lower than those in Ghaziabad and Gurgaon areas.

3. The next level of comparison may be made between the DMA area and the more outlying areas of the NCR in terms of the relative carrying capacities or growth potentials of cities in the respective areas, specifically, between the DMA cities and the "priority" cities of the Regional Plan.

- One of the most critical issue this comparison may bring forth is that the cities closer to Delhi and forming a ring around it, i.e., the DMA cities together with Sonipat have greater capacities to absorb future population than the remote or outlying cities, i.e., the so called "priority" cities of growth, together with Modinagar in terms of (1) their existing land-man ratios, (2) the density norms for individual cities as proposed in the Regional Plan - 2001 which indicate the additional population holding capacities of these cities and (3) the potential urbanisable lands in the tchsils of these cities (if the large amount of rock or hilly lands of Alwar are ignored).
- The nodalities of the DMA, cities, (especially Noida, Ghaziabad and Faridabad) with reference to all major urban centres of the region, assessed on the basis of their cummulative road travel times to and fro, and the

levels of highway access and interconnections are higher than those of the outlying cities. Furthermore, a superior orbital link in the form of a express - way exists connecting the most important industrial growth centres of the region, viz., Faridabad, Noida and Ghaziabad. Railway loop links of G.A.L. and D.A.L. further augments the goods accessibility among these DMA cities.

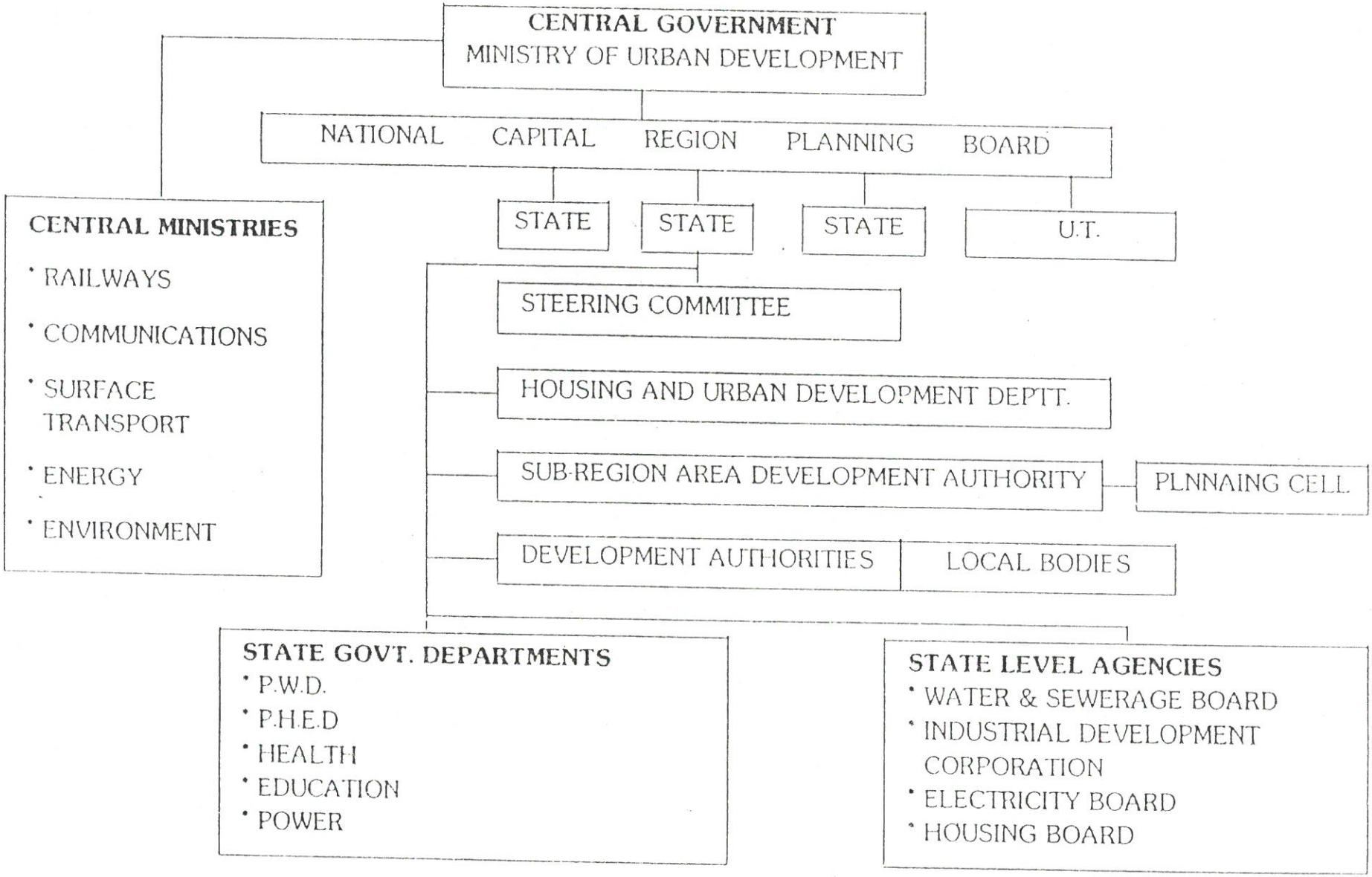
- In terms of the capacities of internal road networks of the cities, as indicated by their respective road densities as well as the relative planned nature of such networks the DMA cities of Noida, Gurgaon and Faridabad, which are also the major industrial centres of the region, are superior to the most priority cities, especially where the typical unplanned and measured road systems of the latter cities (such as Hapur and Bulandhshahr) are considered. Ghaziabad and Sonipat, however, suffers relatively in terms of density of road networks.
- Future industrial prospects are far better in the DMA, especially in Gurgaon and Noida, than the outlying cities in general in terms of both the prevailing structure measured through scale, employment, value added and output and future initiatives, such as the proposed mega projects.
- Definite comparison between the two areas (DMA AND Outlying) is difficult to draw, in terms of the shelter

