Draft Sub-Regional Plan for NCT Delhi -2021

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Including Observations of 69th Planning Committee Meeting of NCRPB held on 23.02.2021

DELHI DEVELOPMENT AUTHORITY
MPMR & NCR Unit

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ABBREVIATIONS

AAM - Advanced Asset Management
ABC - Arial bunched Conductors
AKDIC - Amritsar- Delhi- Kolkata Industrial Corridor
AMASR - Ancient Monuments and Archaeological Sites and Remains
AMI - Advanced Meter Infrastructure
AMR - Automated Meter Reading
AMRUT - Atal Mission for Rejuvenation and Urban Transformation
APCPL - Aravali Power Company Pvt Ltd.
APM - Automatic Passenger Mover
APMC – Agricultural Produce Market Committee
AQI - Air Quality Index
AQMC - Air Quality Monitoring Committee
ASI - Archaeological Survey of India
ASIDE - Assistance to States for Developing Export Infrastructure & Allied Activities
ATM - Anytime Water Machines
AYUSH - Ayurvedic, Yoga and Naturopathy, Unani, Siddha and Homeopathy
BCM - Billion Cubic Meters
BEE - Bureau of Energy Efficiency
BG - Brake Gangwayed/ BG coach
BLY - Bachat Lamp Yojana
BMW – Bio Medical Waste
BNHS - Bombay Natural History Society
BOD – Biochemical Oxygen Demand
BPL - Broadband over Power Line
BRPL - BSES Rajdhani Power Ltd
BRT - Bus rapid transit
BRTS - Bus Rapid Transit System
BYPL - BSES Yamuna Power Ltd
CAGR - Compounded average growth rate
CAP - Comprehensive Action Plan
CBWTF – Common Biomedical Waste Treatment Facility
CCGT - Combined Cycle Gas Turbines
CDM - Clean Development Mechanism
CEA – Central Electricity Authority
CETP - Common effluent treatment plants
CGWB - Central Ground Water Board
CHC - Community Health Centres
CNCR - Central National Capital Region
CNG – Compressed Natural Gas
COD – Chemical Oxygen Demand
CPCB – Central Pollution Control Board
CPHEEO - Central Public Health and Environmental Engineering Organization
CPPR - Centre for Public Policy Research

DCB - Delhi Cantonment Board
DDA – Delhi Development Authority
DEDA – Delhi Energy Development Authority
DELP - Domestic Efficient Lighting Programme
DESU - Delhi Electric Supply Undertaking
DFBOT - Design-Finance-Build-Operate-Transfer
DFC - Dedicated Freight Corridors
DFC - Delhi Flying Club
DFCD – Department of Flood Control of Delhi
DFID - Department for International Development
DGC - Delhi Grid Code
DIMTS - Delhi Integrated Multi-Modal Transit System
DISE - District Information System on Education
DJB - Delhi Jal Board
DMIC - Delhi-Mumbai Industrial Corridor
DMRC - Delhi Metro Rail Corporation
DMSWPCL - Delhi Municipal Solid Waste Processing Company Ltd
DMU – Diesel Multiple Unit
DPCC – Delhi Pollution Control Committee
DPGS - Delhi Parks and Gardens Society
DPIIT - Department for Promotion of Industry and Internal Trade
DR - Demand Response
DSIIDC - Delhi State Industrial Infrastructure Development Corporation
DSLSA - Delhi State Legal Services Authority
DSM - Demand Side Management
DTC – Delhi Transport Corporation
DTFC - District Task Force Committees
DTIDC - Delhi Transport Infrastructure Development Corporation Limited
DTL – Delhi Transco Limited
DTTDC - Delhi Tourism and Transportation Development Corporation
DTW – Depths to Water
DUSIB - Delhi Urban Shelter Improvement Board
DVB – Delhi Vidyut Board
EAI - Enterprise Application Integration
EDFC - Eastern Dedicated Freight Corridor
EDWPCL - East Delhi Waste Processing Company Ltd
EE&REMC - Energy Efficiency and Renewal Energy Management Centre
EEE - Electrical and Electronic Equipment
EERE - Energy Efficiency and Renewable Energy
EESL - Energy Efficiency Services Limited
EHV - Extra-High Voltage
EMU – Electrical Multiple Unit
EOC - Emergency Operation Centre
EPA – Environmental Protection Act
EPCA – Environment Pollution Control Authority
ESCO - Energy Service Company
ESF - Ecosystem Services Framework
ESZ - Eco-Sensitive Zones

EWS – Economically Weaker Section
FDI - Foreign Direct Investment
FOB – Foot Over Bridge
GBCI - Green Business Certification Inc.
GBI - Generation Based Incentives
GDP - Gross Domestic Product
GERMI - Gujarat Energy Research and Management Institute
GIS - Geographic Information System
GNCTD – Government of National Capital Territory of Delhi
GOI – Government of India
GPCD - Gallon Per Capita per Day
GPS – Global Positioning System
GRAP - Graded Response Action Plan
GSDL – Geospatial Delhi Limited
GSDP - Gross State domestic product
GSVA - Gross State Value Added
HCC - Heritage Conservation Committee
HCE – Healthcare Establishments
HEP - Hydroelectric Projects
HFC - Highway Facility Centres
HR – Haryana Roadways
HRTC – Himachal Road Transport Corporation
HT – High tension
HVDS - High Voltage Distribution System
I&FC - Irrigation and Flood Control
IARI – Indian Agricultural Research Institute
ICD – Inland Container Depot
ICD - International Container Depot
ICL - Incandescent Lamps
IFC – Integrated Freight Complex
IGIA - Indira Gandhi International Airport
IL & FS - Infrastructure Leasing & Financial Services
IMD - Indian Metrological Department
INTACH - Indian National Trust for Art and Cultural Heritage
IPDS - Integrated Power Development Scheme
IPGCL - Indraprastha Power Generation Company Limited
IPHS – Indian Public Health Standards
IPT – Intermediate Public Transport
IRC – Indian Road Congress
IRORC - Inner Regional Orbital Rail Corridor
IRS – Indian Remote Sensing
ISBT - Inter State Bus Terminals
ISTS - Inter-State Transmission System
ITS - Intelligent Transport Systems
JICA - Japan International Cooperation Agency
JKRTC - Jammu and Kashmir State Road Transport Corporation
JNNSM - Jawaharlal Nehru National Solar Mission
JnNURM - Jawaharlal Nehru National Urban Renewal Mission

