PLANNING PROPOSALS FOR WATER SUPPLY OF U.P. SUB REGION OF NCR

A DISSERTATION

Submitted in partial fulfilment of the requirements for the award of the degree of

MASTER OF URBAN AND RURAL PLANNING

By

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CANDIDATE'S DECLARATION

I hereby certify that the work, which is being presented in the dissertation, entitled **"PLANNING PROPOSALS FOR WATER SUPPLY OF U.P. SUB REGION OF NCR"**, in partial fulfillment of the requirement for the award of the Degree of MASTER OF URBAN AND RURAL PLANNING submitted in the Department of *Architecture and Planning, Indian Institute of Technology - Roorkee*, is an authentic record of my own work carried out during the period from May 2006 to June 2007 under the supervision of **Prof. R. K. Jain**, Associate Professor, Department of Architecture and Planning, Indian Institute of Technology - Roorkee.

The matter embodied in this dissertation has not been submitted by me for the award of any other Degree.

Place: Roorkee
Dated: June 29 2007

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This is to certify that the above statement made by the candidate **Mr. Matinder Kumar** is correct to the best of my knowledge.

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ABSTRACT

The world is becoming more and more urban with passage of each century. India is no exception to this phenomenon and has experienced rapid urbanization during the last five decades. According to the census 2001, India has a population of 102.86 crores, of which the share of urban population is 28.61 crores. Of the total urban population, 38% is accounted in 35 metropolitan centers. Four mega cities, Mumbai, Kolkata, Delhi and Chennai together account for more than 17% and about 4.5% reside in NCT-Delhi. To check explosive rate of population, a regional was selected named National Capital Region constituting NCT – Delhi, seven districts of Haryana, five districts of Uttar Pradesh and one district of Rajasthan, ensuring the balanced and harmonized development of Delhi and its surrounding areas. Under this regional plan was prepared with detailed Sub – regional Plans, prepared by respective State.

The growth in urban population is a positive feature of economic development particularly as the combined contribution of services and industry to gross domestic product is significantly higher than that of agriculture. The growth has been so rapid and uncontrolled that urban planning and investment in infrastructure has proved to be insufficient, for example the demand for water and sanitation services is growing faster than cities can supply. The inadequate access to potable water and sanitation facility is assuming serious proportions and a major threat to public health.

Though in U.P. Sub region of NCR, water situation is much better than other Sub regions but as per current trend, the water levels in Meerut, Bulandshahr and Ghaziabad districts of U.P. had declined by 0.15 to 2.50 meters during this decade up to 1995 and continue decreasing. The main problem is in urban areas where is

population density is much more than average and ground water sources are not sufficient to fulfill present water demand. As per the study done here, block wise water availability and demand is calculated which shows that few block would come under over – exploited zone where demand exceed than water availability. As per the study, it is analyzed that in U.P. Sub region the main source of drinking water is ground water and over exploitation of ground water is continue without any hindrance. There is no account of privately owned tube wells and exact figure of ground water extraction is still unknown. The over exploitation of ground water is again causing degradation of water quality.

Hence there is urgent need to step ahead for providing adequate amount of water supply, through proper channel having equal utilization of surface water sources as well as check on privately owned tube wells so as to control the use of ground water.

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CHAPTER 1

INTRODUCTION

1.1 Urbanisation Trend

The world is becoming more and more urban with passage of each century. India is no exception to this phenomenon and has experienced rapid urbanisation during the last five decades. The pattern of urbanisation in India, in terms of pace and spread has wide variations among the states in the country. The urban population of 109 million spread over 2590 urban centres in 1971 has increased to 286 million in over 5,161 urban centres in 2001. The level of urbanisation during the same period has increased continuously from 19.9 per cent in 1951 to 27.8 per cent in 2001. According to the census 2001, India has a population of 102.86 crores, of which the share of urban population is 28.61 crores. The urban share increased from 23.33% in 1981 to 25.72% in 1991 and 27.81% in 2001. Of the total urban population, 38% is accounted in 35 metropolitan centers. Four mega cities: Mumbai, Kolkata, Delhi and Chennai together account for more than 17% and about 4.5% reside in NCT-Delhi.

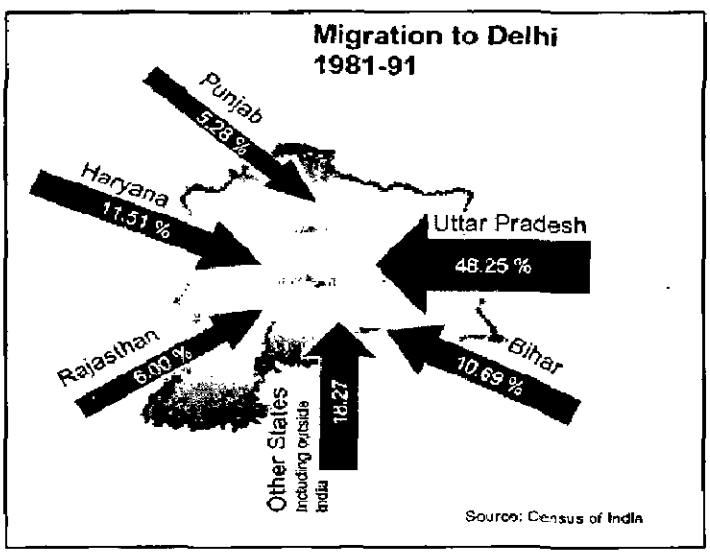


Fig 1.1 Share of Migration of different states to Delhi

1.2 National Capital Region

To check the explosive rate of growth in Delhi's population some efforts were made in the past

through planned Development but all efforts has been in vain because no concerted efforts had been taken in the regional context. The need for regional approach was felt as early in 1959 when the Draft Master Plan for Delhi was prepared. Later on Master Plan of 1962 recommended that a statutory "National Capital Region Planning Board" should be set up for ensuring the balanced and harmonized development of Delhi and its surrounding areas. The statutory organization called "National Capital Region Planning Board" was set up in March, 1985 to plan and promote the balanced and harmonized development of region. The burgeoning pressure of migrated people has heavily stained the infrastructural facilities and resources of Delhi. Therefore it was felt necessary to invest in selected settlements outside the Delhi Metropolis at appropriate distance to relieve the mother city-Delhi from present pressure. This ultimately led to constitution of *National Capital Region with* the help of neighbouring states of Haryana, Rajasthan and Uttar Pradesh. National Capital Region covers an area of 30,242 sq. kms. as per Regional Plan – 2001 of NCR which has increased to 33,578 sq. kms. as per Regional plan, 2021 of NCR.

Map 1.1 National Capital showing its constituent areas

1.2.1. Constituent Areas

The National Capital Region comprising of the following:

a) National Capital Territory of Delhi (1,483 sq. km.)

b) Haryana Sub-region (13,413 sq. km.) comprising of Faridabad,

Gurgaon, Rohtak, Sonepat, Rewari, Jhajjar and Panipat districts.

c) Rajasthan Sub-region (7,829 sq. km.) comprising of whole of Alwar District.

d) Uttar Pradesh Sub-region (10,853 sq. km.) comprising of Meerut, Ghaziabad, Gautam Budh Nagar, Bulandshahr and Baghpat districts.

1.3 The Regional Plan

To achieve basic objectives of balanced and harmonise development, Regional plan-2001 of NCR was prepared. This plan suggested some strategies and programmes related to different sectors to achieve the basic objective of balanced and harmonized development of region. But policy of regional plan 2001 of NCR failed to control the mushrooming of physical growth in Delhi. Induced development which was supposed to be taken place in the priority centres of the region could not become the reality there by Regional Plan-2001 of NCR could not achieve the basic goal of balanced and harmonized development of the region. In the light of the failure of the implementation of development policies and programmes of Regional Plan -2001 of NCR revised development policies and programme are structured in Regional Plan -2021 to ensure the balanced and harmonized development of NCR.

1.4 The Sub Regional Plans

Under the provisions of Section 17 (1) of the Act, 1985 each state is required to prepare a Sub Regional Plan for the Sub – region within the state in order to implement programmes & policies prepared in the Regional Plan of NCR. Sub – regional Plans – 2001 of Uttar Pradesh and Rajasthan Sub – regions were prepared by the respected State Government and were approved by the Board in June 1992 and April 1994 respectively.

1.5 Uttar Pradesh Sub - Region of NCR

U.P. sub region consisted of five districts namely Meerut, Ghaziabad, Bulandshahr, Gautam Budh Nagar and Baghbat districts in which Gautam Budh Nagar and Baghbat are newly built districts carved out from Ghaziabad & Meerut district respectively. U.P. sub region has total area of 10,853 sq. kms. having population 1,15,70,117 out of which 46,14,677 (40%) is the urban population. This accounts for 4.5% (10,853 sq km) of the area of the state and 32.32% of the area of area of NCR.

Table 1.1 Population & Area detail of U.P. Sub region

District	Area (in km)	Population
Meerut	2522	29,97,361
Ghaziabad	1956	32,90,586
Gautambudhnagar	1269	12,.2,030
Bulandshahr	3718	29,13,122
Baghpat	1389	11,63,991

Source: Regional Plan-2021, NCR

1.5.1. Location:

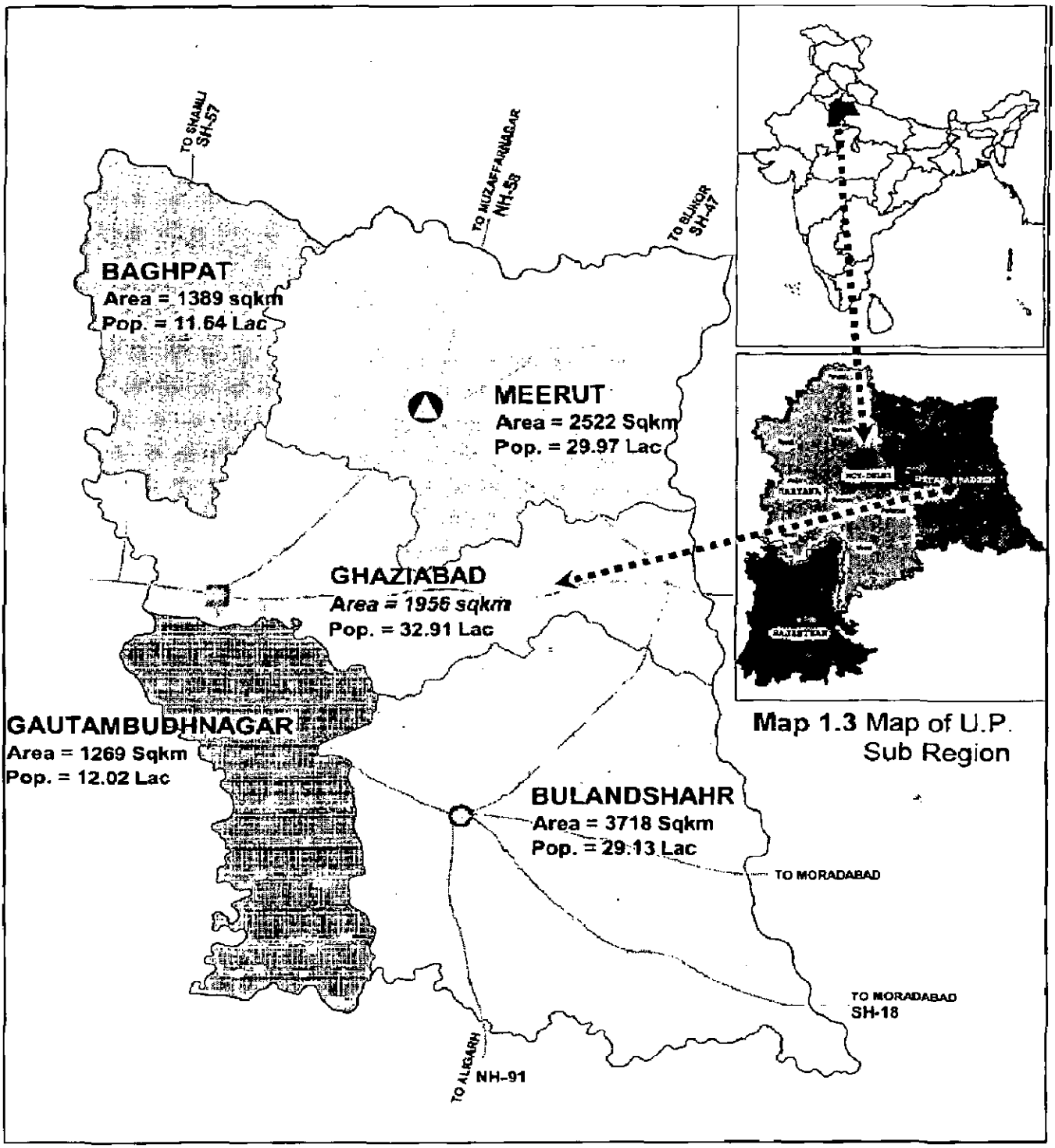
The region falls in the Eastern part of the NCR and Western part of Uttar Pradesh. On the West side it is surrounded by Haryana and Delhi. On the other sides, it is surrounded by other districts of Uttar Pradesh namely Muzzafarnagar district in the North, Bijnor, Muradabad and Budaun district in the East and Aligarh district in the South. It is well connected by rail and road network.

1.5.2 Physical Setting:

Geographically, U.P. sub Region lies between river Ganga on the East and Yamuna on the West and is within Ganga – Yamuna Doab. Almost all the area is plain and flat having a very little slope of 1-2 degree. This area is predominantly new alluvium (khader) and old alluvium (bhangar). New alluvium area is along

different rivers in the form of fingers. The slope of the land is from North to South and east sides.

Map 1.2 Map of India



Map 1.3 Map of U.P. Sub Region

Map 1.4 Map showing U.P. Sub region & its Constituent areas

1.6 WATER SCENARIO

"The Wars of the next century will be on Water."

-Ismail Serageldin,

Vice President, World Bank

Water is an abundant natural resource as three fourth of the surface of earth is covered with it. Total water resource on earth is estimated to be about 1360 million cubic kilometers which is 0.25 per cent of the planet's mass. More than 97 per cent of water is in the form of ocean and seas, 2 percent is locked in ice-caps and glaciers and a large proportion of remaining 1 per cent lies far too deep in the ground to exploit. Thus, only 0.2 million cubic km is fresh water of rivers, lakes, swamps and reservoirs; and 23.4 million cubic km is ground water which is mostly saline. It is only this limited quantity which is available to meet the water demands of human and livestock world over.

India receives annual precipitation of about 4000 km^3, including snowfall. Out of this, monsoon rainfall is of the order of 3000 km^3. Rainfall in India is dependent on the south-west and north-east monsoons, on shallow cyclonic depressions and disturbances and on local storms. India is gifted with a river system comprising more than 20 major rivers with several tributaries. The rivers like Ganges, Brahmaputra and Indus originate from the Himalayas and carry water throughout the year. The snow and ice melt of the Himalayas and the base flow contribute the flows during the lean season. More than 50% of water resources of India are located in various tributaries of these river systems. Apart from the water available in the various rivers of the country, the groundwater is also an important source of water for drinking, irrigation, industrial uses, etc. It accounts for about 80% of domestic water requirement and more than 45% of the total irrigation in the country. Although India occupies only 3.29 million km^2 geographical area, which forms 2.4% of the world's land area, it supports over

15% of the world's population. The population of India as on 1 March 2001 stood at 1,027,015,247 persons. Thus, India supports about 1/6th of world population, 1/50th of world's land and 1/25th of world's water resources. India also has a livestock population of 500 million, which is about 20% of the world's total livestock population. More than half of these are cattle, forming the backbone of Indian agriculture. The total utilizable water resources of the country are assessed as 1086 km^3.

1.7 NEED FOR THE STUDY

The growth in urban population is a positive feature of economic development particularly as the combined contribution of services and industry to gross domestic product is significantly higher than that of agriculture. The growth has been so rapid and uncontrolled that urban planning and investment in infrastructure has proved to be insufficient, for example the demand for water and sanitation services is growing faster than cities can supply. The inadequate access to potable water and sanitation facility is assuming serious proportions and a major threat to public health.

The present surface water resources of the NCR are insufficient to meet the requirement of the various sectors. A holistic view of water requirements should be taken including the demand for the drinking water supply, industrial use and irrigation assigning priority to drinking water and industrial use.

Drinking water requirement for the entire NCR in the year 2001 was 6,787 MLD (6.787 MCM/day or 2477.26 MCM/annum) and the projections for the year 2021 are 11,589 MLD (11.589 MCM/day or 4230 MCM/annum).

As per norms, towns having population one lakh and above, has an average water supply of 200 lpcd, however, actual rate of water supply in these towns varies between 75 lpcd in Bulandshahr to 142 lpcd in Meerut area (refer

Regional Plan – 2021,NCR : Annexure8/1). The situation is even worse in many of the areas in Sub Region where per capita rate of water supply ranges from 28 lpcd in Phalauda to 50 in Baraut as per the data obtained in Regional Plan – 2021, NCR. Per capita availability of water in most of the urban centres had dwindled over the last decade due to rapid urbanisation and lack of financial and water resources. The status of drinking water supply in rural areas also presents a dismal picture. Moreover, many villages did not have local sources of water and almost equal numbers did not have adequate sources.

NCR forms part of the most productive agricultural areas of the country. The Region is endowed with extensive fertile land and good irrigation facilities. In the fast developing scenario of urbanization, the demand for irrigation water will also have to be projected. Therefore, there is a need to assess overall demand of water in the region and prepare the demand supply gap after identifying all the known water resources in the region with the quantities of water which can be produced from them.

Apart from surface water, part demand is also met from ground water. However, entire NCR has been witnessing decline in ground water levels. The decline has been higher in areas underlain by fresh water as compared to areas having marginal to saline ground water. The water levels in Meerut, Bulandshahr and Ghaziabad districts of U.P. had declined by 0.15 to 2.50 meters during this decade up to 1995.

The rate of development of the groundwater resources is unsustainable with most districts of the NCR that are sliding into the dark zone category. This is due to lack of ground water recharging, higher rate of withdrawal; fast pace of urbanization and reduction in run off time for rain water. Thus, recharge of groundwater is a priority.

There are significantly high losses at different stages of water supply system ranging from 30-50% in the conveyance and distribution system apart from losses occurring from treatment plants due to pilferages etc. Water saved is water produced and in the light of this when the water resources are depleting in the region, there is a need to asses the exact quantum of the leakages and identifies their locations to rectify them. Some of the cities/towns in the region have laid canals/pipe lines to obtain water from the already existing canal system at farther places which has resulted in laying of 3-4 parallel canals/pipes causing duplicity of work and expenditure.

Hence, there is a need to adopt regional approach for providing water in the region and undertake a detailed study in this regard which will examine all the aspects discussed above

1.8 AIM OF THE STUDY:

"To prepare a functional Plan for **integrated water supply scheme for the Sub Region** which is technically viable and suggest sustainable long term measures."

1.9 OBJECTIVES OF THE STUDY

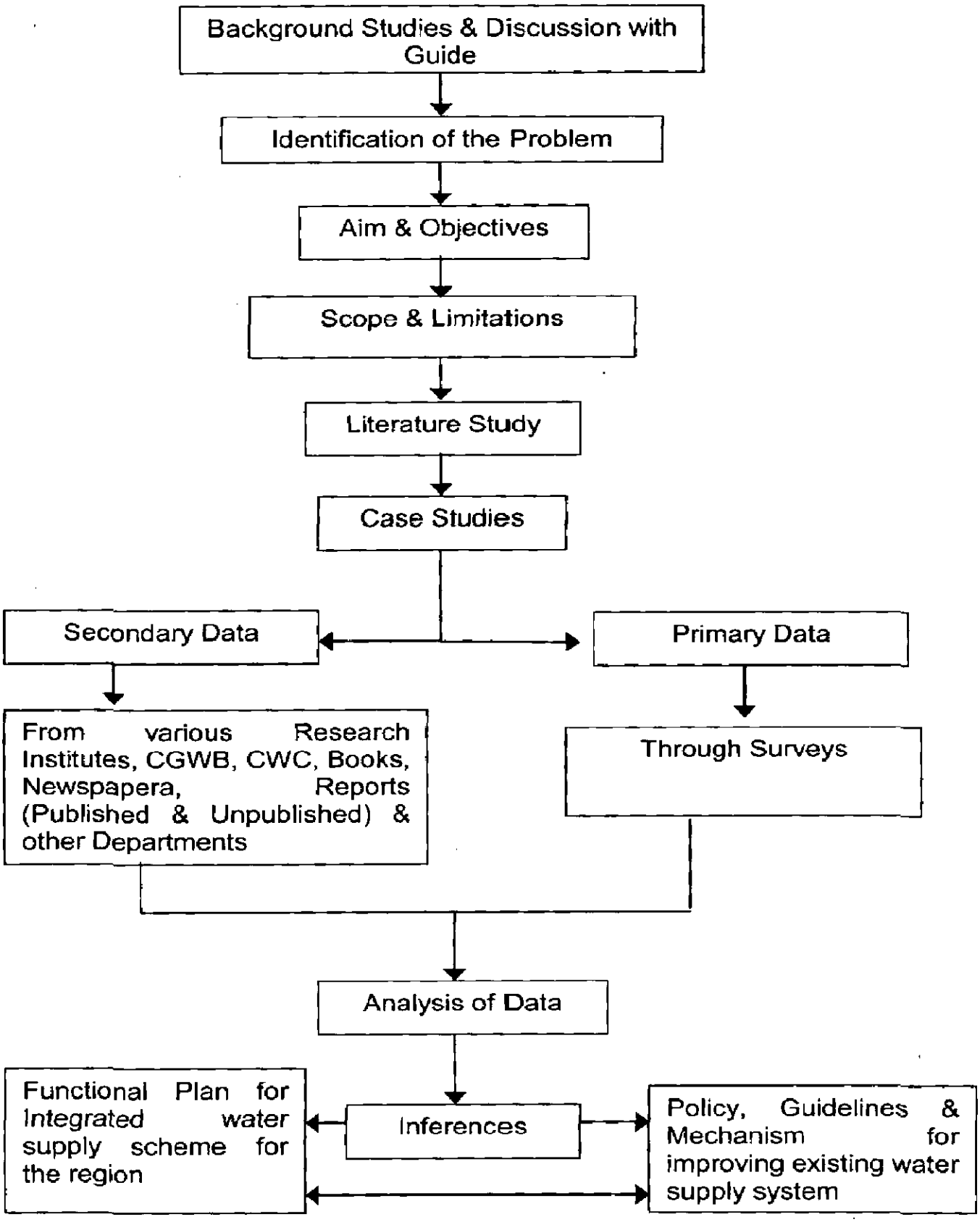
- Identification of all the potential surface water sources, ground water aquifers, inter basin transfer of water, leakages in the existing supply systems etc.
- To evolve mechanism for improving the water supply scenario in the region.
- To prepare a Functional Plan for water which will give a solution to the water requirement for U.P. Sub Region of NCR

1.10 SCOPE OF WORK & LIMITATIONS:

- With the increase in urbanization, the demand of water in urban areas is increasing tremendously which need proper planning. Hence in all the

category of water supply, Domestic water supply would be the priority of the study.

1.11 METHODOLOGY:



CHAPTER 2

LITERATURE STUDY

2.1 OVERVIEW

Literature Study makes one to understand the problem and possibilities so as to finish the study in correct and innovative manner. Considering this fact variety of relevant literature has been referred and appropriate inferences have been drawn so as to get a clear idea about the topic of study. Literature referred has been categorized in following heads –

1. Books
2. Reports
3. Research Papers

The area of literature survey covers various topics like definitions, general concepts, and studies related to the context and various works carried out in the field.

(1) BOOKS:

1. Goodman, Alvin S., Principles of Water Resource Planning Prentice – Hall, Inc., New Jersey, 1984

Introduction:

The objective of this book is to present the principles of water resources planning and to provide a reasonable selection of additional descriptive and analytic material. The main stress is given to the engineering and planning aspects of water resource studies and specialized methods used in water resource planning.

Summary:

This book describes the general process of and detailed methodologies employed in planning projects involving water and related land resources. A project consists of constructed facilities and other measures that control, utilize, or limit the use of water. Planning activities include the identification, formulation, and analysis of projects. Planning activities are also included in subsequent phases of project implementation, including design, construction, and operation. Engineers, but not all other professionals in the water resources field, distinguish between planning and design, applying the latter term to the preparation of detailed engineering studies, drawings, and specifications for structures, equipment, and other components of a project.

This book consists of eighteen chapters compiling the water resource planning in sequence wise. Chapters 1 and 2 present definitions of terms used in water resources planning, the historical and professional setting in which planning takes place, the nature of water as a resource, and the fundamental engineering and economic concepts that should guide water resources planning. Chapters 3 to 6 describe the application of these principles in the estimation of population and water needs, and in the identification, formulation, and preliminary analysis of projects. Such projects may range from a single project meeting a single-purpose need to a regional system in a multiunit, multipurpose, and multi objective framework. In these chapters, the emphasis is on engineering and planning approaches, but with additional analysis of the economic and environmental consequences of projects and other factors that should be considered in these studies. Chapter 7 deals with the problems and techniques of public involvement in the planning process. Chapters 1 to 7 provide the general basis of water resources planning, including additional important considerations

and practical examples. Chapters 8 to 17 provide further elaboration of the techniques of analysis using the specialized methods of various professional disciplines. Chapters 8 to 10 cover many details of economic and financial analyses for a variety of different types of water resources projects. Chapters 11 to 13 describe mathematical modeling and other approaches for handling problems of risk and uncertainty and for formulating projects that are optimal, primarily but not exclusively according to economic criteria. Chapters 14 to 16 present methodologies for evaluating the environmental and socioeconomic impacts of projects. Chapter 17 reviews important legal and institutional aspects. Finally, Chapter 18 suggests approaches for scheduling the monetary and personnel resources to carry out water resource planning.

Inferences:

- Water resource planning techniques are used to determine what measures should be employed to meet water needs taking into account preservation and enhancement of natural water and related land, ecological systems and water, land and air quality.
- Generalized process of water resources planning and management consist of following phases:
    - Establishment of goals and objectives-broad policies; legal and other constraints
    - Problem identification and analysis – collection of data; projection of demand/supply relationship; uses of water and land; opportunity for development and management.
    - *Solution identification and impact assessment – structural solution;* non-structural (management) solutions; preliminary assessment of impacts

- Formulation of alternatives and analysis – criteria and procedure for comparison of alternative.
- Recommendation, including priorities and schedules for implementation
- Decisions
- Implementation – organizations for action, if required
- Operation and management

2. Bansil, P.C., Water management in India, Concept Publishing Company, New Delhi, 2003

Introduction:

The subject water has a vast canvass and can cover a number of volumes if it is required to be dealt in a comprehensive manner. In this book the main focus is on salient aspects of water uses and water management.

Summary:

The whole study is compressed into 17 chapters, divided into 4 parts i.e. setting; Cause and problems; possible solutions and lastly conclusion. The 1st part is divided into 4 chapter starting with introduction about importance of water, major fresh water resources in the country and quality aspect of water. The 2nd chapter deals with the global scenario of water, its percentages in various forms, conflicts over it and international policies to handle it. The 3rd chapter deals with the water scenario of India, its demand and availability, water condition in various states of India and given the brief description of various projects undergoing in various states. The 4th chapter deals with the water situation in capital city Delhi constituting sources of water in Delhi, water management system through various organizations such as CGWB, DDA, NDMC, DJB, CSE, DSIDC etc.

The 2nd part of this book consists of 5 chapters describing various causes and problem arisen in water supply in various fields. This section describe the various problems occur in rural and urban system due to water. Along with domestic water supply, irrigation scenario, which constitute the major share of water, is also described with problems occurred due to changing in cropping pattern.

The 3rd part describes the possible solutions to solve the problem of water scarcity, which our country is facing, and emphasis on water resource planning and management. The solutions include water conservation, rainwater harvesting, integrated watershed development, interlinking of rivers and innovative approaches to irrigation. Finally this study is concluded in last part giving recommendations for consideration and implementation.

Inferences:

- From the scenario of global water supply, it may appear that there is no lack of fresh water worldwide. But it must be taken into account in individual regions of the world, because of the spatial and temporal variations in precipitation; the potential usable water supply is very small. Climate change will account for an estimated 20 per cent of this increase in global water scarcity.
- As per the international norms, if per-capita water availability is less than 1700 m^3 per year then the country is categorized as water stressed and if it is less than 1000 m^3 per capita per year then the country is classified as water scarce. In India per capita surface water availability in the years 1991 and 2001 were 2309 and 1902 m^3 and these are projected to reduce to 1401 and 1191 m^3 by the years 2025 and 2050 respectively.

- Over 40% of treated water is used for purposes other than drinking, so dual water supply system with treated and untreated water for drinking and other purposes can save 80% treated water.
- In most part of the country the ground water resources has been over-exploited causing alarming environmental problems
- Non conventional methods for utilization of water such as through inter – basin transfer, artificial recharge of ground water and desalinization of brackish or sea water, as well as traditional water conservation practices like rainwater harvesting, need to be practice to further increase of utilizable resources.

3. Waterman, E.L., Elements of water supply engineering, John Wiley & Sons, Inc., New York, 1938

Introduction:

In this book, the main emphasis is given to the development of water works system in a logical order from source of supply, methods of transportation of water, method of treatment, distribution system, operation and maintenance and method of financing. Here mainly public water supply has been discussed.

Summary:

It is the second edition of the book and in this all elements of water supply has been discussed. This book is comprises of 22 chapters.

The 1st chapter deals with the municipal water supply system and its requirement with respect to various uses like domestic, commercial, industrial, public use etc. along with losses and wastes occur in various heads. The next three chapters (2 to 5) describe quantity and quality aspects of water supply. In this part, various techniques for examination of quality of water have been discussed. Chapters 6

to 12 describe various sources of water supply like precipitation, ground water sources like springs, artesian supplies etc. and surface water sources like lakes, rivers, reservoirs etc. in these chapters, various techniques to collect water has been also discussed. Chapters 13 to 14, describe the various techniques and equipments used in the process of transportation of water from its natural sources right from the conduits to various types of pumps. Chapters 15 to 18, describe the method of treatment of water like rapid sand filtration, the removal of impurities, and chlorination of water etc. Chapters 19 to 21 describe various distribution systems, their structural features in detail and distribution storage like distributing reservoirs, elevated tanks etc. The last two chapters describe the operation and maintenance of water works systems and its financial management.

Inferences:

- The essential parts of a municipal water supply system are the source from which an adequate supply of suitable water may be obtained; works for te collection of water and transporting it from the point of collection to the municipality in which it is used; works for the purification of water; and works for the distribution of water to the consumer.
- The quantity of water required by the municipality depends upon the rate of use per capita and population of the city. It is expressed in gallons per day or litre per capita per day (lpcd).
- The water consumption is more in case of high pressure water supply as compared to low pressure water supply.
- A careful investigation is required to determine the condition at proposed source of supply including sanitary survey of the territory, both land and

water, within several miles of the proposed intake and the hydrological survey in the immediate vicinity.

- Pumping plants are an essential part of water works systems which are operated on the direct, indirect and direct – indirect principles. The direct system is one in which the water is pumped directly into the distribution system with no elevated storage. The indirect system is one in which all water is pumped to elevated storage reservoirs from which it flows b gravity into the distribution system
- Successful operation and maintenance of a public water supply system means that the system will continuously meet all normal requirement of service; the water delivered to the customer will be of satisfactory quality with little or if possible no variation in quality.

4. Garg, S. K., Water supply engineering, Khanna Publishers, Delhi, 1992

Introduction:

The existing urban settlement's which make a substantial contribution to national wealth, or the cities and town which are stagnating; one common strain is the total inadequacy of water supply, drainage, sewerage and housing. Under Article 47 of the Constitution, it is the duty of the state to improve the standards of living of the people and in particular, to improve the public health standards. (Water, sewerage and housing are three critical elements for life, without which there can be neither health nor comfort.

Inferences:

According to NCU, "New norms have to be devised, with a per capita daily supply of between 80 – 100 liters as an absolutely minimum level, and between 110 – 120 liters on a slightly more desirable level. This is possible only if a minimum per capita daily supply of 170 liters for domestic use is ensured on an equitable basis

The standards for water supply can be qualitative and quantitative. The quantitative standards are variable from place to place. India the average water consumption is kept as following table

Table 2.1 Average Domestic Water Consumption in Indian City

Use	Consumption in lpcd
Drinking	5
Cooking	5
Bathing	55
Washing of clothes	20
Washing of Utensils	10
Washing and cleaning of house	10
Flushing of Latrines	30
Total	**135 lpcd**

But for an average Indian town, as per the Indian Standards recommendation, the per capita demand may be taken as below:

Table 2.2 City Level Per capita Demand of Water

Use	Consumption in lpcd
Domestic Use	135
Industrial Use	50
Commercial Use	20
Civil or Public Use	10
Wastes/ Thefts etc.	55
Total	**270**

Table 2.3 Water Demand as per Population Size

Population of town/city	Per Capita Demand (lpcd)
Less than 20, 000	110
20,000 – 50, 000	110 -150
50,000 – 2 lakhs	150 – 180
2 lakh – 5 lakh	180 – 210
5 lakh – 10 lakh	210 – 240
More than 10 lakh	240 - 270

Source: Water Supply Engineering by S.K. Garg

Table 2.4 Water Quality Standards for public Water Supply

S.No.	Characteristics	Acceptable	Cause of rejection
1.	Turbidity (Units in J.T.U. Scale)	2.5	10
2.	Colour (Units in Platinum Cobalt Scale)	5.0	25
3.	Taste and odour	Unobjectionable	Unobjectionable
4.	pH	7.0 - 8.5	6.5 – 9.3
5.	Total dissolved solids (mg/l)	500	1500
6.	Total hardness (as $CaCo_3$)(mg/l)	200	600
7.	*Chlorides (as CL (mg/l)	200	400
8.	*Sulphates (as SO_4)	200	400
9.	**Fluorides (as F (mg/l)	1.0	1.5
10.	*Nitrates (NO_3)	45	45
11.	Iron (as fat (mg/l)	0.1	45
12.	Manganese (as Mn) (mg/l)	0.05	1.0
13.	*Copper (as Cu) (mg/l)	0.05	0.5
14.	*Zinc (as Zn) (mg/l)	0.001	1.5

15.	Pherolic compounds (as Phenol (mg/l)	0.01	1.50
16.	Anionic detergents	0.2	0.002
17.	Arsenic (as As) (mg/l)	0.05	1.0
18.	*Cadmium (as Cd) (mg/l)	0.01	0.005
19.	*Chromium (as Hexavalenter) (mg/l)	0.05	0.01
20.	*Cyanides (as CN)	0.05	0.05
21.	*Lead (as pb) (mg/l)	0.1	0.05
22.	*Lead (as Pb) (mg/l)	0.01	0.1
23.	*Mercury total (as Hg) (mg/l)	0.001	0.01
24.	*Polynuclear aromatic hydrocarbons (PAH) (mg/l) 0.2	0.2	0.001
25.	Coliform count in water entering distribution system	Shall be nil in any sample of 100ml	0.2

*These characteristics can not be corrected by conventional water treatment methods

(2) REPORTS:

1. Regional plan – 2021, National Capital Region, National capital Region Planning Board, India habitat Centre, New Delhi, September, 2006.

Introduction:

The National Capital Region Planning Board formulated a Regional Plan-2001 for NCR in 1989. This plan aims at: Reducing the pressure of population on Delhi by deflecting 20 lakh population and; Attaining a balanced and harmonized development of NCR, in an Inter-Sate region consisting of NCT- Delhi, 6 Districts of Haryana (now 7), 3 Districts of U.P. (now 5) and part of Alwar District of Rajasthan, covering total area of 30,242 sq.kms.

Regional Plan 2001 provides a model for sustainable urban development and seeks to achieve its objectives through an inter-related policy framework relating to population (re-distribution), settlement systems, regional land use patterns, environmental factors, economic activities and infrastructural facilities etc.

The Plan envisages the development of 6 Delhi Metropolitan Area (DMA) towns i.e. Ghaziabad-Loni, NOIDA, Faridabad, Gurgaon, Bahadurgarh and Kundli and 11 Priority Towns i.e. Meerut, Hapur, Bulandshahr, Khurja, Palwal, Rewari, Dharuhera, Rohtak, Panipat, Alwar and Bhiwadi for absorbing Delhi bound potential migrants.

Summary:

This report consists of 19 chapters starting with the need to prepare regional plan. Then various regions under NCR have been discussed considering their physical setting, geology, hydrology and availability of ground water. Then settlement pattern and economic activities in various sub regions has been discussed. After describing the general scenario of the region, it emphasizes on various infrastructure facilities. Here these facilities are again divided into physical and social. Physical facilities are further sub divided into transportation, power, water, sewerage, solid waste management, drainage and irrigation, telecommunication and shelter. Social facilities cover education and health. It also emphasized the heritage and tourism, environment, disaster management, rural development, regional land use. For harmonized and balanced development, report also describes the counter magnet areas outside the region. And at last, it describes various implementation strategies, management structure and resource mobilization.

Inferences:

- This approach emphasis the balanced and harmonized development in whole of the region by providing adequate facilities in entire region
- Region should be developed as a whole in order to control the migration to Delhi from surrounding areas of U.P., Haryana and Rajasthan.
- At present, there is a large imbalance in water availability in different sub regions of NCR.
- The NCR is a water scarce region, but can have sufficient water if this resource is conserved and managed properly
- There are significantly high losses at different stages of water supply ranging from 30% to 50% in conveyance and distribution system apart from treatment plants including pilferages.

Water Supply - Major Recommendations in RP-2021

The Regional Plan-2021 has made following major recommendations in respect to water supply system in NCR:

- Preparation of integrated regional scheme to augment drinking water supply in the Region
- Construction of upstream reservoirs to store excess water in monsoon for use in lean period
- Augmentation of groundwater resources through rain water harvesting
- Protection and reservation of 2-5% area of NCR for water bodies
- Rationalization of water charges so as to cover at least the minimum O&M cost
- Discouraging intensive development of areas of ground water shortage identified by Central Ground Water Board

- Emphasizing on maintaining quality of water as per the norms set out by the Bureau of Indian Standards

(3) RESEARCH PAPERS:

1. Prof. R.K.Jain, "Infrastructure facilities in urban areas of Uttranchal"

In this technical paper the author broadly covered the emerging scenario of physical infrastructure available in the state. Factors affected the infrastructure facilities system of water supply, sewerage, drainage and at last suggested measures to rationalize the system of providing services.

Infrastructure:

The quality of life in a settlement depends very much on the level of availability, accessibility, quality of infrastructure it provides. Infrastructure, therefore, must be in conformity with the development plan and all other regulations regarding other services. These must be related to the density of population or the intensity of development. Social amenities and infrastructure fall under the social welfare objectives of the urban development programs. The architects, City Planners, Urban Managers and Administrators are required to make special efforts in order to ensure the wider coverage and equitable distribution of infrastructure for the society as a whole.

Poor availability of infrastructure can be attributed to a number of factors

1. Rapid growth demand
2. Limiting capacity of state to provide for such services
3. Increasing gap between demand and supply of water supply
4. Less resources (with authorities) i.e. finances.
5. Obsolete/ Expensive technology
6. Leakage and wastage of services during delivery

7. Highly subsidized services, poor recovery and collection charges, lack of accountability, non involvement of community, lack of will on the part of politicians.

Suggested Approach to rationalize the system of providing services:

1. Realistic norms and standards, to make fair assessment of the requirement
2. Cost of infrastructure to be loaded on the cost of plots
3. Mechanism of levying internal and external infrastructure development charges on prorate basis.
4. Use of new/low cost technologies for optimum use of available resources.
5. Involvement of community to ensure appropriate provision and maintenance of infrastructure like open space, garbage disposal, sanitation of new areas.
6. Involvement of Pvt. Sector (Gurgoan has generated 500 crore from Pvt. Colonizers on a/c of EDC) to vive impetus to infrastructure development.
7. Urban local bodies be permitted to raise resources from the market. (In USA 70 % of capital financing of infrastructure is done by urban local bodies through municipal bonds)
8. Infrastructure development can also be levied for creating resources. (Punjab has raised 100 crores by levying cess on agriculture and petroleum products)
9. Contracting out the urban infrastructure to Pvt. Agencies (such as water supply, solid waste management, sanitation, development & management of green spaces like parks, playground, road, street light etc.)
10. Transfer of development and town planning schemes should be used for road widening, creating open spaces or other physical infrastructure.

2. Prof. T. M. Vinod Kumar, "Water resource management and ward level planning", In ITPI Journal, June – September, 2006

Summary:

This paper is taken from ITPI Journal in the issue of June-September, 2006. This paper examines the all-important issue of water at a global and settlements level. It begins with pointing out issues, which are required to be debated and settled at the global level. It pointed out the wide disparity in water use, which is prevalent in cities and villages. These inequalities impose large-scale disadvantages on the people who are adversely affected in respect of water availability. Global water resources has been discussed and pointed out that the number of people living in water stressed countries is projected to climb from 470 million to three billion by 2025. Then it is argued that water, sanitation and poverty are closely related. Availability of water could reduce poverty to an extent.

Inferences:

- If water is a human right, if poverty alleviation is the priority of the Government and if there is a strong linkage with poverty and water access, ward level planning should be adopted for water management.
- It is at the ward level the community can assess the issue of water management and not at the city level because in every city there is unequal access in different wards in terms of duration of supply, pressure and volume.
- Water should be considered as property of both landed and landless.
- There should be equitable right for water regardless of the fact that population is below or above poverty level.

3. Vikram Soni, "Water and Carrying Capacity of a City: Delhi", In Economic Political Weekly, Nov. 8, 2003

Introduction:

Depending on natural and strategic location the expansion of a city will be bound by some limits, which may be termed as the "Carrying Capacity of the City". In this paper available resource mainly water resource is analyzed and found the total population that it can support.

Summary:

In this paper the main stress is given on limiting scales that exist for all natural features on the planet. Same way, there is some limits to the expansion of the city because with increase in expansion, the time and money will increase for transportation of goods and people. At one time productivity will decrease to a great extent and other stress on natural environment and resources increases, which make the survival difficult. In this paper, this phenomenon of carrying capacity is analyzed taking an example of Delhi City. Here water resource is taken as one of the factor for limiting growth, as water is one of the main sources of living after air. Here growth of Delhi city is analyzed starting from 1960 when there is no question of water shortage.

Here total water resources of water i.e. surface as well as ground water resource taking full calculation of loss of water during evaporation as well as possibility of ground water recharge.