conditions of the cities. The DMA city of Gurgaon, however, is superior to all other cities in terms of housing index and the percentage of pucca housing. The slums population here is also moderate. On the other hand, the most of outlying priority city of Alwar has better shelter condition than most other cities. The priority city of Bulandshahr has clearly the worst housing condition, having the lowest housing index as well as pucca housing and with highest level of slum population, Hapur and Meerut also have poorer shelter condition than most DMA cities excepting Ghaziabad and possibly Sonipat.

- The DMA cities (not considering Sonipat) have clearly better water supply infrastructure than the priority cities in terms of coverage of area and population as well as levels of supply. Noida, especially is far superior to other cities, especially in terms of level of per-capita supply. Hapur and Alwar has the worst water supply condition.
- Also, in terms of sanitation, the DMA cities, especially Noida, Ghaziabad and Faridabad are better than the priority cities.
- The air pollution stress, however, appears to be higher in the DMA region than in the areas of the outlying priority towns. The obvious reason in the much higher level of industrialisation across the DMA.

4 While the relatively superior carrying capacities of Delhi and the DMA cities, in terms of various major indicators, might be apparent from the above discussion, a comparison among the outlying cities (six priority cities and Modinagar) tends to reveal that Meerut has better capacities or growth potential than others in the group. Although Alwar has a slight edge over Meerut in terms of land resources, density and shelter condition, Meerut is far superior to Alwar in term of nodality and accessibility and also better in term of internal road capacities, water supply, sanitation and power. In respect of the above indicator as well as in term of additional population holding capacity, density and land-man ratio Meerut is superior also to the rest priority cities.

FIG 1: **Proposed Organisational Structure For Implementation**



Source: NCR PLAN

CHAPTER 9

INSTITUTIONAL SET-UP

The NCR Planning Board, while preparing the Regional Plan realised that for successful implementation of the Plan suitable institutional arrangements will be necessary at all levels of administration (NCR Regional Plan 2001, 1988: 116). It reviewed the then existing planning and implementation arrangements and made an observation that such arrangements were varied across the three participating States and the Union Territory of Delhi (now National Capital Territory of Delhi), and the same were not fully compatible to integrate developments among the concerned sub-regions at the field level, which encompass both rural and urban areas (ibid,p.116).