JNPT- Jawaharlal Nehru Port
JNU – Jawaharlal Nehru University
KMP - Kundli-Manesar-Palwal Expressway
KMP - Western Peripheral
L & DO – Land and Development Organization
LBNL - Lawrence Berkeley National Laboratory
LCV – Light Commercial Vehicle
LFPR – Labour Force Participation Rate
LIG – Low Income Group
LPCD- Litres Per Capita Per Day
LPCD – Litres Per Capita Per Day
LRT – Light Rail Transit
LT- Low tension
MAV – Multi Axle Vehicle
MBBL - Model Building Bye Laws
MCD - Municipal Corporation of Delhi
MCM - Million Cubic Metres
MDI - Maximum Demand Indicator
MEMU - Mainline Electric Multiple Unit
MES - Military Engineering Service
MGD – Million Gallons per Day
MOD - Merit Order Dispatch
MoEF & CC - Ministry of Environment, Forest and Climate Change
MoHUA - Ministry of Housing and Urban Affairs
MOR - Merit Order Rating
MoRTH - Ministry of Road Transport and Highways
MoUD - Ministry of Urban Development
MPD – Master Plan of Delhi
MPPA - Million Passengers per annum
MRO – Maintenance, Repair and Overhaul
MRTS – Mass Rapid Transit System
MSW – Municipal Solid Waste
MV – Motor Vehicle
MWM - Mobile Workforce Management
NAAQS - National Ambient Air Quality Standards
NAMP - National Air Quality Monitoring Program
NCAP - National Clean Air Program
NCRPB - National Capital Region Planning Board
NCZ - Natural Conservation Zone
NDMC - New Delhi Municipal Corporation
NEERI - National Environmental Engineering Research Institute
NGRI - National Geophysical Research Institute
NH – National Highway
NHAI - National Highway Authority of India
NHPC - National Hydroelectric Power Corporation
NISE - National Institute of Solar Energy
NMA - National Monument Authority
NMSH – National Mission on Sustainable Habitat

NMT – Non-Motorised Transport
NRCD – National River Conservation Directorate
NRLDC - Northern Regional Load Dispatch Centre
NRSC - National Remote Sensing Centre
NSGM - Nation Smart Grid Mission
NSSO - National Sample Survey Office
NSVA - Net State Value Added
NTPS - National Thermal Power Corporation Limited
O & M – Operation and Maintenance
OAE - Own Account Enterprises
PCTR - Per Capita Trip Rate
PCU – Passenger Car Unit
PHC - Primary Health Centre
PMAY - Pradhan Mantri Awas Yojana
PMKVY - Pradhan Mantri Kaushal Vikas Yojana
PNG – Piped Natural Gas
PPCL - Pragati Power Corporation Limited
PPP - Public Private Partnership
PR – Punjab Roadways
PRTC – PEPSU Road Transport Corporation
PTR - Pupil Teacher Ratio
PWD - Public Works Department
R-APDRP - Restructured Accelerated Power Development and Reforms Programme
RESCO - Renewable Energy Service Company
RITES - Rail India Technical and Economic Service
RNCR – Rest of National Capital Region
ROB – Road Over Bridge
RORC - Regional Orbital Rail Corridor
ROW – Right of Way
RPO - Renewable Purchase Obligation
RRTS – Regional Rapid Transit System
RSI – RADARSAT International
RSRTC - Rajasthan State Road Transport Corporation
RTE - Right to Education Act
RUB – Road Under Bridge
RWA - Resident Welfare Association
RWH - Rain Water Harvesting
SBA – Swach Bharat Abhiyan
SDA - State Department of Archaeology
SDA - State Designated Agency
SECI - Solar Energy Corporation of India
SEZ – Special Economic Zone
SH – State Highway
SLB - Service Level Benchmarks
SLDC - State Load Dispatch Centre
SLEPC - State Level Export Promotion Committee
SLNP - Street Lighting National Programme
SNA - State Nodal Agency

SPCB – State Pollution Control Board
SPV - Solar Photovoltaic
SSA - Sarva Shiksha Abhiyan
SSI – Space Systems International
STP – Sewage Treatment Plant
SWM - Solid Waste Management
TCE - Tata Consulting Engineers Limited
TDFS - Transport Demand Forecast Study
TERI - The Energy Resources Institute
THDC - Tehri Hydro Development Corporation Limited
TOWMCL - Timarpur Okhla Waste Management Company Ltd.
TPDDL - TATA Power Delhi Distribution Ltd.
TPO - Town & Country Planning Organisation
TPP - Thermal Power Plants
TSS - Total Suspended Solids
TW – Two-wheeler
UBBL - Unified Building Bye Laws
UER – Urban Extension Road
UGR - Underground Reservoirs
UHBVN - Uttar Haryana Bijli Vitran Nigam
UJALA - Unnat Jyoti by Affordable LEDs for All
ULB - Urban Local Bodies
UNESCO – United Nations Educational, Scientific and Cultural Organization
UPSRTC – Uttar Pradesh Road Transport Corporation
URDPFI - Urban and Regional Development Plan Formulation and Implementation
USWE - Urban Small Water Enterprises
UTC - Uttarakhand Transport Corporation
UTTIPEC - Unified Traffic and Transportation Infrastructure (Planning & Engineering) Centre
V/C Ratio – Volume/ Capacity Ratio
WFPR – Work Force Participation Rate
WPR – Work Participation Rate
WTP – Water Treatment Plant
WWPS - Wastewater Sewage Pumping Stations
WWTP - Wastewater Treatment Plant
YEIDA - Yamuna Expressway Industrial Development Authority
ZDP – Zonal Development Plan

EXECUTIVE SUMMARY

PROJECT BACKGROUND

The Regional Plan 2021 for NCR as prepared by the National Capital Region Planning Board (NCRPB) was notified on 17.09.05 under Section 13 of NCRPB Act, 1985. The Government of NCT Delhi intends to prepare Sub-Regional Plan (SRP) with the perspective of year 2021 within the overall framework of RP- 2021 for NCT Delhi Sub-Region of the National Capital Region.

The National Capital Territory of Delhi, which recorded an extraordinary increase of population, has also witnessed a phenomenal physical and economic growth. This has resulted in tremendous stress on the land use and infrastructure, proliferation of slums and unauthorized development, traffic congestion, deterioration of air and water quality. Present state of development has far exceeded the carrying capacity of the land and environmentally not sustainable having long term implication on the quality of life and livability. Need for planned development of Delhi in a regional context rather than as a standalone entity was felt since the time of preparation of the first master plan during the year 1961-62 which eventually led to enactment of NCRPB Act in the year 1985 and formulation of the Regional Plan for NCR. The National Capital Region includes NCT-Delhi, fourteen districts of Haryana, eight districts of Uttar Pradesh and two district of Rajasthan. Total area of the region is 55,083 sq. km.

Vision of SRP 2021

Taking cognizance of the basic policies envisaged in Regional Plans of 2001 and 2021 the vision of Sub-Regional Plan 2021 for NCT Delhi aims to:

"To make Delhi environmentally sustainable, liveable and inclusive city and to spread the development impetus of Delhi across the National Capital Region by improving linkages between the capital city and its region to achieve balanced development of the entire NCR".

Objectives

To fulfill the above vision, the SRP Delhi 2021 will have the following objectives:

- To assess the existing scenario in order to suggest policies for dispersal of economic activities in line with Regional Plan-2021.
- To study and evaluate the existing infrastructure gaps and suggest measures for improving the quality of life and better living environment while ensuring balanced development within the region.
- To suggest policy framework for optimum utilization of land, natural resources and conservation of environmentally sensitive areas.
- To evolve strategies for effective implementation of policies.