Inferences:

- The large fraction of water used in Delhi is not local but imported from other river basin like Satluj, Bais and Ganga.
- During the flow of water in any river or canal, 30% of water lost by evaporation and other minor losses.

- Generally precipitation is lost to evaporation unless it occurs in bulk.
- Water recharge thus occurs only on days when rainfall exceeds 0.25cm.
- It means water can be recharge in monsoon season only i.e. in July, August and September when rainfall exceed 0.25cm
- There is total surface water supply of 630 MCM per year where 340 from Yamuna, 120 from Ganga & 130 from Beas. Hence total carrying capacity from the total river water resources for Delhi then works out to about 6.3 million people, taking per capita water demand as 300 lpcd (as per Master Plan for Delhi- 2021).
- The total groundwater recharge through rainfall as well as from water harvesting is 150 MCM per year while according to a study by INTACH, there is total water withdrawal from tubewells is 450 MCM, three time than the recharge. Hence carrying capacity from the total ground water reserve works out to be about 1.5 million people making total of 7.8 million people.
- Recycling of sewage water can be one option for water management but it requires huge investment inn installation as well as running cost of these plants is again very high.
- The cost of recycling 200 MCM per year of water is Rs. 1600 crore and will service 2 million people. This means, effectively, an expenditure of Rs 8,000 per person per year for water, alone which is close to per capita income of the country.
- The current population of Delhi is 14 million, which is almost double of the carrying capacity calculating after estimating total water availability and this population again increasing unchecked.
- This shows that we are on course to Urban Genocide.

4. Kanchan Chopra, "Sustainable Use of Water – The Next Two Decades", In Economic Political Weekly, Aug. 9, 2003

Introduction

Projections of water demand and supply based on various scenarios provides a backdrop for examining the relevance of alternative interventions to achieve sustainable use of India's water resources. Sustainable use of water implies focusing on both quality as well as quantity.

Summary

In this paper, the projected water availability and demand for next two decades is analyzed by three scenarios: A business as usual (BAU), High growth (HU) and a sustainable scenario. In BAU scenario, the same trend is taken into considerable, which is prevailing in terms of water demand. In HU scenario, projection of water demand is taken on upper hand. In third scenario i.e. sustainable scenario water demand is projected considering policy intervention for overall sustainability of water in terms of water quality as well as water quantity. In these scenarios, water demand is analyzed by projecting water demand for agriculture use and non – agriculture use separately. Water requirement for agriculture is estimated seeing the future requirement for food grains, cereals, vegetable and fruits separately. In non – agriculture, water requirement for households, industry and power are projected separately at national as well as state level.

Inferences:

- According to UN estimates, Population of India in 2020 would be 1272.2 million
- Increasing income and urbanization leads to shift in consumption pattern from cereals (253 tonnes in 2020) to vegetables and fruits (268 tonnes in 2020).

- Due to land degradation scenario prevailed since 1990, there is 7% reduction in realized output compared with actual output.
- The overall water shortage in 2020 would be limited to 2%. As per projections done in the paper, it seems that surface water use is under utilized to the extent of 21% due to in – built constraints of low water use efficiency. This is accompanied by an over – extraction of groundwater of 25%.
- Such an unbalance growth shall itself be the source of considerable amount of unsustainability.
- Over time, change in land use, in particular degradation of soil, loss of vegetable cover and over – extraction of ground water are likely to affect water availability through their impact on hydrological parameters determining recharge.
- Contamination of groundwater due to sewage, wastewater and garbage results in qualitative deterioration, which may disturb the hydrological cycle and render ground water unsafe for drinking and irrigation.
- It is estimated that 6 -7 % decreases in water supply could be expected on the above accounts.
- There is policy intervention needed in water sector like enabling improved efficiency of surface water use in irrigation; increasing production of rain-fed areas through conventional watershed management; effluent treatment by industries; use of pricing and other instruments for proper water allocation and; creating the appropriate legal and social environment for collective action by stakeholders

CHAPTER 3

CASE STUDY

(NATIONAL CAPITAL TERRITORY OF DELHI)

3.1 INTRODUCTION

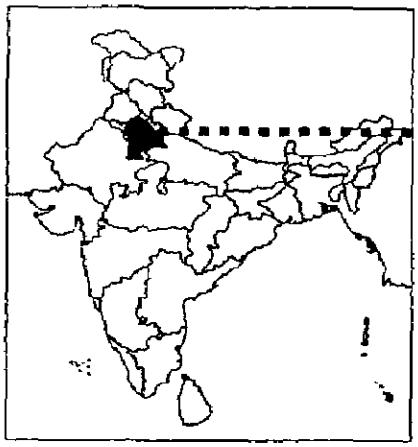
The National Capital Territory (NCT) of Delhi covers an area of 1,486 km^2 and is divided into 9 census districts and 27 sub-divisions. Of this, the urban area, including the new settlements in rural habitations, accounts for about 525 km^2. Delhi encompasses three governing bodies: the Municipal Corporation of Delhi (MCD), the New Delhi Municipal Council (NDMC) and Delhi Cantonment Board (DCB). The MCD is one of the largest municipal bodies in the world according to population size. Of the total NCT area, MCD occupies 94.2 %, whereas NDMC and DCB occupy 2.9% and 2.9% respectively.

3.2 LOCATION

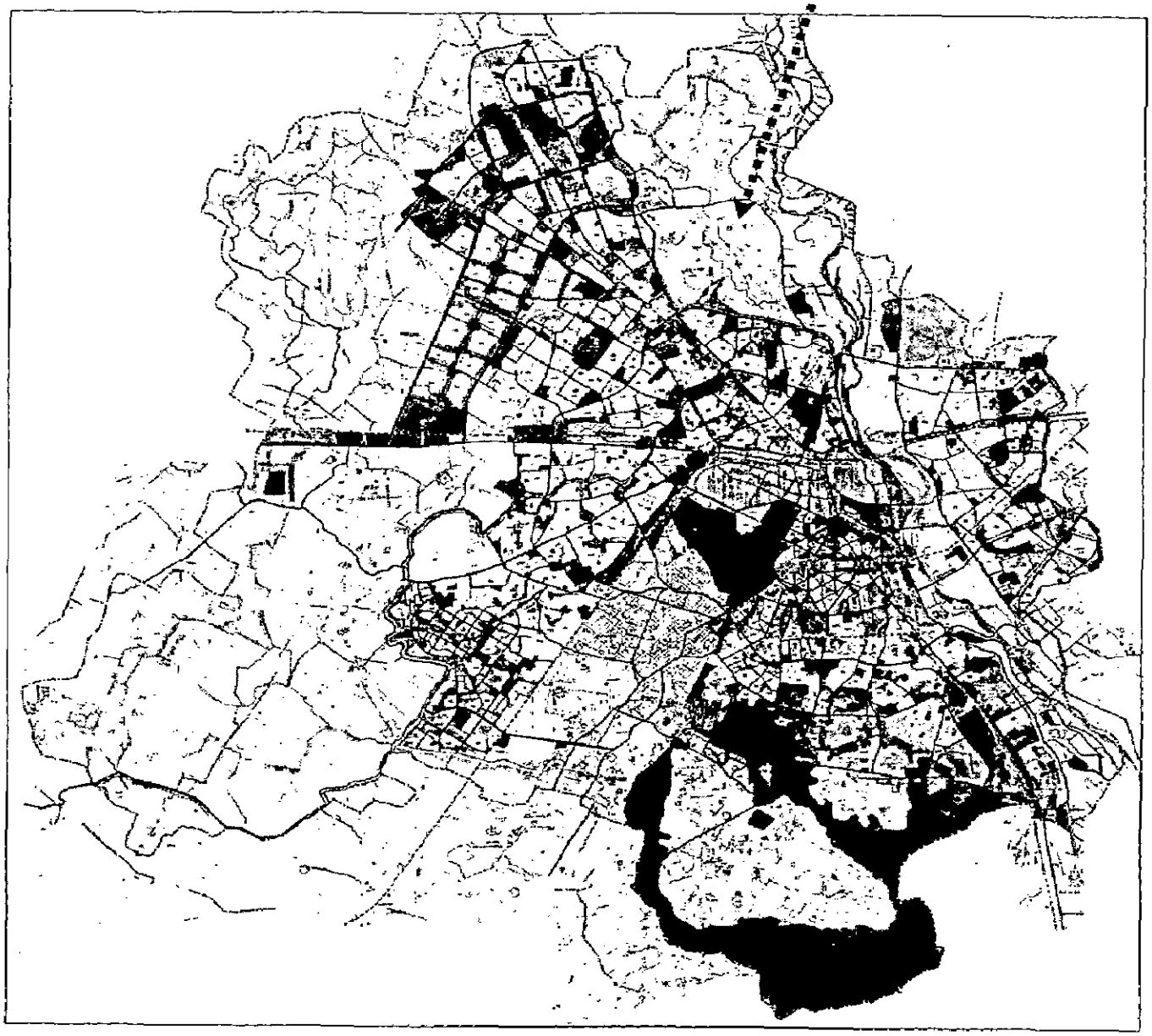
Situated on the banks of the river Yamuna, Delhi is the capital of the country and also the biggest business centre of Northern India. It is surrounded by Distt. Ghaziabad (U.P.) in the East, Distt. Rohtak in the West, Distt. Sonepat in the North and Distt. Gurgaon in South (Haryana). It is situated between 28°-24'-17"& 28°-53' -00" of North Latitude and between 76°-50'-24" and 770-20'-37"of East Longitude. Its maximum length and breadth are 51.90 Kms and 48.48 Kms. respectively.

Five national Highways (NH-1, NH-2, NH-8, NH-10 and NH-24) converge on Delhi's Ring Road. it is also a major junction on the rail map of India.

Map 3.1 Map of India



Map 3.2 National Capital Region



Map 3.3 Land use Plan – 2021, National Capital Territory Delhi

3.3 CLIMATE

The average annual rainfall in the territory is 612 mm. Maximum rainfall occurs in July. The rainfall over NCT of Delhi generates surface water run-off through streams, drains and as sheet flow. Monthly mean temperatures range from 14.3°C in January (minimum 3°C) to 34.5°C in June (maximum 47°C). The heavy rains of the monsoon act as a "scrubber". Northwesterly winds usually prevail; however, in June and July southeasterly predominate. Wind speeds are typically higher in the summer and monsoon periods; in winter, calms are frequent (20 per cent of the time).

3.4 TOPOGRAPHY

Delhi is situated on the banks of the river Yamuna. The river Yamuna flows from north to south. A hard rocky ridge runs from the southern border of NCT in a south-west to north-east direction, towards the western banks of the river Yamuna near Wazirabad barrage. This ridge forms the main watershed in NCT of Delhi. The topography creates a natural drainage system that carries rain and storm water from the higher elevations of the west to the Yamuna River. The eastern low-lying side of Delhi was originally part of the flood plain of the River Yamuna and considered uninhabitable. Today, however, this eastern part, known as the trans-Yamuna area, houses about 20% of the total population of Delhi

3.5 POPULATION

Delhi started as a small city, with a population of approximately .41 million in 1911 and grew steadily to reach a population of .92 million in 1941 with the decadal growth rate averaging approximately 30%. Following independence, the sudden influx of migrants raised the population from 920,000 in 1941 to 1.74 million in 1951, registering a decadal growth of approximately 90%. In the next forty years, the decadal growth has been above 50%.

The 1991 overall population density of NCT in Delhi is 6,352 inhabitants / km^2. The population of Delhi is becoming denser, increasing from 4,200 inhabitants/km^2 in 1981 to about 6,300 inhabitants/km^2 in 1991. In the MCD area, the urban population density is 16,717 inhabitants/ km2, in the NDMC area it is 7,050 inhabitants/km^2 and in the DCB area 2,197 inhabitants/km2.

According to the 2001 census, the population of Delhi is 13.78 million with a floating (or transient) population of 0.3 million to 0.4 million, a common feature of large cities such as Delhi. The census of 2001 implies an average density of 9,286 inhabitants/km^2

Table 3.1 Growth of Population in Delhi (1971-2001)

Year	Population of Delhi (in Lakhs)	Decadal Growth rate in %age)	Decadal Growth of population (in lakhs)
1971	40.70	-	-
1981	62.20	52.82	21.5
1991	94.20	51.46	32.0
2001	143.00	51.80	48.8

Source: Delhi Master Plan - 2021

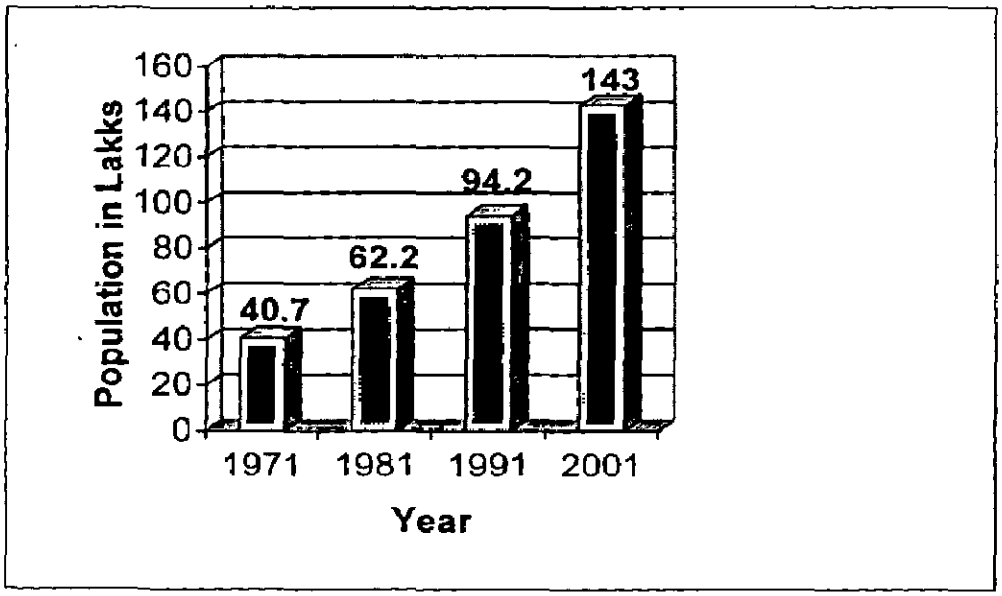


Fig 3.1 Decadal Population Growth of Delhi

3.6 WATER SUPPLY

Every year various parts of Delhi face water scarcity. Delhi is dependent for raw water from distant sources and augmentation of raw water for Delhi has been a permanently unsolved issue i.e. escalating population cannot be matched by proportionate increase in the raw water availability. The water supply to citizens of Delhi is through water treatment plants i.e. Chandrawal (90mgd), Wazirabad (120mgd), Haiderpur (200mgd), Shahdara (100mgd) and rest through Ranney Wells /Tubewells.

3.6.1 Present Sources of Raw Water

The present sources of raw water available to Delhi are as under:-

Yamuna Water - 750 cusec

Ganga Water - 200 cusec at Bhagirathi Water Works

BBMB Water - 225 cusec (Ex. Nangal 371 cusec)

BBMB Water - 40 cusec (Ex. Nangal 60 cusec)

Ground Water - 185 cusec

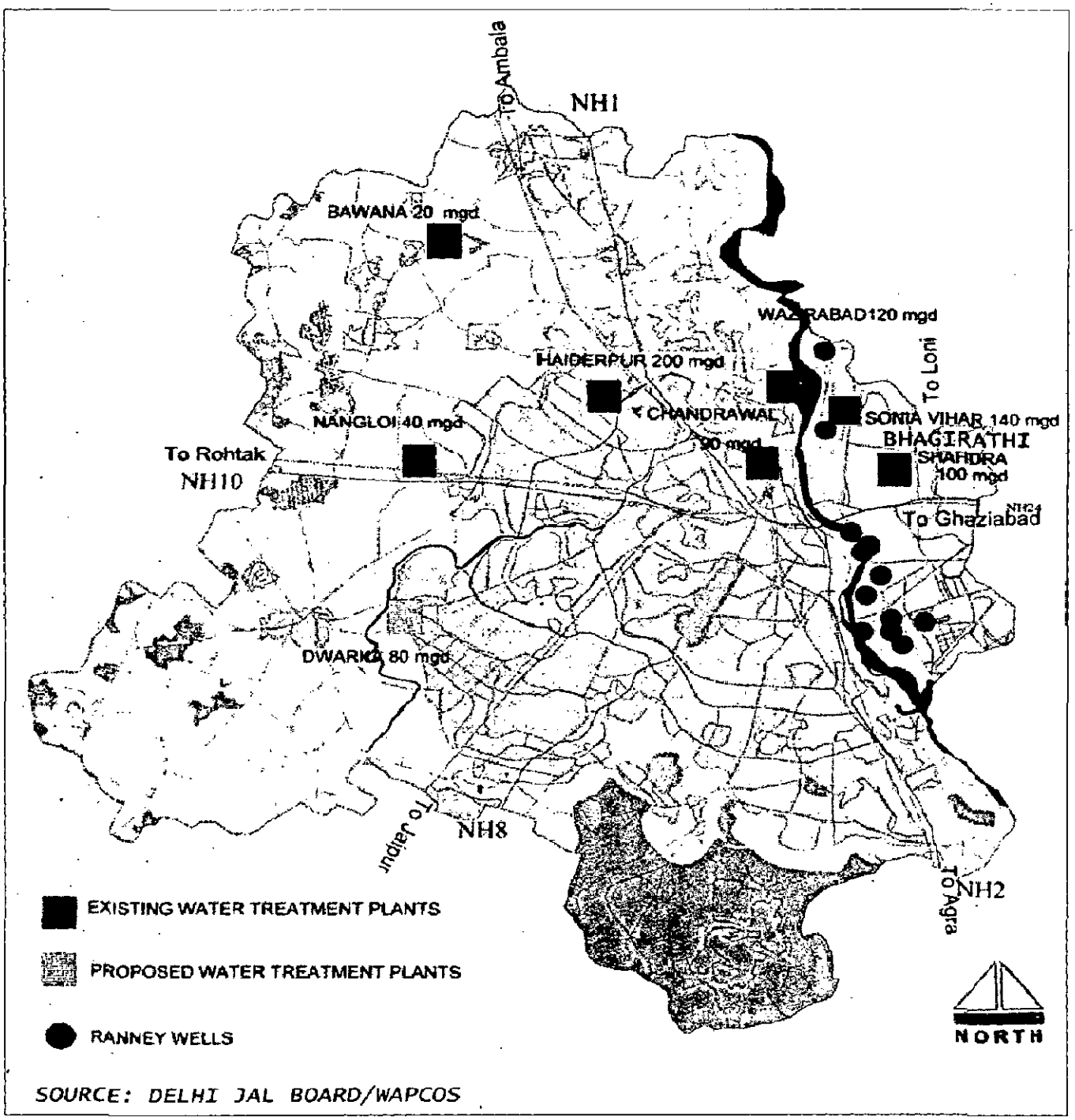
Based on the availability of above raw water, following water treatment plants are functioning:

Table 3.2 Water Treatment Plants based on availability of raw water

S.No	Source of Raw Water	Name of Plant	Installed Capacity
1.	River Yamuna	Chandrawal I, II	90mgd
2.	River Yamuna	Waziarabad I, II & III	120mgd
3.	Bhakra Storage	Haiderpur I	100mgd
4.	Yamuna	Haiderpur II	100mgd
5.	Bhakra Storage	Nagloi	40mgd
6.	Upper Ganga Canal	Bhagirathi	100mgd
7.	Upper Ganga Canal	Sonia Vihar	140mgd
7.	Sub – Surface Water	Ranney Wells/Tubewells	115mgd
		Recycling of waste water at WTP Haiderpur	16
		Total	**821mgd**

Source: Draft Master Plan for Delhi – 2021

Map 3.4 Water Treatment Plants in NCT - Delhi



3.6.2 Share in Yamuna Water

An MOU for sharing of Yamuna water between five riparian states, Haryana, U.P., Himachal Pradesh, Rajasthan & N.C.T. of Delhi has been signed on 12.5.1994 and Delhi share in Yamuna water has been fixed as 0.724 BCM (consumptive). The above allocation is subject to construction of Renuka Dam, Kishau Dam, Lakhwar Vyashi Project, Hathnikund Barrage and parallel lined

channel. Pending construction of these dams, following seasonal allocations have been made: -

Table 3.3 Share of Yamuna water

S.No	State	July to Oct	Nov. to Feb	Mar. To June	Total
1.	Haryana	4.107	0.686	0.937	5.730
2.	Uttar Pradesh	3.216	0.343	0.473	4.032
3.	Rajasrhan	0.963	0.070	0.086	1.119
4.	Himachal	0.190	0.108	0.080	0.378
5.	**Delhi**	0.580 **1926 cusec**	0.068 **231 cusec**	0.076 **255 cusec**	0.724 **808 cusec**

Source: Draft Master Plan for Delhi – 2021

Presently, Delhi is getting about 750 cusecs of raw water during the lean season against a consumptive allocation of 255 cusecs. After fulfilling the consumptive need, 495 cusecs flows back in the river as return flow. With the construction of the dams in the upper reaches of river Yamuna, Delhi's consumptive allocation will be 808 cusecs and total allocation will be 2350 cusecs.

3.7 Level of Water Supply

The Water Supply in Delhi is far from uniformly distributed. The NMDC area/Delhi Cantonment area gets average supply above 450 lpcd while Narela/Najafgarh zone gets less than 80 lpcd on an average with some parts getting less than 35 lpcd water supply. Except the NDMC area the rest of the city has water problems i.e. low water pressure, erratic municipal water supply.

3.7.1 Basis for Per Capita Water Requirement

(i) DELHI JAL BOARD

The Delhi Jal Board is estimating the domestic consumption as per C.P.H.E.E.O. Manual 1999 on water supply which provides for domestic consumption in Metropolitan & mega cities as 150 LPCD plus 15% losses. As per the Manual the water requirement for other uses is to be assessed separately. To assess the water demand for other uses, the Delhi Jal Board has followed the Master Plan

Document-2001. Consequently, the per capita water requirement works out as follows:

1. Domestic:	(150 + 22)	- 172 LPCD
2. Industrial, Commercial and community requirement at 45,000 lts./ Ha. / day		- 47 LPCD
3. Special uses, embassies, floating population, hotels, airports and railway stations etc.		- 52 LPCD.
4. Fire protection @ 1% of total demand		- 3 LPCD
	Total	**- 274 LPCD**

(ii) DELHI DEVELOPMENT AUTHORITY

The total city requirement is considered as 80 gpcd out of which 50 gpcd is for domestic requirement and 30 gpcd for non-domestic purposes. The domestic water requirement of 50 gpcd comprises of 30 gpcd for potable needs and 20 gpcd for non-potable water. The requirement of potable water out of total requirement of 80 gpcd has been assessed as 35 gpcd i.e. 30 gpcd for domestic and 5 gpcd for non-domestic demand while the demand for non-potable water has been assessed as 45 gpcd i.e. 20 gpcd for domestic and 25 gpcd for non-domestic purposes.

3.7.2 Present Water Availability

The Delhi Jal Board having an installed capacity of 650 MGD against which on an average 670 MGD potable water is being produced by optimization of Water Treatment Plants.

3.7.3 Present Water Demand

The present water demand for potable water in Delhi has been assessed as 990MGD @ 60 gpcd for all uses. No allowance is made for use of potable water for parks & lawns /horticulture /agriculture purposes due to water shortage.

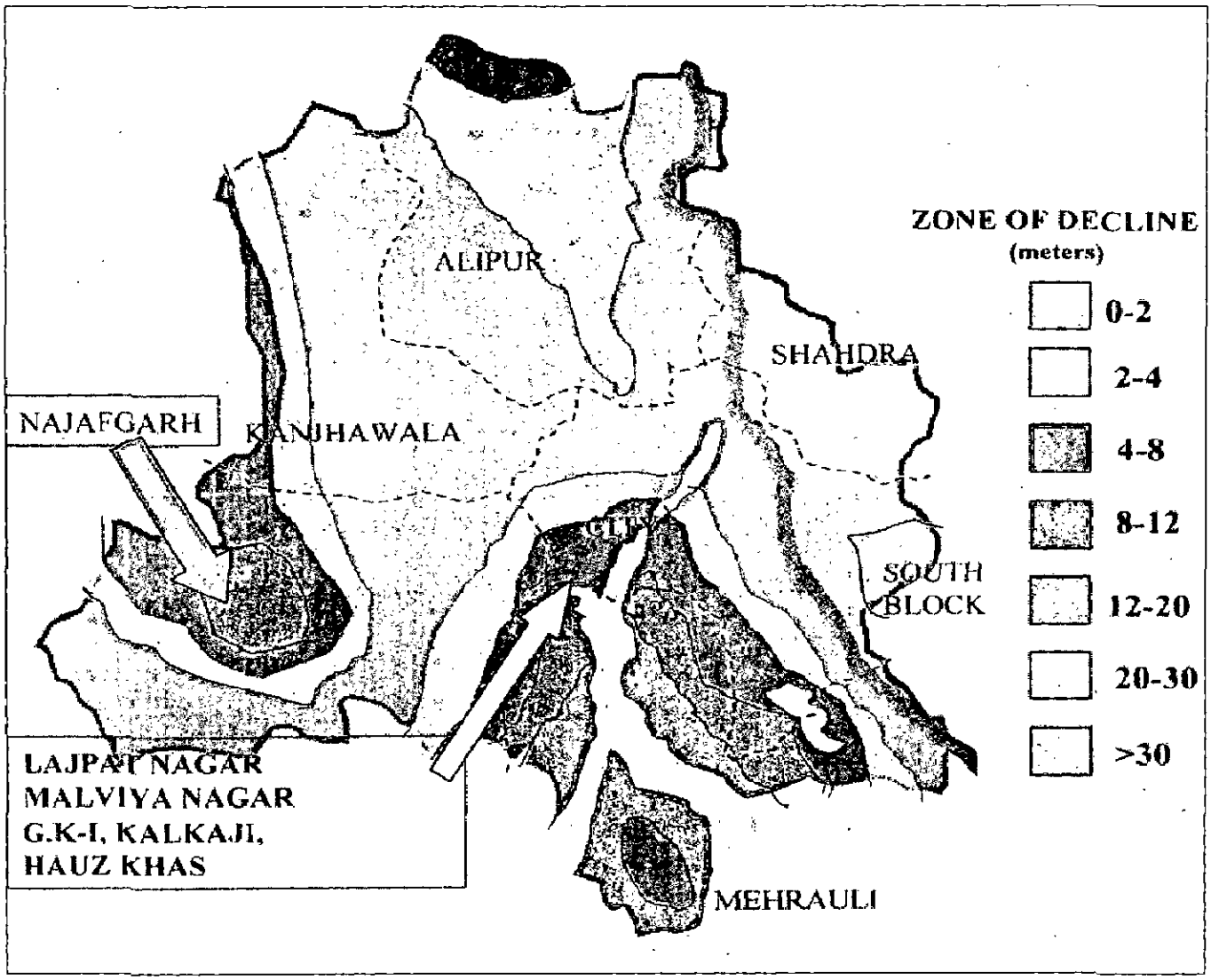
Map 3.5 Levels of Water Supply in Delhi

Source: Delhi Jal Board /NCRPB

3.8 Ground Water Situation

In order to meet water demand – supply gap ground water withdrawal in the NCT Delhi has emerged as a common place phenomenon resulting in the ground water levels falling in the range of 20 -30 meters below land surface in South and South – Western part of Delhi. Overexploitation of ground water has disturbed the hydrological balance leading to decline in productivity of wells, increasing pumping cost, more energy requirement and brackish water upcoming etc.

Map 3.6 Depletion of Ground Water Levels in Delhi



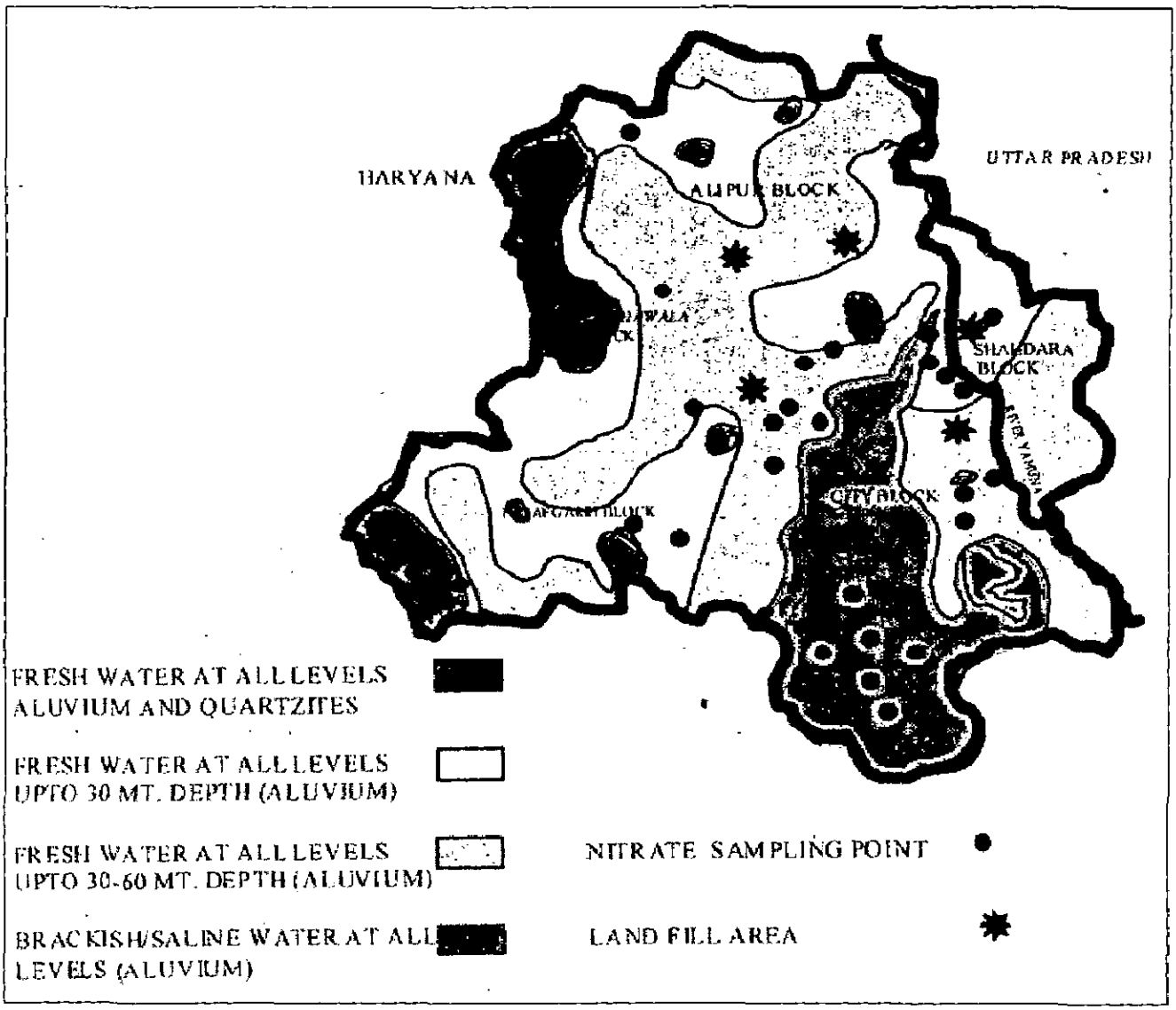
Source: Central Ground Water Board

3.8.1 Ground Water Quality:

Besides the quantity, quality of potable water is another serious concern as it directly affects the health of citizens. Instances have been noticed in the past where, in many places, the sewage water got mixed up with water supply thus contaminating it. The quality of ground water is also variable in space and depth. In the areas west of ridge comprising blocks Najafgarh, kanjhawala, Alipur, City (part), Mehrauli (part) the salinity of ground water generally increases towards South – West and North – West direction being fairly high in areas around Dhansa, Raota in South – West and Auchandi, Kanjhawala, Tikri Kalan in North – West. Occurrence of high nitrate concentration are at several locations i.e. Saboli

(Shahdara) and Kutabgarh (Kanjhawala) have nitrate concentration above 100 mg/l in ground water. Such high levels of nitrate concentration in shallow ground water could be due to leaching from solid wastes, discharge from sewage water etc. The ground water in vicinity of the landfill in Yamuna floodplains also has high nitrate concentration. Similarly Fluoride and other harmful chemical concentrations beyond permissible limits are observed in the ground water at several locations in Delhi.

Map 3.7 Ground Water Quality in Delhi



Source: Central Ground Water Board

3.9. TRANSMISSION, STORAGE AND DISTRIBUTION SYSTEM

The topography of Delhi is such that the difference between the highest and lowest elevation is about 50 meters. The water resources are at the lower levels of the Yamuna River and the various canals that supply raw water. This situation means that all the water has to be pumped to supply from the treatment plants. Booster " stations have been provided in the system where needed and for onward delivery in the distribution system.

3.9.1 Water Transmission

Water from the treatment plants is supplied continuously to the distribution zones via numerous transmission mains supplying various underground reservoirs each with its own booster pumping station for onward delivery to the distribution zones. There are three main in-line booster pumping stations in the transmission system. The total length of the transmission mains is 568 Kms.

The mains are classified by system according to the treatment plant from which they emanate. The diameters of the transmission mains range from 450mm to 1500mm. The Bhagirathi system ranges from 1100mm to 1200mm dia, the Haiderpur system from 1000mm to 1500mm dia, the Wazirabad system from 600mm to 1500mm dia and the Chandrawal system from 450mm to 1200mm dia.

3.9.2 Storage System

There are main reservoirs at 61 locations where underground tanks and associated booster pumping stations supply water to the various distribution systems. These underground reservoirs have a total storage capacity of 731.7ML.

3.9.3. Distribution System

The water distribution system in Delhi is more than a century old. The total length of the distribution system is 9,063 Km's. The water is distributed to the customers

either from the zonal reservoirs, booster pumping stations, overhead tanks or through direct tapping. The customers getting water from direct tapping to the transmission system obtain water for almost 24 hours per day, whereas the other customers generally get water for a few hours per day only. Since some of the mains are very old, replacement of water mains, particularly in the walled city, has been taken up by the Delhi Jal Board authorities. 1500 Km of mains have been planned to be replaces in the 10th five-year plan period.

Water distribution is undertaken in 21 revenue zones. These revenue or maintenance zones do not match with the physical supply zones, the precise-number of which could not be found out. However, official records consider that there are 61 major zones (one for each underground reservoir) and more than 400 minor zones as there are 492 distribution booster pumping stations.

3.9.4. Low supply areas

In areas with short supply of drinking water (because either the distribution system does not cover these areas or it fails to deliver water), the DJB supplies water through tankers. This arrangement also serves the unauthorized colonies where piped water supply has not been provided and also to slum and resettlement colonies.

3.9.5. Supply to unauthorized colonies and rural areas

Piped water supply is being provided to about 270 unauthorized colonies. Out of a total of 567 unauthorized and regulated colonies, 560 are being supplied with water. Piped water supply is also available in all 135 urban villages, with augmentation works being executed to cope with the growing population and falling underground levels. In all 44 resettlement colonies, piped water supply exists. Also, a total of 820 slum colonies have been covered with piped water supply.

3.10 Future Water Supply to Delhi

The future raw water supplies for Delhi are proposed to be augmented through the following sources:

1. Bhakra Storage
2. Sub – Surface water
3. Tehri Dam
4. Renuka Dam
5. Kishau Dam
6. Lakhwar Dam

Of the above, so for the first two sources are confirmed. To get water from Tehri Dam through Upper Ganga Canal, the work is under progress to lay the pipeline connecting Upper Ganga Canal to Sonia Vihar water treatment plant supply approximately 600 MLD of water.

Among the above proposed dams, Renuka and Kishau are under investigation to get clearance.

3.11 Projected Water Demand

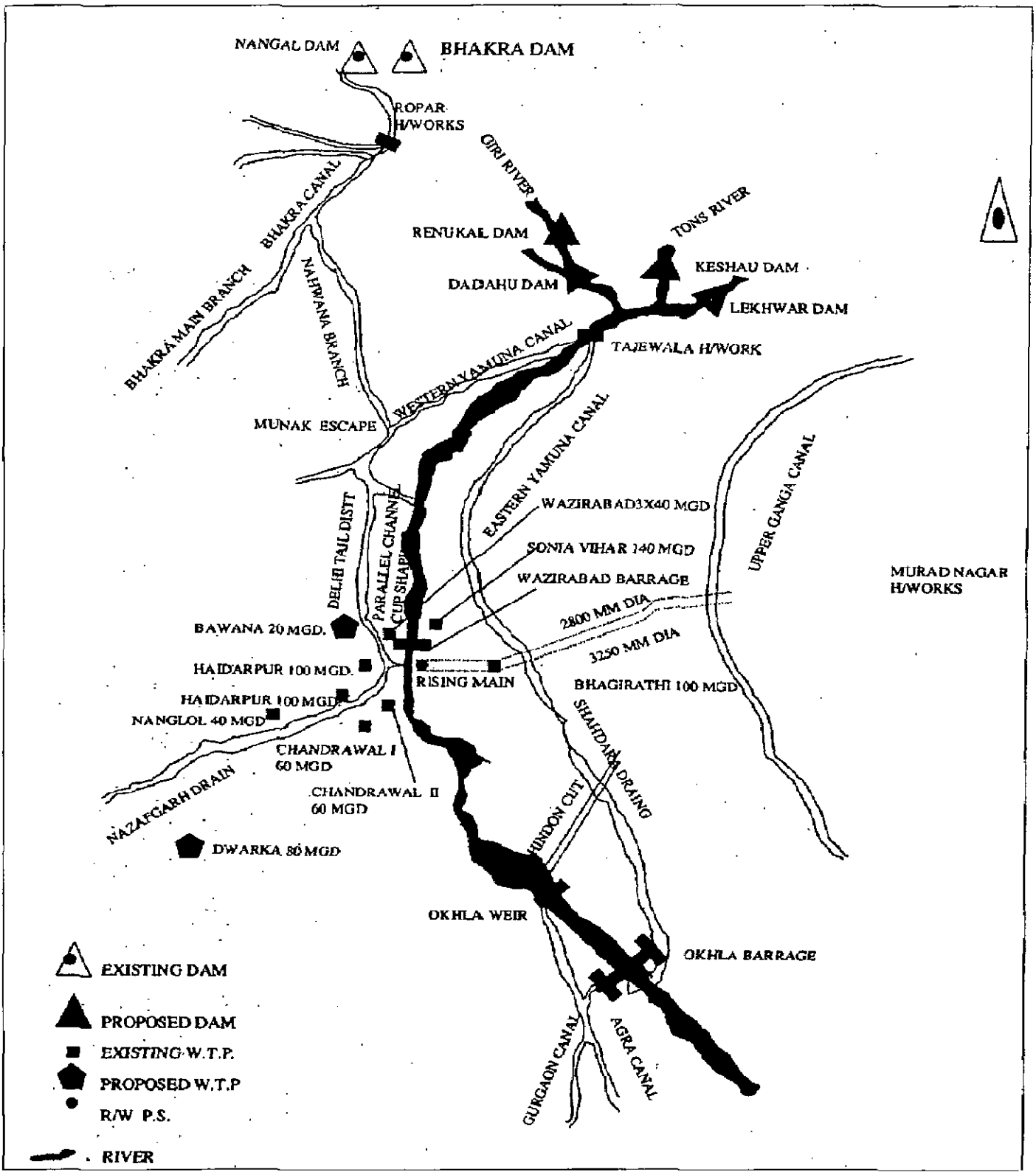
3.11.1 *Projected Water Demand In 2011*

The Delhi Jal Board anticipates that by the year 2011 about 1140 MGD potable water @ 60 gpcd for a population of 190 lacs shall be required. However, the DDA has projected the 2011 water demand as 1520 MGD @ 80 gpcd.

3.11.2 Projected Water Demand In 2021

The Delhi Jal Board anticipates that by the year 2021 about 1380 MGD potable water @ 60 gpcd tor population of 230 lacs shall be required. However, the DDA has projected the 2021 water demand as 1840 MGD @ 80 gpcd.

Map 3.9 Future Sources of Raw Water for Delhi



Source: WAPCOS

3.12 Steps taken by Delhi Jal Board to meet Current Water Demand

(i) Recycling of Waste Water at the Existing Water Treatment Plants:-

Delhi Jal Board has a proposal to recycle waste water of existing water treatment plants which will add about 46 MGD. Delhi Jal Board till now recycling the waste water of Haiderpur water treatment plant to increase the capacity by 16 MGD.

(ii) Extraction of Additional Sub-Surface Water: -

About 15 MGD can be extracted from flood plains of river Yamuna in NCT of Delhi in Palla region through a battery of remaining 30 tubewells as about 70 tube wells out of 100 tubewells as suggested by CG. W.B. has already been commissioned.

Still, there will be a shortfall of 179 MGD, which can only be met if additional raw water of about 360 cusec is allocated to Delhi during the lean period for which the Govt. of N.C.T. may approach Ministry of Water Resources, Govt. of India.

3.13 Policies made by Delhi Government for Efficient Water Management

Seeing to the gap in the present demand and supply and for the overall efficient management of water resources, the following policy decisions need to be taken/implemented on priority:-

(i) Regulation and control of under ground water:-

Presently, there is no control over the extraction of underground water except banning of new bore wells in selected pockets by C.O.W.A. This has led to depletion of water table at an accelerating pace and in future large area will be affected. Depletion of water table would lead to enhancement of demand from the DJ.B. it is, therefore, necessary to bring underground water under the purview of Delhi Jal Board on the lines of similar provision in Chandigarh. A draft bill namely the Delhi Water Board Act (Amendment) Act has been formulated and the same needs to be promulgated at the earliest.

the Delhi Water Board Act (Amendment) Act has been formulated and the same needs to be promulgated at the earliest.

(ii) Cost of enhancement:-

Marginal cost of further enhancements of water is going to be substantial, as it will involve construction of huge reservoirs in the form of dams, construction of conveyance system, construction of transmission, peripheral and distribution main and underground reservoirs in the city. At present, infrastructure development fund is being charged from the Developing Agencies for developed areas @ Rs.15/- per liter of average daily demand, but the same is not enough to finance the cost of the huge reservoirs and dams. So, it is necessary to enhance the same to finance the construction of dams and transmission of bulk/raw water. The quantum of levy and detail modalities can be worked out subsequently.