The main issue, according to NCRPB, is dovetailing the planning and development of the rural and the urban areas. To quote the plan:

The concept of the development of the NCR goes beyond the limited applicability on the urban areas and, has to integrate and harmonise the development of the rural areas also. It is a fact that a number of agencies, such as Zila Parishads, Panchayat Samities, Panchayats, cooperative bodies, in addition to the official agencies of the government, are operating in the rural areas. Since an integrated approach is crucial for the development of the Region, it is of utmost necessity that a suitable

organisation be set up at the sub-regional level which would have jurisdiction for planning in the entire sub-region, and an overseeing role in the implementation of the NCR objectives and policies. It would be necessary at the sub-regional level to have one plan for the entire sub-region consisting of resources from the NCR Planning Board and the regular schemes of the State Plan (p.117).

In consideration of the aforesaid, NCRPB proposed a *Management Structure for Plan Implementation*. It also appended a chart (as given below) entitled *Proposed Organisational Structure for Implementation* (ibid, p.120). NCRPB suggested that the Ministry of Urban Development (Central Government) would lead the organisational structure that would implement the central schemes with the help of other Central Ministries vis. Railways, Communication, Surface Transport, Energy and Environment. For the enforcement and implementation of the regional plan, functional plans, sub-regional plans and project plans through the participating states and the (then) Union Territory and to arrange for, and oversee the financing of selected development projects in the NCR through 'Central Old State Plans' funds and other sources of revenue, the NCRPB comes directly under the MUD - GOI (Ministry of Urban Development of the Govt. of India. Every state had to have a steering committee, Housing and Urban Developmental Department and a Planning Cell. A sub-regional Area Development Authority is recommended as the overall development agency for each of the three member states i.e. Haryana, Rajasthan and Uttar

Pradesh, at the sub-regional level. In addition, there ought to be a separate Town Development Authority for implementation of the respective township master plans and concomitant physical plans or township development projects (Noronah, 1994: 24), failing which the task should be performed by the local bodies. State Government Departments of P.W.D., P.H.E.D., Health, Education and Power and State level agencies of Water & Sewerage Board, Industrial Development Corporation, Electricity Boards and Housing Boards were also proposed as part of the Organisational Structure for each state.

NCR Planning Board

To achieve the objectives of the regional plan, the NCRPB has been made the apex level planning, coordinating, implementing and monitoring body in the entire set-up of the Organisational Structure. Union Minister of Urban Development is the Chairman of the Board with 20 members and 5 co-opted members. Member secretary of NCRPB is its Chief Executive. NCRPB has four divisions which are: Planning, Finance, Project Monitoring and Administration. With the technical and support staff it carries out the functions assigned to it.

Existing Institutional Set-up

Presently, each constituent state has a steering committee headed by the Chief Secretary of the State, and the Secretaries of the different departments as members. The functions of the steering committee are to establish the required coordination at

state level and to decide on critical issues vis-a-vis the implementation of plan and projects. Every state has a Ministry related to Housing and Urban Development. Further the Sub-Region Area Development Authority (SRADA) finds multifaceted manifestation in different states. In Haryana, "NCRPB provides Financial Assistance.....This is availed by HUDA (Haryana Urban Development Agency) for implementing the Development Schemes in NCR Towns" (Basti (1990):3). HUDA acts as the SRADA for Haryana, though it caters to urban development only. For rural areas District Rural Development Agency (DRDA) function at district level for all the districts within the sub-region. For the development of Mewat Backward Region, Mewat Development Board (MDB) formulates policies as the apex body with its executive wing the Mewat Development Agency (MDA) performing the development task at the gross-root level in five blocks of Gurgaon and one block of Faridabad district. Preparation of Development Plans for selected villages has been taken up by Town & Country Planning Department (ibid, p.4).

Meerut Urban Development Authority (MUDA), Bulandshahr Urban development Authority (BUDA) and Ghaziabad Development Authority (GDA) collectively form the SRADA for Uttar Pradesh. Development of NOIDA Industrial Township is undertaken by New Okhla Industrial Development Authority (NOIDA) that has been set up under the Industrial Development Act of that state.