REGIONAL SETTING

NCT Delhi located in the north-central part of India and falls between 28°-24'-17" to 28°-53'-00" North Latitude and 76°-50'- 24" to 77°-20'- 37" East Longitude. NCT Delhi situated on

the banks of Yamuna River and bounded by four districts (i.e. Sonepat, Jhajjar, Gurgaon and Faridabad) of Haryana from west and south-west edges and three districts (i.e. Baghpat, Gaziabad and Gautam Buddha Nagar) of Uttar Pradesh from north-east and east edges.

The NCT Delhi is having duel jurisdiction i.e. Union and State Government. At the time of the1991 Census, Delhi was a single district territory. However, in 1996 the Government of NCT Delhi, through a gazette notification, created nine districts and 27 sub-divisions and Population Census for the year 2001 was conducted for same. For the year 2011, NCT Delhi is comprised of nine districts, 27 sub-districts, 112 villages and 113 towns as per Census of India 2011.

Major Linkages

NCT Delhi embedded with strong connectivity via roadways, railways and airways to NCR and other all the major cities and areas of the country, comprising of various Expressways, National Highways, State Highways, major district roads, other district road, Railway lines, Airports, etc.

Physical Features

Although NCT Delhi comprises only 2.7 percent of NCR it is quite diverse in terms of its physiography and unique geomorphic features such as the river Yamuna, alluvial plains and the remnants of Aravalli range, popularly known as Delhi ridge. Accordingly, NCT Delhi can be divided into three distinct physiographic parts - the Delhi ridge, the Yamuna flood plain and the plains. The ridge constitutes the most dominating physiographic feature of this territory.

The Delhi ridge which is consists of quartzite rocks and extends from southern parts of the territory to western bank of Yamuna. The alluvial formations overlying the quarzitic bedrock have different nature on either side of the ridge. The Yamuna flood plain contain a distinct river deposit. The nearly closed Chattarpur alluvial basin is occupied by alluvium derived from the adjacent quartzite ridge.

DEMOGRAPHIC PROFILE

According to census of India 2011 population of NCR was 4,60,49,032 persons and the NCT Delhi with the population of 167,87,941 persons has the largest share of 36.4 percent followed by Uttar Pradesh sub-region (31.7 percent), Haryana sub-region (24.0 percent) and Rajasthan sub-region has the lowest share of 8.0 percent. In the NCT Delhi share of population has increased from 31 percent in 1981 to 36 percent in 2011, while other sub regions of NCR i.e. Haryana, Rajasthan and U.P. observed decline in share of population in NCR.

NCT-Delhi is highly urbanized with 98 percent of its population living in urban areas as against the national average of 32 percent. The rural population of NCT Delhi has declined by 55.6 percent from 9.5 Lakh in 2001 to 4.20 lakhs in 2011.

Settlement Pattern

As per Census 2011, urban population is 97 percent of total population and accommodating in 75 percent of the area under 113 towns of NCT Delhi. Out of 113 towns (3 Statutory and 110 Census Towns), 15 towns fall in Size Class I which include all the three Statutory Towns and 12 Census Towns. 21 Census Towns fall in Size Class II; 23 Census Towns

fall in Size Class III. The maximum number of Census Towns, i.e., 33 falls in Size Class IV. In the remaining two Size Classes, viz., Class V and VI, the number of towns are 17 and four respectively.

In NCT Delhi, observed reduction in its rural population and settlements. As according to the Census of India, 54 percent area designated as under rural area in 1991, which declined to 25 percent in 2011. Simultaneously, the number of villages were also reduced to 112 in 2011 from 300 in 1991.

ECONOMIC SCENARIO

Delhi is a prosperous state with the second highest per capita income in India. The average per capita income of Delhi remained more than three lakhs in two consecutive years i.e. 2017-18 & 2018-19. Delhi ‘s per capita income is almost three times the national average, both at current and constant prices. Delhi ‘s per capita income at current prices reached 328985 in 2017-18 as compared to 298832 in 2016-17 and 273301 in 2015-16. The advance estimate of per capita income of Delhi at current prices during 2018-19 is estimated at 365529. In view of the constantly changing economic scenario of NCT of Delhi, it is imperative to analyze and assess the economic development trends, along with economic/fiscal policies and suggest future directions of growth.

Delhi ‘s per capita income is almost three times the national average. Per capita income reached Rs.3,28,985 in 2017-18 as compared to Rs.2,98,832 in 2016-17. For 2018-19 estimated per capita GSDP Rs.3,65,529. Gross State Domestic product (GSDP) of Delhi increased at a Compounded annual growth rate (CAGR) (in Rs) of 12.41 per cent between 2011-12 and 2018-19 to reach Rs 7.80 trillion. The contribution of the tertiary sector, recorded at 84.12 per cent in 2018-19, secondary sector at 14.00 per cent and 1.88 percent in the primary sector.

Delhi is an almost fully urbanized state with the growth of workers and non-workers being higher than the national level. While the persons employed in the service sector and industrial sectors constitute a major share, the percentage of persons engaged in the primary agriculture sector is steadily decreasing. Trade and commerce have played a pivotal role in promoting the growth of Delhi ‘s economy by making a significant contribution in terms of GDP and gainful employment to a large section of society. Delhi is the biggest trade and consumption center in North India. It has attained the status of a major distribution center by virtue of its geographical location, historical factors, availability of infrastructure facilities etc.

- NCT Delhi being one of the best performing metro regions in the globe should be used to as a focal point to trigger pace of economic development in the entire NCR. Special emphasis should be given to service sector and selective high value manufacturing sector
- Delhi is fast turning into a commercial hub. There is thus a need to focus our approach towards resolving issues relating to commercial enterprises.
- Provision for integrated freight complexes and wholesale markets along transit corridors
- Encourage knowledge-based economic activities such as IT/ITeS, designing, R&D and financial services.
- Upgradation and modernization of existing industries while promoting hi-tech and low volume- high value-added industries, which are not labour intensive.

The following items/products have got good potential to be manufactured in Delhi –

- Gems & Jewellery
- Handloom, Handicrafts & Decorative Items
- Artificial Jewellery making
- Khadi and Village industries
- Bakery Products
- Electrical Home Appliances
- Packaged Food Products
- Plastic Products, Water purifiers
- Flavours
- Perfumes
- Fragrance & Deodorants
- Garments
- Steel Furniture & Office Furniture
- CFL Lamps
- Invertors & Batteries
- Hosiery & allied Products
- Detergent & cosmetic products
- Leather goods
- Leather Garments
- Packaging Units
- Printing
- Optical lenses
- Board & paper corrugation
- Non PVC Footwear
- Leather footwear
- Corrugated Boxes
- Leather Bags and accessories
- Plastic Containers
- Plastic films and bags
- Steel Fabrication

TRANSPORT

Road Network

It is observed that, growth of vehicular population increased drastically in NCT Delhi during last decade 2001-11, as vehicles per 1000 persons increased from 211 vehicles per 1000 persons in 2001 to 388 vehicles per 1000 persons in 2011. Similarly, the number of vehicles per household has increased from 1.1 in 2001 to 2.0 in 2011. Massive vehicular population of NCT Delhi ultimately adding to traffic congestion especially during peak hours causing loss of valuable man hours.