(iii) Prevention of wastage and theft of water: -

Wastage and theft of water will have to be curbed mercilessly. Suitable amendments are necessary in Delhi Water Board Act to provide for stringent measures for enforcing curbs on theft/wastage of water. Simultaneously, it would be necessary to evolve more intelligent system of leak detection and control which would require investments for metering at all levels, segregation of district metering areas, setting of up of pressure gauges etc.

Inferences:

1. The increase in population in Delhi does not allow the city to manage water supply problem. The demand of water in the city is beyond the capacity of the city.
2. There is unequal distribution of water supply in different areas of the city. In Cantonment area rate of water supply is 509 lpcd while that in Mehrauli is 29 lpcd.
3. The available water in Delhi is very less. About 290 mcm of water is imported from the Ganga, and Beas catchments. This is over a third of the total water resources of Delhi. If we include Tajewala barrage as a non – local catchment, this figure becomes even larger. The point is that water is scarce and people from these catchments will soon be demanding their rights. Furthermore, it is ecologically damaging to transfer water from outside river basins and catchments.
4. The large use of water from River Yamuna in lean period would result in disturbing ecological balance. This kills all life that sustain the quality of water in the river. Further, the huge volume of the effluent discharge of Delhi, over this entire period, collects on the river bed instead of being dispersed by the flow, causing the water and subsoil water to become dangerously toxic.
5. To fulfill current water demand, ground water extraction is on higher side. At present there is total withdrawal of ground water is 450 mcm per year whereas the amount being replenish is merely 150 mcm per year.

CHAPTER 4

STUDY AREA PROFILE

4.1 U.P. Sub region

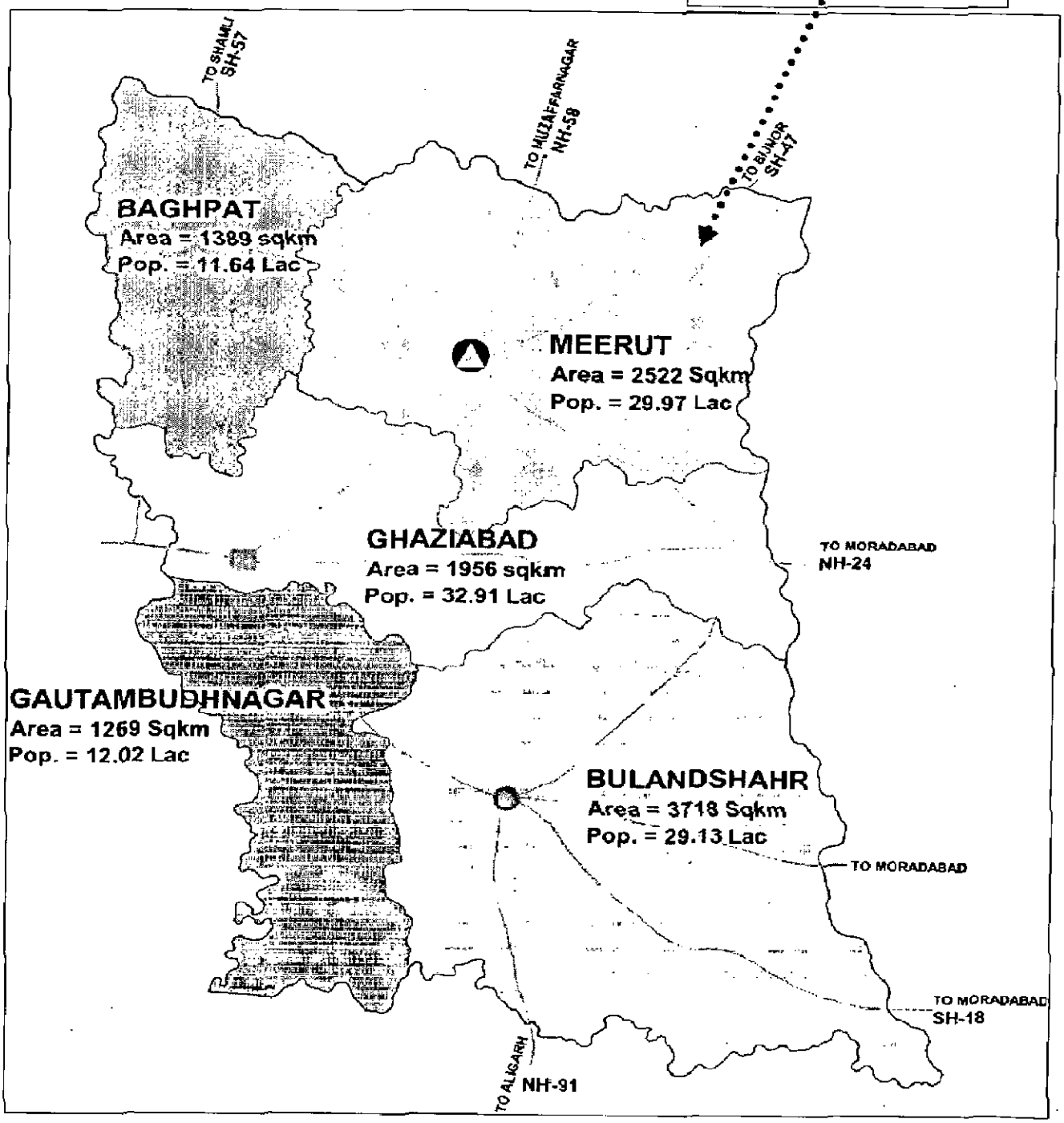
U.P. Sub region of NCR is the second largest part of NCR in terms of area as well as population. U.P. sub region has total area of 10,853 sq. kms. having population 1,15,67,090 out of which 46,31,703 (40%) is the urban population. This accounts for 4.5% (10,853 sq km) of the area of the state and 32.32% of the area of area of NCR. Being a good connectivity with National capital Territory, it has good scope of development.

4.1.1 Location

The region falls in the Eastern part of the NCR and Western part of Uttar Pradesh. On the West side it is surrounded by Haryana and Delhi. On the other sides, it is surrounded by other districts of Uttar Pradesh namely Muzzafarnagar district in the North, Bijnor, Muradabad and Budaun district in the East and Aligarh district in the South. It is well connected by rail and road network with major cities like Delhi- Dehradun by NH-58, Delhi-Muradabad – NH-24, Delhi – Aligarh –NH -91.

Map 4.1 Map of India

Map 4.2 Map of U.P. Sub Region



Map 4.3 U.P. Sub region & its Constituent areas showing Area and Population

4.1.2 Constituents of Sub region

U.P. sub region consisted of five districts namely Meerut, Ghaziabad, Bulandshahr, Gautam Budh Nagar and Baghbat districts in which Gautam Budh Nagar and Baghbat are newly built districts carved out from Ghaziabad & Meerut district respectively.

Table 4.1 District wise area, Population & Population Density

S.No.	District	Area in km	Total Population	Urban	Rural	Pop. density
1	Meerut	2522	29,97,361	1461983	1545378	1188
2	Ghaziabad	1956	32,90,586	1816415	1474171	1682
3	Gautambudh Nagar	1269	12,02,030	449415	752615	947
4	Bulandshahr	3718	29,13,122	674458	2238664	783
5	Baghpat	1389	11,63,991	229432	934559	833
	Total	**10,853**	**115,67,090**	**4631703**	**6945387**	**1066**

Source: Regional Plan-2021, NCR , Census of India, 2001

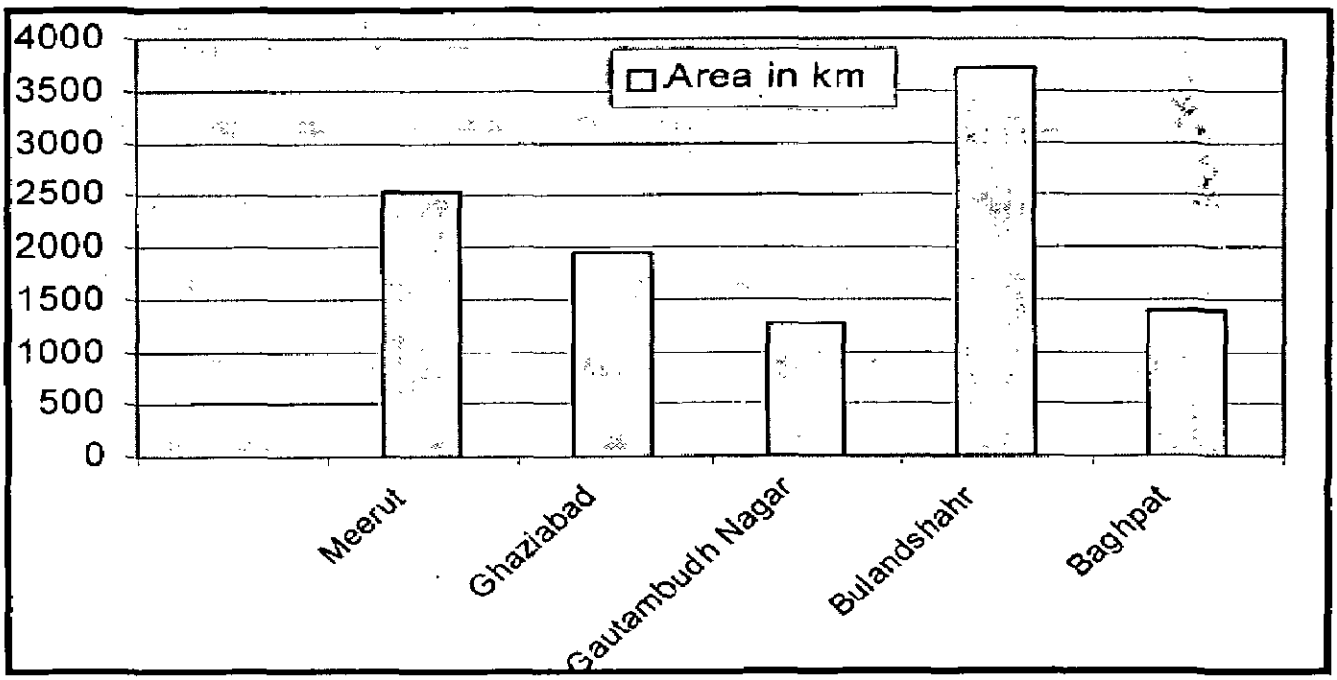
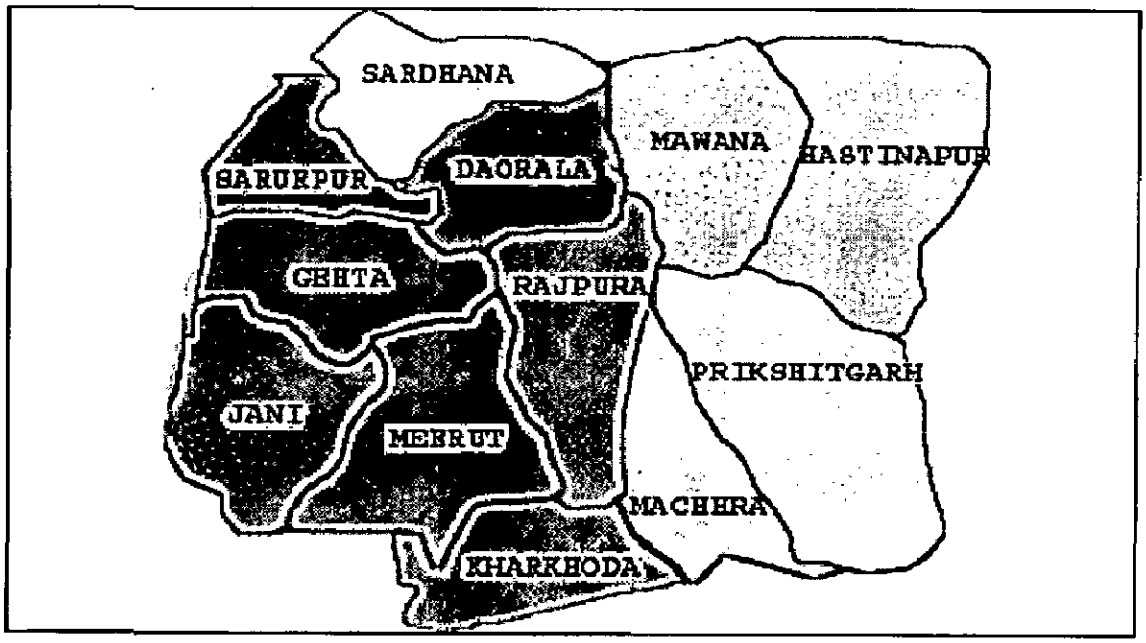


Fig 4.1 Area Comparison of areas of Constituent districts of U.P. Sub region

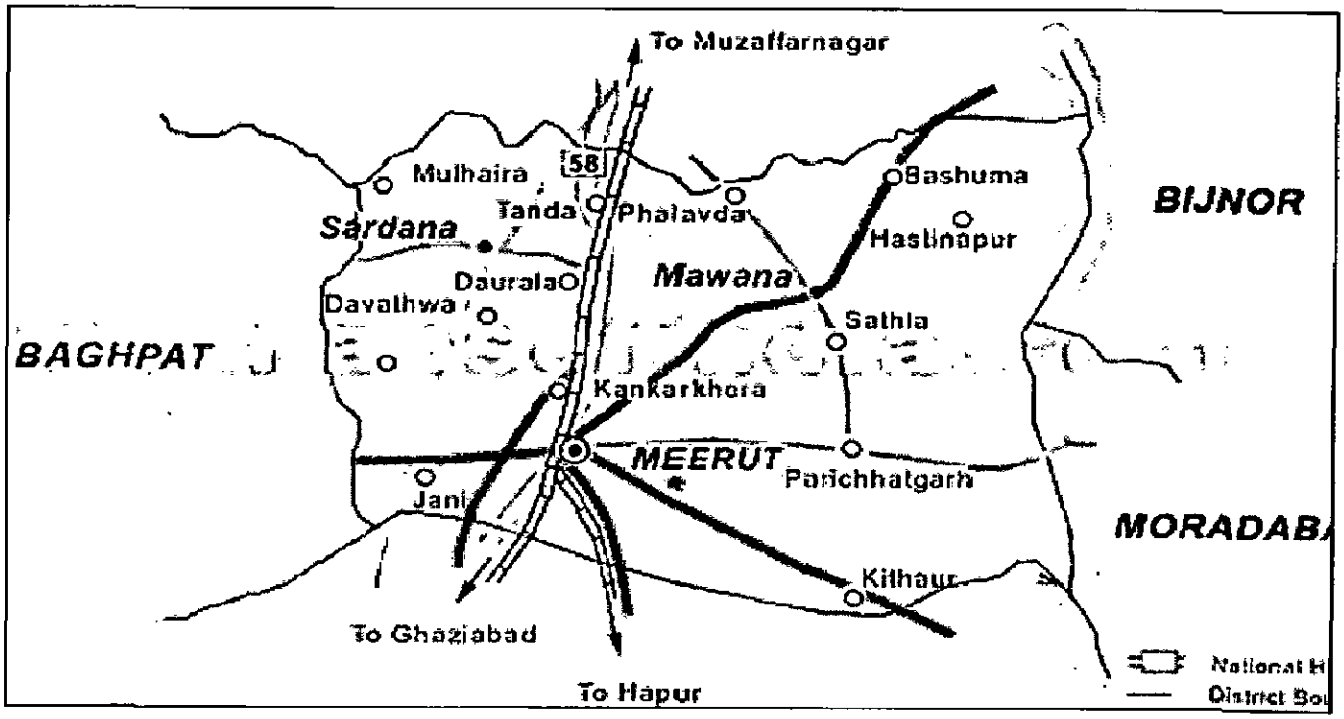
1) Meerut district

Meerut district, comprising of three tehsils- Meerut, Mawana and Sardhana, accounts for 23% (2522 Sq. km) of the total area of the Sub region consisting of 12 development blocks and 16 towns. It has 622 villages accounts for total rural population of 15,45,378 (52%).

Map 4.4 Map showing blocks of Meerut district



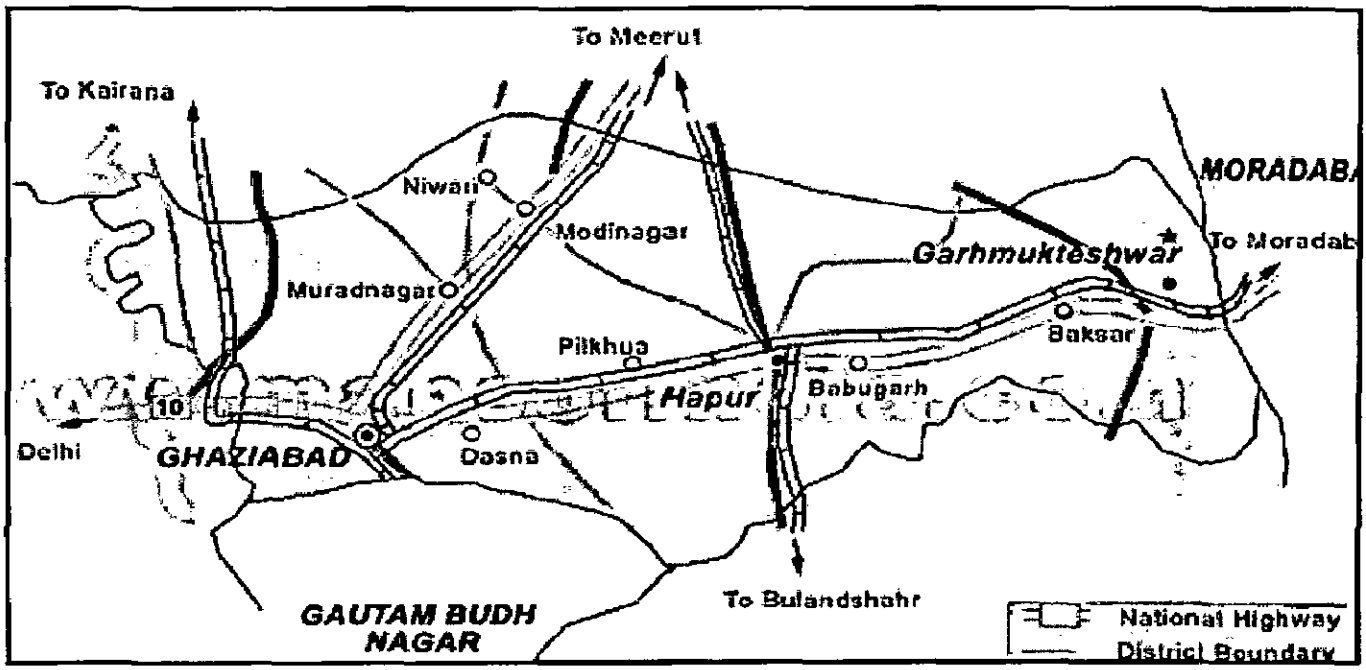
Map 4.5 Map showing Main urban centers of Meerut district



2) Ghaziabad district

Ghaziabad district, comprising of four tehsils- Modinagar, Ghaziabad, Hapur and Garhmukteshwar accounts for 18% (1956 sq.km) of the total area of Sub region consists of 8 development blocks and 17 towns. It has total 522 villages accounts for total rural population of 1474171 (45%).

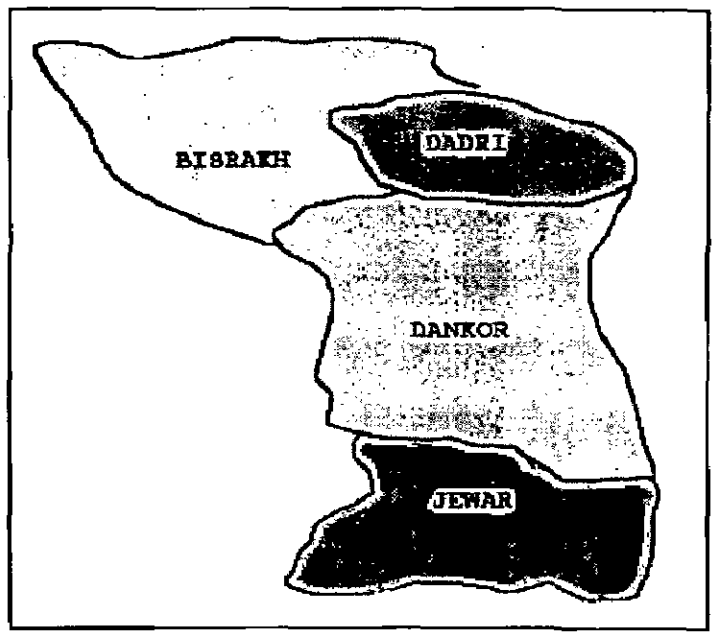
Map 4.6 Main Urban Centers of Ghaziabad District



Map 4.7 Blocks of Gautambudh Nagar District

3) Gautambudh Nagar district

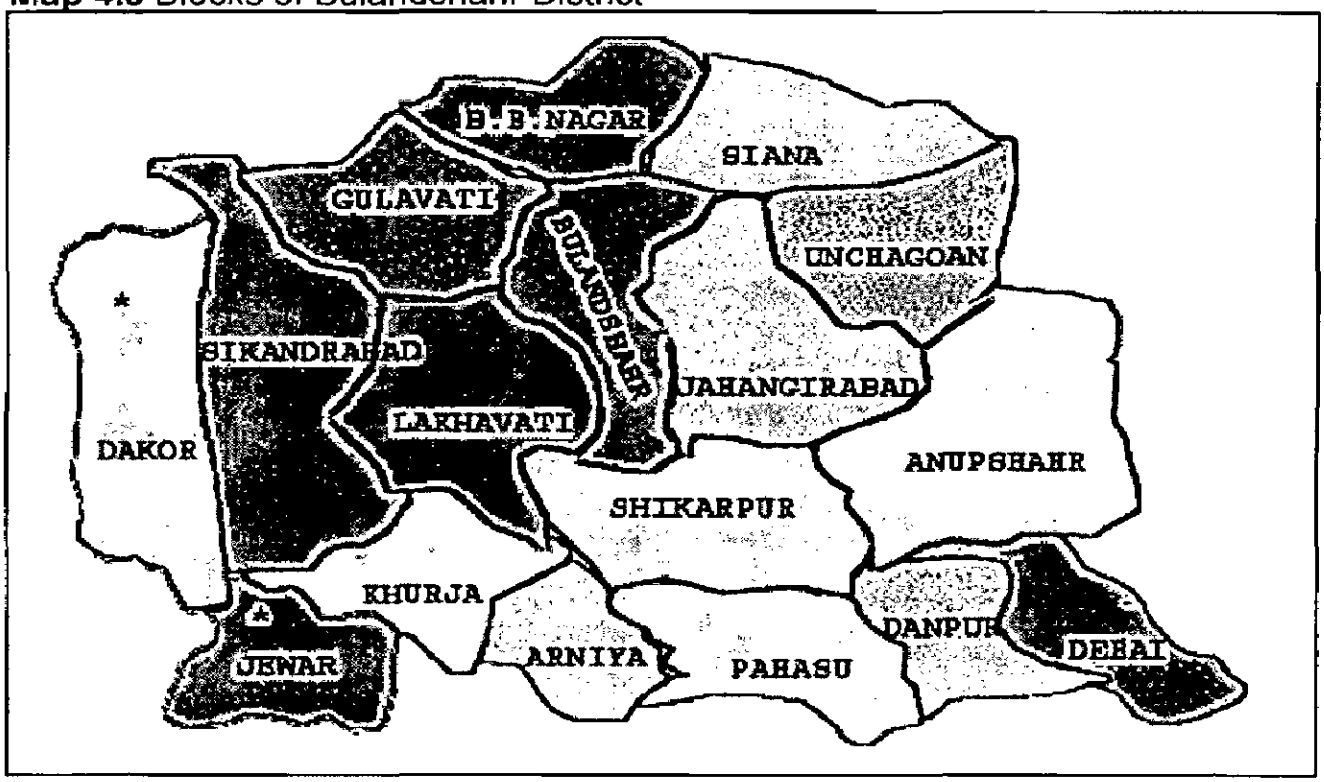
Gautambudh Nagar district, comprising of three tehsils - Dadri, *Gautambudh Nagar and Jewar* accounts for 12% (1269 sq.km) of the total area consists of 4 development blocks and 9 towns. It has 392 villages' accounts for total rural population of 752,615 (63%).



4) Bulandshahr district

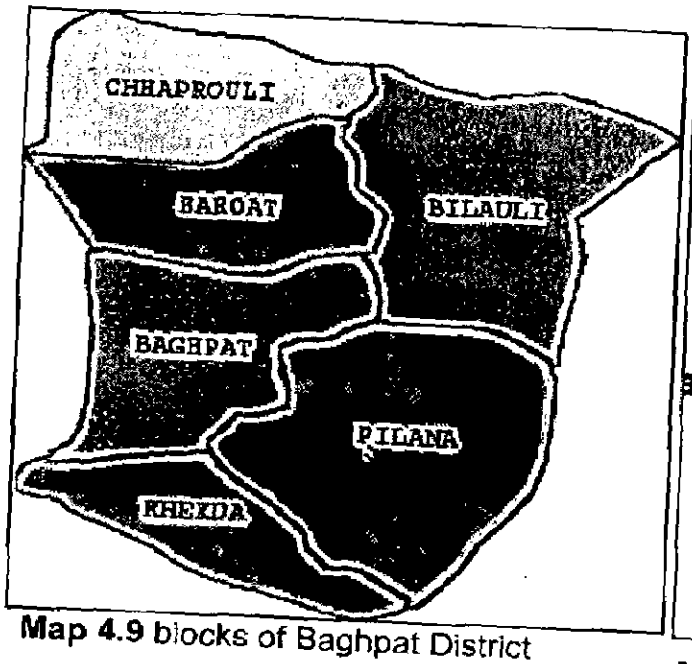
Bulandshahr district, comprising of seven tehsils – Sikandrabad, Bulanshahr, Siana, Anupshahr, Debai, Shikarpur and khurja accounts for 34% (3718 sq.km) of the total area consists of 15 development blocks and 16 towns making a total urban population of 674458 (23%). It accounts for highest area of all the districts in the Sub region. It has 1126 villages' accounts for total rural population of 2238664 (77%).

Map 4.8 Blocks of Bulandshahr District

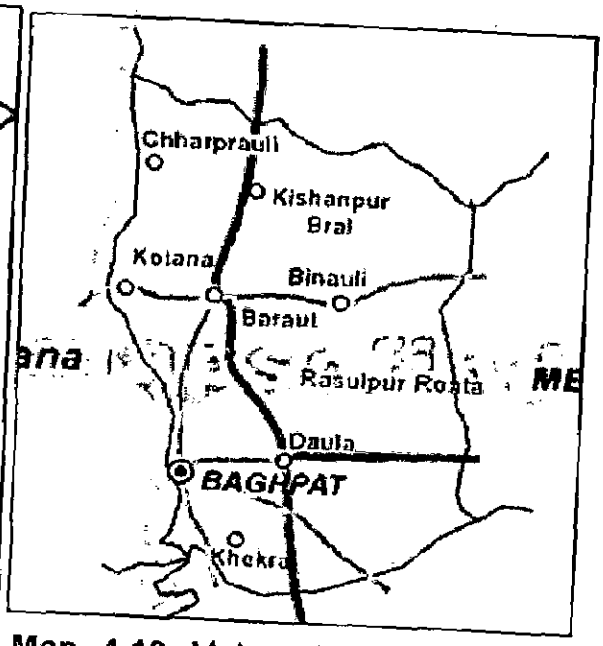


5) Baghpat District

Baghpat is the smallest district of Sub region, comprising of three tehsils – Baraut, Baghpat and khekada accounts for 13% (1389 sq. km) of the total area of Sub region consists of 6 development blocks and 8 statutory towns making a total urban population of 229,432 (20%). It has 290 villages' accounts for total rural population of 934559 (80%).



Map 4.9 blocks of Baghpat District



Map 4.10 Main urban centers of Baghpat

4.1.3 Climate

During the summers, the daytime temperature hovers around 40-45°C. Nights are relatively cooler and mercury dips to a comfortable 30°C. In winters the minimum temperature sometimes goes as low as 2-3°C but usually hovers in the range of 7-8°C. The average annual rainfall in the Sub region is 775--820 mm. Maximum rainfall occurs in in monsson season i.e in the month of july, August and September. It rains scantly during the monsoons as it falls in a semi-arid region. The annual average rainfall never goes beyond 400 millimeters

4.1.4 Topography

Geographically, U.P. sub Region lies between river Ganga on the East and Yamuna on the West and is within Ganga – Yamuna Doab. Almost all the area is plain and flat having a very little slope of 1-2 degree. This area is predominantly new alluvium (khader) and old alluvium (bhangar). New alluvium area is along different rivers in the form of fingers. The slope of the land is from North to South and east sides. The Sub region mainly has sandy and clay soils. In Bulandshahr and some parts of Khurja there are certain pockets of sandy soil which are

barren. Meerut and Ghaziabad districts are mainly covered by older alluvium with occasional alkaline efflorescence. The soil very close to rivers Yamuna and Ganga are sandy in nature.

Map 4.11 Physiography of the Sub Region

The Sub region has little slop towards South. The Sub Region is mainly divided into two physiographic zones. The upper part of the Sub region constituting three districts Baghpat, Meerut and Ghaziabad has a altitude of 600m from MSL while

lower portion of the Sub region constituting two district Gautambudh Nagar and Bulandshahr has an altitude of 200m from MSL.

4.1.5 Demographic Profile

The region has reported a total population of 115 lakh during 2001 inhibited in 63 urban centers and 3185 rural settlements. The urban population of the region is 63 lakh which is 48% of the total population of the region. The population density of the region is 1066 persons per sq. km. which is much higher than all India average of 324 and 689 of Uttar Pradesh.

(i) Population distribution

The Sub region's main constituent district, Ghaziabad has a maximum population of 32.9 lakhs being about 28.5% of the total population followed by Meerut with 25.9% and Bulandshahr with 25.2%. The urban population to the total population has been registered as 40% having a decadal growth rate (1991-2001) of 48%

(ii) Population growth rate

Table 4.2 Decadal Population Growth of Uttar Pradesh Sub–Region (1961-2001)

Year	Total		Rural		Urban	
	Population (Person)	Decadal Growth (%)	Population (Person)	Decadal Growth (%)	Population (Person)	Decadal Growth (%)
1961	44,50,172	---	36,71,496	---	7,78,676	---
1971	54,40,296	22.25	43,51,826	18.53	10,88,470	39.78
1981	69,68,646	28.09	50,19,579	15.34	19,49,067	79.06
1991	90,01,704	29.17	58,84,092	17.22	31,17,612	59.95
2001	115,67,090	28.53	69,45,387	18.21	46,31,703	48.02

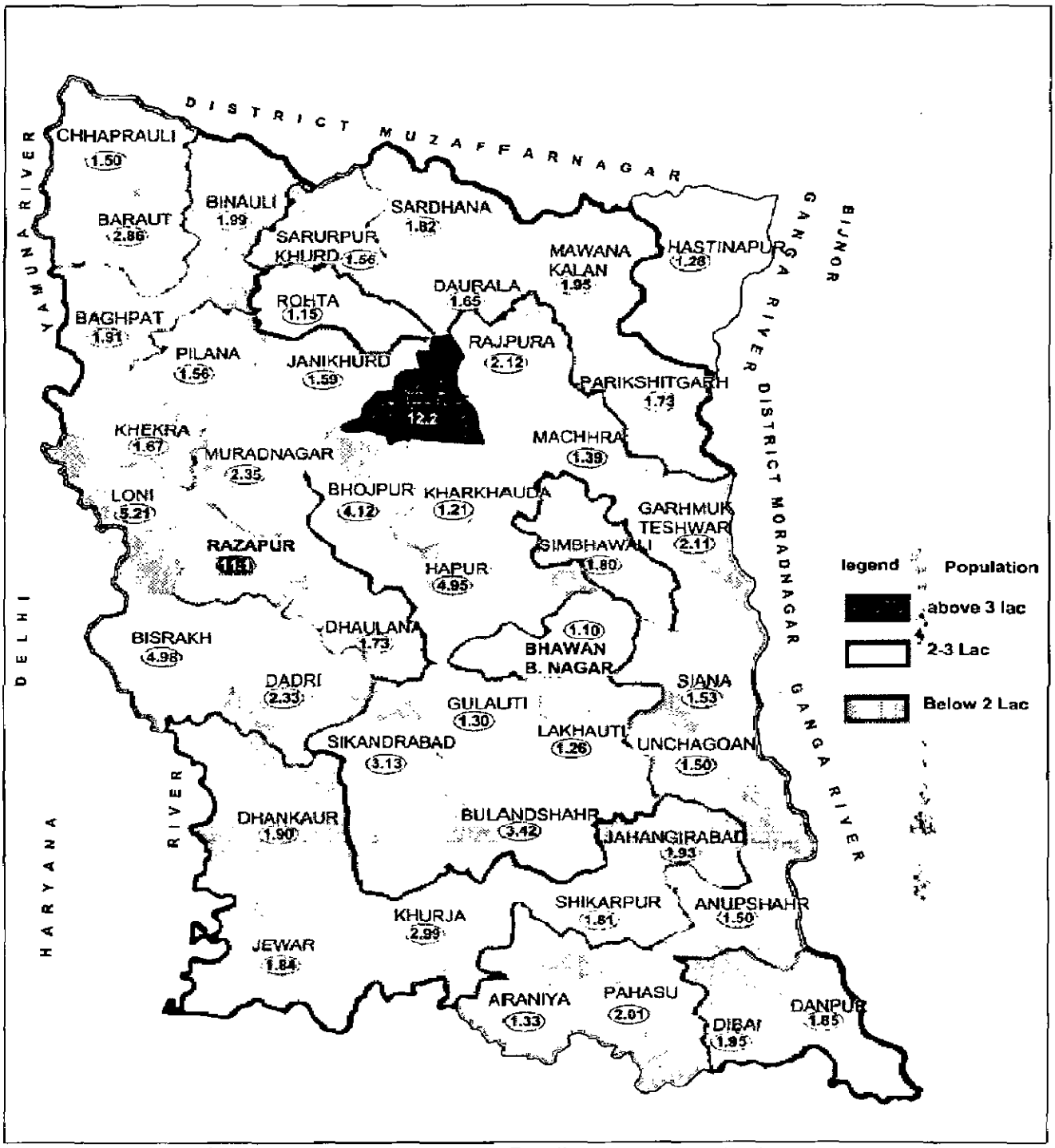
Source: Census 1961, 1971, 1981, 1991 and 2001, Census of India

Table: 4.3 Block wise Population Distribution (Urban & Rural) 2001

S.No.	Blocks	Population 2001		
		Rural	Urban	Total
1	Chhaprauli	132,209	17,798	150,007
2	Baraut	200,996	85,708	286,704
3	Baghpat	142,800	48,789	191,589
4	Pilana	146,229	10,112	156,341
5	Khekra	126,412	40,335	166,747
6	Binauli	185,913	13,263	199,176
7	Sarurpur Khurd	143,182	12,609	155,791
8	Sardhana	133,561	48,314	181,875
9	Daurala	135,998	28,720	164,718
10	Mawana kalan	126,137	69,191	195,328
11	Hastinapur	106,829	21,249	128,078
12	Parikshitgarh	155,575	17,369	172,944
13	Machra	139,083	0	139,083
14	Rohta	115,096	0	115,096
15	Janikhurd	140,748	18,451	159,199
16	Meerut	53,451	1,166,606	1,220,057
17	Rajpura	163,425	48,314	211,739
18	Kharkhoda	108,809	12,593	121,402
19	Bhojpur	167,715	244,819	412,534
20	Muradnagar	130,187	104,561	234,748
21	Razapur	120,739	992,690	1,113,429
22	Loni	271,466	249,287	520,753
23	Dhaulana	172,675	0	172,675
24	Hapur	276,904	217,922	494,826
25	Simbhawali	180,461	0	180,461
26	Garh Mukteshwar	177,508	33,847	211,355
27	Sikandrabad	242,808	69,867	312,675
28	Gulaothi	87,337	42,903	130,240
29	Lakhaothi	105,543	20,097	125,640
30	Bulandshahr	166,051	176,425	342,476
31	Shikarpur	147,771	33,187	180,958
32	B. B.Nagar	100,882	9,322	110,204
33	Syana	101,391	51,788	153,179
34	Jahangirabad	141,611	51,394	193,005
35	Khurja	200,059	98,610	298,669
36	Araniya	132,612	0	132,612
37	Pahasu	173,003	28,025	201,028
38	Unchagaon	136,015	13,761	149,776
39	Danpur	164,841	20,407	185,248
40	Dibai	160,548	34,877	195,425
41	Anupshahr	156,970	23,795	180,765
42	Dankaur	170,583	19,480	190,063
43	Jewar	134,101	49,572	183,673
44	Bisarakha	182,650	315,808	498,458
45	Dadri	175,682	57,416	233,098

Source: Census of India - 2001, Sankhiyka Patrika, Uttar Pradesh

Map 4.12 Block wise Population of U.P Sub region of NCR - 2001



Source: Census of India - 2001, Sankhiyka Patrika, Uttar Pradesh

(iii) Population density

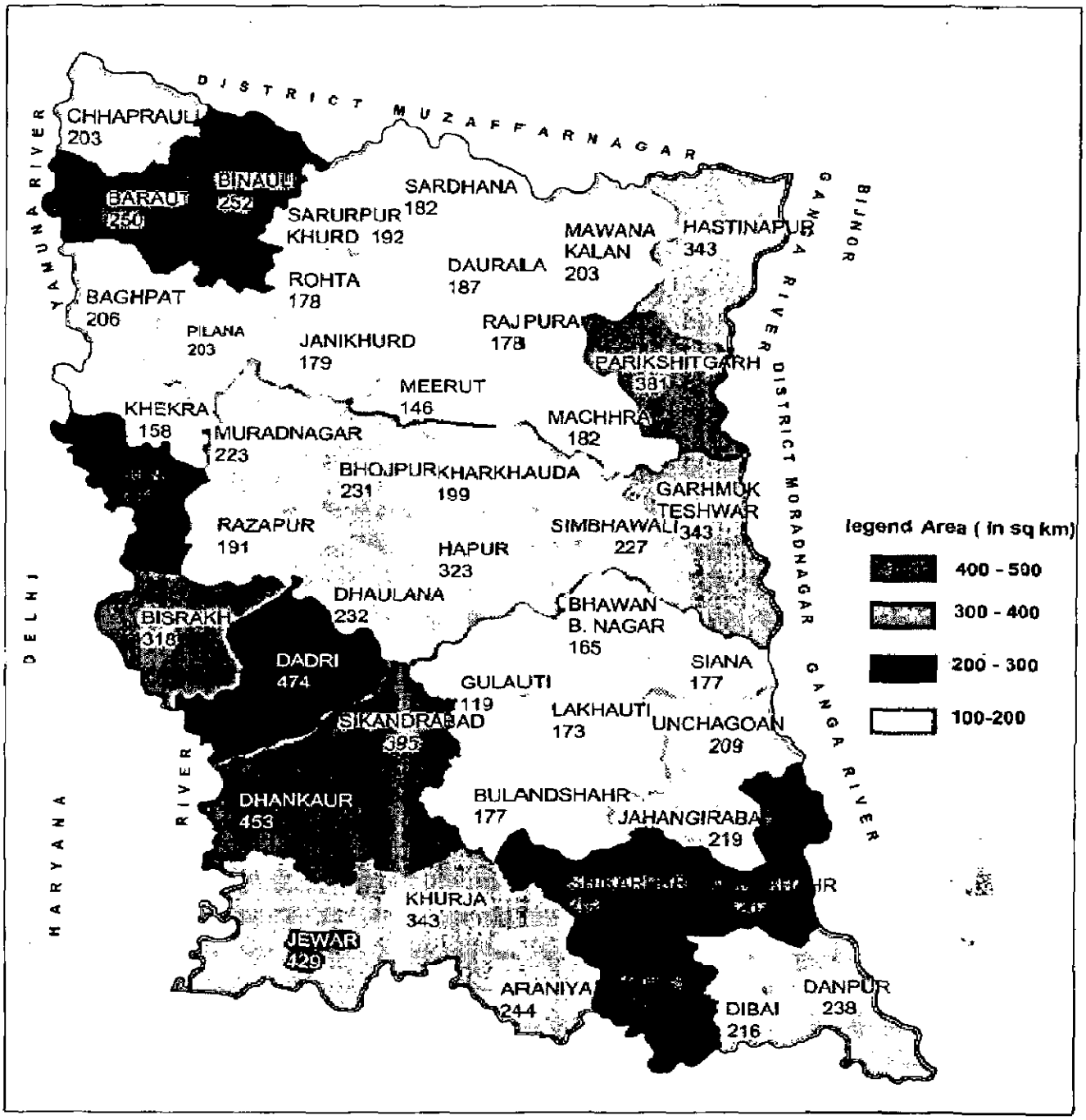
U.P. Sub region has a population density of 1066 persons per sq. km. which is much higher than all India average of 324 and 689 of Uttar Pradesh. The Sub region has the high population density due to economic development and rapid growth associated with its land being very fertile.