In the Rajasthan Sub-region, the State Government has presently extended the scope of the Urban Improvement Trust of Alwar that now acts as SRADA to include development of Bhiwadi, one of the identified priority towns". But NCRPB has accepted the limitations of this arrangement (NCR Plan 2001, 1988: 117). Again, the real development is catered by DRDAs only in both Uttar Pradesh and Rajasthan.

Planning Cell:

Haryana, Rajasthan and Uttar Pradesh have Planning Cells to carry out the preparation of the sub-regional plans, functional plans, project plans etc. and provide the necessary information to the NCRPB for preparation of its plans. Functions of the Planning Cell include:

- monitoring and coordination of the progress made in the implementation of development projects;
- scrutinize the projects prepared by implementing agencies e.g. HUDA in Haryana in relation to: their financial viability, their consonance to the Master Plan of the city/town in question and the objectives of the NCR Regional Plan.

The Planning Cells are headed by Chief Coordinators of Planning, with necessary technical and support staff. Planning Cell for Delhi that prepared the sub-regional plan for the city, has been withdrawn, as the Delhi Development Authority (DDA) has been focusing on the dispersal of population and development through the Master Plan for Delhi 2001.

Local bodies have yet to take up the task of development with their responsibility being emphasized especially after the enactment of 73rd and 74th Constitutional (Amendment) Acts of 1992. As state government departments and state level agencies work in a stereotyped manner, the Central Ministries have also not been able to coordinate their own sectoral plans and programmes with the Ministry of Urban Development (now Ministry of Urban Affairs and Employment) and the NCRPB. Noronah (1994) says "as the various Ministries/Deptt. of the Central Government, mainly those of surface Transport, Railways, Power and Communications, will be responsible for providing the necessary major infrastructural facilities pertaining to their respective sectors in the Eighth Plan period, it is envisaged that separate sub-component plans would need to be drawn up by each of these Ministries/Deptts. to facilitate monitoring of these schemes in the Central sector of the NCR investment programme during the Eighth Plan period".

Financial Mechanisms:

Suitable monitoring systems were proposed to be developed to help NCRPB to arrange for, and oversee the financing of selected development projects in the NCR through the Centre and the State Plan funds and other sources of revenue. "In case of projects with financial assistance of the NCR Planning Board, it is proposed that each implementing agency/organisation would have the following institutional arrangement" (NCR Plan 2001, 1988: 118):

i. Within the Implementing Agencies in participating states: Creation of a Programme Monitoring Unit (PMU) which would be responsible for monitoring of programmes of the agency/organisation including projects funded by NCR Planning Board. This Unit will monitor the achievement of the overall goals of the sectoral programmes and also physical and financial progress of industrial projects funded by all sources, including NCR Planning Board. This unit will submit a quarterly progress report to be evaluated by the Planning Cells (in the Town and Country Planning Department) of the State Government and finally to the NCR Planning Board for review by the Project Sanctioning and Monitoring Group of the Board.

ii. In Central Ministries: In case of NCR projects to be implemented by Central Ministries, progress reports on quarterly basis will be made available to the NCR Planning Board secretariat for review by Project Sanctioning and Monitoring Group of the Board.

iii. For monitoring of projects of both State and Central Schemes, a Project appraisal monitoring and evaluation system will be developed in the NCR Planning Board (ibid, pp.118-119).

Existing Situation:

Notwithstanding the amount of funds spent till date and in order to trigger the large-scale development in NCR within the

limited time left before the dawn of 2001 AD, the approved strategy provides that the entire central budgetary support of Rs. 2000 million in Eighth Five Year Plan should be matched by proportionate grants (now the ratio is 75:25 by central & state sector) from the member state/ NCT governments and the resultant endowment of Rs. 4000 million utilised as "seed money" to raise additional resources through a judicious mix of public and private sector borrowings and other capital mobilisation schemes. With this in view alternative approaches and specific options are under active consideration, such as:

- floating a dedicated financial institution for the Nation Capital Region at the apex level which would be in a position to perform these functions on sound professional lines. This company, which would have an equity base consisting of the aforesaid seed money of Rs.4000 million would have to raise loan finance in the ratio of 1:3 in order to finance the entire State Sector investment programme on development of new townships as well as sub-regional centres and counter-magnet areas (a feasibility study commissioned by NCR Planning Board has established that this would be the most viable and effective mode for financing the total Eighth Plan investment programme for NCR, particularly if its day-to-day management is entrusted to promote corporate sector as in the case of HDFC and ILFS);

- the formation of 3 separate infrastructural development financial companies at the sub-regional level which can utilise proportionate seed money to be provided by the NCR Planning Board out of its Central Plan assistance of Rs. 4000 million and the corresponding matching contribution of the respective State governments in order to raise additional equity/loan assistance of the order of 1:3 so as to finance the respective sub-regional development programmes for new townships, etc. as per the approved Eighth Plan programme of NCR (ibid, pp.24-25).

In view of the aforesaid, one has to wait and see what comes out in course of time, but then the mechanism of the flow of funds is to be studied. The process is as under:

The Planning Cell of the constituent states can ask the Implementing Agencies or the latter also on their own can formulate development projects to utilise the NCR Plan funds. These projects are submitted to the Planning Cell of the respective State that scrutinizes them in relation to financial viability, their consonance with the town/city Master Plan and with the objectives of NCR Plan. If necessary, the Planning Cell can modify/modulate make desired changes and send them to NCRPB through the State Government. If NCRPB finds the project apposite, it releases funds to the state government. The funds can be given directly to the Implementing Agency provided the State Government gives a

declaration that the amount has been spent for the development of the project.

Monitoring Mechanism:

- Project Monitoring Group of NCRPB:

A Project Monitoring Group (PMG) has been set-up recently within NCRPB headed by a Deputy Director and supported by an Assistant Director and a Junior Accounts Officer. The function of the PMG is to scrutinise the development projects sent by the State Governments vis-a-vis the objectives of the NCR Plan.

- Programme Monitoring Units (PMUs) of Implementing Agencies:

PMUs exist in the three states that are within the Planning Cell and they perform the duties and functions entrusted to them.

- Project Sanctioning and Monitoring Group (PSMG):

A PSMG is set-up in the Planning Board that is headed by Secretary, Ministry of Urban Development. Others that constitute PSMG are member Secretary of NCRPB, (who is a Joint Secretary of the GOI), Joint Secretary Finance, Ministry of Urban development -GOI and concerned Secretaries of the Urban

development Ministry/Deptts. of the states. All major decisions regarding sanctioning and monitoring of project are taken by PSMG.

- Progress Reports from Central Ministries:

Contrary to the proposal, no project progress reports quarterly or any basis, are made available to the NCR Planning Board for review by the PSMG.

- Project Appraisal, Monitoring and Evaluation System:

The proposed Project Appraisal, Monitoring and Evaluation System has not been developed for monitoring of projects both for the State and Central Schemes till date.

Suitable Scientific Systems:

With regard to land use and Environmental aspects, the Plan proposed that "suitable Scientific Systems" would be developed within the Secretariat of the NCRPB for monitoring of major developmental activities like:

- Landuse - through sequential/periodical aerial photographs/satellite imageries, to evaluate persistent trends of landuse over a period of time and monitor unauthorised developments and to detect growth trends of urban areas for review by the Planning Committee and the NCR Planning Board.

- Environmental - through the constitution of a Joint Committee represented by the respective constituent State Pollution Control Board, Central Pollution Control Board and the NCR Planning Board, to be reviewed by the Planning Committee and the NCR Planning Board (NCR Plan 2001, 1988: 119).

On the practical side of the picture today, NCRPB has been developing a system with the help of GIS to process geographical information about unauthorised development and upto date urban spread.

The Environmental aspect has not been death with so far.

Managerial Resources:

Nothing has been mentioned in the name of "Managerial Resources" in the Plan except the fact that the aforesaid provisions are proposed in a chapter entitled "Management Structure for Plan Implementation".