Existing road network of NCT of Delhi consists of both ring – radial road pattern. Broadly, the road network is designed for regional, intra - city and local traffic comprising of expressways, National Highways, ring roads and other urban roads.

Rail Network

In the National Capital Territory of Delhi both intercity and intra-city passenger movements are being catered to by the existing rail network comprising the Regional and Ring Rail Systems respectively. While, Delhi is the headquarter of the Northern Railways of Indian Railway and also a major railway junction having six major railway stations i.e. New Delhi, Old Delhi, Hazrat Nizamuddin, Anand Vihar, Delhi Sarai Rohilla and Delhi Cantt of NCT Delhi.

Public Transport

Public transport in Delhi has two major components viz. bus transport and metro rail. These two major transport systems are playing a vital role in facilitating public transport in Delhi. In fact, both the systems are the lifeline of the people of Delhi. At present, the daily ridership of Delhi Metro is 60 lakhs in the year 2020. However, daily average passenger ridership on DTC and cluster buses is 29.86 lakh in the year 2018.

Airport

Indira Gandhi International Airport (IGIA) is the primary civil aviation hub for India and the National Capital Region of India. It is spread over an area of 5106 acres (2066 Ha), situated in Palam, South-West of New Delhi. IGI Airport is the busiest airport in India in terms of passenger traffic and second busiest in term of cargo traffic. The overall airport infrastructure has the capacity to handle 62 MPPA (Million Passengers per annum) and Cargo handling capacity of 1.5 MMTPA.

Traffic Characteristics

Average Daily Traffic (ADT): 12,10,896 vehicles (12,27,873 PCUs) at NCT-Delhi boundary

Passenger ADT: 11,07,043 vehicles, Freight ADT: 1,03,853 vehicles. The volume / Capacity Ratio: 1.01 to 2.83 on major roads. Occupancy: two wheelers- 1.59, three wheelers-2.93, Car/Jeep-2.79, Buses- 39.77 & mini buses- 11.18

Trip Length Frequency: Two-wheeler- 87 percent up to 0-25 km, 3wheeler- 89 percent up to 100 km and buses trip lengths up to 250 km. Vehicle Trip Purpose: Work' and 'Business' (32 percent and 23 percent), Social trips (13.0 percent) & Education trips were low (2.3 percent).

Travel Pattern characteristics:

Total 151 lakhs person trips (Intra-City: 117 lakhs and Inter-city: 33.4 lakh trips per day). Modal Split: Private modes (i.e. Two-wheeler & Cars): 41 percent. Public transport modes (i.e. Auto, Bus, Metro, Trains): 59 percent. Per capita trip rate (PCTR) (excluding walk trips): increased from 0.72 in 1981 to 0.87 in 2001. Trip by purpose: Educational (38 percent), Work (30 percent), Business (15 percent) and other (15 percent).

POWER

The per-capita consumption of the consumers in Delhi is more than 1,561 units per annum as against the national average of 1,122 units in 2016-17. The power supply position of

Delhi has been viewed in terms of peak demand experienced and met by individual DISCOMs. Indraprastha Power Generation Company Limited (IPGCL) and Pragati Power Corporation Limited (PPCL) are managing the power plants in Delhi having a total installed generation capacity of 1983.2 MW.

Total generation Capacity of Power in Delhi: 2955 MW (7346 MU) and total peak Demand 7400 MW (2017-18). Per-capita consumption in Delhi is more than 1561 units against national average of 1122 units in 2016-17. Other than TPDDL, all other DISCOMs face a shortfall in the range of 7.40 percent to 23.44 percent in terms of peak demand (FY 2015-16 to FY 2018-19). Coal based power stations are shut down. CCGTs (Gas turbines) underperforming due to unavailability of gas. Delhi has 1697 MW gas based embedded generation capacity lying unutilized. Delhi's solar potential is 2.5 GW, with roof-top space availability for solar panels at 31 sq. km. Potential to shave off 10 percent of peak demand by 2025. Of this potential, 26 percent is in the government/public sector, 25 percent in commercial/ industrial sector, and 49 percent in domestic sector. Peak demand met increased from 4720 MW in 2010-11 to 6526 MW in 2017-18. System availability is 97 percent in the last eight years. During 2010-11 to 2017-18, 50 percent jump in domestic sector.

Power purchase in Delhi has grown by 55.38 percent during the last 10 years. 25.76 percent of total power purchase from own generation. 74.24 percent is purchased from Central Govt., Jhajjar power station (APCPL), Sasan power station, Nathpa Jhakhri power station, NTPS Stations, NHPC, THDC and NPC. There is a need to focus on innovations and renewable sources of energy. Instantaneous generation of renewables on a hot June day can exceed the entire power demand of the state, hence need for smart grids, grid flexibility and transmission.

There is a need to encourage and focus on renewable sources of power production and innovations in the power sector. Follow the leads of Demand side management, replacement of old sick cables, expand and upgrade the power distribution network.

WATER

Due to high water consumption of the urban populace, Delhi is a heavily water stressed state. Delhi has several sources of water. These are surface water (chiefly Yamuna sub-basin, Ganga and Indus Basins), potential surface water sources from proposed dams in the high Himalayas, ground water aquifers especially in alluvial formations, treated wastewater (increases commensurately with supplies), rainwater (local storm waters generated in Delhi's six sub-basins and flood waters transiting through Delhi from Haryana discharging into Yamuna). Delhi is a riparian state of the River Yamuna which is the only river flowing through the NCT of Delhi. This river constitutes the primary source of water supply to NCT Delhi.

Water is supplied to about 18 million population of Delhi through existing water supply network comprising of 14355 km long pipelines and more than 107 underground reservoirs (UGRs). Delhi uses an average of 835 MGD raw water daily from various sources: Ganga River (330 MGD), Yamuna River (207 MGD), Bhakra Storage (218 MGD), and groundwater (80 MGD). The water treatment and supply capacity, which was 650 MGD in 2002, has been increased to 906 MGD in 2014. There 12 Water Treatment Plants in Delhi and two new Water Treatment Plants have been constructed at Dwarka (50 MGD) and Okhla (20 MGD).

South & SW Delhi, being at the tail end receive less water, resulting in excess ground water extraction, depletion in ground water. 1.79 lakh un-metered connections & 4.00 lakh meters' defective/ non-functional. Water subsidies are unsustainable for O & M which leads to more wastage, drains govt. financially.

The need for a single unified agency such as 'State Water Resources Board' should be established and tasked with policy related issues for integrated water resources development and management is elaborated upon. Water Metering coupled with improved recovery of revenue to help reduce the revenue-expenditure gap. Commercial approach should be adopted by the local bodies for revenue generation. 'Public-Private Partnership' needs to be introduced for operation and maintenance of water supply.