Table 4.4 Blockwise Area, Population and Population Density - 2001

S.No	Blocks	Area (in sq Km)	Population 2001	Pop. Density (per sq km
1	Chhaprauli	203.92	150,007	736
2	Baraut	250.52	286,704	1,144
3	Baghpat	206.23	191,589	929
4	Pilana	203.14	156,341	770
5	Khekra	158.79	166,747	1,050
6	Binauli	252.21	199,176	790
7	Sarurpur Khurd	192.2	155,791	811
8	Sardhana	182.19	181,875	998
9	Daurala	187	164,718	881
10	Mawana kalan	203.58	195,328	959
11	Hastinapur	343.28	128,078	373
12	Parikshitgarh	381.1	172,944	454
13	Machra	182.35	139,083	763
14	Rohta	178.45	115,096	645
15	Janikhurd	179	159,199	889
16	Meerut	146.75	1,220,057	8,314
17	Rajpura	190.61	211,739	1,111
18	Kharkhoda	199.12	121,402	610
19	Bhojpur	231.87	412,534	1,779
20	Muradnagar	223.67	234,748	1,050
21	Razapur	191.55	1,113,429	5,813
22	Loni	261.45	520,753	1,992
23	Dhaulana	232.71	172,675	742
24	Hapur	323.2	494,826	1,531
25	Simbhawali	227.97	180,461	792
26	Garh Mukteshwar	343	211,355	616
27	Sikandrabad	395.24	312,675	791
28	Gulaothi	119.43	130,240	1,091
29	Lakhaothi	173.42	125,640	724
30	Bulandshahr	177.52	342,476	1,929
31	Shikarpur	262.96	180,958	688
32	B. B.Nagar	165.31	110,204	667
33	Syana	177.85	153,179	861
34	Jahangirabad	219.25	193,005	880
35	Khurja	343.26	298,669	870
36	Araniya	243.97	132,612	544
37	Pahasu	275.9	201,028	729
38	Unchagaon	209.27	149,776	716
39	Danpur	238.53	185,248	777
40	Dibai	216.31	195,425	903
41	Anupshahr	262.77	180,765	688
42	Dankaur	452.78	190,063	420
43	Jewar	428.99	183,673	428
44	Bisarakha	318.25	498,458	1,566
45	Dadri	473.82	233,098	492

Source: Census of India - 2001, Sankhiyka Patrika, Uttar Pradesh

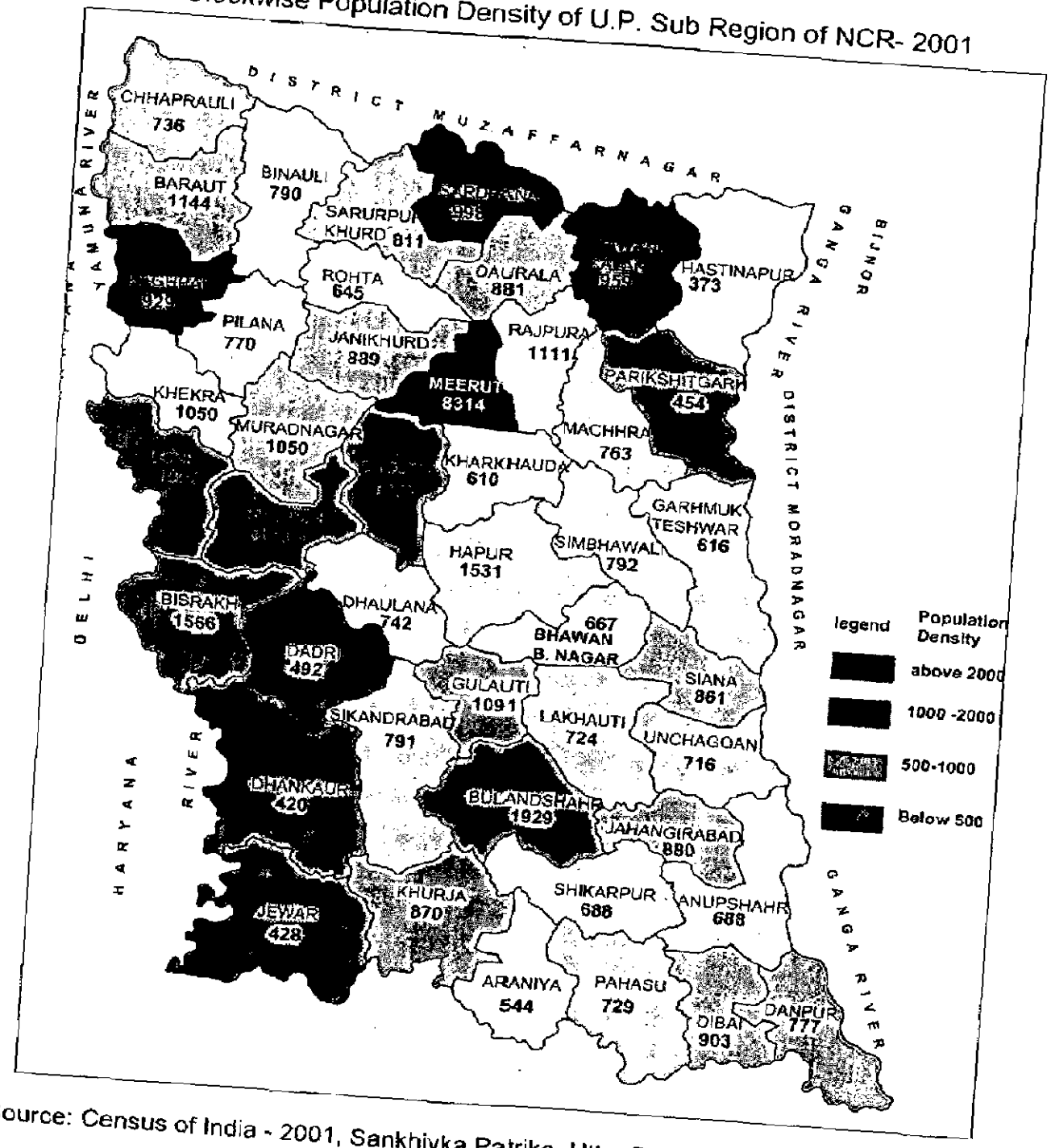
Map 4.13 Block wise Area of U.P Sub region of NCR



Source: Census of India - 2001, Sankhiyka Patrika, Uttar Pradesh

In U.P. Sub region, maximum blocks having area between 200 – 300 sq. km. There are only three blocks i.e also in Gautambudh Nagar district having area more than 400 sq.km., in which Dadri block have the highest area of 474 sq. km. Gulauti block in Bulandshahr district have the lowest area of all blocks i.e. 119 sq. km.

Map 4.14 Blockwise Population Density of U.P. Sub Region of NCR- 2001



Source: Census of India - 2001, Sankhiyka Patrika, Uttar Pradesh

According to 2001 census, there were two blocks namely Meerut and razapur having population density above 2000, Meerut having highest of 8314 person per sq. km. This is due to high urbanisation in these two blocks having cities Meerut in Meerut block and Ghaziabad in Razapur block. These two cities are growing at a very fast pace.

4.1.6 Settlement Pattern

(i) Urban Settlements

The number of urban settlements in the NCR region increased from 94 in 1981 to 108 in 2001. The number of metropolitan cities (more than 10 lakhs) in the region increased from one (Delhi) in 1991 to three (Delhi, Meerut and Faridabad) in 2001. The population of Ghaziabad, taken together with the population of Loni town also reached the one million mark. There are 63 urban settlements in Uttar Pradesh Sub-region and 7 Class-I urban centers.

Table 4.5 Urban Settlement in U.P. sub region as compared with NCR

Urban Settlement	U.P. Sub Region	NCR
Class – I (100,000+)	7	17
Class – II (50,000 -99,999)	9	9
Class – III (20,000 -49,999)	15	27
Class – IV (10,000 -19,999)	23	38
Class – V (5,000 -9,999)	8	15
Class – VI (below 5,000)	1	2
Total	**63**	**108**

Source: Census Regional Plan – 2021, NCR

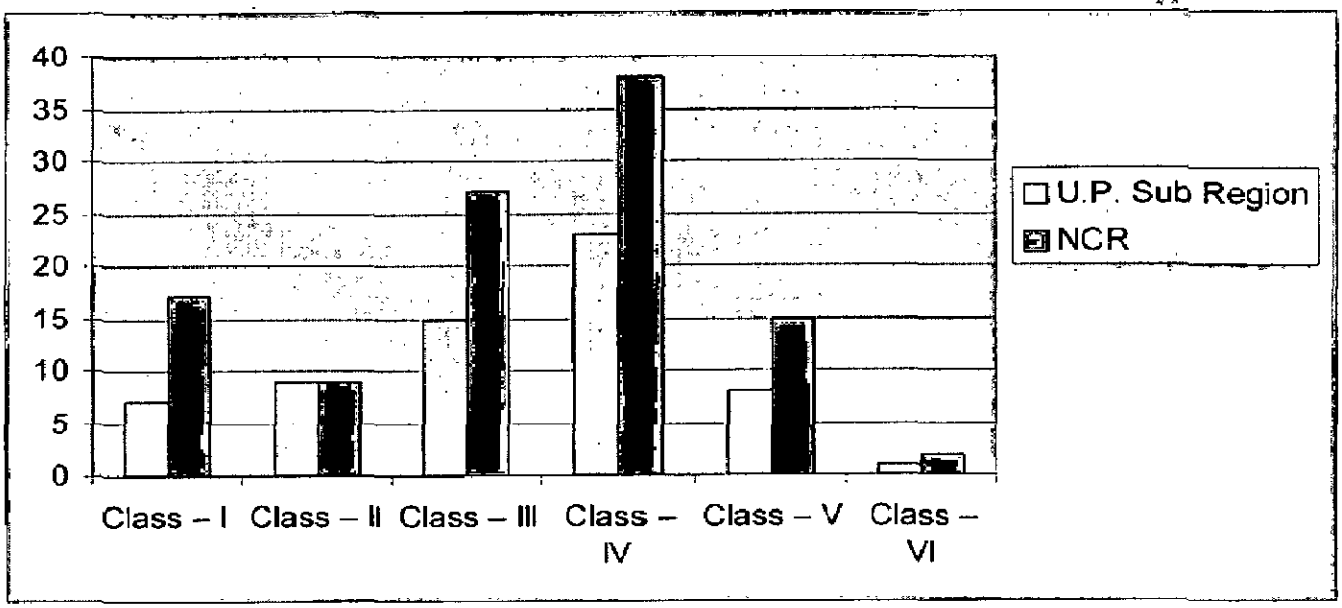


Fig. 4.2 Urban Settlement in U.P. Sub region as compared with NCR

Table 4.6 Urban Settlement in U.P. Sub region with Decadal Growth and Projected Population

Sub District/ Tehsil	Sub region/ City/Town	Class	Population			Decadal Growth		Projected Pop.	
			1981	1991	2001	1981-1991	1991-2001	2011	2021
Baraut	Baraut (MB)	II	46292	67705	85708	46.26	26.59	107932	135920
	Tikri (NP)	IV	11315	12784	13427	12.98	5.03	16258	19685
	Doghat (NP)	IV	10019	12310	13263	22.87	7.74	16139	19637
	Chhaprauli (NP)	IV	13805	16008	17798	15.96	11.18	21793	26684
Baghpat	Baghpat (MB)	III	17157	24939	36384	45.36	45.89	47458	61902
	Agarwal Mandi (NP)	IV	9353	10871	12405	16.23	14.11	15271	18798
Khekada	Khekada (NP)	III	24984	35191	40335	40.85	14.62	49698	61235
	Aminagar Sarai (NP)	IV	6837	8274	10112	21.02	22.21	12633	15782
Meerut	Meerut (M Corp.)	I	536615	849799	1161716	58.36	36.7	1490153	1911444
	Sewalkhas (NP)	IV	10278	14402	18451	40.12	28.11	23300	29423
	Kharkhoda (NP)	IV	8708	10550	12593	21.15	19.36	15651	19452
	Aminagar (CT)	V	-		5500			6881	8634
	Mohiuddinpur (CT)	VI			4890			6118	7677
Sardhana	Karnawal (NP)	IV	9895	11047	12609	11.64	14.14	15523	19109
	Sardhana (MB)		30138	42980	48314	42.61	12.41	59291	72762
	Daurala (NP)	IV	9146	10025	10685	9.61	6.58	12974	15754
	Lawar (NP)	IV	11535	14471	18035	25.45	24.63	22631	28397
Mawana	Mawana (MB)	II	37620	51701	69191	37.43	33.83	88289	112658
	Kithaur (NP)	III	13791	19270	23614	39.73	22.54	29519	36900
	Hastinapur (NP)	III	11637	15081	21249	29.6	40.9	27465	35501
	Bahsuma (NP)	IV	7906	9060	10561	14.6	16.57	13059	16148
	Parikshitgarh (NP)	IV	11328	13677	17369	20.74	26.99	21889	27585
	Phalauda (NP)	IV	10357	13970	17206	34.88	23.16	21533	26948
Modi nagar	Modinagar (MB)	I	87665	123279	113218	40.63	13.51	172063	211578
	Muradnagar (MB)	II	26047	44395	74151	70.44	67.03	100515	136253
	Bisokhar (CT)	IV			10476				
	Begumabad (CT)	IV			16235				
	O.F.Muradnagar (CT)	IV	9026	12792	10756	41.72	-15.92	12536	14611
	Faridnagar (NP)	IV	9116	10940	11272	20.01	3.03	13599	16406
	Niwari (NP)	V	7078	8841	9921	24.91	12.22	12171	14931
	Patala (NP)	V	7847	9181	9733	17	6.01	11806	14320
Ghazia--bad	Ghaziabad (M Corp.)	I	287170	511759	968256	78.21	89.2	1366611	1928856
	Loni (NP)	I	10259	36561	120945	256.38	230.8	220926	403558
	Behta Hajipur (CT)	II	4058	30360	94298	648.15	210.6	166028	292320
	Dharoti Khurd (CT)	III			34044			42595	53445
	Dasna (NP)	III	13037	16963	24434	30.11	44.04	31764	41292

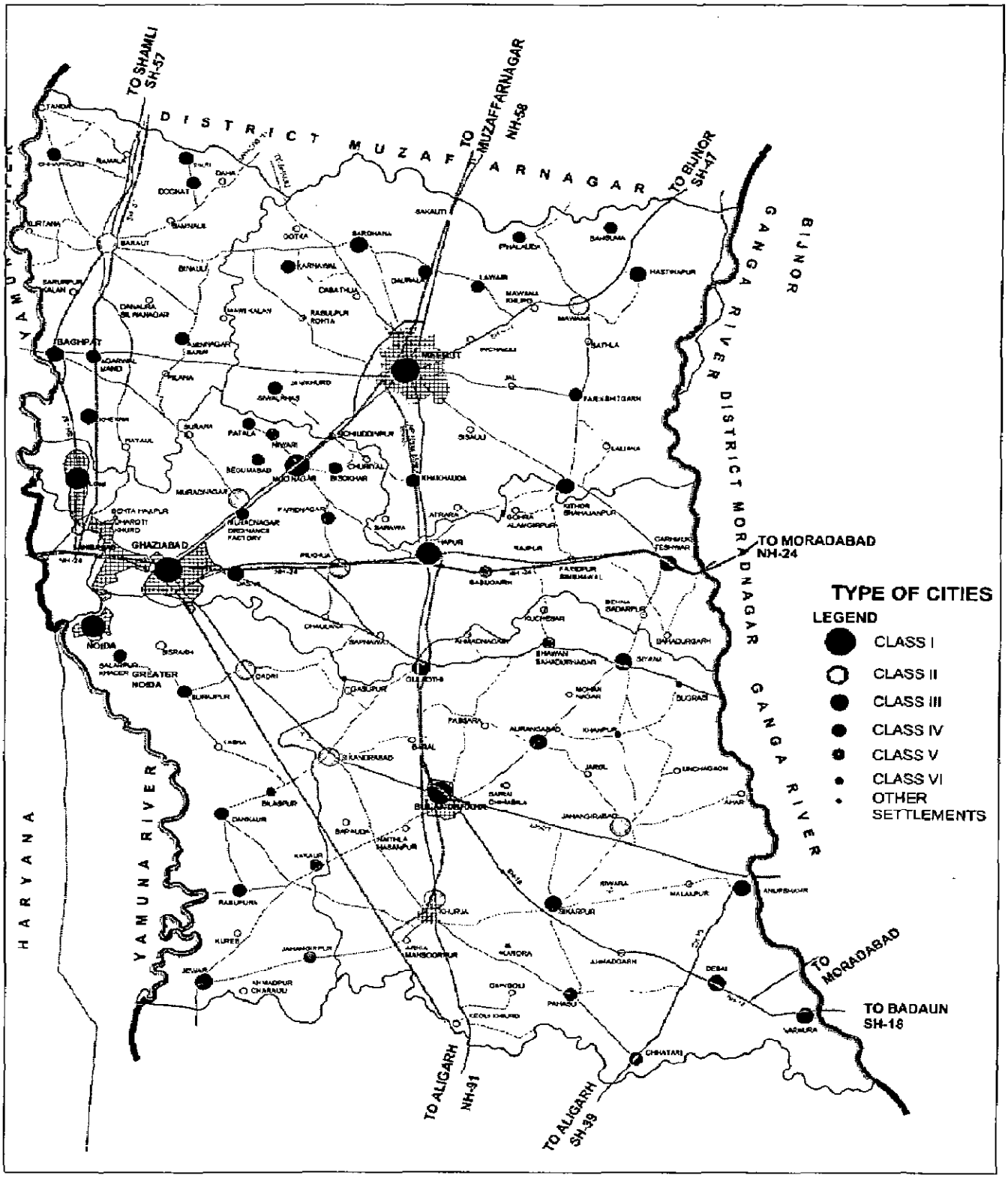
Hapur	Hapur (MB)	I	102837	146262	211983	42.23	44.93	276020	359402
	Pilkhuwa (MB)	II	37884	50162	66907	32.41	33.38	85305	108762
	Babugarh (NP)	V	2389	3581	5939	49.9	65.85	8033	10866
Garhmuk teshwar	Garhmukteshwar (MB)	III	17914	25241	33847	40.9	34.1	43210	55164
Dadri	Noida (CT)	I	37000	146514	305058	295.98	108.21	445731	651274
	Dadri (MB)	II	19723	32883	57416	66.72	74.61	78912	108456
	Salarpur Khadar (CT)	IV			10750			13450	16876
Gautam budh nagar	Dankaur (NP)	IV	7935	9531	11999	20.11	25.89	15091	18980
	Bilaspur (NP)	V	4661	6127	7481	31.45	22.1	9344	11671
Jewar	Jewar (NP)	III	15275	21376	27016	39.94	26.38	34009	42811
	Rabupura (NP)	IV	8999	10769	13046	19.67	21.14	16267	20283
	Jahangirpur (NP)	V	6447	8206	9510	27.28	15.89	11745	14505
	Kakod (NP)	V	4299	5838	7139	35.8	22.29	8920	11145
Sikandra--bad	Sikandrabad (MB)	II	43135	60992	69867	41.4	14.55	86076	106044
Buland--shahr	Bulandshahr (MB)	I	103436	127201	176425	22.98	38.7	227126	292398
	Aurangabad (NP)	III	11622	15402	20097	32.52	30.48	25488	32326
	Gulaothi (MB)	III	24416	33982	42903	39.18	26.25	53995	67954
Siana	Siana (MB)	III	22410	29888	38999	33.37	30.48	49461	62730
	Bugrasi (NP)	IV	8307	11093	12789	33.54	15.29	15777	19463
	Khanpur (NP)	IV	8311	11420	13761	37.41	20.5	17138	21344
	Bhawan Bahadur Nagar (NP)	V	*6779*	*9101*	*9322*	*34.25*	*2.43*	*11234*	*13538*
Anupshahr	Jahangirabad (MB)	II	29301	37981	51394	29.62	35.32	65757	84135
	Anupshahr (MB)	III	15193	19684	23795	29.56	20.88	29655	36959
Debai	Debai (MB)	III	22430	27721	34877	23.59	25.81	43859	55153
	Naraura (NP)	III	9573	15652	20407	63.5	30.38	25877	32812
Shikarpur	Shikarpur (MB)	III	21499	29197	33187	35.81	13.67	40820	50209
	Pahasu (NP)	IV	9016	13127	17122	45.6	30.43	21713	27536
	Chhatari (NP)	IV	5862	8202	10903	39.92	32.93	13890	17694
Khurja	Khurja (MB)	II	67119	80305	98610	19.65	22.79	123324	154233
Total			**1937499**	**2998919**	**4535995**			**6081367**	**8224408**

Source: Census of India 2001, Regional Plan – 2021, NCR

(ii) Rural Settlements

According to the Census 2001, there are 7,528 rural settlements of various sizes in the National Capital Region. Of these, 3,185 are in Uttar Pradesh Sub-regions. More than 162 lakhs persons lived in rural areas in NCR in 2001, accounting for about 44% of its population.

Map 4.15 Urban Settlements in the Sub Region



Source: Regional Plan – 2021, NCR, U.P. Su –regional Plan -2001, Toposheets of Meerut, Ghaziabad, Baghpat, Gautambudhnagar & Bulandshahr district,

CHAPTER 5

WATER SUPPLY IN U.P. SUB REGION

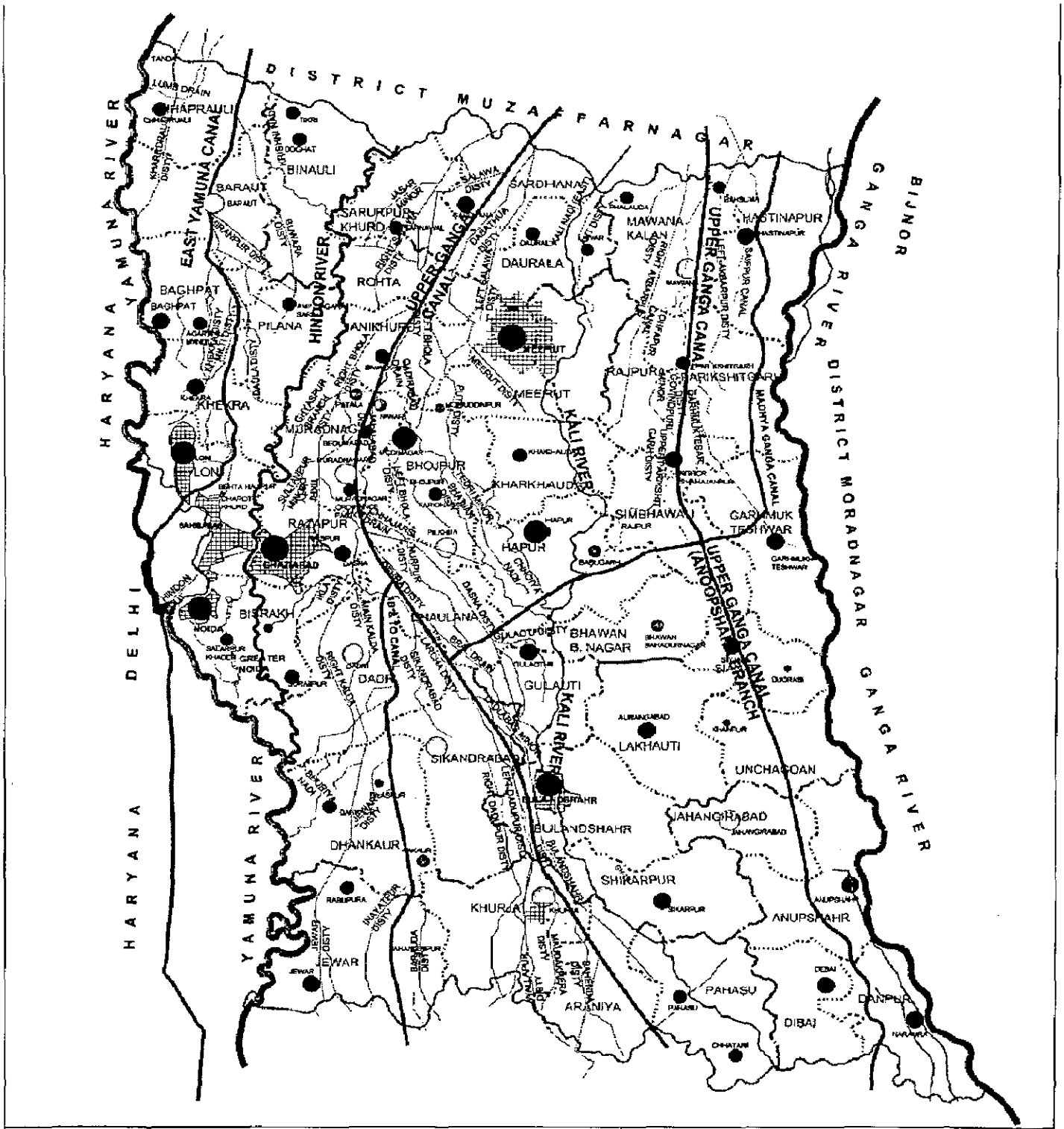
PRESENT SCENARIO

5.1 Surface Water Sources

The U.P. Sub Region is endowed with adequate water resources. The main sources of water supply in the Sub – Region are rivers and canals. The main rivers of the Sub-region are as follow:

1. **Ganga River:** It flows on the eastern boundary on the sub region touching Meerut, Ghaziabad and Bulandshahr district. Out of these districts, it mainly flows inside in Meerut district especially in Hastinapur and Parikshitgarh blocks of Meerut district.
2. **Yamuna River:** It flows on the Western boundary of the sub region touching Baghpat, Ghaziabad and Gautambudh Nagar district.
3. **Kali Nadi:** It is basically originate as nalla from Khatauli in Muzzafarnagar district and mix up with other local nallas in the sub region to make it a small river. It flows through Meerut, Ghaziabad and Bulandshahr districts of the sub region and lastly merges with Ganga River in Farukhabad district. It generally takes the sewerage of Meerut, Hapur, Bulandshahr and Khurja.
4. **Hindon:** It originates from the hills of Dehradun and flowing through Saharanpur and Muzzarnagar districts of Uttar Pradesh, enter to the Baghpat district of the Sub region where it combine with Karsuni River near Binauli. Kali wist also join it at the boundary of the sub region.

Map 5.1 Surface Water Sources in the Sub Region



LEGEND

- SUB REGIONAL BOUNDARY
- BLOCK BOUNDARY
- CITY BOUNDARY
- RIVER
- CANAL
- DISTRIBUTRIES
- CLASS- I CITIES
- CLASS II CITIES
- CLASS III CITIES
- CLASS IV CITIES
- CLASS V CITIES
- CLASS VI CITIES

TITLE:

SURFACE WATER SOURCES IN U.P. SUB - REGION OF NCR

NORTH

The canals which Irrigate sub region are as follow:

1. Eastern Yamuna Canal: It originates from Yamuna River near Bhogriwala in Saharanpur district. It flows through Baghpat and Ghaziabad district of the sub - region. Through Loni, it goes out of the sub –region. It takes the shortest span in the sub region.

2. Upper Ganga Canal: The construction of Upper Ganga Canal was conceived & constructed by Proby T. Cautley during the period 1840-1854. In the beginning one of the branches of river - a natural channel flowing near Haridwar - was made use of to divert practically the entire winter flow by construction of temporary obstructions across other branches. The UGC system then comprised 910 km of main canal and branches and 5280 km of distributaries to provide irrigation facilities in the district of Saharanpur, Muzaffarnagar, Meerut, Bulandshaher & Aligarh; total area irrigated annually being 0.7 million hectares. The canal with a head discharge of 190 cumecs (6750 cusecs) presently provides irrigation in a gross command area of about 20 lakh ha. in 10 districts of Western Uttar Pradesh. There are 4 major cross drainage works in initial 36 kms of the main canal. In the revised proposal, the canal has to carry an increased discharge of 295 cumecs (10419 cusecs). The maximum capacity of the canal in head reaches is proposed to be as 370 cumecs (13068 cusecs) which includes 20% extra inflow for silt ejector. The main branches of UGC are: -

1. Deoband branch
2. Anupshahar branch
3. Mat branch
4. Hathras branch; taking off from Mat branch.

Table 5.1 Share of Various Canal Division of U.G.C. During Kharif & Rabi

Name of Division	Period I (1/4 - 19/5)	Period II 20/5 - 17/6	Period III (18/6 to start of Monsoons	Period IV Monsoons to 30/12
Muzaffarnagar Div.	32.8	25.1	25.9	16.0
Anupshahr branch Div. Meerut	16.8	14.8	14.6	12.0
Anupshahr branch Narora Div.	1.7	3.9	3.6	5.4
Meerut Div.	21.9	17.2	17.0	9.5
Bulandshahr Div.	6.7	8.9	8.9	9.8
Mat Branch Div.	10.9	16.3	14.6	30.0
Aligarh Div.	9.2	13.8	15.4	17.3

It enters in the Sub – region in two parts. It divides into two parts in Jauli in Muzaffarnagar namely Meerut Div. and Anupshahr branch Meerut Div. Meerut Div. again divided into two parts near Dhaulana namely Mat branch Div. and Bulandshahr Div. Mat branch passes through Dadri, Dankaur & Jewar; and lastly ended up in Mathura.

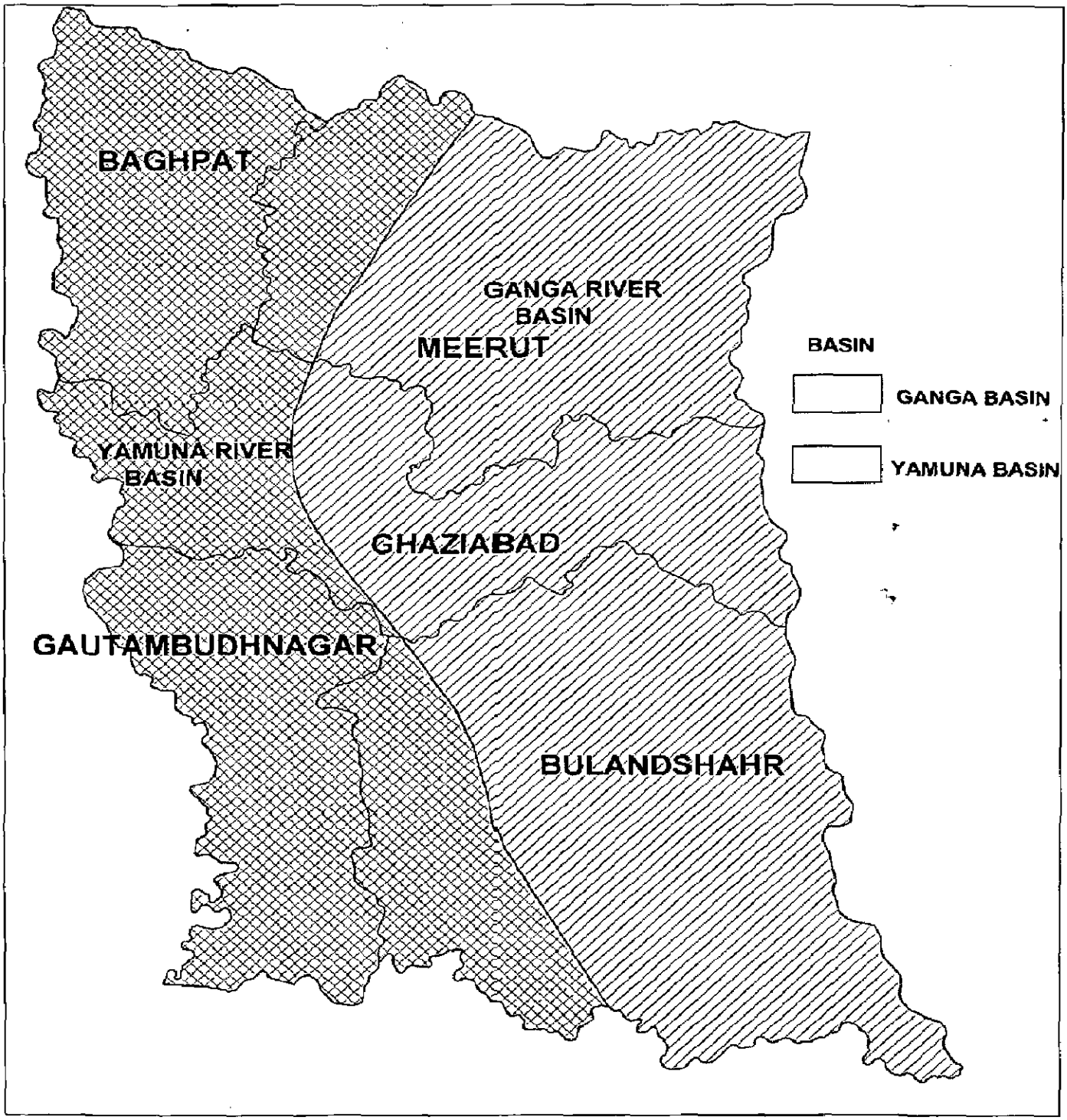
3. Madhya Ganga Canal

The Madhya Ganga Canal project was formulated for utilization of surplus monsoon waters of the Ganga during Kharif for development of paddy cultivation in the two dry pockets between Anupshahr branch & Upper Ganga Canal and between Upper Ganga Canal & Karwan Nadi in the lower command of Upper Ganga Canal. The project envisages construction of a barrage across the Ganga near Bijnour, Main Madhya Ganga Canal off- taking from the right bank and terminating in the Upper Ganga Canal, Lakhaoti branch with its distribution system, Mat branch feeder with its distribution system, Amarpur Dy. with its distribution system, Parallel Mat branch and Parallel Hathras branch Canal and remodeling of existing Mat, Hathras and Anupshahr branch canals of Upper Ganga Canal System.

The project will provide annual irrigation to 178 thousand ha. of which 64 thousand ha. will be in the new command areas of Ghaziabad, Bulandshahar &

Aligarh districts and balance in the existing command of Upper Ganga Canal in the districts of Saharanpur, Muzaffarnagar, Meerut, Ghaziabad, Bulandshahar, Aligarh, Mathura, Agra, Etah & Mainpuri in the western part of Ganga-Yamuna Doab. The project was taken up for execution in 1977 and was targeted for completion by December 2000.

Map 5.2 River Basins in the Sub Region



The Sub region lies between Ganga and Yamuna doab. Yamuna River basin covers Baghpat and Gautambudh Nagar fully and Meerut, Ghaziabad and Bulandshahr districts partially while Ganga River basin covers more than half part of three districts namely Meerut, Ghaziabad and Bulandshahr.

5.2 Ground Water Sources

Groundwater is a dependable resource that is contained and transmitted through the interstices in rock materials below the earth surface. It is considered and rather used to be a cheap and easily extractable commodity. However, with a rapid growth of population and all round development, there is incessant pressure on the ground water withdrawal resulting compulsive awakening in terms of both the quality and quantity. If the present trend of the increasing demand remains incontrollable, the resource may be as strategic as are the minerals and the petroleum resources. Though in contrast to these, the resource of groundwater as a part of hydrologic cycle is replenishable.

Central Ground Water Board under the Ministry of Water Resources, Government of India is the Apex body in the country to deal with all the aspects of groundwater.

The geographical area of U.P. is 2,40,927 and population 16,60,52,859 (2001 census). Uttar Pradesh being the most populous state of the country faces problems like decline in water level, water logging conditions and ground water pollution. Therefore, it is imperative to plan the development of ground water in more scientific and planned manner for its economic

5.2.1 Ground Water Level

Depth to water in any area is of great significance in deciding drilling depths, selection of pumping devices, crops to be grown and deciding areas for ground water storage / artificial recharge. The indiscriminate exploitation of ground water

has led to depletion of storage and lowering of water levels in many parts on one hand and rise in water levels to critical limits on the other hand in parts of certain Canal Command areas. The management of ground water storage thus becomes essential to avoid any adverse impact.

The water levels in Uttar Pradesh show a wide variation from less than 2 mbgl to more than 30 mbgl. In Bhabher area, the depth to water level varies from 8 to 35 mbgl, while in Tarai, it ranges from less than 2 to 10 mbgl. The central and eastern parts of the state shows a wider range of water levels varying from less than 2 mbgl as observed in Sharda Sahayak Canal Command area to more than 20 mbgl along the natural levees formed on either side of river Ganga. The water levels in southern parts (Plateau Region) vary from 2 to 30 mbgl.

The western parts of Uttar Pradesh are characterised by deeper water levels ranging from 8 to more than 30 mbgl, as noticed in most of the districts. The water levels have shown significant declining trends over the last two decades due to over exploitation of the ground water resource.

5.2.2 Water Level Trends

Over exploitation of ground water, especially in western parts of Uttar Pradesh has led to decline in water levels over the past few years. The State Ground Water Department has categorised the blocks on the basis of level of development of ground water and water level trends. Out of 803 accessment units (Blocks), 37 has been catagories as over exploited, 13 as critical, 88 as semi critical and 665 as safe. Out of 50 over exploited and critical blocks, 19 blocks are located in western parts of the state in districts of Agra, Aligarh, Baghpat, Bareilly, Badaun, Etah, Farrukhabad, Ferozabad, Jyotibaphulenagar, Moradabad and Saharanpur. The water level declining trends in these blocks are about 30 to 55 cm/year in either pre or post monsoon period or both. Out of 88

semi-critical blocks, 28 are located in western U.P. On the other hand, in the Canal Command areas, the water logging and related problems like salinization & degradation of soils are posing a threat. The exploration carried out in the deeper zones indicates ample scope for ground water development. The tube wells tapping area in Bhabar and Terai zones, the yield ranges from 30 – 60 lps whereas the tube wells tapping in the central Ganga plains, the yield ranges from 25 -75 lps.

5.2.3 Ground Water Resource Potential

As per the National Water Policy, development of ground water resources is to be limited to utilization of the renewable part of the naturally occurring ground water available in sub-surface domain. The present development policy, obviously forbids utilization of the secular reserve to prevent ground water mining. Precise assessment of replenishable ground water resources and its development in terms of area which can be irrigated in the framework of land availability, cropping pattern, etc. is, therefore, key to our plans to develop ground water resources for various uses. The complexities of processes governing occurrence and movement of ground water make the problem of ground water assessment somewhat difficult, as not only vast volume of data is required to be collected but also many disciplines of science have to be involved in a coordinated manner.

The annual replenishable ground water resource of the state has been estimated as 76.35 bcm and net annual ground water availability is 70.18 bcm. The annual ground water development is 70%.

As a joint venture of the Central Ground Water Board and the Ground Water Department, U.P. have estimated replenishable ground water potential on districtwise basis, based on GEC 1997 Methodology and the estimates for U.P. (alluvial area).

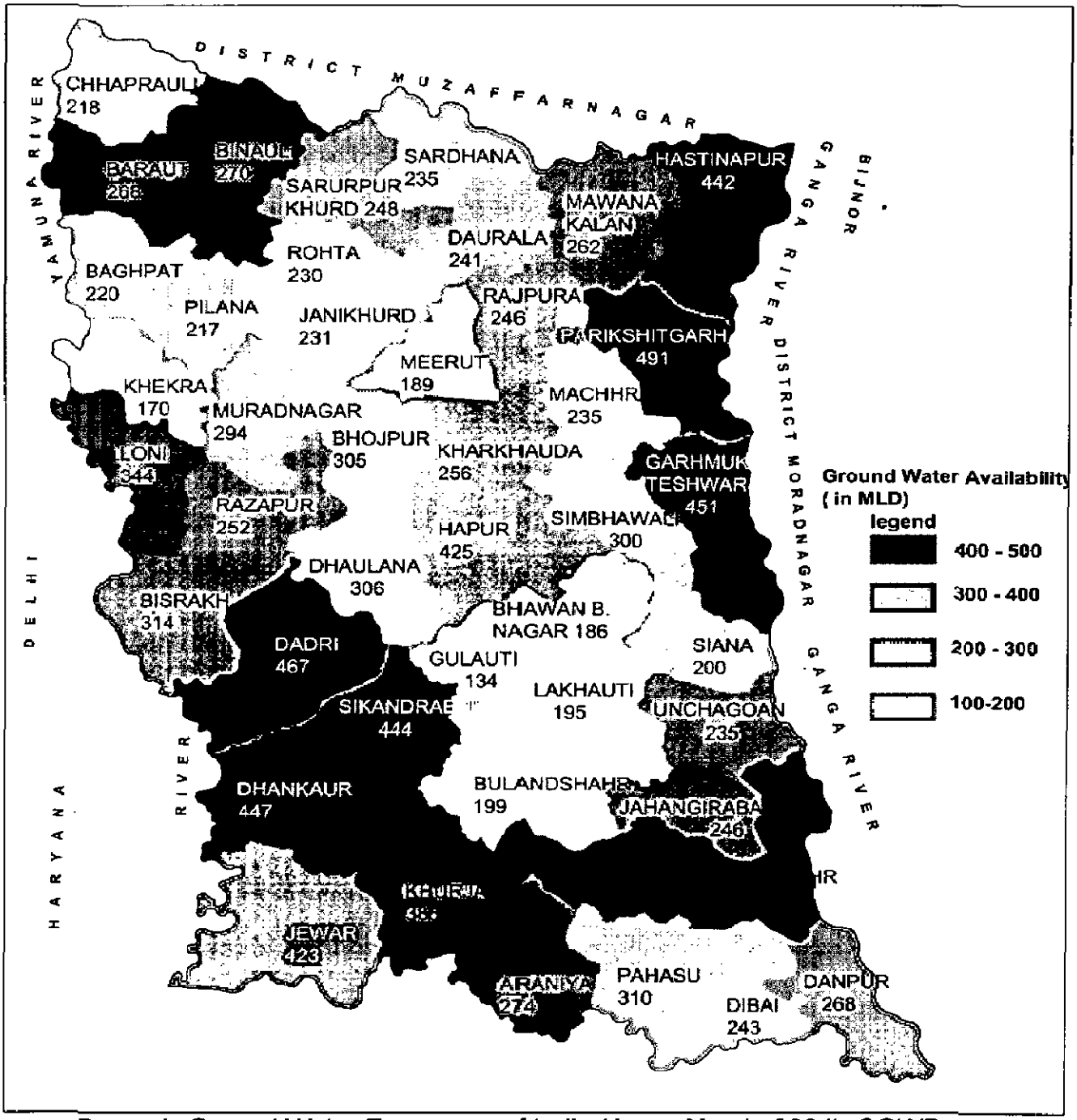
5.3 Ground Water Availability

Table 5.2 Blockwise Ground Water Availability

S No.	Blocks	Area (in hac)	Ground water availability (in ham)	water availability (in MLD)
1	Chhaprauli	20,392	7,953	218
2	Baraut	25,052	9,770	268
3	Baghpat	20,623	8,043	220
4	Pilana	20,314	7,922	217
5	Khekra	15,879	6,193	170
6	Binauli	25,221	9,836	270
7	Sarurpur Khurd	19,220	9,033	248
8	Sardhana	18,219	8,563	235
9	Daurala	18,700	8,789	241
10	Mawana kalan	20,358	9,568	262
11	Hastinapur	34,328	16,134	442
12	Parikshitgarh	38,110	17,912	491
13	Machra	18,235	8,570	235
14	Rohta	17,845	8,387	230
15	Janikhurd	17,900	8,413	231
16	Meerut	14,675	6,897	189
17	Rajpura	19,061	8,959	245
18	Kharkhoda	19,912	9,359	256
19	Bhojpur	23,187	11,130	305
20	Muradnagar	22,367	10,736	294
21	Razapur	19,155	9,194	252
22	Loni	26,145	12,550	344
23	Dhaulana	23,271	11,170	306
24	Hapur	32,320	15,514	425
25	Simbhawali	22,797	10,943	300
26	Garh Mukteshwar	34,300	16,464	451
27	Sikandrabad	39,524	16,205	444
28	Gulaothi	11,943	4,897	134
29	Lakhaothi	17,342	7,110	195
30	Bulandshahr	17,752	7,278	199
31	Shikarpur	26,296	10,781	295
32	B. B.Nagar	16,531	6,778	186
33	Syana	17,785	7,292	200
34	Jahangirabad	21,925	8,989	246
35	Khurja	34,326	14,074	386
36	Araniya	24,397	10,003	274
37	Pahasu	27,590	11,312	310
38	Unchagaon	20,927	8,580	235
39	Danpur	23,853	9,780	268
40	Dibai	21,631	8,869	243
41	Anupshahr	26,277	10,774	295
42	Dankaur	45,278	16,300	447
43	Jewar	42,899	15,444	423
44	Bisarakha	31,825	11,457	314
45	Dadri	47,382	17,058	467

Source: CGWB

Map 5.3 Block Wise Ground Water Availability (in MLD)



Source: Dynamic Ground Water Resources of India (As on March, 2004), CGWB, Ministry of Water Resources, GOI, Faridabad -2006

The Above map shows that whole of the Gautambudh Nagar have good G.W. availability except Bisrakh block while all blocks of Baghpat district have critical situation where G.W. is below 200 mld per block. In Meerut district, except Meerut block all blocks have almost good G.W. availability. In Ghaziabad district G.W. availability varies from 250 -500 mld. Overall Gulauti block has the minimum G.W. availability while Prikshitgarh block has highest of it.