SEWERAGE, SOLID WASTE MANAGEMENT, DRAINAGE AND IRRIGATION

The growth of the city beyond reasonable limits imposes unbearable strain for provisioning of two most basic services: water and sanitation. NCT Delhi with 164 lakhs of inhabitants, is no exception as it generates large volumes of both liquid and solid wastes.

Sewerage

As per Census 2011, Delhi had a population of 16.753 Million and as per the Delhi Master Plan 2021, the population of Delhi is projected to be 23 Million. Presently, approximately 50 percent of Delhi is not connected with sewerage system. The percentage of network coverage in NCT Delhi in the year 2011 was 55 percent and Delhi Jal Board is the service provider for entire NCT Delhi region.

Presently Delhi is divided into six drainage zone namely Rithala, Keshopur, Okhla, Shahdara, Coronation Pillar and Outer Delhi. Keshopur, Okhla, Rithala, South of Shahdara and Coronation Pillar drainage zones are majorly sewered with pockets of unsewered colonies. The North of Shahdara and Outer Delhi extending from Narela, Bawana in North, Najafgarh in West to Bhati Kalan & Dera Mandi in South, are predominantly unsewered. The whole of NCT of Delhi has been delineated into 12 proposed drainage zones excluding Cantonment and Airport area

About 50 percent of population is covered by sewerage network, and sewage generated from the remaining population is going through a number of surface drains into the river. Delhi Jal Board (DJB) is responsible for treatment of domestic sewage in the NCT of Delhi and also the executing agency entrusted with the construction and maintenance of the Wastewater Treatment Plants (WWTPs), Wastewater Sewage Pumping Stations (WWPSs), Sewerage Networks and associated structures. DJB has 34 WWTPs at 21 locations in the NCT of Delhi along with WWPSs.

At present there are 34 Wastewater Treatment Plants (WWTPs) at 21 different locations, equipped to treat 2700.03 MLD (594.72 MGD) of sewage with utilization of around 57 percent. Capacity of WWTP varies from (0.66 MGD) to (170 MGD). In NCT Delhi, 645 MLD of treated effluent is reported to be used in Horticulture/ Irrigation/ Power plant, against present sewage generation of 2996 MLD which works out to be 21 percent. It is observed that Okhla drainage zone is generates the highest amount of waste water that is 162 MGD in 2021 and 187 MGD in 2031 followed by Shahdara zone, Rohini-Rithala zone and Kanjhawala-Bawana zone because these zones are having larger catchment areas and higher concentration of population served by

sewerage network. Rest of the zones are relatively smaller with lesser population and propose to generate less than 100 MGD by 2021 and 2031.

It is recommended that the entire area of NCT Delhi should be covered with sewer facilities. Strengthening and up- gradation of old sewer lines should be carried out in view of re-densification and redevelopment. A detailed Sewerage Zonal plan should be prepared with the purpose of zero disposal of sewage in the river Yamuna.

Storm Water Drainage

The topography of Delhi created a drainage system that carried rain and storm water from higher elevations of the West to the Yamuna, providing a natural drainage. While the eastern, low-lying side was originally a part of the flood plain of the river and considered un-inhabitable due to frequent floods. The Eastern wing which is also called Trans-Yamuna area houses about 20 percent of the total population of Delhi.

Natural Drainage System

The NCT of Delhi has three major drainage basins, namely, Najafgarh, Barapullah and Trans-Yamuna basins. There are also a couple of very small drainage basins (Aruna Nagar and Old Chanderwal) that have outfall directly into Yamuna. The Najafgarh basin is the largest of all the basins and accounts for close to two third of the area of NCT of Delhi. At present there are about 201 drains flowing in different drainage basins, out of which Najafgarh basin has the highest of 123 drains followed by 44 in Barapullah and 34 in Trans-Yamuna basin. The final disposal of majority of the storm water generated from Delhi is into river Yamuna through outfall points distributed across the stretch along its course through Delhi.

As per the drainage map prepared by the Irrigation and Flood Control Department, GNCTD, NCT of Delhi has been demarcated into six drainage zones namely (i) North Zone, (ii) West Zone, (iii) Central North West and South East Zone, (iv) Central South and South East Zone, (v) East Zone, and (vi) South Zone. The length of natural drain in the city is 415 km carrying discharge of 1,000 cu m. Alipur catchment located in the north has the longest length of drain measuring 140 km and has a discharge of 174 cumecs.

Manmade Drainage System

The total length of drains is 1,700 kms spread over 12 municipal zones. There are 1,296 drains with a total length of 1,694.1 km out of which the west zone has the longest length which measures 410 km and Sadar- Paharganj zone with the shortest length measuring 4.5 km. Shahdara North zone has the highest number of drains which is 197 and Sadar-Paharganj and city zone has the lowest number of drains which are 10 each.

It is recommended that encroachments and diversion of water bodies (like rivers, lakes, tanks, ponds, etc.) and drainage channels (irrigated area as well as urban area drainage) must not be allowed, and wherever it has taken place, it should be restored to the extent feasible and maintained properly. There is a natural temptation to dispose off wastes into available storm water collection system with impunity. Use of garbage disposal bags should be made mandatory for businesses along road carriageways. Many of the water bodies have become redundant over the years and are not even properly connected to their catchments. Once rejuvenated, these water

bodies can play a pivotal role in reducing the flooding as they act as detention and recharge basins. They should be continuously monitored and maintained in order to reduce runoff into storm drains.

Solid Waste Management

Delhi produces the largest amount of solid waste in the country i.e. 10,500 tonnes per day of municipal solid waste. Total waste generated in 2011 was 8390 MT per day which is estimated to be 15750 MT per day in 2021. The municipal corporations manage the waste in three ways namely composting, waste to energy and by sending it to landfill sites.

Approximately 55 percent of the total generated waste is processed through Waste to Energy and Waste to Compost plants and rest is dumped in three Sanitary Landfill Sites (SLFs). About 70–80 percent of the generated MSW is collected, while the rest remains unattended to on streets or in small open dumps. These Landfill Sites were proposed to be filled to its full capacity for the period of 20-25 years. However, it is observed that these sites have been utilized for more than 40 years. The total capacity of the landfill site also has been over spilled. There is hardly any segregation done in most part of Delhi, the efficiency is less than 70 percent.

It is recommended that a detailed Solid Waste management plan needs to be prepared on the basis of guidelines provided by CPHEEO manual for managing the solid waste in the city. It would be appropriate that the local bodies plan for the entire city indicating landfill sites in a decentralization manner for reducing the transportation cost and also for reducing carbon footprints. There is a need to improve the efficiency and effectiveness of solid waste management at each stage including waste segregation at source, waste collection, waste transportation, treatment and disposal of waste which can be achieved by strengthening the institutional capacity building measures. NGOs and private sector to be involved through PPP mode for effective management of waste. At the same time, informal sector which consists of rag pickers, door to door collectors, etc. to be included in the SWM planning process.