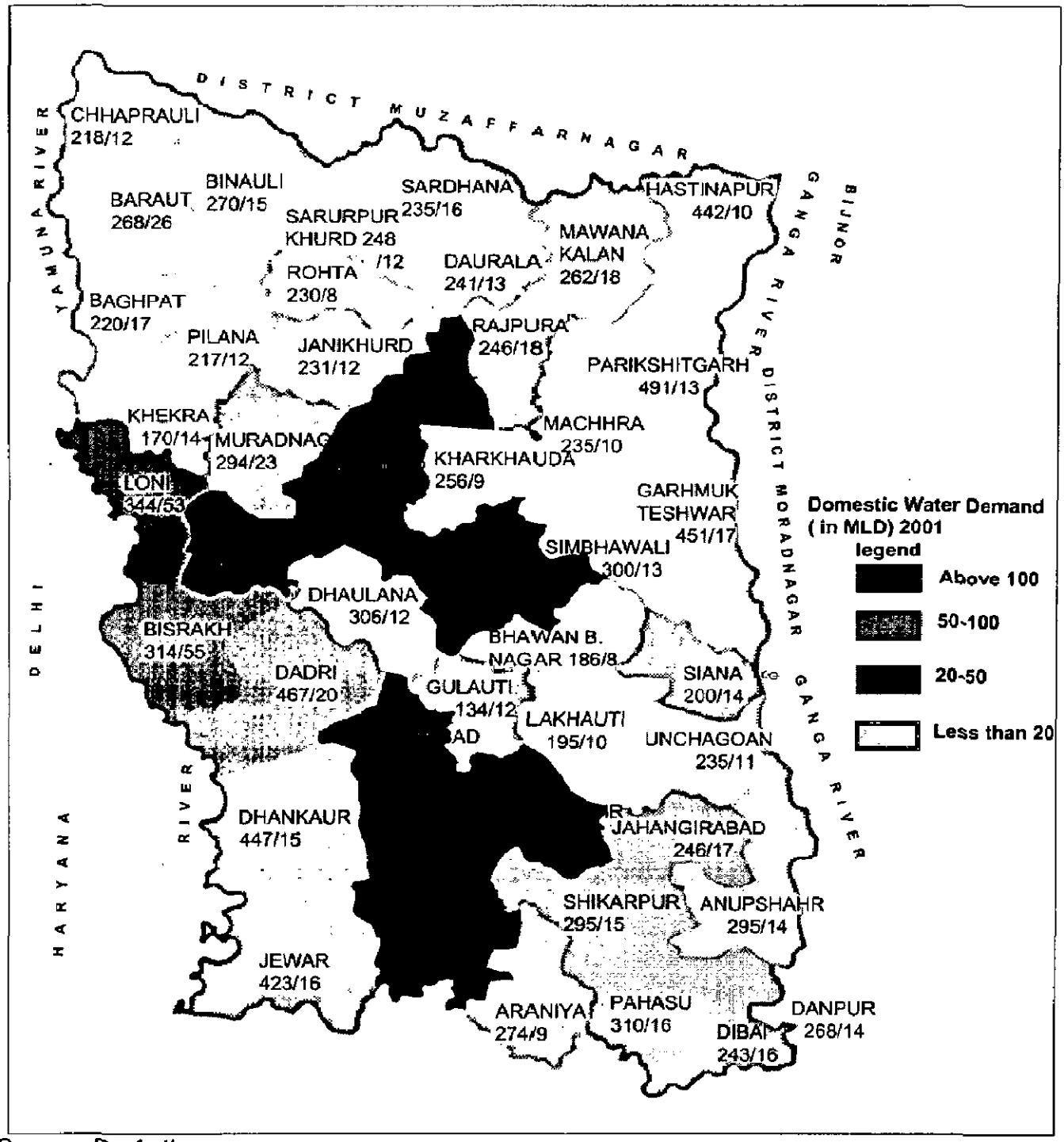
5.4 Domestic Water Demand

Table 5.3 Blockwise Domestic Water Demand - 2001

S.No.	Blocks	Rural Water Demand @ 70 lpcd (in Litres)		Urban Water Demand @ 135 lpcd (in Litres)		Total Water demand (in MLD)
		Rural Pop.	Water Demand	Urban Pop.	Water Demand	
1	Chhaprauli	132,209	132,209	17798	17,798	11.7
2	Baraut	200,996	200,996	85708	85,708	25.6
3	Baghpat	142,800	142,800	48789	48,789	16.6
4	Pilana	146,229	146,229	10112	10,112	11.6
5	Khekra	126,412	126,412	40335	40,335	14.3
6	Binauli	185,913	185,913	13263	13,263	14.8
7	Sarurpur Khurd	143,182	143,182	12609	12,609	11.7
8	Sardhana	133,561	133,561	48314	48,314	15.9
9	Daurala	135,998	135,998	28720	28,720	13.4
10	Mawana kalan	126,137	126,137	69191	69,191	18.2
11	Hastinapur	106,829	106,829	21249	21,249	10.4
12	Parikshitgarh	155,575	155,575	17369	17,369	13.2
13	Machra	139,083	139,083	0	0	9.7
14	Rohta	115,096	115,096	0	0	8.1
15	Janikhurd	140,748	140,748	18451	18,451	12.3
16	Meerut	53,451	53,451	1166606	1,166,606	161.2
17	Rajpura	163,425	163,425	48314	48,314	18
18	Kharkhoda	108,809	108,809	12593	12,593	9.3
19	Bhojpur	167,715	167,715	244819	244,819	44.8
20	Muradnagar	130,187	130,187	104561	104,561	23.2
21	Razapur	120,739	120,739	992690	992,690	142.5
22	Loni	271,466	271,466	249287	249,287	52.7
23	Dhaulana	172,675	172,675	0	0	12.1
24	Hapur	276,904	276,904	217922	217,922	48.8
25	Simbhawali	180,461	180,461	0	0	12.6
26	Garh Mukteshwar	177,508	177,508	33847	33,847	17
27	Sikandrabad	242,808	242,808	69867	69,867	26.4
28	Gulaothi	87,337	87,337	42903	42,903	11.9
29	Lakhaothi	105,543	105,543	20097	20,097	10.1
30	Bulandshahr	166,051	166,051	176425	176,425	35.4
31	Shikarpur	147,771	147,771	33187	33,187	14.8
32	B. B.Nagar	100,882	100,882	9322	9,322	8.3
33	Syana	101,391	101,391	51788	51,788	14.1
34	Jahangirabad	141,611	141,611	51394	51,394	16.8
35	Khurja	200,059	200,059	98610	98,610	27.3
36	Araniya	132,612	132,612	0	0	9.3
37	Pahasu	173,003	173,003	28025	28,025	15.9
38	Unchagaon	136,015	136,015	13761	13,761	11.4
39	Danpur	164,841	164,841	20407	20,407	14.3
40	Dibai	160,548	160,548	34877	34,877	15.9
41	Anupshahr	156,970	156,970	23795	23,795	14.2
42	Dankaur	170583	170,583	19480	19,480	14.6
43	Jewar	134101	134,101	49572	49,572	16.1
44	Bisarakha	182650	182,650	315808	315,808	55.4
45	Dadri	175682	175,682	57416	57,416	20.1

Source: By Author

Map 5.4 Block Wise Domestic Water Demand – 2001



Source: By Author

The above map shows that Meerut and Razapur blocks have maximum domestic water demand. In comparison with other blocks, these two blocks have exceptionally very high domestic water demand. The main reason of this is the high urbanisation in these blocks. Most of the blocks have less than 20 mld domestic water demand.

CHAPTER 6

DEMAND FORECASTING

6.1 Proposed Hierarchy of Settlements

Regional Plan-2001 had proposed a four-tier settlement system i.e., Regional Centres, Sub-regional Centres, Service Centres and Basic Villages. Keeping in view the changing demographic scenario of the region, additional categories of settlements have been added and some changes in the nomenclature and functional classification of other settlements are proposed. Henceforth, the following six-tier hierarchy of settlements is proposed in the Regional Plan-2021:

Table 6.1 Proposed Six Tier Hierarchy of Settlements

S.No.	Hierarchical Level	Population Range
1.	Metro Centre	10 lakhs and above
2.	Regional Centre	3 to 10 lakhs
3.	Sub-regional Centre	0.5 to 3 lakhs
4.	Service Centre	10,000 to 50,000
5.	Central Village	5,000 to 10,000
6.	Basic Village	Below 5,000

Source: Regional Plan 2021

6.2 Population projection

Recognizing the urban growth dynamics in the Sub region population projection has been made. The population of the NCR is projected to be 614.38 lakhs by 2021. The population of U.P. Sub region is projected to be 150.83 lakhs by 2011 and 198.29 lakhs by 2021. The percentage of share of U.P. Sub region is expected to decrease from 31.19% to 31.02% by 2011 and thereafter to 30.92% by 2021.

Map 6.1 Blockwise Population of U.P Sub region of NCR – 2021

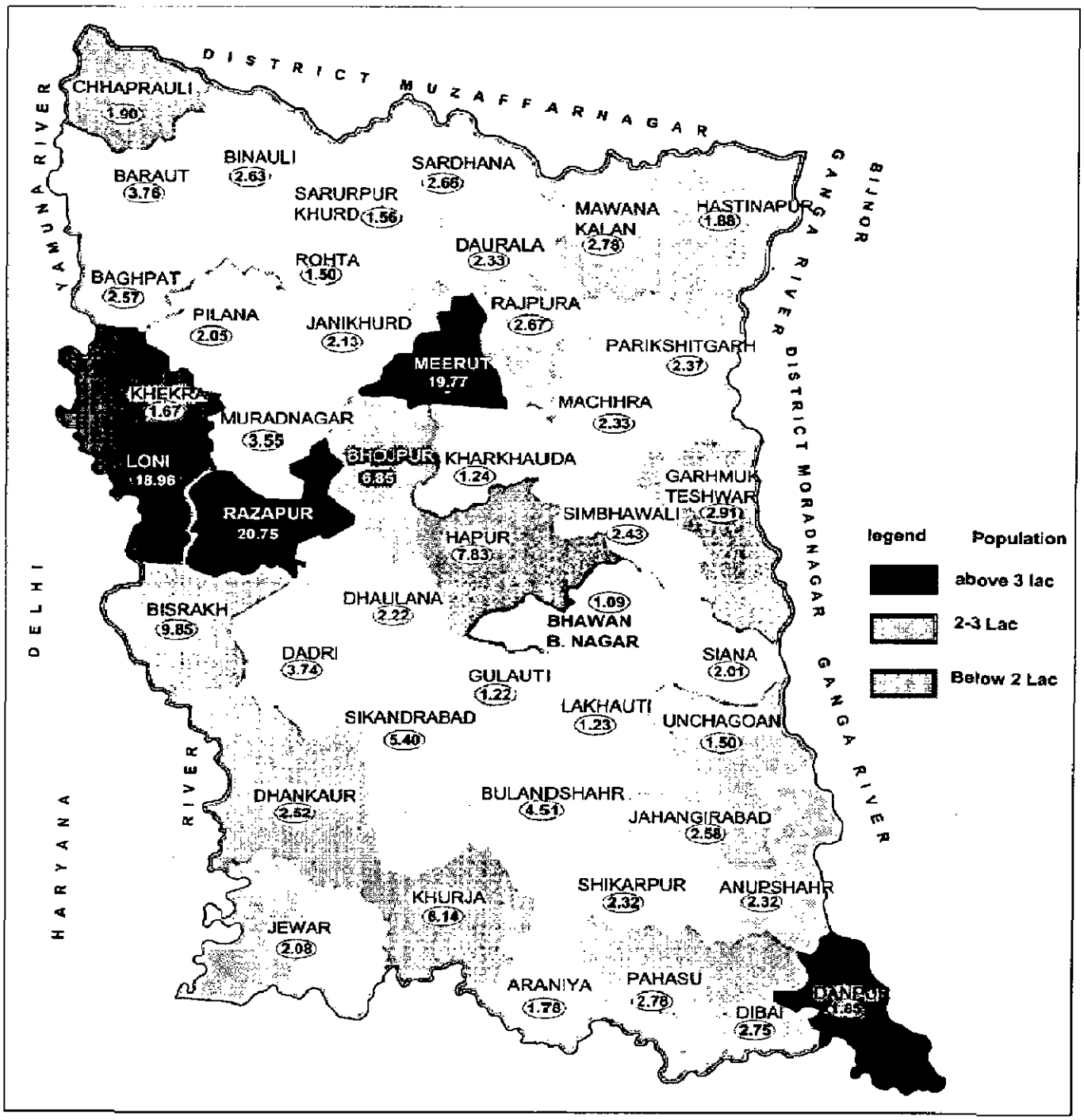
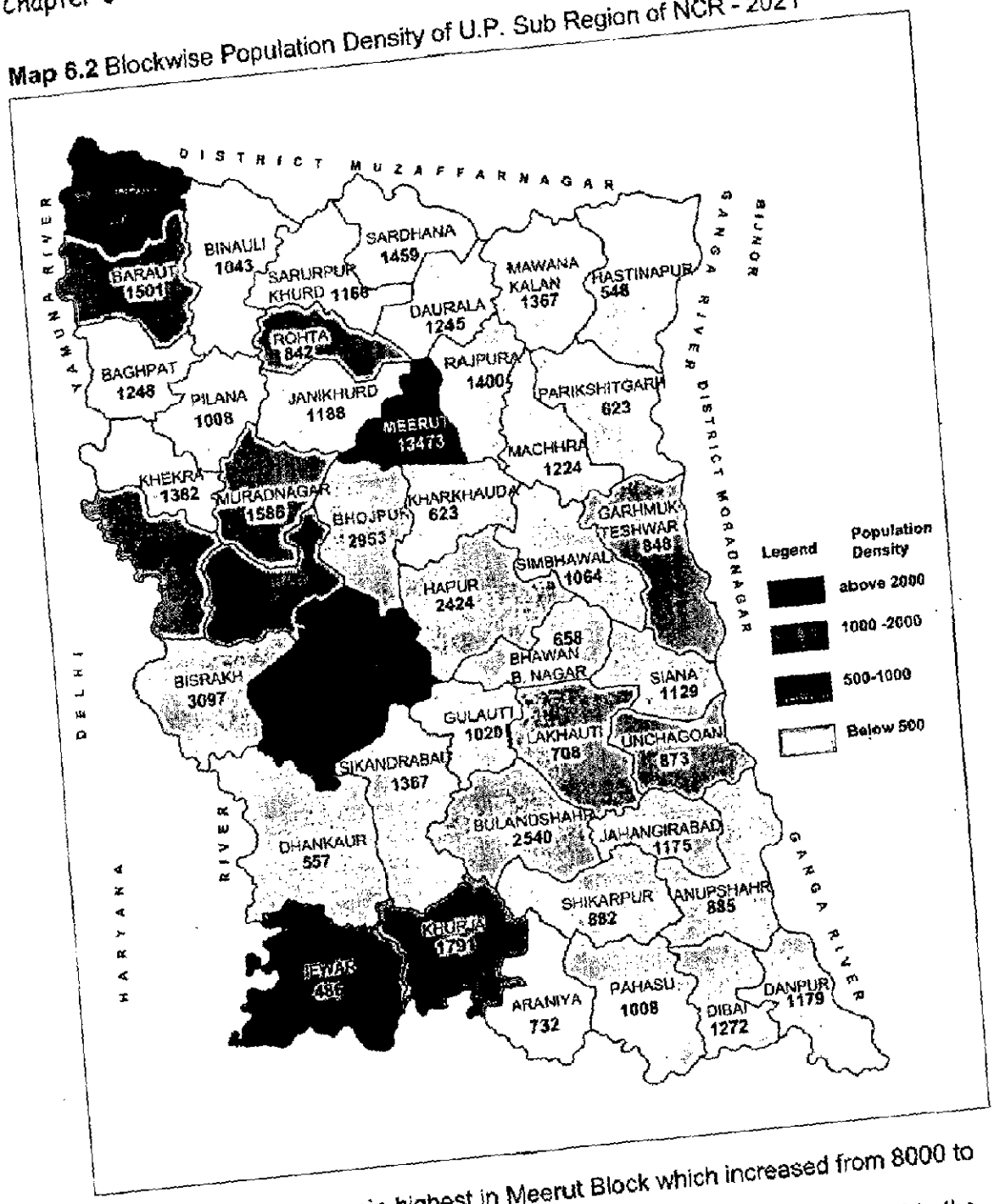


Table 6.2 Blockwise Area, Projected Population and Population Density - 2021

S.No.	Blocks	Area (in sq Km)	Projected Population 2021	Pop. Density (per sq km)
1	Chhaprauli	203.92	190,059	932
2	Baraut	250.52	375,906	1,501
3	Baghpat	206.23	257,345	1,248
4	Pilana	203.14	204,833	1,008
5	Khekra	158.79	219,522	1,382
6	Binauli	252.21	263,054	1,043
7	Sarurpur Khurd	192.2	224,091	1,166
8	Sardhana	182.19	265,730	1,459
9	Daurala	187	232,766	1,245
10	Mawana kalan	203.58	278,340	1,367
11	Hastinapur	343.28	187,978	548
12	Parikshitgarh	381.1	237,413	623
13	Machra	182.35	223,226	1,224
14	Rohta	178.45	150,180	842
15	Janikhurd	179	212,722	1,188
16	Meerut	146.75	1,977,200	13,473
17	Rajpura	190.61	266,780	1,400
18	Kharkhoda	199.12	123,963	623
19	Bhojpur	231.87	684,687	2,953
20	Muradnagar	223.67	354,731	1,586
21	Razapur	191.55	2,075,212	10,834
22	Loni	261.45	1,895,696	7,251
23	Dhaulana	232.71	221,641	952
24	Hapur	323.2	783,451	2,424
25	Simbhawali	227.97	242,616	1,064
26	Garh Mukteshwar	343	290,775	848
27	Sikandrabad	395.24	540,159	1,367
28	Gulaothi	119.43	121,815	1,020
29	Lakhaothi	173.42	122,833	708
30	Bulandshahr	177.52	450,983	2,540
31	Shikarpur	262.96	232,029	882
32	B. B.Nagar	165.31	108,701	658
33	Syana	177.85	200,828	1,129
34	Jahangirabad	219.25	257,683	1,175
35	Khurja	343.26	614,641	1,791
36	Araniya	243.97	178,476	732
37	Pahasu	275.9	278,056	1,008
38	Unchagaon	209.27	182,730	873
39	Danpur	238.53	281,321	1,179
40	Dibai	216.31	275,089	1,272
41	Anupshahr	262.77	232,439	885
42	Dankaur	452.78	252,285	557
43	Jewar	428.99	208,364	486
44	Bisarakha	318.25	985,519	3,097
45	Dadri	473.82	373,673	789

Source: by Author

Map 6.2 Blockwise Population Density of U.P. Sub Region of NCR - 2021



Population density is again highest in Meerut Block which increased from 8000 to 13000. Next block is Razapur with population density of 10,834. In 2021, the number of blocks having population density more than 2000 would increase from to 7. Mainly those blocks which are at close proximity to Delhi, has higher population density. Jewar is the only block having population density less than 500.

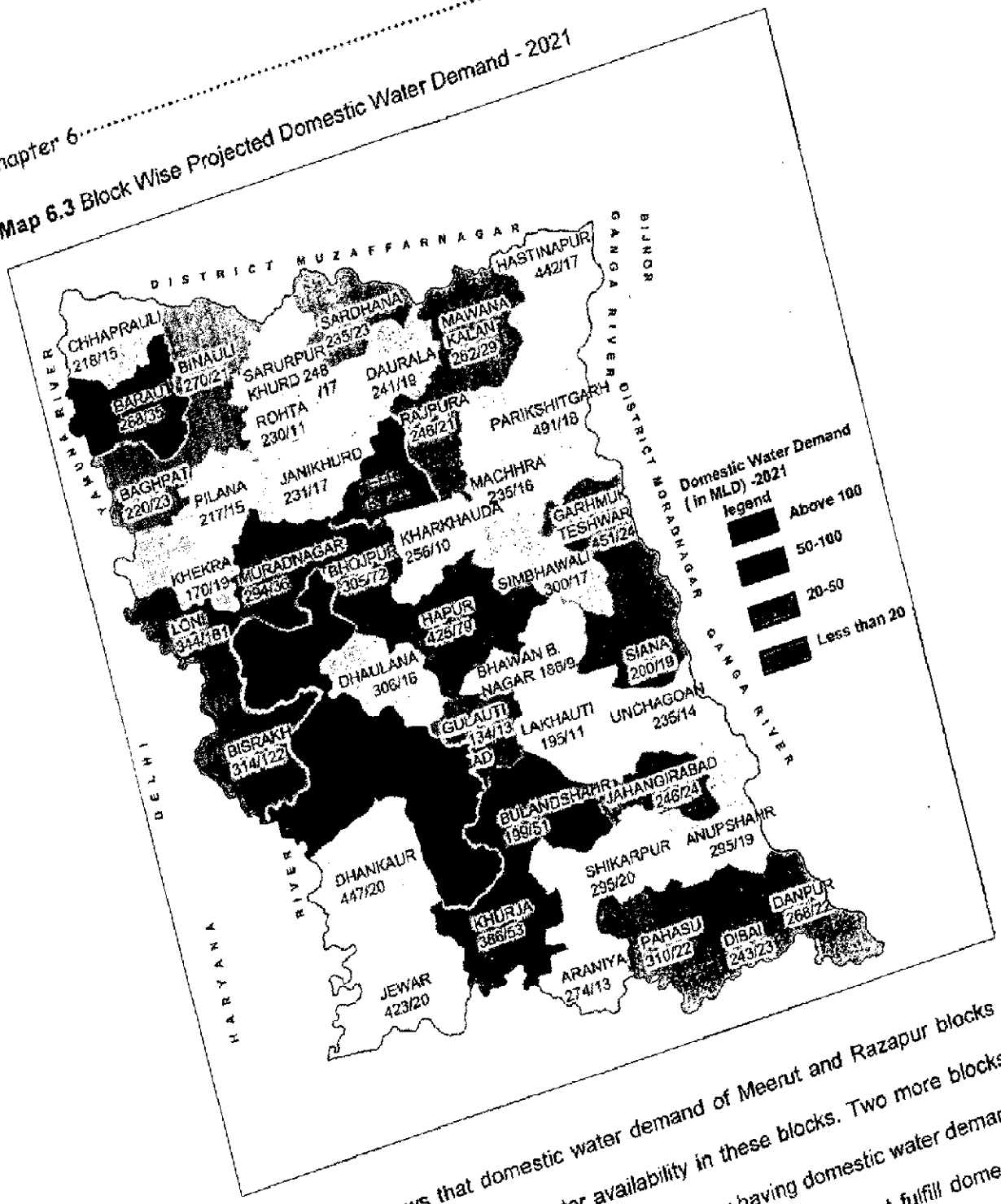
6.3 Projected Domestic Water Demand

Table 6.3 Blockwise Projected Domestic Water Demand - 2021

S.No.	Blocks	Rural Water Demand @ 70 lpcd(in litres)		Urban Water Demand @ 135 lpcd(in litres)		Total Water demand (in MLD)
		Rural Pop.	Water Demand	Urban Pop.	Water Demand	
1	Chhaprauli	163,375	163,375	26684	26,684	15
2	Baraut	239,986	239,986	135920	135,920	35.1
3	Baghpat	176,645	176,645	80700	80,700	23.3
4	Pilana	189,051	189,051	15782	15,782	15.4
5	Khekra	158,287	158,287	61235	61,235	19.3
6	Binauli	223,732	223,732	39322	39,322	21
7	Sarurpur Khurd	204,982	204,982	19,109	19,109	16.9
8	Sardhana	192,968	192,968	72,762	72,762	23.3
9	Daurala	188,615	188,615	44,151	44,151	19.2
10	Mawana kalan	138,734	138,734	139,606	139,606	28.6
11	Hastinapur	136,329	136,329	51,649	51,649	16.5
12	Parikshitgarh	209,828	209,828	27,585	27,585	18.4
13	Machra	223,226	223,226	0	0	15.6
14	Rohta	150,180	150,180	0	0	10.5
15	Janikhurd	183,299	183,299	29,423	29,423	16.8
16	Meerut	58,079	58,079	1,919,121	1,919,121	263.2
17	Rajpura	229,880	229,880	36,900	36,900	21.1
18	Kharkhoda	104,511	104,511	19,452	19,452	9.9
19	Bhojpur	311,198	311,198	373489	373,489	72.2
20	Muradnagar	174,616	174,616	180115	180,115	36.5
21	Razapur	105,064	105,064	1970148	1,970,148	273.3
22	Loni	1,146,273	1,146,273	749423	749,423	181.4
23	Dhaulana	221,641	221,641	0	0	15.5
24	Hapur	413,183	413,183	370268	370,268	78.9
25	Simbhawali	242,616	242,616	0	0	16.9
26	Garh Mukteshwar	235,611	235,611	55164	55,164	23.9
27	Sikandrabad	434,115	434,115	106044	106,044	44.7
28	Gulaothi	53,861	53,861	67954	67,954	12.9
29	Lakhaothi	90,507	90,507	32326	32,326	10.7
30	Bulandshahr	158,585	158,585	292398	292,398	50.6
31	Shikarpur	181,820	181,820	50209	50,209	19.5
32	B. B.Nagar	95,163	95,163	13538	13,538	8.5
33	Syana	118,635	118,635	82193	82,193	19.4
34	Jahangirabad	173,548	173,548	84135	84,135	23.5
35	Khurja	460,408	460,408	154233	154,233	53.1
36	Araniya	178,476	178,476	0	0	12.5
37	Pahasu	232,826	232,826	45230	45,230	22.4
38	Unchagaon	161,386	161,386	21344	21,344	14.2
39	Danpur	248,509	248,509	32812	32,812	21.8
40	Dibai	219,936	219,936	55153	55,153	22.8
41	Anupshahr	195,480	195,480	36959	36,959	18.7
42	Dankaur	210,489	210,489	41,796	41,796	20.4
43	Jewar	130,765	130,765	77,599	77,599	19.6
44	Bisarakha	317,369	317,369	668,150	668,150	112.4
45	Dadri	265,217	265,217	108,456	108,456	33.2

Source: By Author

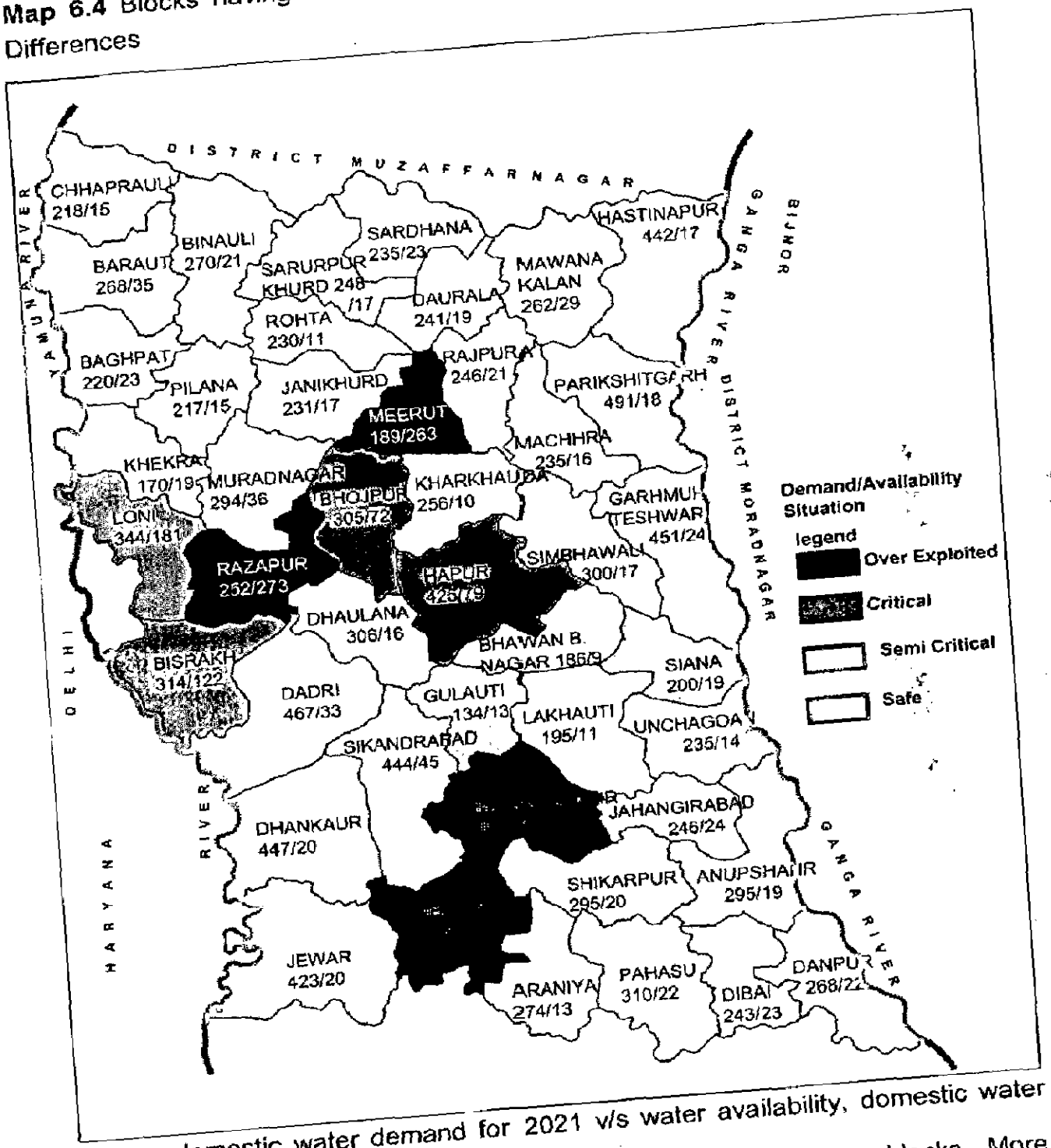
Map 6.3 Block Wise Projected Domestic Water Demand - 2021



Above map shows that domestic water demand of Meerut and Razapur blocks would be more than ground water availability in these blocks. Two more blocks Loni and Bisrakh will also come in same category having domestic water demand more than 100 mld. This shows that only ground water can not fulfill domestic water demand. Surface water which is currently used for irrigation would also make available for drinking.

6.4 Expected Demand - Supply Gaps

Map 6.4 Blocks having Critical Water Situation as per Availability & Demand Differences



As per domestic water demand for 2021 v/s water availability, domestic water demand would exceed from ground water availability in few blocks. More precisely Meerut and Razapur block would face this problem in future. This would happen mainly due to increase in population and that is mainly due to urban population. In these two blocks, mentioned above, would face this water problem

due to increase in population of their respective cities i.e. Meerut City in Meerut block and Ghaziabad City in Razapur block.

Loni and Bisrakh block would come under critical block as to fulfill domestic water requirment; they have to suffer in other areas mainly for irrigational water demand. The situation could be worse than expected as these blocks are attached with NCT – Delhi on one side and block Razapur on other side which is already facing the same problem.

In next category i.e. in Semi Critical Blocks, there are four blocks namely Bhojpur, Hapur, Bulandshahr and Khurja. There is same case with Bhojpur as in Loni and Bisrakh. Bhojpur block falls between Meerut and Razapur block which are already come under over exploited blocks so there are chances of shifting this block from semi critical to critical.

Other all blocks are safe if we consider them as per projected domestic water requirment for 2021. If we consider that out of total water availability, 15% for domestic and industrial, and remaining 85% for irrigation, then again these 37 blocks are safe.

CHAPTER 7

ANALYSIS OF SELECTED BLOCKS

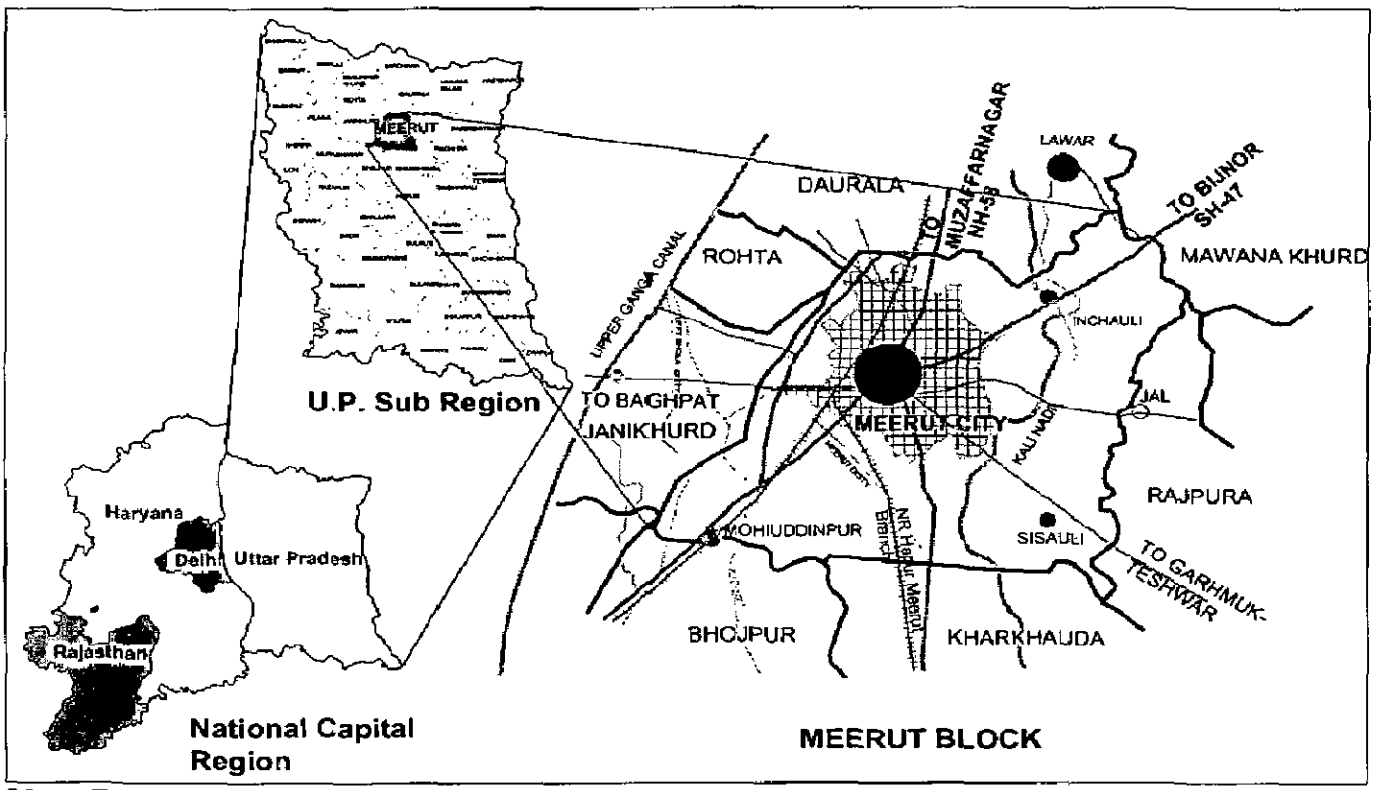
As per the water demand – supply analysis of the Sub region , the projected demand for 2021 exceed than existing water sources in the region for two blocks namely Meerut and Razapur which are discussed as follow:

7.1 MEERUT BLOCK

It is one of the densely populated block in whole of the Sub region. It has population density of 8314 persons per sq. km. Meerut block has highest population as per 2001 census i.e. 12.2 Lakh and having an area of 176 sq. km.

7.1.1 Location

It lies in the South corner of Meerut district and touches with Ghaziabad district on its South –West side.



Map 7.1 Location Map of Meerut Block

7.1.2 Demographic Profile

Table 7.1 Population Distribution in Meerut Block (1991 -2021)

Year/Population	Rural	Urban	Total
1991	51,277	8, 49,799	9, 01,076
2001	53,451	11, 66,606	12, 20,057
2011 (Projected)	55,717	14, 90,153	15, 45,870
2021 (Projected)	58,079	19, 19,121	19, 77,200

The above table reveals that there is growth rate of 35% from 1991-2001, in which rural population has very less growth rate of 4%. Again in total population, main share is of urban population i.e. 94% in 1991 which has increased to 96% in 2001 and will be 97% in 2021. In Meerut block, there are two urban area i.e. Meerut City which has now become Metro City (or million plus city), which constitute 95% of the population of the block and second is Mohiuddinpur census town which according to 2001, came in Class VI cities having a population of 4890 which is negligible against Meerut City.

Through the area of Meerut block is also less and hence highly dense. Due to high population and being a Metro City, Water demand has increase and as per standards also, there should 200 lpcd water supply for million plus cities.

Due to less area, ground water availability is also less. In terms of surface water sources Kali Nadi flows through Meerut block but in downward side of city. Hence water of Kali Nadi could not be used as drinking purpose. At present, Kali Nadi is used for cleaning the city by taking whole of sewerage of the city. Upper Ganga Canal is also flow on the West side of block, 10 km away from centre of Meerut city.

As most of the population lies in Meerut City, it would be better to discuss Meerut City and its water supply system in Detail so as to find out the shortcoming to improve the water supply of the city w.r.t. whole block.

7.2. MEERUT CITY

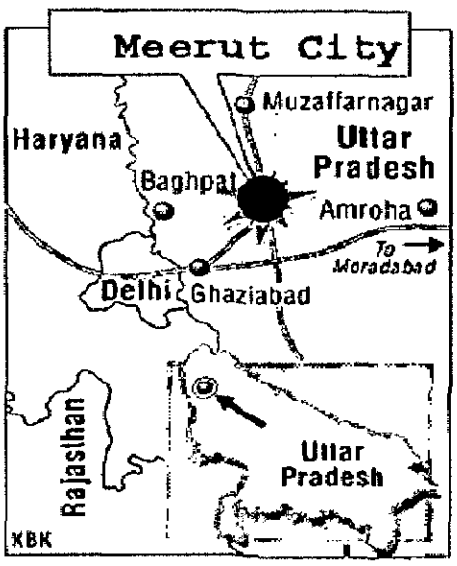
7.2.1 General Introduction

Meerut is a large and prosperous city in the north Indian state of Uttar Pradesh. It has a population of almost 1.2 million people. The city is historically important because it was the birth place of the Indian revolution against British rule, but it is also becoming an economic centre for the surrounding area. Meerut has seen a boom in the construction business as this city now has many buildings, shopping complexes and apartments. Meerut is the largest supplier of sports goods and also the largest manufacturer of musical instruments in India. Meerut is also a major educational center for Northwest India. People from the entire country and from all over the world come here in order to continue their studies and earn their degrees.

7.2.2 Physical Characteristics

(i) Location

Meerut lies in Western U.P., on the Delhi- Haridwar National Highway (NH-58). It is in the centre of Ganga-Yamuna Doab. Kali River flows in the east of it which takes its entire sewerage disposal as the normal slope is from North – West to South- East. There is Ganga Canal in the West of it approximately 10 km away.



Map 7.2 Location Map of Meerut City

(ii) Temprature

Meerut qualifies as one of the hottest towns not only in Uttar Pradesh but also in entire Northern Plain. In summers, this stuffy and painfully congested city witnesses a sudden surge in temperature and at times, mercury goes beyond

even 44°C mark. The humidity is appalling and is sure to leave you puffing and panting. During the summers, the daytime temperature hovers around 40-45°C. Nights are relatively cooler and mercury dips to a comfortable 30°C. Winters are bit chilly but are the best time to visit Meerut. The minimum temperature sometimes goes as low as 2-3°C but usually hovers in the range of 7-8°C

(iii) Rainfall

The most rainfall occurs between the months of June and September, which is monsoon season. The rainfall varies from 775 to 820 mm which occur mainly in monsoon season. It rains scantly during the monsoons as Meerut like Delhi falls in a semi-arid region. The annual average rainfall never goes beyond 400 millimeters

7.2.3 Demographic Profile

Table 7.2 Decadal Population Growth of Meerut City (1901-2001)

S.No.	Decade	Population	Decadal Difference	Decadal Difference (%)
1	1901	121,180	-	-
2	1911	119,435	-1,745	-1.44
3	1921	125,506	6,071	5.08
4	1931	141,025	15,519	12.37
5	1941	179,155	38,130	27.04
6	1951	239,440	60,285	33.65
7	1961	294,853	55,413	23.14
8	1971	371,760	76,907	26.08
9	1981	536,615	164,855	44.34
10	1991	849,799	313,184	58.36
11	2001	1,170,985	321,186	37.80

Source: Meerut Master Plan -2021

In 1901, the population of Meerut was 1.2 Lakh which doubled in 1951 and reached up to 2.4 lakh. From 1981 -1991, the growth rate was highest i.e. 58% which took the populaton from 5.4 lakh to 8.5 lakh. As per 2001 census, the

population has reached 1 million population and it is estimated that if the present rate of urbanisation will continued, the it will be doubled in 2021.

Map 7.3 Decadal Population Growth of Meerut City

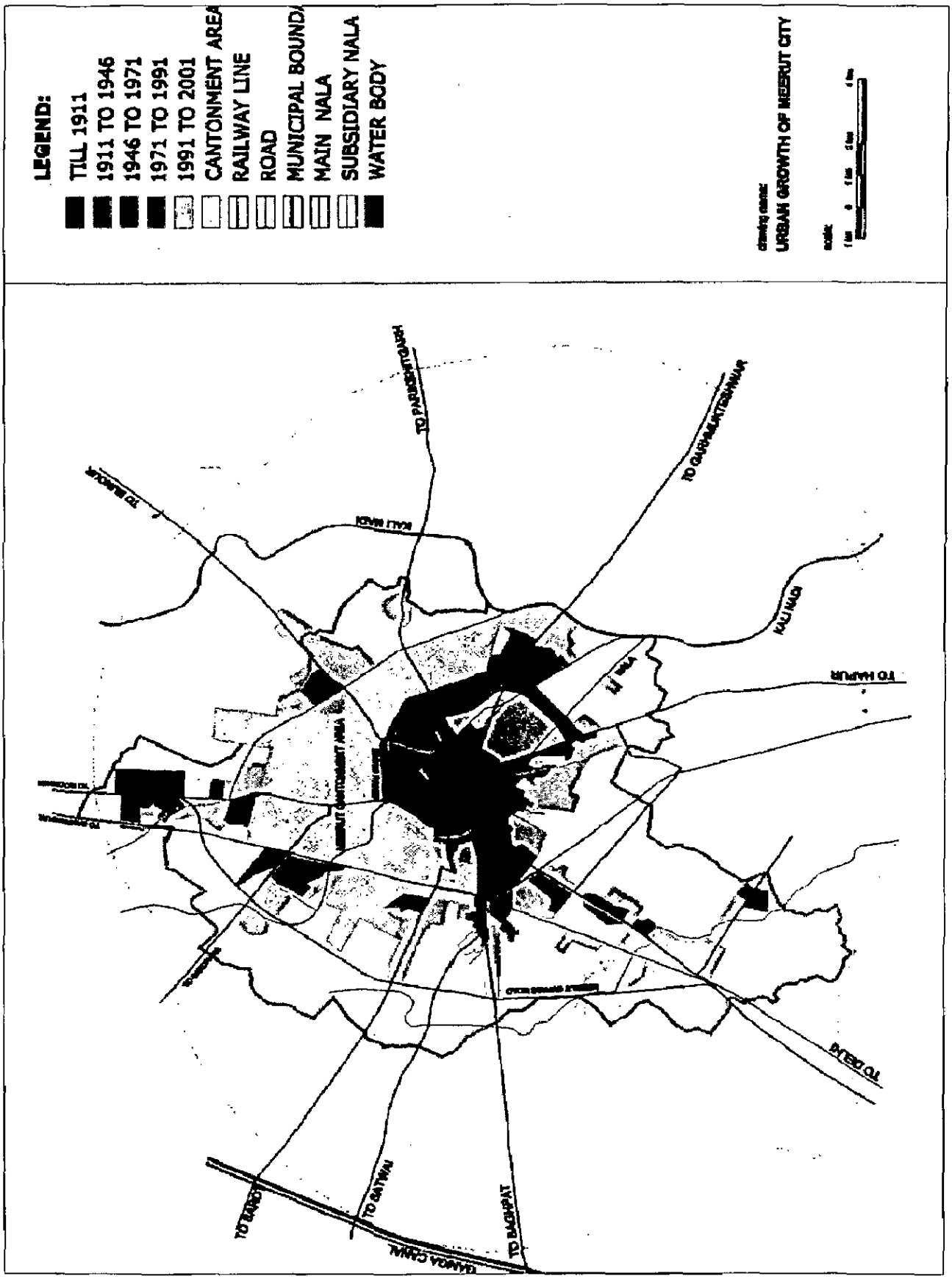


Table 7.3 Wardwise Population, Area and Population Density, 2001

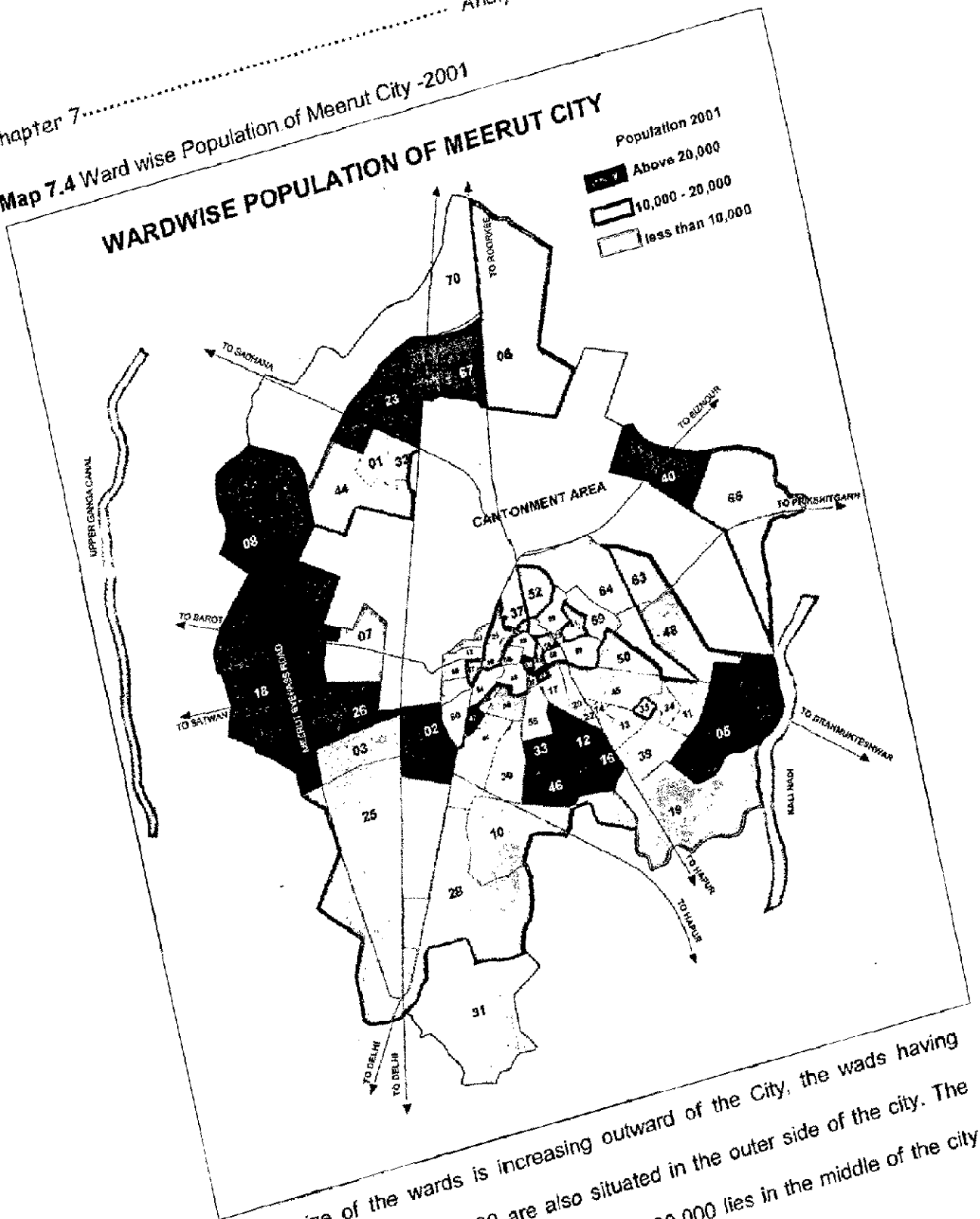
S.No.	Ward	Population	Area (in hac.)	Pop.Density
1	Shivlokpuri	12,496	74	169
2	Mevala	25,137	190	132
3	Maliyana	19,251	262	73
4	-	18,521	76	244
5	Medical College	33,517	580	58
6	Palrera	10,234	852	12
7	-	8,679	160	54
8	Shobhapur	20,378	860	24
9	Subhash Nagar	8,928	180	50
10	Lisari	13,984	338	41
11	-	14,521	90	161
12	Fakhrudin Ali	42,840	110	389
13	Jaidi Nagar	16,993	73	233
14	Kidvai Nagar	13,206	5	2,641
15	Shahpeer Gate	13,911	12	1,159
16	Jakir Colony	33,744	17	1,985
17	Dakshini Islamabad	11,400	25	456
18	Kharoali	33,936	696	49
19	-	18,541	832	22
20	Purvi Islamabad	10,460	21	503
21	Kothi Athanas	18,947	26	729
22	Karim Nagar	11,739	4	2,935
23	Nagalathasi	26,391	860	31
24	Surai Bahlol	21,990	5	4,398
25	Sundra Putha	14,397	1,324	11
26	Multan Nagar	26,761	236	113
27	Purva Ilahibax	15,440	20	772
28	Rithani	18,581	876	21
29	Purva Abdullahvasi	7,274	4	1,819
30	Rashid Nagar	16,820	118	143
31	Kashi	3,482	1,132	3
32	Govind Puri	15,094	42	359
33	Tarapuri	20,855	31	673
34	-	15,241	41	372
35	-	8,920	20	446
36	Brahmpuri (West)	11,560	9	1,284
37	Thapar Nagar	9,614	44	219
38	Kotla	10,675	30	356
39	-	11,581	310	37
40	Radha Garden	23,656	428	55
41	Shiv Saktinagar	14,838	194	76
42	Makbara Abu	7,335	2	3,056
43	Purva Hafiz Abdul Karim	8,644	9	960
44	Kasampura	15,051	224	67

45	Kailashpuri	16,800	112	150
46	PraladhNagar	31,666	209	152
47	Brahmpuri (East)	29,870	22	1,370
48	Sports Colony	17,178	312	55
49	Ishwarpuri	9,030	8	1,129
50	Foolbagh Colony	19,413	62	313
51	Baghpat Gate	14,234	17	837
52	Gopal Singh Pura	11,427	66	173
53	Surajkund	9,441	38	248
54	Mata ka Bagh	8,596	19	448
55	Prempuri	7,725	38	203
56	SaddeekNagar	10,901	46	237
57	KhairNagar	10,702	15	695
58	Daudgram	6,262	9	728
59	Meerut College	9,082	50	182
60	Devpuri	7,643	66	116
61	Mohanpuri	12,081	38	318
62	Moripara	13,202	10	1,320
63	Netaji Nagar	12,040	100	120
64	Saket	9,407	154	61
65	Kanoongoyan	571	13	44
66	PadavNagar	18,837	460	41
67	Roshanpur Dorli	25,506	604	42
68	Gudri Bazaar	8,879	9	1,009
69	Jativara	9,775	21	470
70	Modipuram	9,038	248	36
	Total	**1,074,869**	**14,188**	**76**

Source: *Meerut Master Plan – 2021*

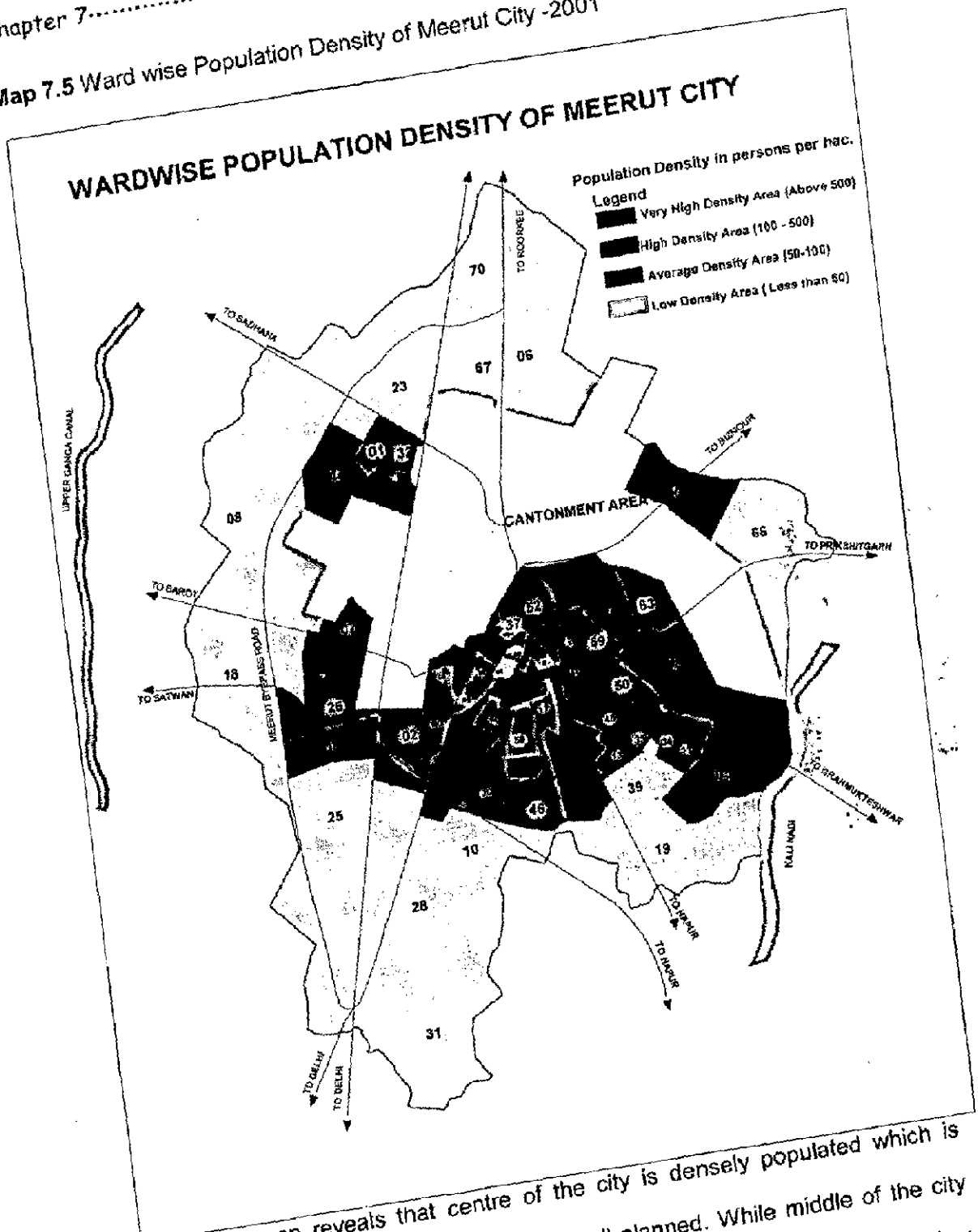
Meerut City constituted of 70 wards making total area 14,188 hectares and occupies total population of 1,074, 869 as per 2001 census. The average population density of city is 76 persons per hectare. Out of the 70 wards, ward No. 12, 'Fakhrudin Ali' is largest in population i.e. 42, 840 and Ward No. 65 'Kanoongoyan' is smallest with population of 571. In respect to area, Ward No. 25 'Sundra Putha' is largest in area i.e. 1324 hac. and Ward No. 42 'Makbara Abu' is smallest having area 2 hac. Density wise Ward No. 24 'Suraj Bahlol' has the highest population density of 4398 persons per hectare and ward no. 31 'Kashi' have the minimum population density of 3 persons per hectare.

Map 7.4 Ward wise Population of Meerut City -2001



As the size of the wards is increasing outward of the City, the wads having population more than 20,000 are also situated in the outer side of the city. The wards having population between 10,000 to 20,000 lies in the middle of the city and towards South-West corner of the city.

Map 7.5 Ward wise Population Density of Meerut City -2001



The above map reveals that centre of the city is densely populated which is generally the old part of the city and not well planned. While middle of the city area have the average density. The outer portion of the city is comparatively low density areas and new area which is under proper planning guidelines.

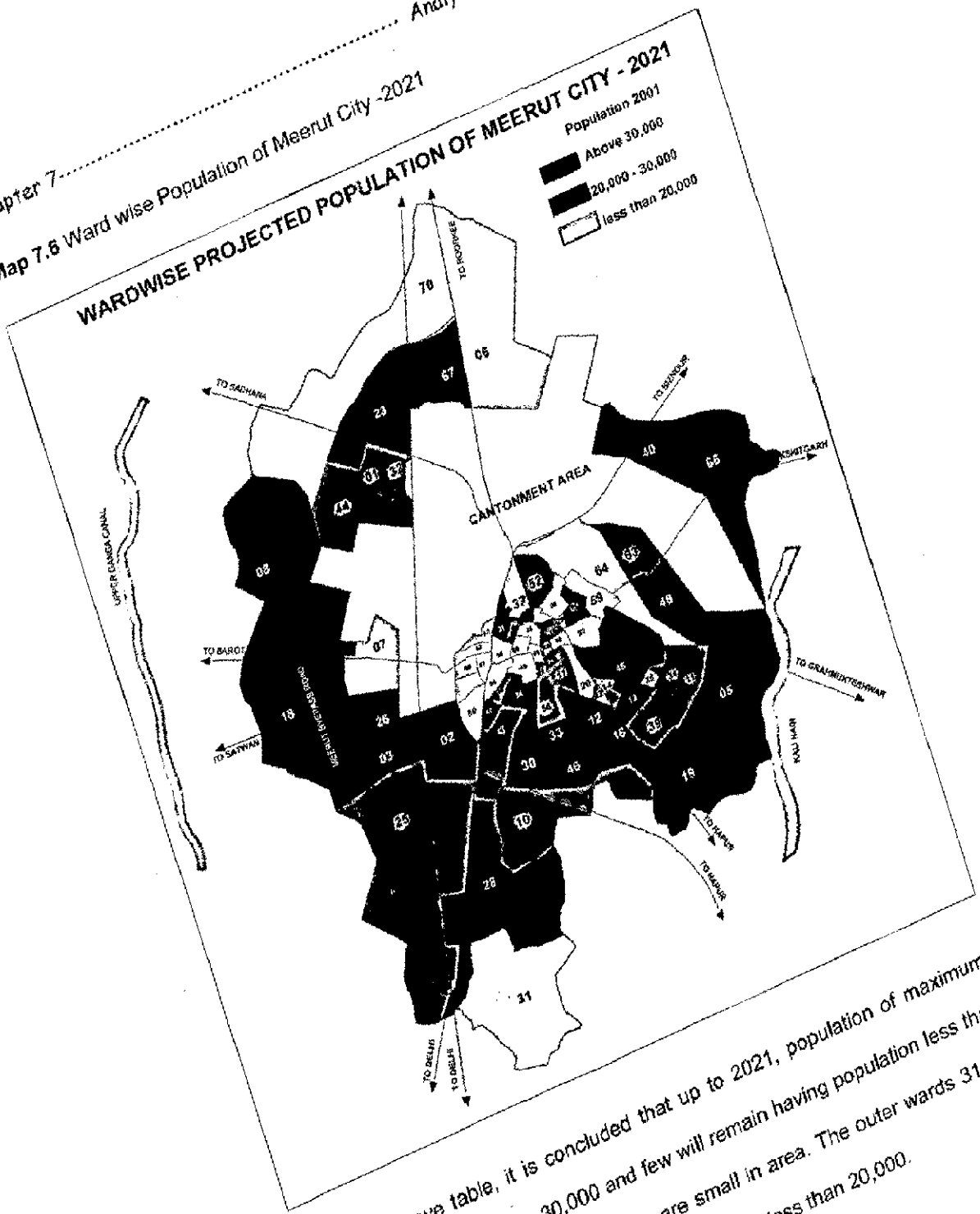
Table 7.4 Ward wise Projected Population and Population Density, 2021

S.No.	Ward	Population	Density
1	Shivlokpuri	22,569	305
2	Mevala	45,400	239
3	Maliyana	34,769	133
4		33,451	440
5	Medical College	60,535	104
6	Palrera	18,484	22
7		15,675	98
8	Shobhapur	36,805	43
9	Subhash Nagar	16,125	90
10	Lisari	25,257	75
11		26,227	291
12	Fakhrudin Ali	77,374	703
13	Jaidi Nagar	30,691	420
14	Kidvai Nagar	23,852	4,770
15	Shahpeer Gate	25,125	2,094
16	Jakir Colony	60,945	3,585
17	Dakshini Islamabad	20,590	824
18	Kharoali	61,292	88
19		33,487	40
20	Purvi Islamabad	18,892	908
21	Kothi Athanas	34,220	1,316
22	Karim Nagar	21,202	5,300
23	Nagalathasi	47,665	55
24	Sarai Bahlol	39,716	7,943
25	Sundra Putha	26,003	20
26	Multan Nagar	48,333	205
27	Purva Ilahibax	27,886	1,394
28	Rithani	33,559	38
29	Purva Abdullahvasi	13,138	3,284
30	Rashid Nagar	30,379	257
31	Kashi	6,289	6
32	Govind Puri	27,261	649
33	Tarapuri	37,666	1,215
34		27,527	671
35		16,111	806
36	Brahmpuri (West)	20,879	2,320
37	Thapar Nagar	17,364	395
38	Kotla	19,280	643
39		20,917	67
40	Radha Garden	42,725	100
41	Shiv Saktinagar	26,799	138
42	Makbara Abu	13,248	5,520
43	Purva Hafiz Abdul Karim	15,612	1,735
44	Kasampura	27,184	121
45	Kailashpuri	30,343	271
46	PraladhNagar	57,192	274
47	Brahmpuri (East)	53,949	2,475

48	Sports Colony	31,025	99
49	Ishwarpuri	16,309	2,039
50	Foolbagh Colony	35,062	565
51	Baghpat Gate	25,708	1,512
52	Gopal Singh Pura	20,638	313
53	Surajkund	17,051	449
54	Mata ka Bagh	15,525	809
55	Prempuri	13,952	367
56	SaddeekNagar	19,688	428
57	KhairNagar	19,329	1,255
58	Daudgram	11,310	1,315
59	Meerut College	16,403	328
60	Devpuri	13,804	209
61	Mohanpuri	21,820	574
62	Moripara	23,844	2,384
63	Netaji Nagar	21,746	217
64	Saket	16,990	110
65	Kanoongoyan	1,031	79
66	PadavNagar	34,022	74
67	Roshanpur Dorli	46,067	76
68	Gudri Bazaar	16,036	- 1,822
69	Jativara	17,655	- 849
70	Modipuram	16,324	66
	Total	1,941,333	137

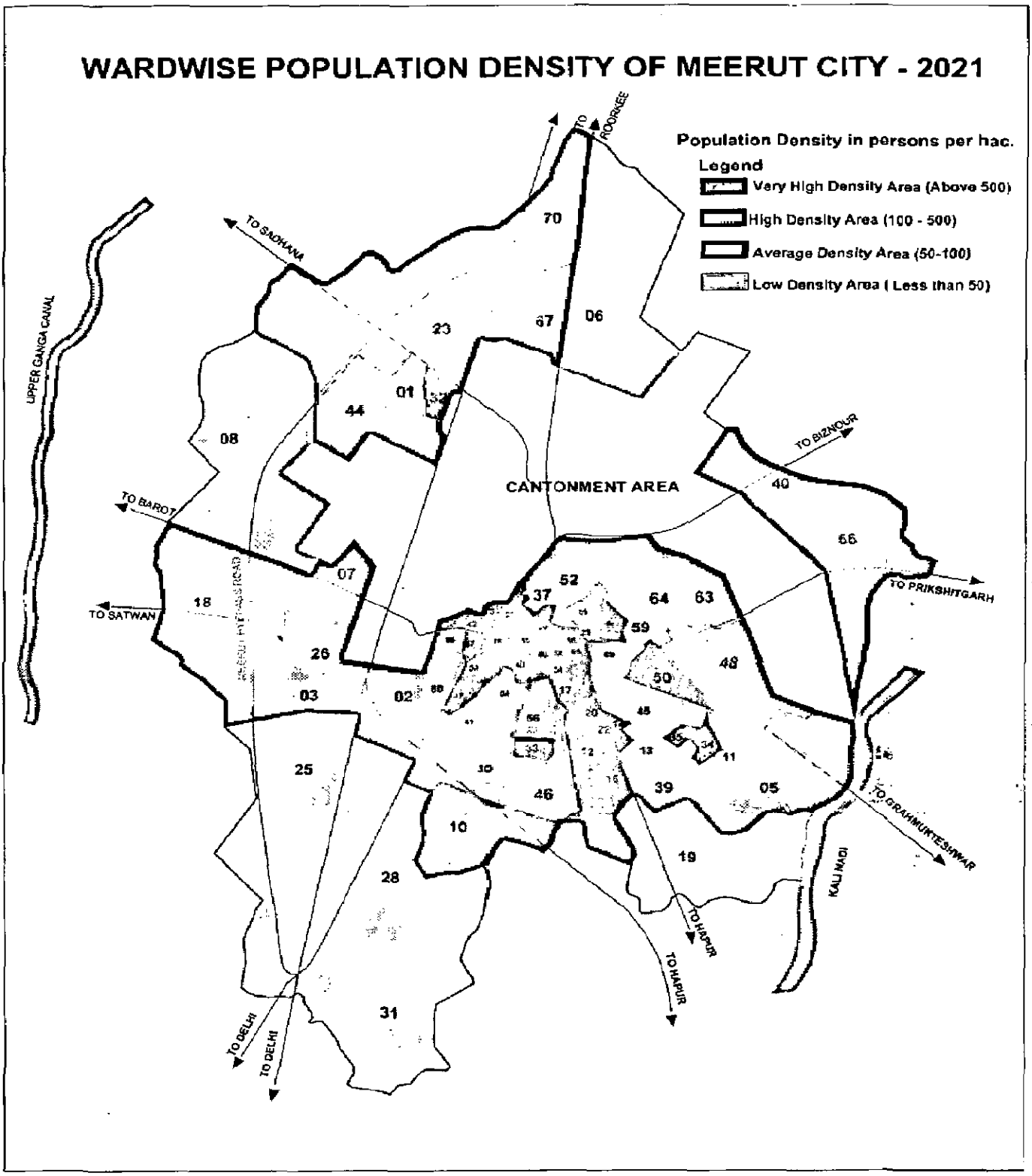
Source: By Author

Map 7.6 Ward wise Population of Meerut City -2021



From the above table, it is concluded that up to 2021, population of maximum wards would reach above 30,000 and few will remain having population less than 20,000, mostly the inner wards which are small in area. The outer wards 31, 70 and 06 being large in area would have population less than 20,000.

Map 7.7 Ward wise Population Density of Meerut City -2021



The inner portion of the city would be highly dense ranging from 100 -500. The centre most part of the city is very high dense having population density above 500 persons per hectare. The outer area would be least affected by population growth and would remain average to low density area.

7.3 Water Supply of Meerut City

7.3.1 Evolution

In Meerut the protected water supply has started since 1886 and at that time the water supply plant was constructed at a cost of over Rs. 7, 51,710. For Meerut urban area, there were total of three source of water supply. They are - Upper Ganga Canal (18 kms. West of town), tubewells within the urban area and handpumps. The city of Meerut meets its domestic and commercial water requirements from surface and sub surface water sources. The piped water supply scheme was introduced in 1895 for a population of 1, 16, 000 at the rate of 12 gpcd. A water works on Ganga canal near Bhola about 15 km, East of the city was constructed and water was pumped through cast iron pipes rising main into two steel tanks of 450 KL situated in Tehsil compound which is the highest point of the city. It was then distributed through distribution system of cast iron pipes.

7.3.2 Existing Conditions

With increase in population and rise in the living standards of the people, the demand for water has also increased. In the Meerut municipal area, the ground water sources are good enough. But due to increase in demand of water for agricultural industries as well as domestic purposes, the ground water table is decreasing day by day. Meerut, the most advanced district of western Uttar Pradesh, in terms of literacy and agriculture is experiencing the crunch. However, the problem of contamination is intensifying - making residents and authorities tense.

However, up to 1950 the original system as described above continued. First improvement and augmentation was done by constructing a tubewell in Lisari

gate in the year 1950. Since then many reorganizations of the system have been taken place.

The surface source for water is from Ganga canal and sub- surface sources are tubewells which are at present 88. The authorities responsible for the water supply in Meerut are UP Jal Nigam, Meerut Municipal Corporation and MDA. Jal Nigam is responsible for transmission of water from the source till the corporation's jurisdiction and also for operation and maintenance of drinking water supply in rural areas within MDA limits. The Municipal Corporation is thereafter responsible for supplying of water within its jurisdiction and also maintaining the system

7.3.3 Treatment

The water coming from all sources (tubewells or Ganga Canal) is treated in the treatment plant that are constructed adjacent to the source i.e. pump houses. Only chlorination process is done and then water is supplied to the consumers.

7.3.4 Distribution

Meerut Municipal Corporation, which is not having any surface water availability in its close proximity, is totally based on ground water. The water supply system of the city has been distributed in nine independent zones and three townships of Kankar kheda, Buxer Kheda and Abdullahpur so as to make the maximum utilization of available sources and storage tanks. The total water supplied by Meerut Nagar Nigam is 158.29 mld and the requirement of the water comes out to be 141.3 mld (this is at the distribution end) but at the receiving end there is shortage of water supply which indicates the loss of water while transportation, whether it is leakage loss or theft of water.

7.3.5 Water Zones

Zones under city core area are as follow:

Zone 1: Kotwali Zone

Zone 2: Baccha Park Zone

Zone 3: Civil Line Zone

Zone 4A: Ghanta Ghar Zone

Zone 4B: Transport Nagar Zone

Zone 5A: Suraj Kund Zone

Zone 5B: Nauchandi Zone

Zone 6A: Bhagwatpura Zone

Zone 6B: Bumipul Zone

Zone 7: Shastri Nagar Zone

Zone 8: Shastri Nagar (South) Zone

Zone 9A: Maliyana Zone

Zone 9B: Putha Village

Three independent townships are:

1. Abdullahpur Zone
2. Kankar Khera Zone
3. Buxer Khera Zone

MDA settlements which are having individual water supply:

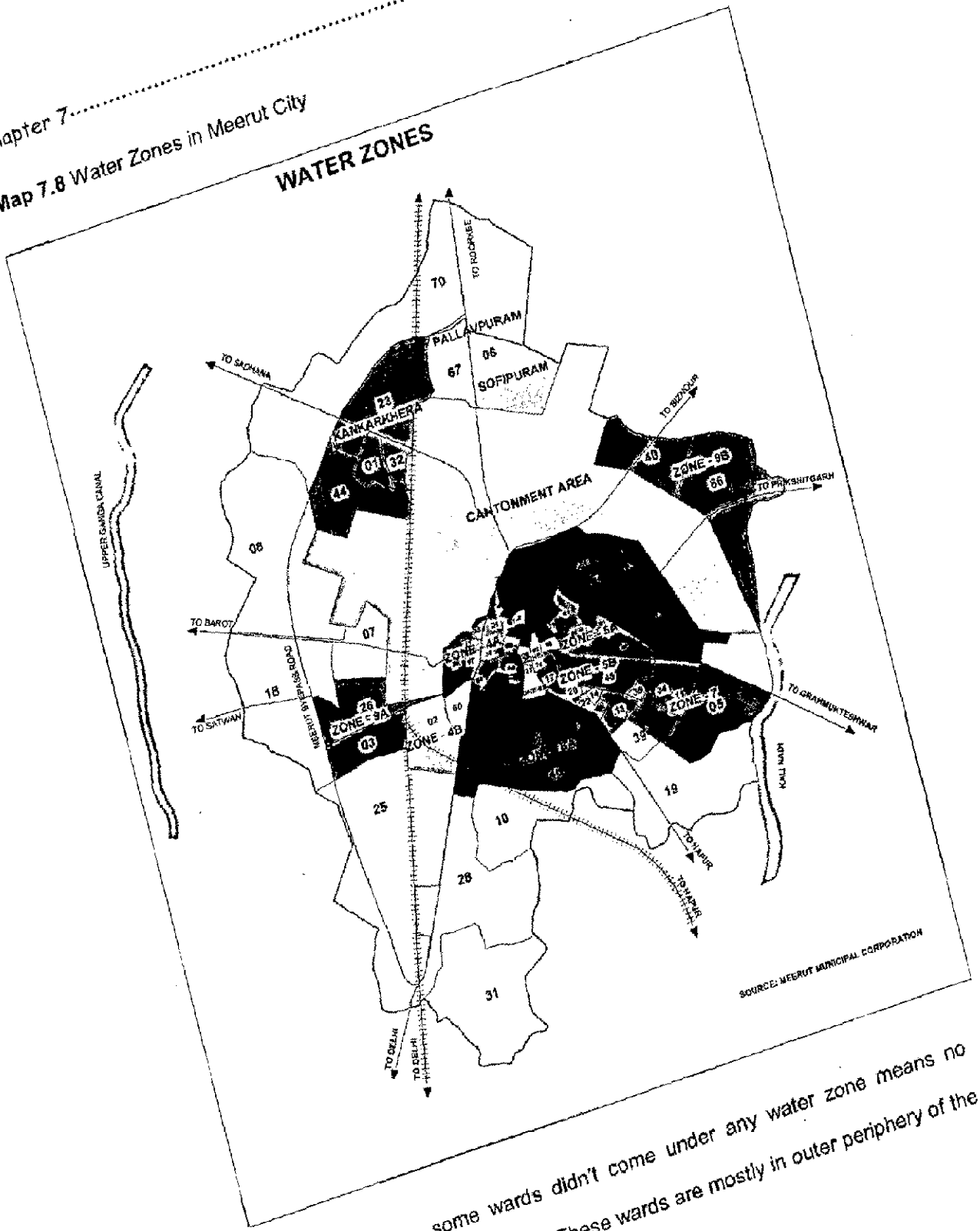
1. Sradhapuri Phase – 1
2. Sanik Vihar
3. Defence Enclave
4. Ved Vyas Puri
5. Shatabdi Nagar
6. Lohiya Nagar

7. Pallav Puram
8. Raksha Puram
9. Pandav Nagar
10. Ganga Nagar

Out of the 70 wards, about 59 are provided with adequate municipal supply. Remaining 11 wards lack a systematized supply. Over the years, the dependence on groundwater has skyrocketed resulting in the depletion of aquifers. During a Rajya Sabha debate, C P Thakur, the union minister of water resources, mentioned Meerut as the town recording a fall of more than 4 m in water tables every year.

The distribution system is also inadequate in the areas of dense population while the outer areas have only the skeleton distribution system. Zone-9 around the original Malayana village across the railway line is fast developing but has a very small percentage of piped water supply system.

Map 7.8 Water Zones in Meerut City



Out of 70 wards, some wards didn't come under any water zone means no municipal water supply is there. These wards are mostly in outer periphery of the city having average or low population density.

Table 7.5 Zone wise Water Supply & Demand for 2001 (in MLD)

S.No.	Water Zone	Supply (in mld)	Demand (in mld)
1.	Zone 1: Kotwali Zone	10.75	7.88
2.	Zone 2: Baccha Park Zone	6.43	6.00
3.	Zone 3: Civil Line Zone	13.92	8.58
4.	Zone 4A: Ghanta Ghar Zone	21.50	16.01
5.	Zone 4B: Transport Nagar Zone	7.13	5.90
6.	Zone 5A: Suraj Kund Zone	13.92	7.36
7.	Zone 5B: Nauchandi Zone	15.36	12.13
8.	Zone 6A: Bhagwatpura Zone	13.92	35.78
9.	Zone 6B: Bumipul Zone	1.92	1.07
10	Zone 7: Shastri Nagar Zone	18.72	5.55
11.	Zone 8: Shastri Nagar (South) Zone	9.60	0.18
12.	Zone 9A: Maliyana Zone	3.84	8.28
13.	Zone 9B: Putha Village	1.92	7.64
14.	Kankar Khera Zone	9.93	12.42
15.	Pallavpuram	2.30	4.59
16.	Sofipuram	2.88	1.84

Source: Meerut Municipal Corporation

The above table reveals that there is uneven distribution of water in different water zones. Some water zones have less demand than supply whereas in some wards is very high than supply especially in Zone-6A: Bhagwatpura Zone. Demand of water in this zone is 35.78 MLD whereas supply comparatively is very less i.e. 13.92 MLD.

Zones 9A, 9B, Kankarkhera, and Pallavpuram are also comes under water deficient zones.

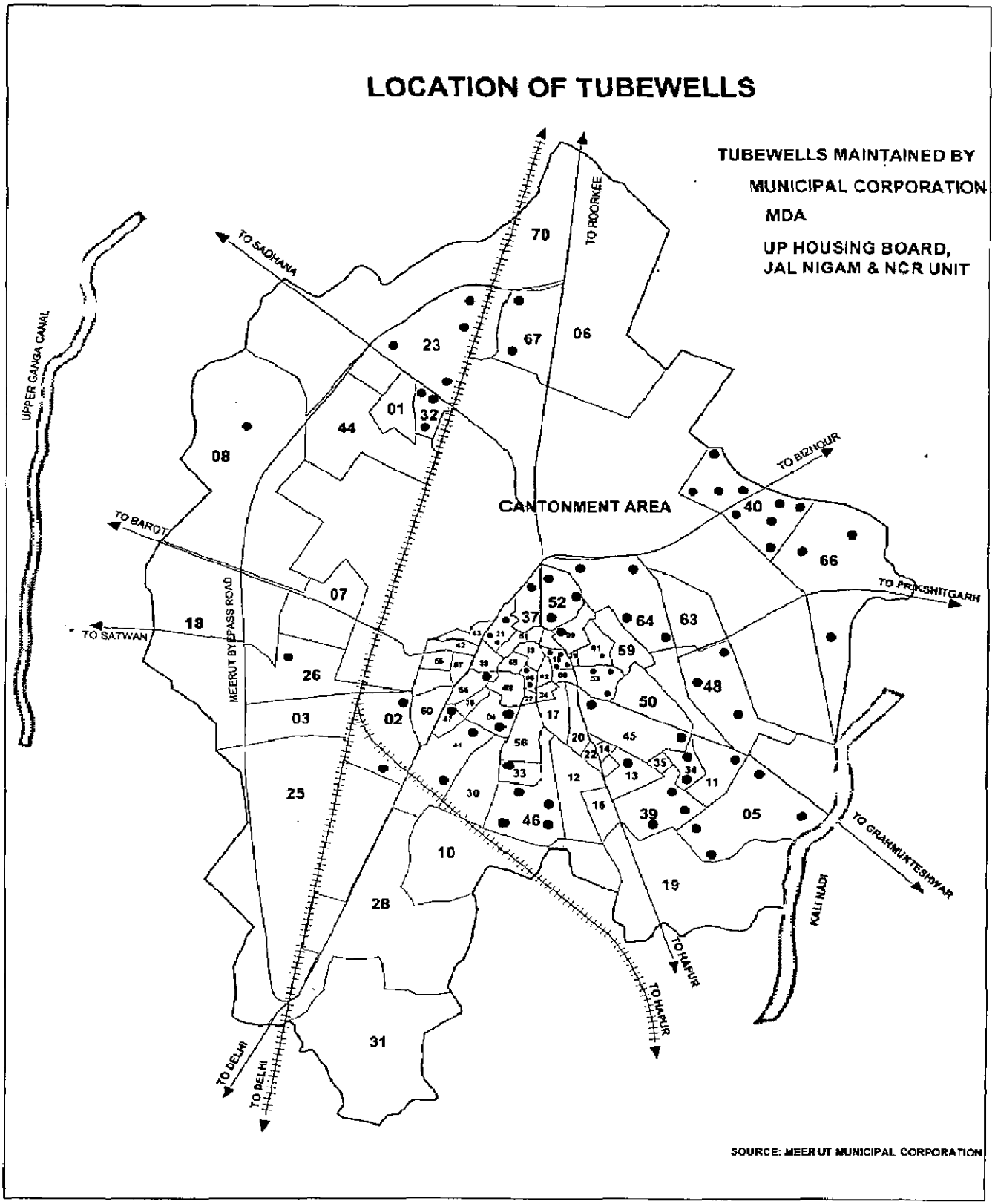
Table 7.6 Detail of Existing Tubewells being maintained by Nagar Nigam, Meerut

S.N	Location of Tubewell	Year of commissi-oning	Wards	Discharge (lpm)	Discharge (mld)
Zone -1					**10.75**
1.	Lisari Gate	1975	62, 58, 68, 27	500	0.48
2	Prahlad Nagar -1	-		1200	1.15
3	Prahlad Nagar –II	1993		4500	4.32
4	Guzari Bazar	2000		5000	4.80
Zone – 2					**6.43**
5	Ladies park	1965	15, 69, 52, 37	1000	0.96
6	Gym Khana	1965		500	0.48
7	Chippi Tank	1984		1200	1.15
8	Sharma smarak	1985		2000	1.92
9	Purva Ahiran	1989		1500	1.44
10	Shahpeer Gate	-		500	0.48
Zone – 3					**13.92**
11	Civil Lines	1960	59, 63, 64, 48	700	0.67
12	Commissionary	1965		2500	2.40
13	Circuit House	1986		2000	1.92
14	Jail Chungi	2002		5000	4.80
15	Mangal Pandey Nagar	-		1500	1.44
16	Mangal Pandey Nagar	-		300	0.29
17	Saket	1985		2500	2.40
Zone – 4A					**21.50**
18	Town Hall No. 2	1987	21, 51, 65, 49, 54, 55, 38, 42, 43, 57	1500	1.44
19	Mahapalika	1972		1200	1.15
20	Bhola water works	1976		1200	1.15
21	Makbara abu	1986		1500	1.44
22	Menka Cinema	1989		2000	1.92
23	Ismyle School	1998		4500	4.32
24	Apsara Cinema	1962		500	0.48
25	Duffarin	2000		5000	4.80
26	Patel Nagar	2001		5000	4.80
Zone – 4 B					**1.73**
27	Transport Nagar	1984	60, 02	1800	1.73
Zone – 5A					**15.36**
28	Suraj Kund (Khatta Road)	1986	50, 53, 61	2000	1.92
29	Suraj Kund (Gandhi Park)	1986		2500	2.40
30	Suraj Kund (Store)	1998		5000	4.80
31	Mahan Puri	2000		5000	4.80
Zone – 5B					**15.36**
32	Nauchandi –I	1978	17, 20, 45, 22, 13, 14	1500	1.44
33	Nauchandi –II; Kalyan Nagar	1995		4500	4.32
34	Nauchandi- III	2001		5000	4.80
35.	Ram Bahg	1999		5000	4.80

Zone – 6A					**13.92**
36	Bhagwat Pura – I (OHT)	1998	4, 30, 33, 56, 41, 47, 36, 12, 46, 16, 41, 36	5000	4.80
37	Alok Vihar	1989		2000	1.92
38	Sardar Patel Inter College	1995		3000	2.88
39	Sakur Nagar	1995		4500	4.32
Zone 6B					**1.92**
40	Vikaspuri	1983	56	2000	1.92
Zone 7					**18.72**
41	Shastri Nagar Taj Garhi	1974	11, 33, 34, 39, 35, 5	1500	1.44
42	Shastri Nagar H Block	1978		1500	1.44
43	Shastri Nagar K Block	1978		1500	1.44
44	Shastri Nagar sector -2	1980		1000	0.96
45	Shastri Nagar Sector -3	1981		1500	1.44
46	Shastri Nagar B Block	1990		2000	1.92
47	Shastri Nagar Sector 9 (i)	-		1000	0.96
48	Shastri Nagar Sector 9 (ii)	-		1000	0.96
49	Shastri Nagar Sector 3	2001		3000	2.88
50	Jagriti Vihar	-		5500	5.28
Zone - 8					**9.60**
51	Shastri Nagar L Block	2000	39	5000	4.80
52	Shastri Nagar K Block	2000		5000	4.80
Zone 9A					**3.84**
53	Maliyana	1995	3,26	4000	3.84
Zone – 9B					
54	Abdullahpur	1992	66, 40	2000	1.92
55	Kaseru Khera	1974		500	0.48
56	Kaseru Khera	2002		3000	2.88
Kankerkhera					
57	TW No. 1	1985	23, 44, 32, 01	900	0.86
58	TW No. 2	1986		1500	1.44
59	TW No. 3	1998		5000	4.80
60	TW No. 4	2002		3000	2.83
61	Scheme No. 10	-		1500	1.44
62	Indira Nagar	2001		5000	4.80
Pallav Puram Phase -1					
63	TW No. 1	-	67, 6	1200	1.15
64	TW No. 2	-		1200	1.15
65	Sofipur	2002		3000	2.80
				Total	**158.29**

Source: *Meerut Municipal Corporation*

Map 7.9 Map showing Location of Tubewells in Meerut City



At present, there are 68 tube wells, 20 overhead tanks and 3 underground tanks. The capacity of 20 overhead tanks is 20500 KL and that of 3 underground tanks is 16000 KL. Of the total supply of 158.5 MLD, only 14.8 MLD supplied from Ganga canal.