SHELTER

NCT Delhi had about 33.40 lakhs households against 164 lakhs persons. Thus, average household size works out to 4.9 persons which has marginally dropped from 5.4 in 2001. The highest (3.69 percent) percentage of dilapidated houses is found in New Delhi District of NCT Delhi which has many old bungalows of colonial times with very low occupancy and developments of new residential areas is limited due to strict development controls.

Ownership of houses is very high in Delhi with about 68 percent of households having their own houses. 99 percent of the households have access to sanitation facilities. The number of households having access to treated water is 81 per cent, as against 75 per cent 10 years ago. Less than one per cent of the households are without both toilet and electricity facilities. Residential and residential cum other uses have increased from 72.6 percent in 2001 to 81.0 percent in 2011

Slums

In India 42.6 Million people were living in the slums in 640 cities in 2001, out of which 4.8 percent are in NCT Delhi. In 2011, 14.6 percent (4,87,718) of the total households in Delhi Municipal Corporation have been living in slums, which is comparatively lesser than other

Million plus cities like Greater Mumbai, Kolkata and Chennai. Only Bangalore (M.C) has lesser slum population as compared to Delhi.

Unauthorised Colonies

It is estimated that in Delhi there are 1797 Un-authorised Colonies, which are to be regularized as per government policy.

These have about 40 lakh population which needs to be effectively incorporated in the mainstream of urban development. This requires the provision of infrastructure services and facilities for which differential norms and procedure have been devised.

Night Shelters

The DUSIB has established and is operating 132-night shelters with all necessary infrastructure facilities located across Delhi. The capacity created by the DUSIB as on date can accommodate 12,400 shelter less people in the 132-night shelters located across Delhi.

It is recommended that Additional Housing stock to be created through in-situ augmentation of services in slums instead of going for new housing developments. Emphasis to be given more on social housing scheme and rental housing for migrants, economically weaker sections, close to their work places. Wherever possible, Redevelopment schemes for unauthorized colonies and Slums by plot reconstitution to be implemented.

SOCIAL INFRASTRUCTURE

While physical infrastructure improves physical connectivity, the sustainability of economic growth and development is dependent on social infrastructure, more importantly education and health infrastructure.

Education

It may be emphasized that educational facilities have been recognized as a critical investment for sustaining the socio-economic development. Since NCT-Delhi has traditionally been a city with relatively better availability of educational infrastructure than rest of the NCR. The literacy in Delhi has continuously been improving and also the literacy gap has been decreasing. There is an upward trend in the Literacy Rate for both male and female.

The Literacy Rate of 75.29 percent in 1991 increased to 81.67 percent in 2001 which further increased to 86.20 percent in the 2011 Census. Out of the total 5239 schools in NCT Delhi, 2772 schools (52.9 percent) are government schools and 2467 schools (47.1 percent) are private schools. Right to Education Act (RTE) mandates an optimal student teacher ratio of 30:1 for all Indian Schools, in NCT-Delhi the ratio is in the range of norm except in upper primary and higher secondary level where it is 38:1. As a whole in NCT-Delhi 64.6 percent of the schools are Pucca, 7.4 percent partially Pucca, 3.5 percent Kutcha, 18.4 percent multiple type and 6.1 percent schools have no buildings.

The higher education infrastructure in Delhi comprises of 23 Universities (incl. Central/ State universities, Deemed universities), five Institutes of National Importance and 188 Colleges (incl. General/ Professional colleges). In addition, there are 112 Standalone Institutions imparting

diploma course in various fields; and there are Vocational Training Institutions and *Pradhan Mantri Kaushal Vikas Yojana (PMKVY) institutions.*

It is recommended The Master Plan should make available land at appropriate locations for the development of school complexes which may house different level of schools in an area where each school complex will be a semi-autonomous unit providing integrated education across all stages from elementary to secondary education. More investment is needed in Higher Education, Research and Training Institutions for providing State of Art facilities. Higher Education Institutions may also be involved in collaborations with Foreign Educational Institutions, Research laboratories, etc.

Additional hostel facilities in higher educational institutions all over NCT Delhi should be created to accommodate students coming from different parts of the country.

Health

Health infrastructure is an important indicator to understand the health care provision delivery provisions and mechanisms in the region. Health infrastructure in India is structured at three levels namely primary (Sub Centre and Primary Health Centre), secondary (District Hospital and Community Health Centre) and tertiary (Nursing homes, specialty and super-specialty hospitals) based on population norms.

The NCT Delhi accounts for only two percent of the primary level facilities to the total number of primary level facilities (151) present in NCR. On the other hand, in terms of tertiary level medical care i.e. district hospitals and multi-specialty hospitals, Delhi has a maximum number of 134 accounting to 85 percent of that of NCR. There are 260 dispensaries which do not have any inpatient facility but only observation beds. More than half of the private health facilities accounting for 56.5 percent of NCR are concentrated in the NCT-Delhi. The ratio of Government Hospitals to Private Hospitals in NCT Delhi is the highest in NCR region i.e. 1: 4.8. In NCT Delhi, the proportion of beds is more in Government Hospitals than that of Private Hospitals. In government hospitals, occupancy rate in NCT-Delhi is the highest 72 percent in whole of NCR.

The number of health-care facilities under almost all categories (Hospitals, nursing home, maternity home, dispensary) fall short of the MPD-2021 provisions. It is observed that contamination of drinking water, air pollution, congestion, adulteration of edible items, passive lifestyle and lack of cleanliness are some major reasons for health problems in NCT Delhi. Therefore, it is imperative to have a special emphasis on the preventive measures for creating a better healthy environment. It will also ease out the pressure on the health infrastructure and medical facilities to be provided in NCT Delhi. It is recommended that; the State Government should have a plan to take preventive measures immediately for the entire area of NCT Delhi.

This plan should include the availability of clean drinking water, well laid drainage and sewer, complete removal of municipal waste and other garbage from the roads and colonies, removal and treatment of biomedical and other waste, regular cleaning of roads, drains and other water bodies, regular vaccination of children and pet animals, removal of dairies and animal rearing from the urban areas, treatment of industrial waste, punitive actions against adulteration of edible items, complete closure and removal of air/water polluting industrial units, ban on garbage burning etc. to clean the environment.

HERITAGE AND TOURISM

Historically, developments in Delhi took place in a triangular patch of land with River Yamuna on one side and the northern range of Aravalli hills on the other two sides. The capital city of Delhi is rich in culture, architecture and human diversity, varied history, monuments, museums, galleries, gardens and exotic shows. The city houses the diverse range of natural and man-made built assets form Indraprastha (rule of Pandavas of Mahabharata fame) rein to contemporary British rule.

Delhi is the potential hub of connectivity and destination to most of the tourist circuit and destinations in the Northern Plains as it strategically connects to rest of the pan northern areas and popular and remote destinations by virtue of its logistical facilities and compatible visitor infrastructure.The major tourist destinations in Delhi are as follows:

Heritage Zones

The following areas have been identified as Heritage Zones:

i. Heritage complex within Walled City of Delhi, Shahjahanabad.
ii. Heritage complex within Lutyens Bungalow Zone.
iii. Heritage complex within Nizamuddin and Humayun's Tomb Complex.
iv. Heritage complex within Mehrauli area.
v. Heritage complex within Vijay Mandal - Begumpur - Sarai Shahji - Lal Gumbad.
vi. Heritage complex within Chirag Delhi. However more areas can be added to this list based on studies by concerned agencies.
vii. 'Imperial Cities of Delhi' in UNESCO's list of World Heritage Cities.
viii. Lodi Garden – Safdarjung Tomb
ix. Deer park-Green park

Archaeological Park

The following areas have been designated as Archaeological Parks:

i. Mehrauli Archaeological Park.
ii. Tughlaquabad Archaeological Park.
iii. Sultan Garhi Archaeological Park.
iv. Purana Qila (Indraprastha) Archaeological Park
v. Northern Ridge Archaeological Park

1. Natural Heritage (Eco-Tourism Sites)

The following areas have been designated as Natural Heritage sites:

i. River Yamuna
ii. Delhi Ridge
iii. Naturally or constructed Baolies/ Water Bodies/ wetlands/ Lakes
iv. Forests/ Urban Parks/ Biodiversity Parks/ Heritage Gardens
v. Eco- Sensitive Zone - Asola Bhatti wildlife sanctuary (Indira Priya Darshani Sanctuary), Okhala Bird Sanctuary

Business Tourism

The new Industrial Policy 2010-21 aims to provide a conducive environment for knowledge-based and hi-tech IT/ITeS industries in Delhi. The real estate market in Delhi is lucrative and attracts investors from India and abroad. Owing to the advanced infrastructural base, the city meets the requirements of a profitable investment. Real estate sector contributed around 28.49 per cent to Delhi's Gross State Value Added (GSVA) in 2018-19. (India Brand Equity Foundation)

Medical Tourism

Popular Medical Treatments- Delhi multi-specialty hospitals under study provide medical treatment for a wide range of simple and complex medical problems. Cardiac, Orthopedics, Neurology, Oncology, Organ Transplant, Eye Surgery and Tumour treatment are some of the popular medical treatments undertaken by the patients visiting Delhi-NCR hospitals. Patients are also found to be coming Delhi for Spine treatment, Hip Surgery, Bone Marrow Transplant, ENT, Hernia, Gastroenterology, Diabetes and Hypertension.

Sports Tourism

Sport is the primary reason for travel whereas the leisure element may reinforce the overall experience. New Delhi's developed infrastructure and transportation, the Indian government has always given it a top priority while hosting sporting events like the two Asian Games (1951 and 1982) and Commonwealth Games 2010. Sports enthusiasts to explore their interests in different sport fields encouraging tie-ups with Delhi tour operators, Delhi has emerged as a Sport Tourism destination and which boost overall tourism in the country.

General recommendations for social and cultural activities, education, health and medical, business and recreational facilities of international standards should be promoted and developed in the NCT-Delhi.

ENVIRONMENT

Delhi has a much larger green cover than any of the other metropolitan city in the country, and could well be called a "Green City". The state is endowed with several ecologically sensitive natural features which need to be preserved and protected. As per the Delhi Master Plan-2021 availability of urbanisable land in NCT- Delhi is 1, 48,300 ha which includes 19,509 ha area of the natural features (forests, wild life sanctuary, Ridge, River Yamuna and other water bodies/ Drains) that is 13.16 percent to total geographical area of NCT- Delhi whereas in NCR-Regional Plan-2021 green areas in NCT- Delhi in year 1999 was 7015.00 ha (4.73 percent) and 6282.05 ha in year 2012 (4.24 percent).

The chapter is divided into Greens (Forests, Nature conservation Zone, Ecological sensitive areas and Biodiversity parks)

Forests: The Indian Forest Act, 1927, defines three categories of forests: Reserved Forest, Protected Forest and unclassified forests. The total areas of reserved and protected forests in NCT- Delhi are 85 sq. kms (Department of Forest) which is 5.73 percent of the geographic area of

NCT-Delhi. However, as per Regional Plan-2021, the total forest area in NCT- Delhi was 62. 82 sq. kms during the year 2012.

Nature Conservation Zone (NCZ): The major natural features, identified as environmentally sensitive areas, are the extension of Aravalli Ridge NCT- Delhi, forest areas, the rivers and the tributaries of Yamuna, sanctuaries, major lakes and water bodies There are more potential areas available in NCT-Delhi that can be designated under Nature Conservation Zone. Following are the Natural features that can be designated under Nature Conservation Zones are:

2. **Foot Hills of Aravalli (Delhi Ridge)**
3. **Watercourse Corridors- Drains & Canals (Man-Made and Natural), Wetlands (Najafgarh Wetland), Bhalaswa (OX- Bow Lake), Water Bodies**
4. **Woodlands, Forests (Reserved, protected, other forests), National Parks and Sanctuaries**
5. **Environmentally sensitive/ significant areas**
6. **Areas of Natural and Scientific Interest (Biodiversity Parks, Areas with endangered species- Flora & Fauna**
7. **Biosphere Reserves**
8. **City Green Belt**
9. **Planned Greens (Parks, Gardens, Heritage/ Cultural Sites)**

Eco-Sensitive Zones: Eco-Sensitive Zones are the special areas identified by the Ministry of Environment, Forests and Climate Change (MoEFCC) under Environment Protection Act, 1986. The State-wise details of ESZ listing, Asola Bhatti Wildlife Sanctuary categorized under ESZ. Okhla bird sanctuary falling within boundary of NCT-Delhi along the west bank of Yamuna may also be designated as eco-sensitive zone and accordingly necessary notification may be issued under Environment Protection Act, 1986

Biodiversity Parks: Under the DDA Act 1957 with a view to safeguard, conserve, preserve and manage the ecological, aesthetical and cultural values of Biodiversity sites in the National Capital Territory of Delhi, the Delhi Biodiversity Foundation is set up by Delhi Development Authority in exercise of its powers under section 5-A of the ACT and sets Delhi Biodiversity Foundation Regulations (Amendments 2015). A total of six Biodiversity Parks have been notified by Delhi Development Authority are as follows:

1. Yamuna Biodiversity Park
2. Aravalli Biodiversity Park
3. Kamla Nehru Ridge Biodiversity Park
4. Tilpath Valley Biodiversity Park
5. Neela Hauz Biodiversity Park
6. Tughlaqabad Biodiversity Park

Yamuna Flood Plain

River Yamuna in Delhi is about 50 kms in length with floodplains having width of 1.5 to three kms. The total area of active floodplain including river bed is about 97 sq. km. of which about 16.5 sq. km. is under water and the remaining 80.5 sq. km. Almost 25 percent of the flood

plain has been built-up as indicated in the Zonal Development Plan (Zone O). Out of the remaining 75 percent of the flood plain area, some are developed/ to be developed by DDA as planned greens such as the Yamuna Biodiversity Park, Golden Jubilee Park. Major drains are draining into the River Yamuna and acts as a disposal grounds for sewer and other municipal waste. River Yamuna is highly stressed by the pollution loads it receives 84 percent of the total BOD load through major drains and rest through canals.