Table 7.7 List of Over Head Tanks and Underground Reservoirs under Nagar Nigam, Meerut

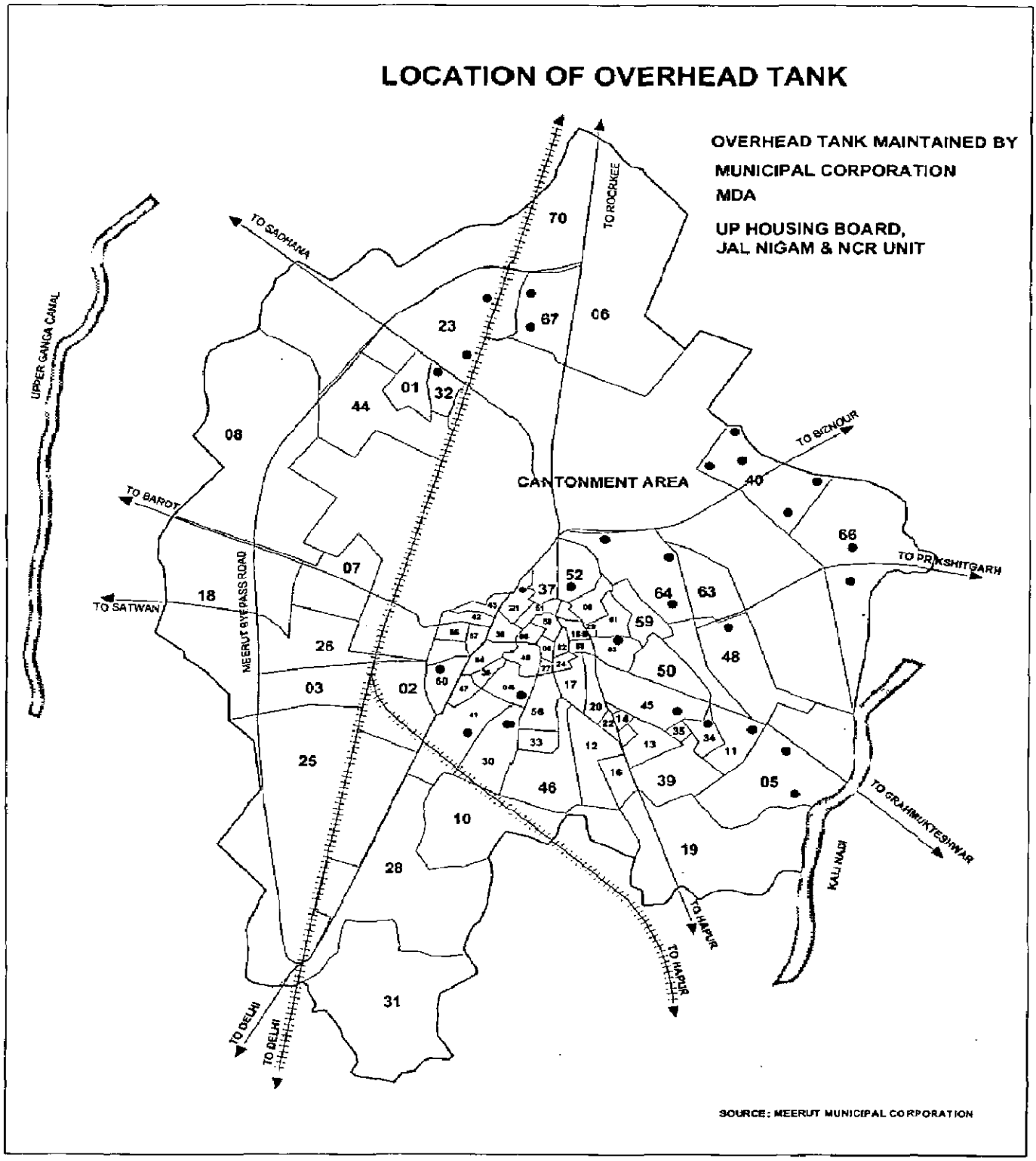
S.No.	Location of O.H.T.	Capacity Kl.
1.	Nauchandi	1250
2	Ladies Park	1125
3	Kankerkhera	1500
4	Shastri Nagar Block (B)	600
5	Near Old Tehsil Kotwali	2 X 450
6	Pallavpuram Phase – I	1700
7	Shastri Nagar (H)	900
8	Town Hall	1800
9	Kaseru Baksar	90
10	Bhagwatpura	1100
11	Abdullahpur	100
12	Surajkund	2500
13	Civil Lines	450
14	Shastri nagar Sector – 3	1000
15	Shastri nagar Sector – 9	1100
16	Delhi Road Scheme -10	1000
17	Circuit House	500
18	Mangal Pandey Nagar	650
19	Jagriti Vihar Sector – 4	1200
20	Jagriti Vihar Sector – 7	1350

Source: Municipal Corporation Meerut

Underground Reservoir

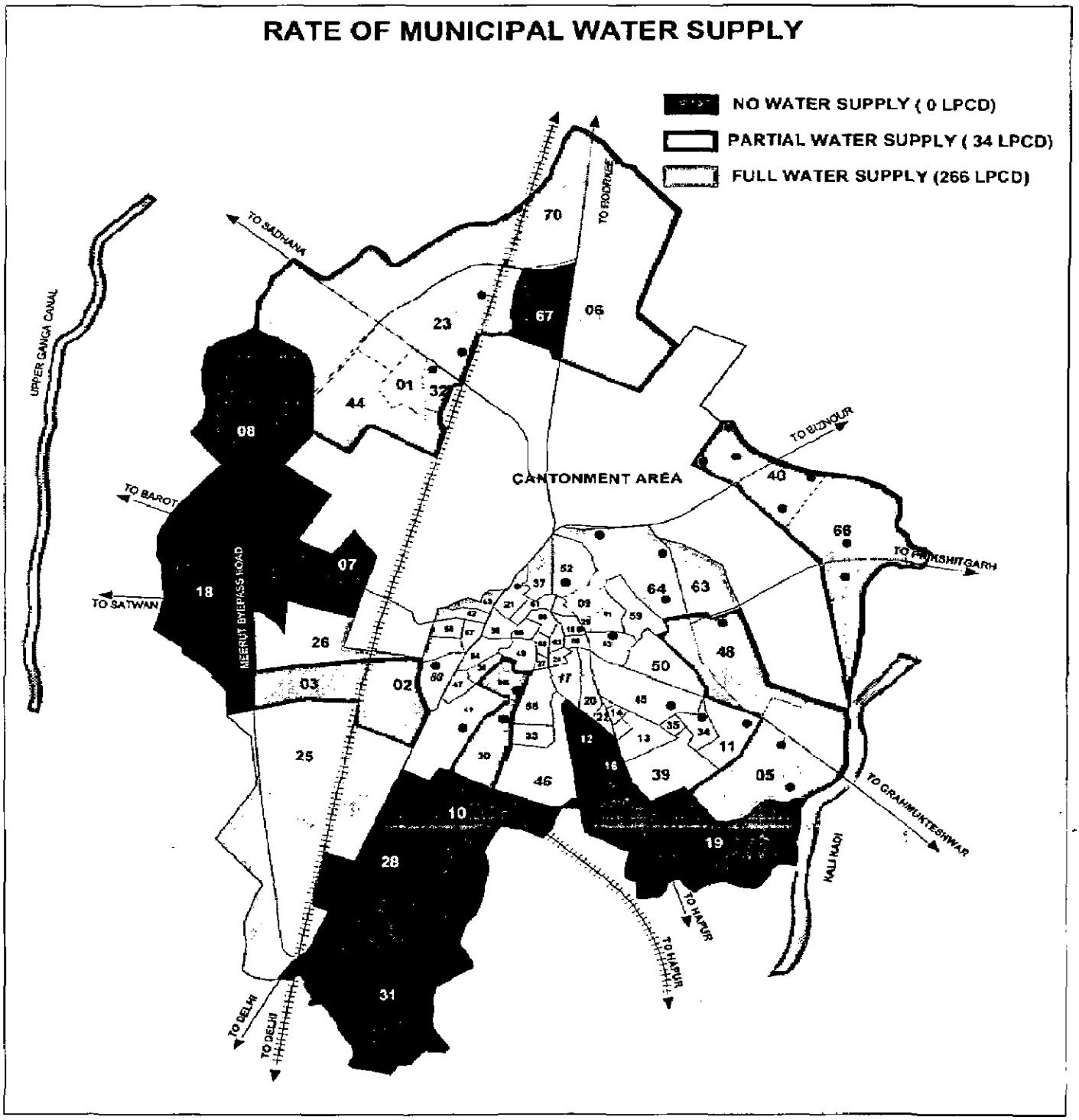
1	Town Hall	6000
2	Circuit House	5000
3	Sharma samark	5000

Map 7.10 Map showing Location of Overhead Tanks in Meerut City



There is work in progress to construct 26 new tube wells and overhead tanks which would supply the total water of 44 MLD making total supply of 202.5 MLD.

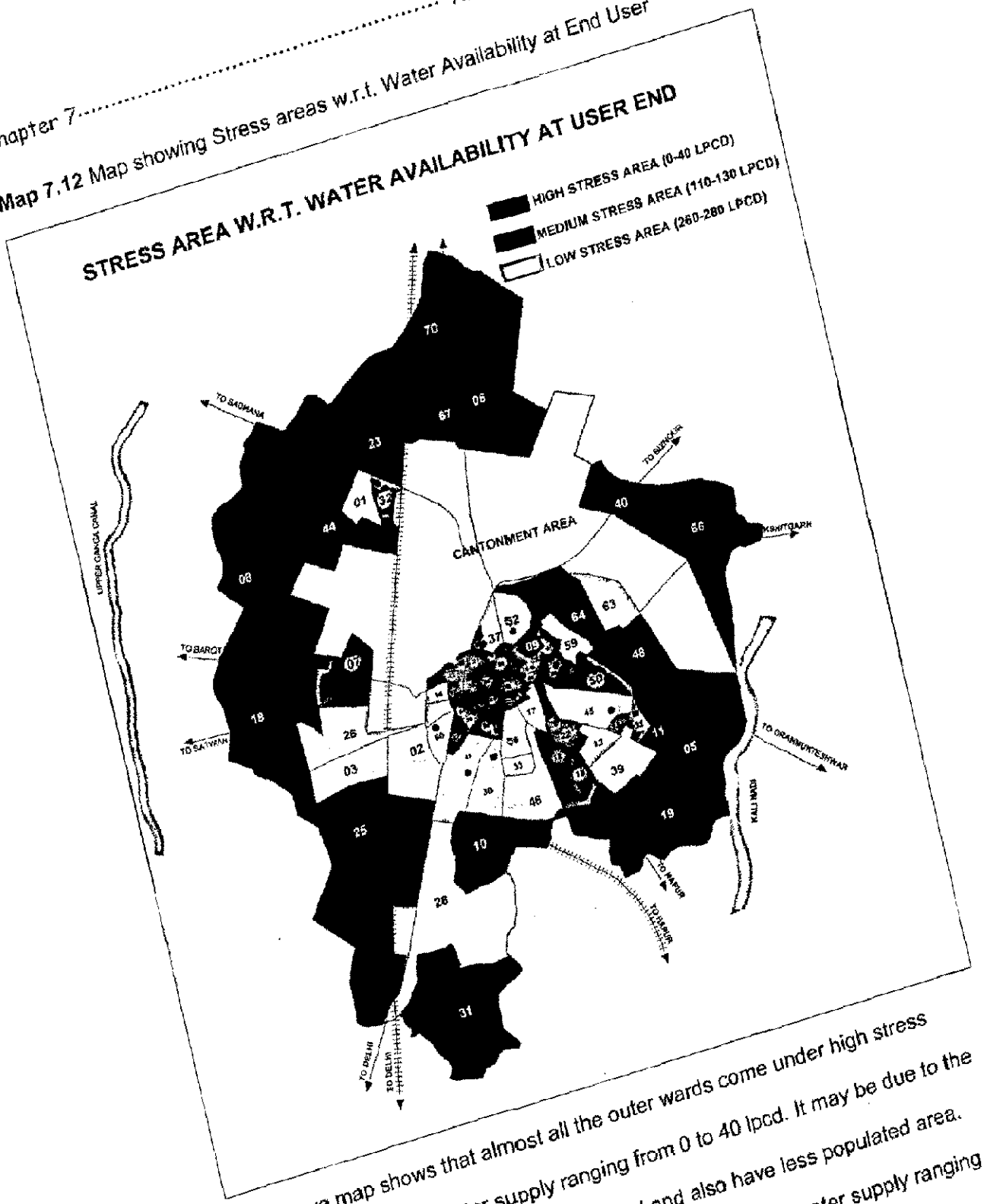
Map 7.11 Map showing Rate of Municipal Water Supply in different wards



Till now, there are many wards which do not have any municipal water supply. In wards 1,2, 3, 4, 5, 6, 23, 30, 40, 44, 48, 66 and 70 have very less water supply than required.

In wards 7, 8, 10, 12, 16, 18, 19, 28, 31 and 67, there is no provision of municipal water supply.

Map 7.12 Map showing Stress areas w.r.t. Water Availability at End User



The above map shows that almost all the outer wards come under high stress area having very less water supply ranging from 0 to 40 lpcd. It may be due to the reason that these areas are less developed and also have less populated area. The inner portion comes under medium stress area having water supply ranging from 110 to 130 lpcd.

7.3.6 UNDERGROUND WATER

Rapid increase of urbanization, industrialization and agriculture growth has brought in its associated problems of the presence of undesirable matter, i.e., pollution in the ecosystem especially in the surface and ground water bodies.

Surface water pollution is generally caused by runoff or direct dumping of undesirable and / or excess substances into the body of water. Polluted water from the storm drains and sewage treatment plant overflows contribute to surface water pollution.

Ground water pollution is caused by seepage of undesirable material into the ground that reaches the water table. As you go deeper into the ground more natural filtering is done. Wells have to be dug deep enough to draw water that is not polluted. In the much polluted areas this may not be feasible.

On a global scale, pathogenic contamination of drinking water poses that most significant health risk to humans and there have been countless numbers of disease outbreaks and poisonings throughout history resulting from exposure to untreated or poorly treated drinking water. These toxic contaminants through the surface water, ground water and other pathways moves in the aquatic environments, their concentration and structure along the many transport flow paths and relative risks that these contaminants pose to human and environmental health. The toxic contaminants of water has a serious impact on all living creatures and can negatively affect the use of water for drinking, household needs, recreation, fishing, transportation and commerce.

7.3.6.1 Underground water condition

Ground water is the main source of water supply which is drawn through handpumps; wells, tubewells etc. Good quality of ground water is available at 35 - 38 mts depth. There is depletion in the water level in the district by 0.15 - 2.5 mts

during the last decade.

Ground water is an important development resource. The majority of town in Meerut district is dependent on ground water for consumption for both domestic and non domestic uses.

The analysis of both surface and ground water resources indicates that the endowment is sufficient, provide that it is carefully conserved and managed. Hydrological Meerut district is a part of the vast central Ganga plain, a monotonous stretch of a low relief plain with its depositional and erosional geomorphic features. Exploratory drilling on the Ganga plain as a whole has revealed that it is thick pile of alluvium.

7.3.7 Quality of Water

In 2002, CSE along with JF studied Meerut's water quality (www.cseindia.org/html/lab). The analysis of samples collected from handpump and municipal water supply source in different parts of the city indicates a dangerous trend. The concentration of total dissolved solids, magnesium and chloride were above the permissible limits. Bromide content was also found to be high, making it unfit for drinking purposes even after chlorination. However, the municipality has completely overlooked this fact, as their supply continues as before. These problems are creeping in as a number of poisonous effluents from various industries are increasingly dumped into surface water sources without adequate treatment. Further, intensive sugarcane production in Meerut district has not only led to overexploitation of groundwater reserves but also in intensifying pollution.

In April 2001, the building bylaws were amended to make rainwater harvesting mandatory in both the old and new constructions. But its implementation is far

from satisfactory. Further, contamination can only be checked if the polluting units are pressurized by people to adopt proper treatment facilities.

In Meerut, unlike in other cities, at least a public debate has begun to make groundwater free of poison.

7.3.7.1 Quality of Underground Water

Based on water analysis done at different locations of Meerut City viz, Pallavpuram, Brahampuri, Lekha nagar, Vijay Nagar, Shahpeer Gate and Subhash nagar, it is concluded that ground water is not suitable for drinking purpose because they contain high level of bromide, total dissolved solid, calcium and chemical oxygen demand than the BIS prescribed level.

7.3.8 Projected Water Demand - 2021

In the metropolitan area, the total water demand up to 2021, as per 200 lpcd standard, would be 460 MLD. At present the total water demand from different sources is 158.5 MLD which is going to increase up to 202.5 MLD as per current work of progress. Hence total amount which is needed to take is 258 MLD (460 – 202).

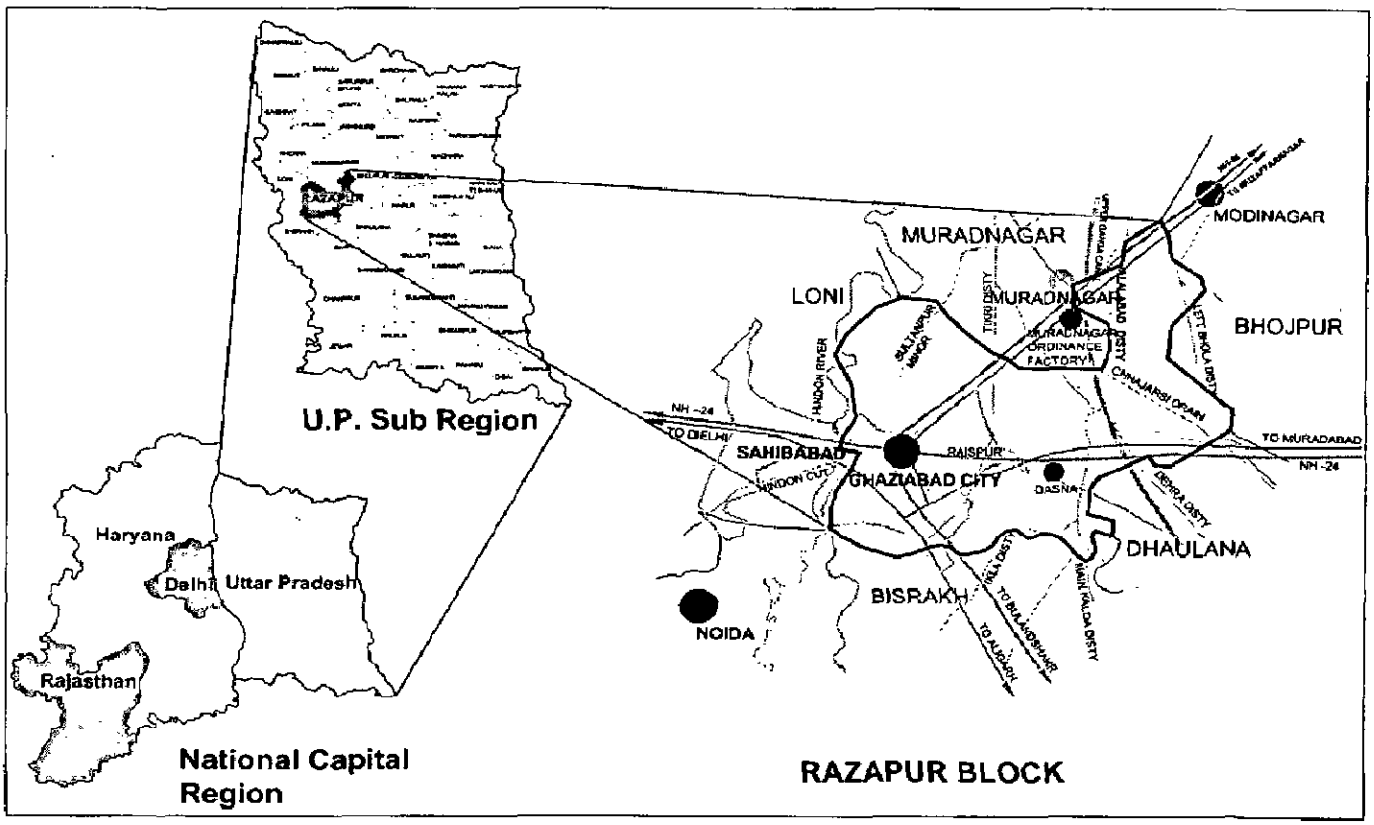
7.4 RAZAPUR BLOCK

Razapur block is second most densely populated block in the Sub region after Meerut block having a population of 11 lakh as per 2001 census. It has population density of 5813 persons per sq. km. and having a total area of 192 sq. km.

7.4.1 Location

Razapur block lies in West end of Ghaziabad district and approximately in the middle of Sub region. It is surrounded by Loni, Muradnagar, Bhojpur, Dhaulana and Bisrakh blocks. It is well connected by road and rail network. NH-58, connecting Delhi – Haridwar and NH-24 connecting Delhi- Moradabad, pass through Razapur block. Same network follows for railway line.

Map 7.13 Location Map of Razapur Block



Razapur block is endured with good surface water resources in the form of river and canal. On the West end of the block, Hindon River flows which is seasonal

river and have water only in rainy season. Ganga canal also flows through the block which initiates many distributaries through it like Jalalpur Disty, Dehra Disty, Sultanpur minor, Tikri minor, main Kalda disty etc.

7.4.2 Demographic Profile

Table 7.8 Population Distribution in Razapur Block (1991 -2021)

Year/Population	Rural	Urban	Total
1991	1, 29,433	5, 28,722	6, 58,155
2001	1, 20,739	9, 92,690	11, 13,429
2011 (Projected)	1, 12,629	13, 98,375	15, 11,004
2021 (Projected)	1, 05,064	19, 70,148	20, 75,212

From the above table it is concluded that on one side urban population in Razapur block is increasing at a faster pace i.e. 88% between 1991 -2001 while rural population is decreasing at the rate of 7% from 1991-2001. It is estimated that if this trend of growth would continue then the population will cross the figure of 20 lakh.

The main constituent of the growth of Razapur block is Ghaziabad City which is extending its limit with the fast pace of industrialization. Now Ghaziabad city also extended to Loni block and in Ghaziabad Master Plan -2021, the surrounding cities namely Loni and Muradnagar are considered for homogeneous development.

7.5. GHAZIABAD CITY

7.5.1. Introduction:

National Capital Region (NCR), a unique region, is the fastest growing region. It has the best economic base for growth of industries and new economy as well (software, Export Promotion Zone (EPZ) and Special Economic Zones (SEZ)). Within NCR, Ghaziabad is one of the fast developing Delhi metropolitan area city. Ghaziabad district, carved out of Meerut district in 1976, had Ghaziabad as class-I city. During partition of India, it was a class III town. With onset of industralisation of the surrounding areas, it became class II town in 1961 and with growth rate of 82.10% in 1961-1971, it acquired the status of class I city in 1971. After Kanpur, Ghaziabad is the biggest industrial city in Uttar Pradesh (U.P.) state. The city has grown at very fast pace during the last three decades to emerge as a Metro and strengthen its economic base. The city has one of the best road and rail connections among cities in U.P. State

Ghaziabad, the headquarter of the district of the same name, lies on the Grand Trunk road about a mile east of the Hindon river in Lat. 28° 40' North and Long. 77° 25' East, 19 Kms. east of Delhi and 46 Kms. South-West of Meerut with which it is connected by a metalled road. Other roads lead north-Wesr to Loni and Baghpat and east to Hapur and Garhmukteshwar. As its boundary is adjacent to Delhi, it acts as the main entrance of Uttar Pradesh and that is why it is also called the GATEWAY OF U.P.

Ghaziabad town is almost equally divided into eastern and western segments by the river Hindon flowing from north to south. The older part of the city is in the eastern part which is called the Cis-Hindon Area (CHA) and the newly developed areas on the western side of Hindon and nearer to Delhi is called the Trans - Hindon Area (THA). During the past two decades there has been extensive

development of the town with rapid growth in population which now stands at about 1.04 million.

7.5.2. Topographical & Geological Conditions:

Trans & Cis Hindon area of Ghaziabad located on right and left Bank of River Hindon respectively. Topography of Ghaziabad town is almost flat terrain. The ground slopes from East to West. Maximum & Minimum levels of the area vary from Reduced Level 212 to 204 m. General ground water table is about 5.5 m below ground level. In general, soil is alluvial type. The area of the town is 71 sq. kms.

7.5.3. Demographic Profile:

Table 8.9 Decadal population growth of Ghaziabad City

Year	Population	Growth rate (%)
1981	287170	-
1991	511759	78.21
2001	968256	89.2
2011	1366611	
2021	1928856	

Source: *Ghaziabad Master Plan - 2021*

7.5.3.1 Population Density:

Average population density of the area is 14690 per sq. Km.

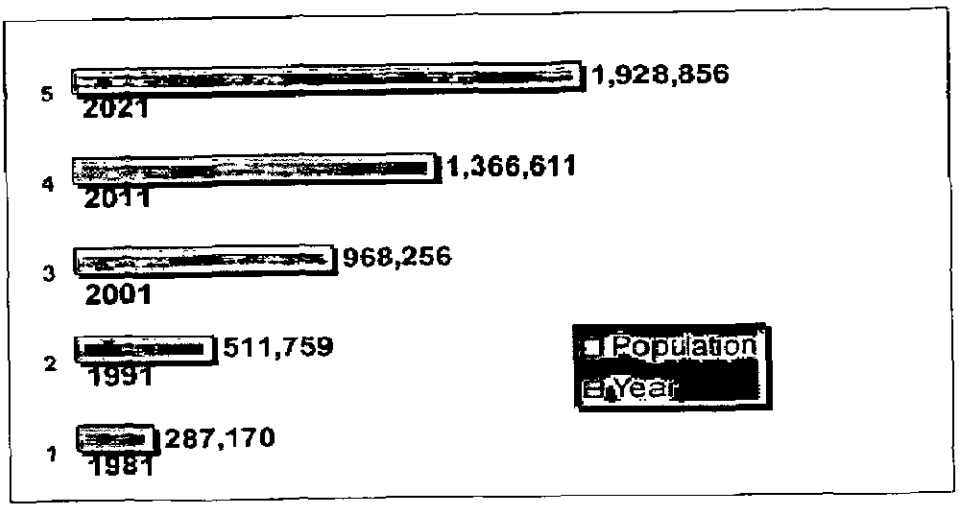
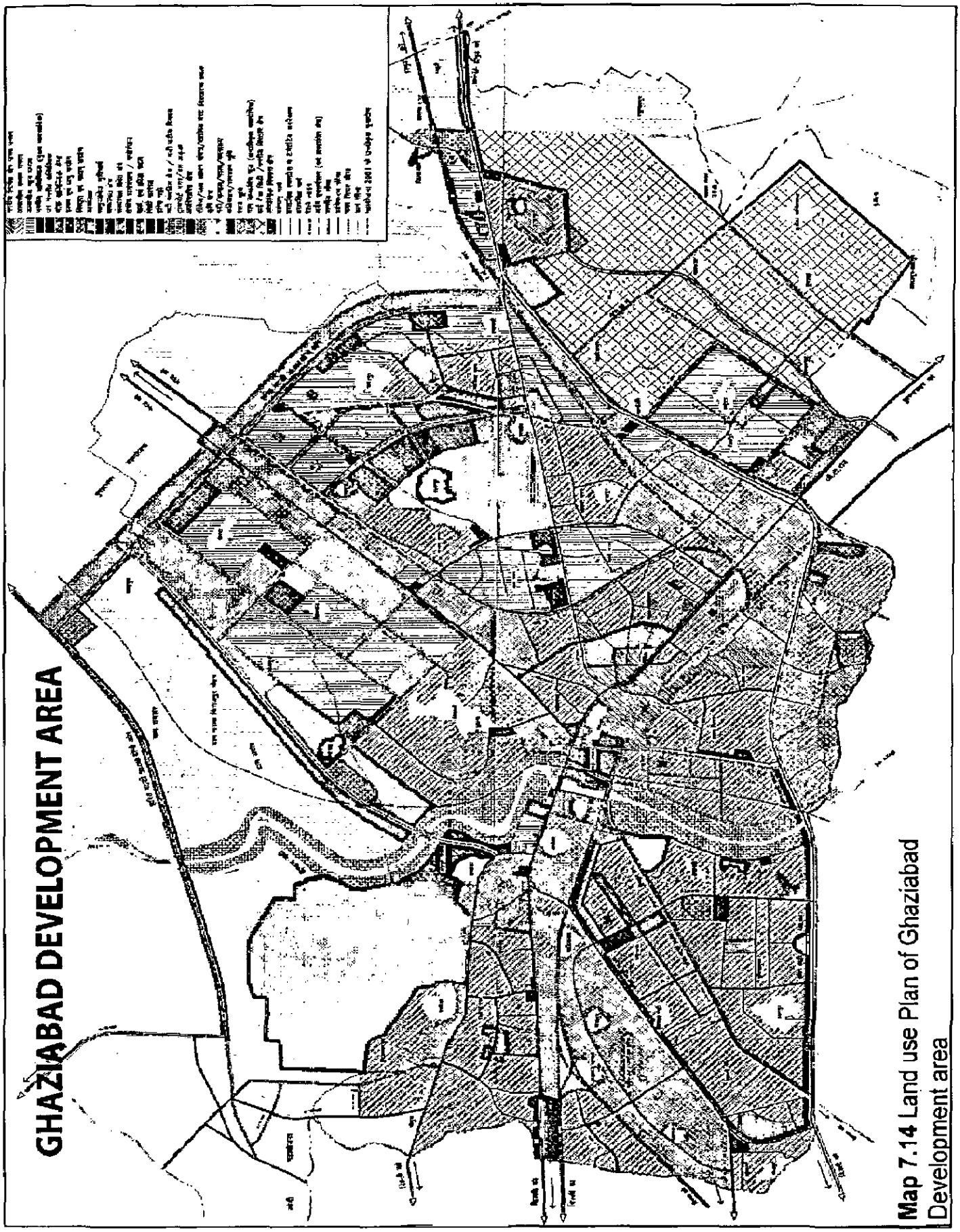


Fig 7.1 Decadal Population growth of Ghaziabad City

The status of Ghaziabad was upgraded from Municipal Board to Municipal Corporation, known as Ghaziabad Nagar Nigam (GNN) on 31 August 1994 following 74th Constitution Amendment Act 1992 and conformity legislation by state government. GNN area has been divided into four administrative zones namely City zone, Kavi Nagar Zone, Vijay Nagar Zone and THA Zone. The area is further divided into 60 wards.

The economy of the town has been bi-functional – industries-cum-services since 1971. The industrial development of the city is visible on both sides of Hindon River. Chemical and allied distillery (33%) dominates its industrial scene. It is also an important centre for trade and commerce in western U.P. sub-region. The workforce participation ratio and percentage workers in secondary sector are marginally declining but the size of work force in the city has maintained its increasing trend.



Map 7.14 Land use Plan of Ghaziabad Development area

7.6 GHAZIABAD – WATER SUPPLY SYSTEM

Hydro-geologically, U.P. sub-region of NCR, comprising of Ghaziabad, Meerut and Bulandshahr districts, is a part of vast central Ganga plain, a monotonous stretch of a low relief plain. Ghaziabad district is very fertile and it lies in the doab of Ganga and Yamuna rivers. The district is bestowed with shallow and deep aquifers and the city has been exploiting the ground water source since last four decades. Apart from utilizing ground water for providing water through hand pumps in rural and unauthorized areas, ground water has been utilized for piped water supply since 1955, when piped water supply scheme was introduced.

The water supply facility, in developments carried out by Nagar Palika and thereafter Ghaziabad Improvement Trust, was on colony basis. From 1977, onwards Ghaziabad Development Authority started developing the Master Plan sectors and with U.P.Jal Nigam services, water supply facility continued to be provided on sector basis without any water supply master plan. To prepare the status and pre-feasibility report of water supply in Ghaziabad city, U.P.Jal Nigam, in 1995, delineated the water supply zones for equitable, economical and efficient distribution of water. Ghaziabad city, under the jurisdiction of GNN and Development Authority has been divided into CHA having 23 Master Plan sectors and 10 Master Plan sectors of THA Residential areas of the Railways, Central Government and Police Department are considered in separate water supply zones having their own independent water supply system.

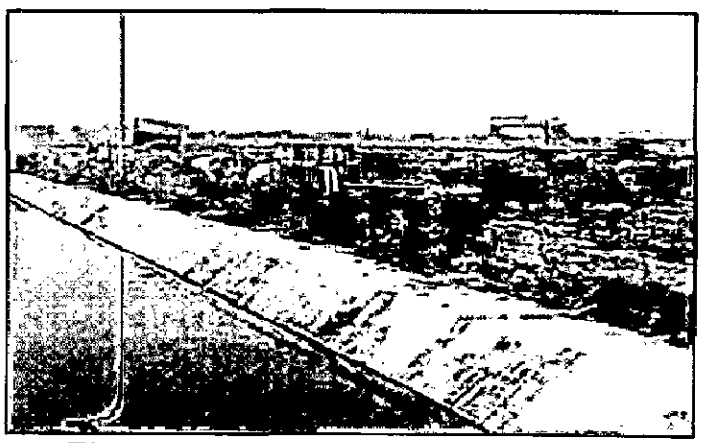


Fig 7.2 Reactor Chamber at the STP at Ghaziabad

7.6.1 Water Scenario

According to Nagar Nigam, water supply is totally depending up on ground water sources. Along with Nagar Nigam, uncontrolled extraction of ground water by industrial units, group housing societies and large housing areas, water level is going deeper at faster rate.

From the sources, it is estimated that water level decreased 20 -30 feet . There is one project of using surface water of 50 cusec from Ganga canal to Trans Hindon area is under finishing stage. From this 50 cusec, 15 cusec fro housing board projects and 15 cusec for residential colonies of Ghaziabad development Authority.

In Ghaziabad, due to high rate of urbanization, the demand for water increasing day by way and gap between supply and demand is also increasing.

7.6.2 Zone wise Distribution of Water Supply

Ghaziabad Nagar Nigam (Water department) has divided the total area into six zones namely:

1. Kavi Nagar Zone
2. City Zone – I
3. City Zone – II
4. Vijay Nagar Zone
5. Mohan Nagar Zone
6. Vasundra Zone

1. Kavi Nagar Zone

In this total no. of pumps are 45 having total discharge capacity of 43600 LPM. From total of 45 pumps, 31 have over head tanks while 14 of them have direct supply system. Head of water varies from 30 to 40 mts in which 27 having a head

of 40 mts and 18 have 30 mts. All the pumps are submersible. Discharge from the pumps ranges from 300 LPM to 1500 while average discharge is 1200 LPM.

Serving Areas:

Kavi Nagar, raj Nagar, Shastri Nagar, Vivekanand Nagar, Loha Mandi, Govindpuri area and Gilghar village.

2. City Zone – I

In this total no. of pumps are 40 having total discharge capacity of 33200 LPM. From total of 40 pumps, 18 have over head tanks while 22 of them have direct supply system. Head of water varies from 30 to 40 mts in which 15 having a head of 40 mts and 25 have 30 mts. All the pumps are submersible. Discharge from the pumps ranges from 300 LPM to 1200 while average discharge is 1000 LPM.

Serving Areas:

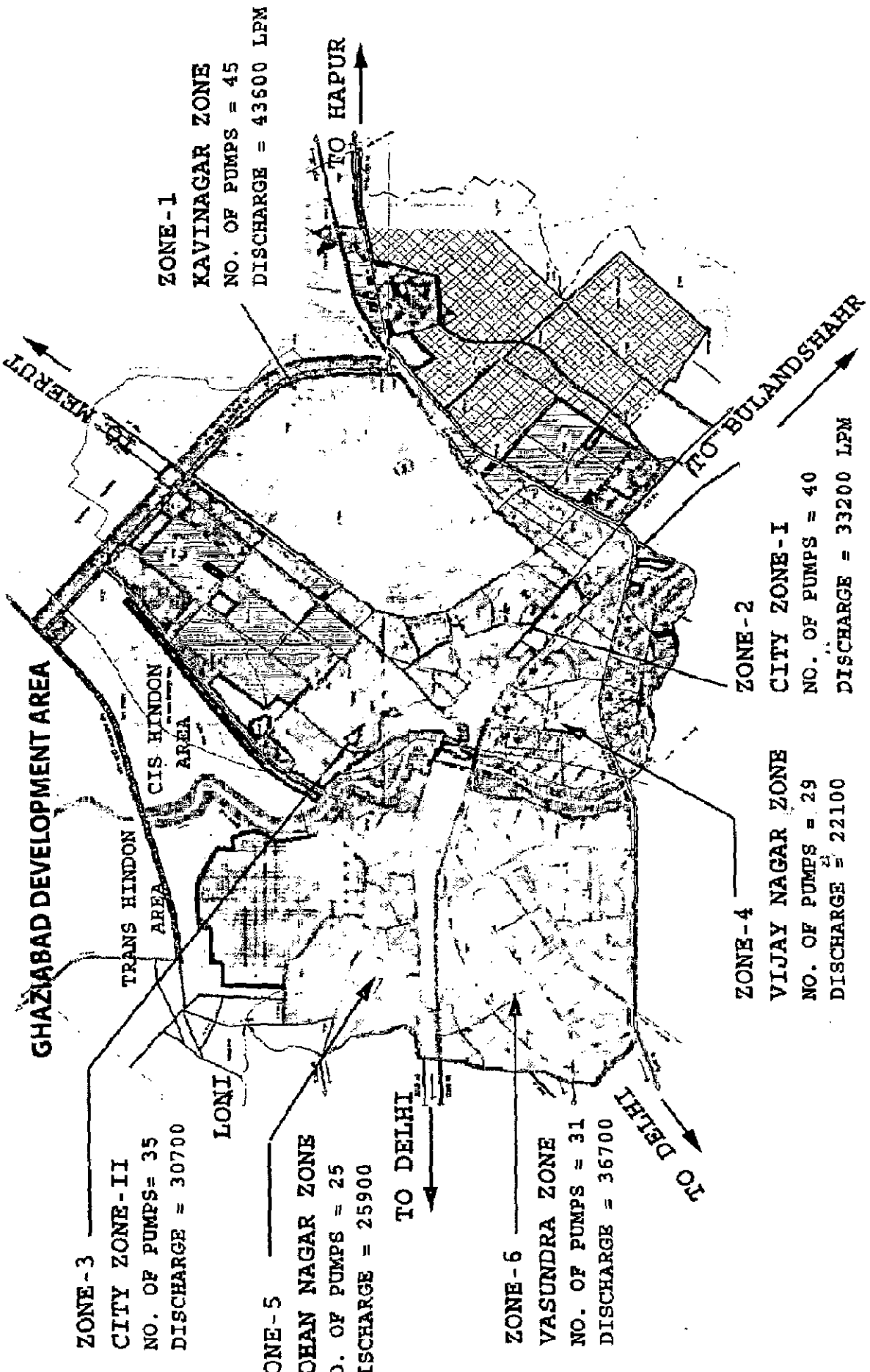
Arjun Nagar, Tulab Nagar, Kirana mand, Arya Nagar area, Kot village, Nehru Nagar, Gandhi Nagar, Ashok Nagar, Dayanand Nagar, Old city area, Company bag, Chandrapuri, Sohanlal area and Malivada.

3. City Zone – II

In this total no. of pumps are 35 having total discharge capacity of 30700 LPM. From total of 35 pumps, 14 have over head tanks while 21 of them have direct supply system. Head of water varies from 20 to 40 mts in which 14 having a head of 40 mts, 19 have 30 mts and 2 have 20 mts. All the pumps are submersible except one which is VT Pump. Discharge from the pumps ranges from 300 LPM to 1200 while average discharge is 1000 LPM.

Serving Areas:

Lohiya Nagar, Patel Nagar, Nand village, Banvari Nagar, New Arya Nagar, New Bus stand, Director Park, Gautam Nagar, Kaila Area, Harvansh Nagar, Jassipura and Shivanpura area.



Map 7.15 Water Zones of Ghaziabad Development

4. Vijay Nagar Zone

In this total no. of pumps are 29 having total discharge capacity of 22100 LPM. From total of 29 pumps, 23 have over head tanks while 6 of them have direct supply system. Head of water varies from 30 to 40 mts in which 21 having a head of 40 mts and 8 have 30 mts. All the pumps are submersible except two which are VT Pump. Discharge from the pumps ranges from 300 LPM to 1200 while average discharge is 1000 LPM.

Serving Areas:

Ambedkar Nagar, Shivpuri, Maveyee,, Kailash Nagar, Gopuri, Sunderpuri, Rampuri, Bhudh bharat Nagar, Pratap Vihar and Vijay Nagar

5. Mohan Nagar Zone

In this total no. of pumps are 25 having total discharge capacity of 25900 LPM. From total of 25 pumps, 23 have over head tanks while 2 of them have direct supply system. Head of water varies from 20 to 50 mts in which 21 having a head of 50 mts, 2 have 30 mts and 2 have 20 mts. Ratio of submersible v/s VT pumps is 17 : 8. Discharge from the pumps ranges from 500 LPM to 1600 while average discharge is 1000 LPM.

Serving Areas:

Rajender Nagar, Rajender Nagar Industrial area, Karheda area, Arthala area, Shyam Park X, Lajpat Nagar, Saheed Nagar, Mohan Nagar, Chandra Nagar, Rampura, Radhakunj, Ramprashtha, Shalimar Garden, Jawahar Park, Ganesh Puri, Brindavan Garden, Janakpuri, Vikram Enclave and Shyam Enclave.

6. Vasundra Zone

In this total no. of pumps are 31 having total discharge capacity of 36700 LPM. From total of 31 pumps, 24 have over head tanks while 6 of them have direct supply system. Head of water varies from 30 to 50 mts in which 7 having a head

of 50 mts, 20 have 30 mts and 4 have 20 mts. Ratio of submersible v/s VT pumps is 21 : 9. Discharge from the pumps ranges from 500 LPM to 12000 while average discharge is 800 LPM.

Serving Areas:

Khaushambi, Shahibabad Village, Surya Nagar, Radha kunj, Ramprashtha and Brij Vihar.

Currently, there are 204 tube wells supplying water at the rate of 12 hours a day in which 180 are of Nagar Nigam and 24 of GDA. They supply 160 MLD water. If we suppose current population of Ghaziabad to be 11 lakhs then water supply of 145 lpcd is currently supplying which is less than standard water supply of 225 lpcd. In some areas like Lohiya Nagar, Patel Nagar, Kailash colony etc. water supply is not proper. There are problems of low pressure, limited supply etc.

The main reason of this problem is the less storage facility, due to which water supply is direct causing low pressure. Again the minimum distance between two tubewells is not maintained causing less extraction of water. Leakage in the pipe line in many areas is causing almost 10% of water loss.

7.6.3 Water storage

There is total water capacity of 90,000 liters in terms of overhead tanks and underground tanks in the city which is not sufficient as per standards. For the water purification, only chlorine is used. This chlorination is done by self driven dozers but that is only in few places. In most of the places, it is done manually. One water purification machinery is under construction for the water coming from Ganga canal.

7.6.4 Piped water supply

There is piped water supply in most of the areas of city except villages coming under Nagar Nigam area. And in some areas having unplanned residential colonies near Nandigram and Dundaheda, there is no piped water supply. 15% of the area of the city is dependent on hand pumps for their domestic water requirement.

There is no account of personally bored out shallow wells. Instead of regulations given by central water commission that without permission boring of tubewells is illegal, there is lot many tubewells having no account.

7.6.5 Ground water Quality

Ground water quality in the city is much better than normal. Only in some parts of Hindon area, water is not suitable for drinking. In one or two places, water is polluted, generally near the industrial units where chlorine and nitrate contents are found in the water.

7.6.6 Infiltration Rate

In terms of recharge and infiltration, area near Hindon River has good infiltration rate which is needed to be taken into account for future proposals.

Due to extensive use of ground water, the water table in few places went 10-12m down. In current situation, general ground water level is in between 12m to 25m.

CHAPTER 8

Government Initiatives

8.1. Introduction

As the crisis approaches and as water resources become scarce, the risk of conflict over them will become greater. After 2025 AD climate change could also make conditions worse if precipitation amounts decrease in the major food producing regions and evaporation rates increase. The bulk of the increase in food production has to come from irrigated lands and this, in turn, will require more money to be spent on long distance water transfers, dams and the like, should the resources be available. The increasing size and number of cities will create a much bigger pollution load unless sanitation systems are provided. Urgent and decisive action must begin now if impending water crisis of a national proportions later in the 21st Century - are to be avoided during the next 30 years.

The Government of India is concerned with the poor Water Supply and Sanitation services provided in urban centers, as none of the 35 Indian cities with a population of more than one million distribute water for more than a few hours per day, despite generally sufficient infrastructure. Also, only a few recover O&M costs from user fees and none have performance indicators that compare with average international standards. A National Water Policy was drawn up to manage this resource efficiently which was again revised in 2002. All five year plans have given importance to the effective usage and management of this basic infrastructure. An analysis of the efforts of the government in development of this infrastructure and the resultant output is presented here.

8.2. Initiatives at the National Level

8.2.1. Five Year Plans

Urban water supply has remained an important area of concern and allocation of funds is being made right from the First Plan. The outlay for Urban Water Supply and Sanitation which was Rs.43 crores in the beginning, increased to RS.550 crores by the Fifth Plan over 65 per cent of it in the urban areas. During this period, the water supply program was not given a high enough priority in the national planning process. The constraint on resources in the States and the competing demands for programs in other sectors compelled the State and local governments to give relatively lower priority to water supply in the allocation of funds. There was also at the same time insufficient appreciation of the magnitude and complexity of the problem.

The importance of providing safe water supply and sanitation as a basic minimum need without meeting which no improvement in the living standards of the people could take place, was reiterated in the Draft Fifth Five Year Plan 1974-79 which included drinking water for villages in its Minimum Needs Program. The Draft Fifth Five Year Plan declared that adequate resources would be allocated for the program irrespective of the resources constraints of individual States. The objective of the Minimum Needs Program for drinking water was to provide the facility to all villages suffering from chronic scarcity or having unsafe sources of water. The Plan provided for an expenditure of Rs. 381 crores on rural water supply and sanitation as compared to a total of Rs. 289 crores provided in all the previous Plans.

During the Sixth Plan, priority was given to the completion of on-going urban water supply and sewerage schemes, including augmentation of the existing systems in the larger cities. It is expected that about 930 urban water

supply schemes and 120 urban sewerage and drainage schemes will be completed during this period. In addition, it was proposed that new schemes of water supply will be taken up in about 550 towns and sewerage schemes in 110 towns. The Sixth Five Year Plan was launched at a time of increasing awareness, both nationally and internationally, of the importance of safe drinking water supply in sustaining the processes of economic and human resource development and improving the quality of our environment. The drought of 1979-80, which was accompanied by an acute scarcity of drinking water in many parts of the country where wells, tanks and other sources dried up in large numbers, added urgency to the search for a lasting solution to the problem.

The Eighth Plan specifically talked about the Urban Water Supply scenario in the country. It was during this period that the Accelerated Urban Water Supply Program was launched. This program aims at providing water supply in towns with a population of less than 20,000.

The Tenth five year plan which is currently being implemented envisages completing the task at hand, namely, 100 percent coverage of rural and urban populations with safe drinking water. It aims at the Levying of water tariff and stepped tariff on volumetric basis for revenue recovery. It also aims at devising a reliable method for assessing the health payoff accrued out of providing safe drinking water to serve as a guiding point for future investments. Innovative and cost effective technologies are to be encouraged in the implementation and administration of water supply systems along with a dual system of water supply and zoning of distribution system for avoiding physical losses.

8.2.1.1. Failings

Although a national water supply program was launched in 1954 during the very First Five Year Plan, and progressively larger allocations were made for water

supply and sanitation in the succeeding Five Year Plans, the progress made so far in the provision of safe water supply and basic sanitation can hardly be called satisfactory.

The available statistics relating to the status of rural and urban water supply in India present a discouraging picture especially in the rural areas. The situation in the urban areas is relatively better but here too, particularly in the hundreds of smaller towns, water supply and sanitation arrangements are far from adequate. The statistics in fact do not fully portray the hardship and inconvenience that is experienced by the poor particularly the women and the children, in areas where water is scarce, inadequate or polluted. In terms of man-days lost due to water-borne or water related diseases which constitute nearly 80 per cent of the public health problem of our country, the wastage is indeed colossal.

8.2.2. Rainwater Harvesting

The country has begun to take rainwater-harvesting and groundwater recharge serious at all levels. These are at the heart of its massive Integrated Watershed Development Program, which provides public resources to local communities to treat watershed catchment areas and to construct rainwater harvesting and recharge structures. Trends during the 1990s also suggest a progressive shift of budgetary allocation from irrigation development to water harvesting and recharge.

Across India, some 6.2 million hectares of rain-fed lands are currently under treatment through 5,200 micro-watersheds, at a whopping cost of Rs 8 billion (for the year 2001-2002). Of the total cultivable area of 142 million hectares, 89 million hectares of non-irrigated land requires similar investments.

Improving the productive use of water is another area that is receiving attention. Punjab, the bread-basket of the country, has taken the lead by encouraging its rice and wheat growing farmers to switch to water-saving diversified farming. So far, the state is exporting 'virtual water' in the form of water-intensive crops like rice and wheat. It has now developed an incentive system to encourage farmers to switch to other crops along with a suitable buy-back mechanism for the harvest. These are potentially powerful indirect demand-management strategies that do not even form part of academic discourse. However, they offer important trade-offs that need closer scrutiny.

Water stress has led to the revival of domestic rainwater harvesting techniques as well. Himachal Pradesh became the first state in the country to make the installation of rooftop rainwater systems mandatory in all new constructions. Over the years, a number of states and cities have promulgated similar orders.

8.2.3. Decade for International Water Supply and Sanitation

The global concern with the need to provide drinking water and elementary sanitation to the people in developing countries led the United Nations Water Conference at Mar del Plata (Argentina) in 1977 to call for a ten year campaign by member-countries and international agencies to provide access to safe water and sanitation for all people. The ten years 1981-90 have been designated as the International Drinking Water Supply and Sanitation Decade. India as a signatory to the Resolution has pledged its full support to the action plan under the International Decade.

8.2.4. Public Private Partnership

Scarcity in recent years has turned water from an ignored and abundant resource into an expensive commodity. Although water privatization is a relatively new

phenomenon, varied forms of public private partnership in water supply provision are being practiced in India, ranging options from large scale trucking; formation of water corporations; water vending kiosks and door to door service; coin operated meters. Recently many progressing cities have come up with various shades of privatization of water supply. Already, some 30 cities in the states of Maharashtra, Karnataka, Andhra Pradesh and Rajasthan are inviting bids for their respective municipal water supplies from a handful of multinational corporations specializing in water. Tirupur town in Tamil Nadu and Hubli-Dharwad in Karnataka have moved closer to the privatization of their water utilities.

8.2.5. Initiatives by Financing Agencies

HUDCO and other financial institutions in India are increasingly becoming assertive in emphasizing the need to appropriately fix/revise the tariff/charges as a pre-condition to gain access to institutional credit. For instance, in respect of the water supply scheme in Jaypore, Orissa, HUDCO had emphasised the need for immediate hike in tariff rates both in respect of domestic, commercial and industrial rates followed by an annual automatic increase of 10 per cent. In addition a one time connection charge of Rs. 4000 per connection was also insisted. Similarly, in respect of Kolhapur in Maharashtra, in addition to immediate hike of the tariffs ranging from 75 to 100 per cent depending on the type of use, an automatic increase of 10 per cent in the tariff every four years was insisted. This was in addition to levy of a minimum advance registration charge of Rs. 2000 per new domestic connection. Advance registration charge has been introduced in 4 States and charges from Kiosks in 2 states. HUDCO is also insisting on 100% metering of all consumer connections in the schemes being financed by it from the point of view of water conservation, better realization of

revenue and for providing basic need of water to the low income groups at subsidized rate. The domestic water tariff ranges from Rs. 1.50 to Rs. 6.00 per kilo liter, with an increase of 10 to 15 per cent every year so that the public do not feel the pinch of sudden increases of water tariff.

8.2.6. National Water Policy 2002

The National Water Policy of Government of India stresses the urgent need for conservation of water with the objective to foster efficient utilization in all the diverse uses of water. The National Water Policy has accorded top priority to Drinking Water Supply in the allocation of water resources for various beneficial uses. It is, therefore, very necessary to make long-term planning of water resources management for a period of 30-40 years ahead by National and Provincial Governments by preparing Water Resources Management Master Plans and implementing the same effectively.

8.2.7. National Water Development Strategy

Water Development Agency set up by the Union Government under the Ministry of Water Resources has prepared in 1980 a National Perspective Plan for development of country's water resources, disregarding political boundaries of States. The National Perspective Plan envisages the construction of about $180X10^6$ ML of storages, which, along with the inter-links, will facilitate additional utilization of nearly 240 $X10^6$ ML of water for beneficial use. This will enable irrigation over an additional area of 35 million hectare, comprising 25 million hectare by surface water and 10 million hectare by increased use of ground water, besides 34,000 MW of substantial hydro power generation, flood control and other multifarious benefits would accrue.

8.3. Initiatives in the Study Area: U.P. Sub Region of NCR

8.3.1 Water Harvesting

The High court directed Uttar Pradesh government to make water harvesting compulsory. It has also directed that no map for construction of houses, buildings, multi-storeyed buildings, shopping complexes, malls and colonies be passed unless provisions are made for the same. Court ordered restoration of ponds encroached and illegally occupied by builders, colonizers and others either in personal capacity or through allotment by development authorities on or before October 8, 2001. It also directed the State government to constitute a committee of experts to find out ways and means to check declining level of underground water in the state and make water harvesting compulsory.

8.3.2. Groundwater Conservation

Uttar Pradesh, which is going through an acute power crisis, is faced with yet another major problem, the ground water table in most of places is going down to alarming low level. The State Ground Water Department (SGWD) has already sounded a SOS to stop the over – exploitation of the ground water for agriculture purposes in view of drinking water scarcity looming large in the State. The ground water situation is worse in the Western Part of the State where 70 percent of the ground water had already been exploited.

The U.P. Government, however, knows the situation and has prepared an action plan to deal with it.

The Central Ground Water Agency (CGWA) has over the past two years issued numerous notifications which ban or control the withdrawal of groundwater in certain designated 'notified areas' of the NCR. In these notifications, the CGWA has made registration of tubewells mandatory for all owners in 'notified areas'

where the water table has reached critical levels. These include parts of Delhi, Gurgaon, Ghaziabad and Faridabad.

8.3.2.1. Failings

1. The groundwater notification does not seem to be working. U.P. Sub region has about a lakh registered tubewells and twice the number unregistered about which the authorities are at a loss for words.

2. Illegal borewells can be identified only through inspection or if someone informs the CGWA or SGWD.

3. The notifications haven't been accompanied by awareness campaigns to inform the citizens about the orders. As people are not aware, they get a tubewell installed without seeking permission.

4. Monitoring has been inadequate leading to ineffective enforcement.

8.3.3. Rainwater Harvesting

There are large tracts of land in the State where the crest of Earth is hard which makes it difficult for rainwater to seep in easily. So for 122 development blocks in 41 districts have been identified where special efforts would be mounted to preserve rain water so than it could enter the crest.

U.P. Government, however, plan to launch water recharge projects and rain water harvesting techniques to minimise the loss but it requires money and huge man power. The SGWD is being recognized for this purpose and departmental officials are being planned to be posted in all 70 districts to create awareness among the rural folks and farmer.

8.3.4 Artificial Recharge

The Uttar Pradesh government's experiment to recharge excess river water, via earthen canals, has succeeded in raising the water table and bringing down cultivation costs

The Uttar Pradesh government's experiment to artificially recharge groundwater has opened up a new and practical way to conserve and rejuvenate falling groundwater reserves. The project -- the Madhya Ganga Canal Project (MGCP), which occupies lower Ganga canal commands -- was initiated in 1988. It has succeeded in raising the water table, thereby reducing pumping costs for irrigation. In 2000, the International Water Management Institute (IWMI) carried out a study on the Lakhaoti branch canal of the MGCP, to assess the impact of the diversion of surplus Ganga water, during the kharif season, on groundwater levels and cropping patterns. The Lakhaoti branch is spread over 205.6 thousand hectares and covers the districts of Ghaziabad, Bulandshahr and Aligarh in western Uttar Pradesh. It is bound by the drainage canals of the Kali and Nim rivers.

According to the study, the canal project has helped raise the groundwater table to 6.5 metres, and brought down the cost of pumping for irrigation from Rs 4,500 to an economical Rs 2,700 per ha metre.

8.4. Conclusion

The main conclusion that can be drawn from the above Government initiative that at least water problem is now does not remain is simple problem. It is global accepted problem which needs serious action. Government of U.P. has taken good steps in this regards like Artificial Recharge through Madhya Ganga Canal. Further Public – Private partnership is need to augment the water recharging as well as optimal use of water

CHAPTER 9

ISSUES, STRATEGIES & PROPOSALS

As per the present rate of urbanisation, demand for water is increasing at a faster rate. As U.P. Sub region falls under Ganga – Yamuna Doab, this region have adequate water resources i.e. surface as well as ground water sources. For irrigation purposes, generally surface water sources are used as there are adequate facilities of canals and rivers. There is a good network of canals such as Upper Ganga canal, middle Ganga Canal and Eastern Yamuna canal.

But for domestic purpose or drinking purpose, mostly ground water is used that may be in the form of private or government tubewells. Still there is no account of privately owned tubewells and also no control over them which leads to decrease in water table at faster rate. Due to fast trend of population growth, requirement for water is increasing day by day which lead over exploitation of ground water (as discussed in chapter 6, "Demand Forecasting")

9.1 Broad Issues/ Problems

9.1.1 Ground Water Exploitation

The rate of development of the groundwater resources is unsustainable with most districts of the NCR that are sliding into the dark zone category. This is due to lack of ground water recharging, higher rate of withdrawal; fast pace of urbanization and reduction in run off time for rain water. Thus, recharge of groundwater is a priority. Presently four blocks Loni, Hapur, Baghpat and Gulaothi come under semi critical zones, two blocks namely Chhaprauli and Khekada come under critical zones where three blocks binauli, Pilana, Bhawan

Bahadur nagar come under over exploited zones. Out of 45 blocks in the region 9 blocks have not good ground water situation, which is of great concern. As per the report publish by CGWB, Meerut district have the least annual ground water availability i.e. 12066 ham as compared to other district of the region.

9.1.2 Water Loss in distribution

There are significantly high losses at different stages of water supply system ranging from 30-50% in the conveyance and distribution system apart from losses occurring from treatment plants due to pilferages etc. Water saved is water produced and in the light of this when the water resources are depleting in the region, there is a need to asses the exact quantum of the leakages and identifies their locations to rectify them.

9.1.3 Overlapping of Canals/Pipes

Some of the cities/towns in the region have laid canals/pipe lines to obtain water from the already existing canal system at farther places which has resulted in laying of 3-4 parallel canals/pipes causing duplicity of work and expenditure.

9.1.4 Urban water Supply

There is provision of piped water supply in all priority urban areas of the U.P. Sub Region and these towns are drawing water mainly from tube wells. Out of 17 proposed Sub Regional Centers namely Narora, Siana, Surajpur, Kasna and Shahjahanpur are not having piped water supply.

The present surface water resources of the NCR are insufficient to meet the requirement of the various sectors. A holistic view of water requirements should be taken including the demand for the drinking water supply, industrial use and irrigation assigning priority to drinking water and industrial use.

Drinking water requirement for the entire NCR in the year 2001 was 6,787 MLD (6.787 MCM/day or 2477.26 MCM/annum) and the projections for the year 2021 are 11,589 MLD (11.589 MCM/day or 4230 MCM/annum).

As per norms, towns having population one lakh and above, should has an average water supply of 200 lpcd, however, actual rate of water supply in these towns varies between 75 lpcd in Bulandshahr to 142 lpcd in Meerut area (refer Regional Plan – 2021,NCR : Annexure8/1). The situation is even worse in many of the areas in Sub Region where per capita rate of water supply ranges from 28 lpcd in Phalauda to 50 in Baraut as per the data obtained in Regional Plan – 2021, NCR. Per capita availability of water in most of the urban centres had dwindled over the last decade due to rapid urbanisation and lack of financial and water resources. The status of drinking water supply in rural areas also presents a dismal picture. Moreover, many villages did not have local sources of water and almost equal numbers did not have adequate sources.

NCR forms part of the most productive agricultural areas of the country. The Region is endowed with extensive fertile land and good irrigation facilities. In the fast developing scenario of urbanization, the demand for irrigation water will also have to be projected. Therefore, there is a need to assess overall demand of water in the region and prepare the demand supply gap after identifying all the known water resources in the region with the quantities of water which can be produced from them. Part demand is also met from ground water. However, entire NCR has been witnessing decline in ground water levels. The decline has been higher in areas underlain by fresh water as compared to areas having marginal to saline ground water. The water levels in Meerut, Bulandshahr and Ghaziabad districts of U.P. had declined by 0.15 to 2.50 meters during this decade up to 1995.

9.2 Broad Strategies at Sub Regional Level

9.2.1 Ground Water Recharge

Some of the blocks are facing severe downfalls in water table resulting in degrading of quality of water as well as depletion of ground water. So it becomes necessary to recharge ground through rainwater harvesting, watershed management, maintaining natural surface water sources like ponds, wells, canals and rivers so as to store run off water that may be rainwater or sewerage water.

9.2.2 Inter basin Linkage

Water of few rivers like Hindon and Kali is not utilised well as they are rainy nallahs. To utilise the water of these rivers, proper maintenance of rivers is required like Yamuna Action Plan. After that they should be linked to other rivers like Hindon with Lower Yamuna Canal and Kali with Upper Ganga Canal, so as to utilise the water at different location for domestic as well as for irrigation purpose.

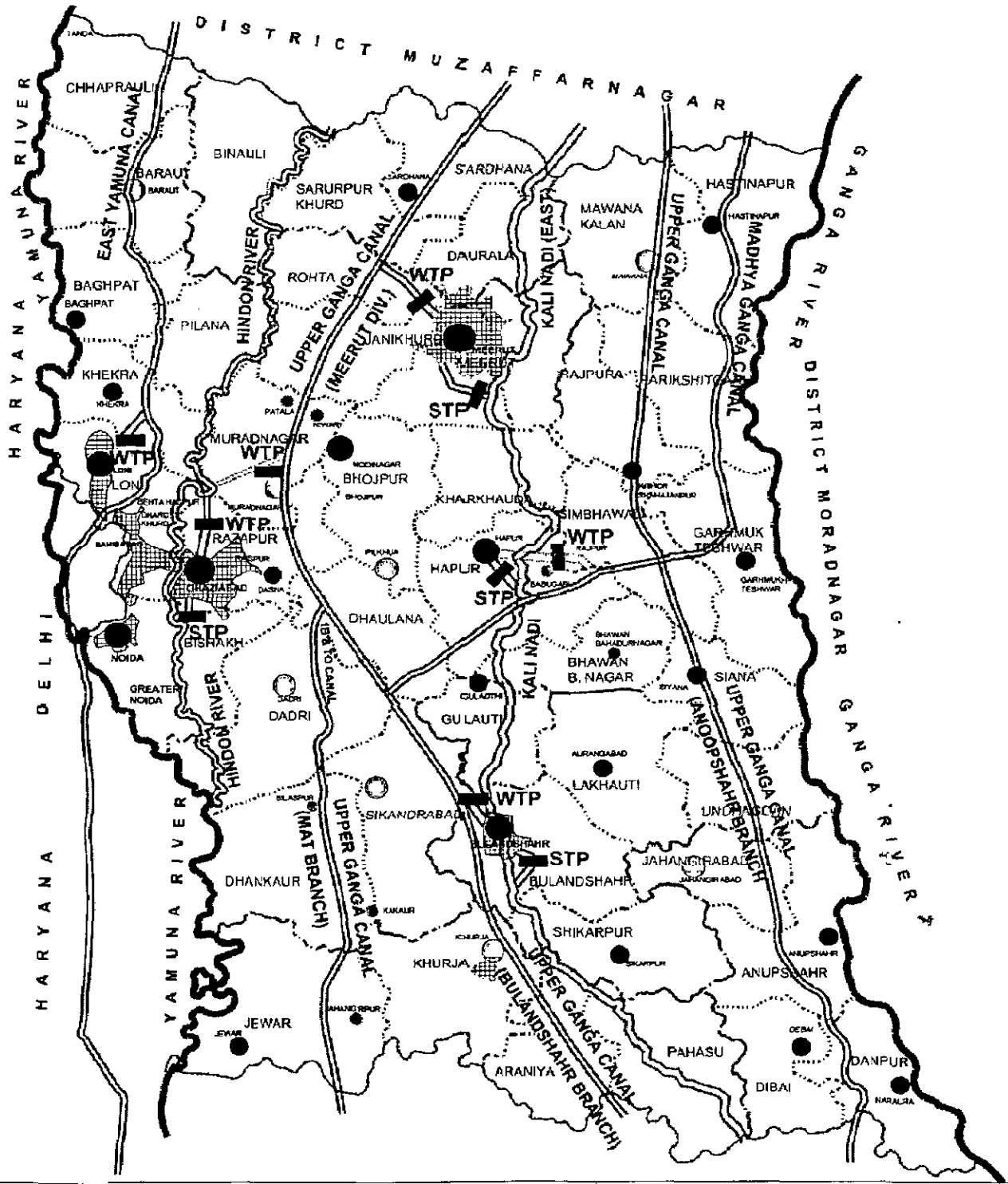
9.2.3 Emphasis on Balanced and Harmonised Development

In U.P. Sub Region, basically two cities Meerut and Ghaziabad are highly dense due to immense urbanisation in previous few decades. But the resources and infrastructure are not adequate for that population in terms of land and water, which leads to low standard living. The trend of this kind of development is again seen in Loni block, which is growing at a tremendous rate. So emphasis should be given to multicentric development.

9.2.4 Protection of Surface Water Sources:

The surface water sources like rivers, canals, lakes and pond should be protected from deposition of waste as well as encroachments. The proper norms should be made for the river front development so that these water bodies can be enhanced and quality of water can be maintained. Rivers like Hindon and Kali flow through the Ghaziabad and Meerut city respectively and these cities are

Map 9.1 Proposals for Efficient Water Supply in the Sub – region



LEGEND

SUB REGIONAL BOUNDARY	CLASS- I CITIES
BLOCK BOUNDARY	CLASS II CITIES
CITY BOUNDARY	CLASS III CITIES
RIVER	CLASS IV CITIES
CANAL	CLASS V CITIES
GREEN BELT	CLASS VI CITIES
STP SEWERAGE TREATMENT PLANT	WTP WATER TREATMENT PLANT

TITLE:

PROPOSALS FOR EFFICIENT WATER SUPPLY IN U.P. SUB - REGION OF NCR

NORTH

growing at a faster rate. The rates of land in these cities are again rising up. So it would be the general tendency of people as well as authorities to capture maximum of the land near these river front. Hence there should be strict regulation in the Master Plan of these cities to reserve a sufficient amount of area under water bodies.

9.3 SPECIFIC ISSUES & STRATEGIES OF MEERUT AND RAZAPUR BLOCK

9.3.1 MEERUT BLOCK / CITY

Main Issues

Meerut block is growing at very fast pace and mainly Meerut City coming under Meerut Block. Due to high population growth, water demand has increased considerably which leads to over exploitation of ground water sources. There is no adequate measure to control the boring of private tubewells. As per the projected population for 2021, the water demand for 2021 would be 460 MLD and at present only 158 MLD is provided by municipal authorities and which is going to increase up to 202 MLD as per current work in progress. But still there is need of 258 MLD water for projected population in 2021. There is no doubt that most of it would be certainly taken from ground water sources which will again lead to decrease in ground water table.

1. Ground Water Exploitation

Ground water is the main source of water supply, which is drawn through hand pumps, wells, tube wells etc. Good quality ground water is available at 35-38 mts depth. Due to absence of surface water sources, there is increased dependence on ground water. Merely 7 per cent (14.8 MLD) water is supplied through surface water. All this resulted into increase in the depth of ground water level by 0.15-2.5 mts during last decade.

Thus, the reliability and sustainability of the ground water source is questionable. In such situation it is imperative for Meerut Development Authority to augment alternative source for sustainable use of water for longer run.

2. Inadequate Storage Capacity:

In terms of the storage adequacy the proportion to total water supply has been estimated 30 per cent. However this capacity of storage is inadequate in case of additional demand for year 2011 and 2021.

3. Water treatment

Ground water is being supplied for drinking purpose and there is very little supply of surface water for drinking purpose owning to lack of treatment facilities.

4. Unequal water supply

The gross average per capita supply in the city is 175 litres per day, which is well above the acceptable minimum standards of 135 lpcd. At same time ward numbers1, 2,3,4,5,6,23, 30, 40, 44, 48, 66 and 70 are partially covered and ward no. 7, 8, 10, 12, 16, 18, 19, 28, 31 are yet to be covered therefore there is high inequality in distribution of water.

5. Contamination of water due to old service connections.

The system age varies from 20 to 50 years, in various localities. The age of the system contributes to leakage and water loss. There has been often complaining in cantonment area for mixing up of the Sewerage water with Potable water. Old pipe line network often results into high operation and maintenance cost.

6. System Losses

The transmission and distribution losses account for 20-25 % of the total supply. However study is required to ascertain losses due to transmission.

Strategies

The strategies formulated to achieve the above goals focus upon

- Water supply planning and Undertaking Capital work.
- Water Auditing
- Ground water Recharge
- Institutional strengthening and capacity building
- Strict Bye –Laws to maintain the Water Quality
- Future Requirements

Strategies have been formulated in consultation with citizens' representatives, voluntary organizations, elected representative of the council.

1. Water supply planning and Capital work

The program shall be designed so as to ensure that water supply infrastructure provision matches the community needs. It shall envisage augmentation, storage treatment and distribution of the water supply in an effective and efficient manner. The current work shall focus on new developing area.

Though Upper Ganga canal is only 10 km away from city and presently there is only 14.8 MLD of water is taken from it, which is 7% of total supply in the city. If we focus on future water requirement and present trend of decreasing of ground water table, it become much more essential to withdraw water from Upper Ganga canal through a large project taking water from it in good percentage.

2. Water Auditing

Water Auditing is the best practice to reduce the system losses. This would involve leak detection studies apart from the studies on the quality and quantity of water drawn at the consumer end and would explore alternatives for effective water supply systems. Water metering to avoid the wastage of water can be implemented.

3. Ground Water Recharge

As MDA is heavily dependent on ground water, it is depleting and other water quality parameter like TDS and Ph has exceeded the limits (Development profile-UP Sub region).

Hence it is necessary for MDA to explore this option with community participation. MDA will identify appropriate location in different localities for recharging ground water through recharge wells. Bye-law to be modified and strict provision should be made compulsory to construct recharge well before development permission is given to the Apartment, Housing societies.

4. Institutional Strengthening and Capacity building

In order to effectively administer the water program in a cost effective and customer focused manner it was conceived imperative that the employees of engineering department undergo training in Project Planning, Implementation, Monitoring and Evaluation. In Addition, capacity building efficiency can be further increased by electronic data base management program.

5. Strict Bye –Laws to maintain the Water Quality

According to the analysis done by CSE, surface water sources are being polluted by various industries as there is not proper dumping of waste material produce by the industries as there are three main industrial areas in the city. Hence strict regulations should be made for the treatment of wastes produced by the industries.

6. Future Requirements

Capital Investment required towards Water Supply systems directed towards Augmentation, storage capacity, treatment, Distribution Network and provision of bore wells to cover newly developable areas,

Capital investments in infrastructure are planned so as to address issues focusing upon,

- Financing infrastructure for water supply from Public – private partnership through TP scheme Mechanism.
- Cover the existing uncovered populated area; and
- Development of new facilities to provide services catering to newly developable area, which also cover services to economic weaker section.

9.3.2 GHAZIABAD BLOCK /CITY

Main Issues

1. **Receding water table:**

Presently 204 tubewells are working at a rate of 12 hours and considering the line loss, they supply 160 MLD of water. For the projected population for 2021, approximately 517 MLD water is required for 2021. Presently mainly ground water is going to extract to meet water supply requirements which results in decrease in ground water level at a fast pace. Ban on ground water abstraction for sale and supply (commercial) of water in Ghaziabad Nagar Nigam area by Central Ground Water Authority highlights the depleting and deteriorating ground water conditions. Water table receded in maximum portion of CHA from 5 m to 7 m bgl range to 7 m to 15 m bgl range during the time period of 1987 to 1993.

2. **Poor quality of services:**

There are intermittent supplies of 2 to 3 hours once a day in specific water supply zones of THA while twice a day in remaining water supply zones of THA & CHA accompanied with supply at low pressure. In some areas like Lohiya Nagar, Patel Nagar, Kailash colony etc. water supply is not proper.

There are problems of low pressure, limited supply etc.Transmission and distribution networks have worn out, physical losses are significant, ranging from 20% to 35%, low pressures and intermittent supplies usually result in contamination of water in the distribution network. Leakage in the pipe line in many areas is causing almost 10% of water loss.

3. Inadequate service coverage:

Piped water supply covers 5% of the abadi population, 16% of slum population, 65% of general population (excluding slum population). There is 67% to 86% population coverage in the administrative zones while overall coverage was 78% in 2001.

4. Disparity in water provision.

Water supply rate for the city was 104 lpcd with variation of 75 lpcd to 163 lpcd among various administrative zones and variation within the water supply zones was from 62 lpcd to 230 lpcd

5. Deteriorating environmental conditions.

Over–exploitation of aquifers, depletion of water resources and pollution by human waste and industrial effluents are having a negative impact on environmental conditions. Receding water table and continuous withdrawal is affecting the quality of ground water. Surface water resource flowing through the city is too much polluted and quantity is also insufficient. In some parts of Hindon area, water is not suitable for drinking. In one or two places, water is polluted, generally near the industrial units where chlorine and nitrate contents are found in the water.

6. Weak financial position: Financial position of the GNN with respect to water supply is not healthy as revenue collected from the service is barely sufficient to cover its operation and maintenance expenses; and

7. Poor Accounting and Management:

There is no account of personally bored out shallow wells. Instead of regulations given by central water commission that without permission boring of tubewells is illegal, there is lot many tubewells having no account.

Strategies

1. Increased Use of Surface Water Sources

Seeing the over exploitation of ground water sources and continuous decrease in water table suggest mixed use of ground water and surface water to fulfil the current and future water demand, instead of taking water only from ground water sources. . Hindon River passes through Ghaziabad city but do not have water, which can be treated and supplied for drinking purpose. So there is need to construct watershed on Hindon River so as to store the water.

Secondly, there is Upper Ganga Canal flowing through Razapur block. Currently water of 635 MLD water is being supplied to Delhi from Upper Ganga Canal through a pipeline laid down from Muradnagar to Sonia Vihar water treatment plant. So there is lot of possibility to extract water from Upper Ganga Canal making 50 -50 ratios for total supply of water (i.e. 50% from ground water sources and 50% surface water sources)

2. Increase in Water Storage Capacity

As there are not adequate water storage facilities and GNN has to supply water by Direct supply which causes low pressure in the supply line. It should be supplied after proper storage so that water can be treated well and pressure can be maintained.

3. Proper Utilization of Existing Facilities

Presently 204 tubewells are working at a rate of 12 hours and considering the line loss, they supply 160 MLD of water. If same tubewells work at a rate of 16 hours

a day and considering 10% line loss, then they will supply 234 MLD. It means that currently 32% less water is being supply than its capacity. By doing so, they can increase the efficiency of existing facilities.

4. Working out "Water supply network plan"

Water supply network plan should be made so that exact location of pipes should be known to every department and it should be made in collaboration with development authority as well as municipal authority. It would help to locate the defected network and can be corrected easily and would save lot of time than time taken in previous practices.

5. Periodic Inspection Needed

Periodic inspection of the water supply mains as well as pumps should be done so as to check any leakage in the pipes. It would also help to avoid any contamination of drinking water.

6. Strict Regulation for Ground Water Recharge

There should be strict regulation for ground water recharge. For new construction, it should be made necessary to construct ground water recharging well so as to use the rainwater for ground water recharge.

7. Specific Attention to Quality of Water

Proper regulation should be made for the disposal of industrial as well as other wastes so that it would not contaminate surface water as well as ground water.

CONCLUSION

With the fast trend of urbanization, the need for infrastructure is increasing at a faster pace. Under this urbanization trend, National Capital Region is influenced a lot due to National Capital Territory - Delhi at its center. There are more job opportunities in National Capital Region than other cities of Northern India. The population of NCR is growing at a decadal growth rate of 36% and requirement for infrastructure, specially water supply and sanitation are of great concern.

Today there is concern over water supply in both ways, qualitatively as well as quantitatively. U.P. Sub region of NCR is one of the sub regions where water supply problem is becoming a major concern. Though, this part of NCR has enough amount of water for irrigation as well as domestic purposes, the population in the sub region is unevenly distributed creating the water scarcity problem in few blocks of the sub region especially in Meerut and Razapur blocks.

Though there is a very good network of rivers and canals in the sub region, due to high cost of water treatment plants, ground water is used as the main source for drinking purposes. The main source of water supply in the main cities of the sub region is tube wells. There are a large number of unaccounted privately owned tubewells. All these lead to the ground water exploitation. So the way to handle this problem is to utilize water sources i.e. surface water as well as ground water, very optimally. To stop ground water exploitation, surface water sources should be equally utilized. For ground water recharge, rainwater harvesting, watershed development should be done with the help of strict rules and norms. The surface water bodies should be cleaned well at regular interval so as to maintain the flow of water and self cleansing can take place.

To maintain the quality of water, there should be strict norms for waste and sewerage waste disposal so as to protect water bodies as well as ground water from contamination.

Henceforth, to solve the water problem, government as well as public should work together and treat water resource as important as petroleum. If this thinking does not change then that day is not for behind when water would cost as equal as petroleum.

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Make water harvesting compulsory: HC to UP

TIMES NEWS NETWORK

Lucknow: Lucknow Bench of Allahabad High Court on Friday directed Uttar Pradesh government to make water harvesting compulsory. It has also directed that no map for construction of houses, buildings, multi-storeyed buildings, shopping complexes, malls and colonies be passed unless provisions are made for the same.

Division Bench comprising Justices D P Singh and J M Paliwal passed the order on a PIL filed by one Rajiv Tiwari.

Court ordered restoration of ponds encroached and illegally occupied by builders, colonisers and others either in personal capacity or through allotment by development authorities on or before October 8, 2001. In case, any plot has been allotted, which is part of a pond or lake, such allotment should be cancelled forthwith. The allottees may be given other plot in lieu of such allotments, said the bench.

The petitioner's lawyer H S Jain submitted that due to fall in ground water level, there could be acute water crisis after three or four decades in some of the cities. Already water-related crimes are increasing in some blocks and districts of the state.

The Bench directed the director-general of police to provide district-wise data of criminal cases relating to water disputes in UP. The district magistrate and the superintendent of police of each district shall ensure that no further construction is raised over plots which are part of ponds and lakes in revenue records, the Bench said.

Court has sought from the state government report on total area of ponds and lakes which have been encroached upon for construction of houses, multi-storeyed buildings and shopping malls, etc. It also directed the state government to constitute a committee of experts to find out ways and means to check declining level of underground water in the state and make water harvesting compulsory.

The high court asked the state government to submit compliance report on August 7, while directing the higher authorities, including the chief secretary, to take initiatives in this regard.

According to director of UP ground water department, the level of groundwater is decreasing every year at the rate of almost 10 to 60 centimetres. In some districts, this rate is more than a metre.

ACTION ON GROUND

- No construction plan to be passed if it does not have provision for water harvesting
- Government told to restore ponds encroached upon and illegally occupied by builders, colonisers and others
- Government told to constitute a committee to find out ways and means to check declining level of underground water

Ground water level in U.P. at an alarming stage

The State Government prepares an action plan

LUCKNOW: Uttar Pradesh, which is going through an acute power crisis, is faced with yet another major problem-the ground water table in most of the places is going down to alarmingly low levels.

The State Ground Water Department (SGWD) has already sounded a SOS to stop the over-exploitation of the ground water for agriculture purposes in view of the drinking water scarcity looming large in the State.

Out of 820 development blocks in 70 districts of the state, the ground water level in over 450 blocks has been found to be in the category of the seriously affected, the seenario giving sleepless nights to the State authorities, the SGWD officials said here.

Cause of worry

The ground water level in as many as 140 blocks was 'really' a cause of worry, the officials said. Of these in 100 blocks, the ground water level is in the State of either 'critical' or 'semi-critical'.

The U.P. Government, however, knows this alarming situation and has prepared an action plan to deal with it specially when the mercury is rising, the power supply is perpetually erratic and the prospects of the Monsoon are not encouraging either.

The ground water situation is worse in the Western part of the State where 70 per cent of the ground water had already been exploited and the indiscreet use of water pumps and other mechanism had left little scope for the king water resources.

- **The Ground Water Department has already sounded a SOS to stop the over-exploitation of the ground water for agriculture purposes**
- **The situation is worse in the Western part of the State**

Though, the network of canals is existent in the region and other areas as well but the over dependence on the ground water sources has depleted the ground water table to an abysmally low level.

The officials said while the ground water is used for irrigation and drinking water, the large share of agriculture exploitation leaves little margin of usage for drinking water.

The wells, artificial ponds and natural lakes are being dried up and the hand pumps become non-functional due to low water level in most parts of the western U.P., the reports reaching here at the state headquarters said.

Even as the ground water status in the Western distficts of Agra, Muzaffarnagar, Bijnore, Ghaziabad, Moradabad, Hathras and Meerut is cause of concern, the position in central districts of Fatehpur, Rae Bareli, Unnao, Jhansi, Jalaun and Lakhimpur Kheri is no better. Simlar is the case with Eastern UP as well where the water level is going down considarably.

In a joint survey by Central Groundwater Department and the SGWD last year, the situation of ground water in 22 development blocks of 13 districts was found to be 'over-exploited' and 'critical', whereas the water level in 75 development blocks of 29 districts was 'semi-critical'.

In a worsened scenario this year, ground water level in 38 blocks was found to be 'over-exploited' and 'critical' while in 88 blocks, the level is in the category of 'semi-critical'.

The reports from Agra-Chambal have said that the water level in this belt has dipped as low as 60 feet.

Rain water

There are large tracts of land in the state where the crest of earth is hard which makes it difficult for rain water to seep in easily. So far 122 development blocks in 41 districts have been identified where special effort would be mounted to preserve rain water so than it could enter the crest.

Wells, ponds and small dams to check the flow of water are required to ensure that the rain water seeps inside, according to a study.

UP government, however, plans to launch water recharge projects and rain harvesting techniques to minimise the loss but it required money and huge man power.

The SGWD is being reorganised for this purpose and the departmental officials are being planned to be posted in all 70 districts to create an awarenes among the rural folks and th farmers.- UNI