Air Pollution

Most of the pollution in Delhi comes from outside its geographic boundaries. The pollution from different sources like vehicles, industries, stubble burning etc. is trapped close to the ground becomes more and more polluted. This accumulation and trapping of pollutants affects not only Delhi, but the entire belt from Punjab to West Bengal in the east, which turns into an inverted "bowl" that collects pollutants. To reduce air pollution, Graded Response Action Plan (GRAP) along with Comprehensive Action Plan (CAP) and 41 directions issued by CPCB under Air Act-1981 are being implemented by the Civic Agencies, Transport Department., Urban Development Department, Traffic Police and Pollution Control Committee of Delhi.

Water Pollution

Water pollution contribution is due to the discharge of untreated industrial and municipal wastes in the drains and River Yamuna. The river is so contaminated that it is classified in the category E which makes its water non-suitable for utilization. The River water quality is degraded by high organic contents, excessive presence of pathogens, accumulation of pollutants in the catchment area, deforestation in the catchment area, reduction in the quantity of water and discharges from sewage treatment plants into the river.

Disaster Management

Delhi is extremely vulnerable to natural disaster like earthquakes and floods as well as human induced disasters such as bomb-blasts, acts of terrorism, fires, industrial and chemical hazards, floods, building collapses, road accidents, water logging, etc. The entire region of Delhi is in Seismic Zone IV, at high risk to earthquakes as gathered from the earthquake hazard map given in the Vulnerability Atlas of India 2001, and can face an earthquake of 5.5 to 6.7 on Richter scale (MSK intensity VIII).

Mainly following disaster events have been experienced in Delhi:

1. Earthquake
2. Floods and Urban flooding
3. Drought
4. Wind (Andhi, Heat wave (Loo), Tornado)
5. Fire
6. Construction of unsafe buildings loading to collapsing of buildings

Disaster management in NCT-Delhi is to concede disaster management strategy/plan under the guidelines of National/ State/District Disaster Management Authority. This includes pre-disaster preparedness, immediate relief arrangement in disaster affected area, and post-disaster relief and rehabilitation and restoration of basic facilities.

SUB-REGIONAL LAND USE

Conversion of Agricultural Land to Non-Agricultural Built up Use

During 1999-2012, built-up area has increased by 9.02 percent (13,374.08 ha.) from 47.31 percent to 56.33 percent of the total land area of NCT Delhi, through conversion of agricultural land, waste lands, forest cover and water bodies. 52.69 percent i.e.78,138.00 ha. of land area is still not built up yet which includes vast agricultural rural areas, forest areas, waste land, water bodies etc. Built up or urbanised area has increased from 17,287.45 ha which constituted 11.7 percent of NCT area in 1958-59 to 83,536 ha. in 2012 which now constitutes 56.33 percent of NCT area, a net increase of 44.7 percent.

Unplanned/haphazard Growth in Environmentally Sensitive Areas

Satellite imageries shows that environmentally fragile and sensitive areas such as Yamuna riverbed/ wetland, ridge areas, forest areas are being subjected to both authorised and unauthorised developments, which adversely affecting the landuse and eco-system of the area. Large-scale change of landuse for re-densification i.e. East Kidwai Nagar, Sarojini Nagar, R.K. Puram and Srinivaspuri; EIA & TIA contributing to environmental issues and traffic in surroundings.

Policies and Proposals:

Following five major land use zones have been identified for policies and proposals for each of the zones. Controlled Development/Regulated Zone. Agricultural (rural) zone within controlled/developed/regulated area, Green buffer, Natural Conservation Zone

Proposed development should not be permitted in the natural conservation zones, planned green areas, agriculture areas, ground water recharging areas and water bodies. Underused land recommended to be planned for redevelopment with higher density in order to make optimum use of land resource as per the prescribed norms. A dynamic city-level integrated transport-land use model for NCT Delhi needs to be prepared. There is a need to propose integrated redevelopment schemes of the influence area of MRTS stations be prepared based on TOD principles.

IMPLEMENTATION STRATEGIES, MANAGEMENT, STRUCTURE AND RESOURCE MOBILISATION

The strategies for the sub regional Plan-2021 are formulated to suit the implementation of different policies proposed in the Plan. It is important to have an efficient management system for speedy implementation of the Plan proposals and for proper monitoring of the projects. Accordingly, the role of each body has been defined at NCRPB level, State/NCR Cell level, besides at State Departments and Agencies level, and also at Central Ministries level. NCR Planning & Monitoring Cells were proposed to work under the administrative control of the respective State Govts. and are multi-disciplinary in nature and act as coordinating agencies for various sectoral programmes.

It is observed that financing of various projects is critical to the success of the Plan and it is noted that the funds for development activities in the NCR are available mainly for: NCRPB assisted

projects, for which the Board provides loan up to 75 percent of the cost of the project; State Government projects which are implemented by various development authorities, local bodies, housing boards, industrial development corporations, etc.; and projects funded by Central Ministries such as Railways, Communications and Information Technology, Shipping, Road Transport and Highways, etc.; and Private sector investment in infrastructure.

Public – Private Partnerships (PPPs) is the first step towards privatization pending legal reforms and institution of a regulatory framework. Institutional environment with multiplicity of agencies, lack of coordination, inadequate and ill-equipped manpower etc.; financial and fiscal environment with limited availability of funds, inappropriate lending policies, improper pricing policies etc.; and legal environment with obsolete codes, laws, bye-laws and regulations all tend to limit the potential of PPP.

There is no land use mentioned as “Agricultural land” in MPD-2021. Also most of the villages of Delhi have been urbanized and thus agriculture is not an occupation profoundly under execution.Thus, Chapters pertaining to Irrigation and Rural Development have not been incorporated in the SRP for NCT Delhi 2021.

The telecommunication facility being the local level facility like Solid Waste Management is to be undertaken by concerned local bodies, service providing agencies will follow the MPD-2021 /concerned ZDP/ concerned LOPs. Therefore, the Chapter Telecommunication is not included in this document.

CHAPTER 1. INTRODUCTION

1.1 National Capital Region

The National Capital Territory of Delhi, which recorded an extraordinary increase of population has also witnessed a phenomenal physical and economic growth. This has resulted in tremendous stress on the land use and infrastructure, proliferation of slums and unauthorized development, traffic congestion, deterioration of air and water quality. Present state of development has far exceeded the carrying capacity of the land and environmentally not sustainable having long term implication on the quality of life and livability. Need for planned development of Delhi in a regional context rather than as a standalone entity was felt since the time of preparation of the first master plan during the year 1961-62 which eventually led to enactment of NCRPB Act in the year 1985 and formulation of the Regional Plan for NCR. The National Capital Region includes NCT-Delhi, 14 districts of Haryana, 8 districts of Uttar Pradesh and 2 district of Rajasthan. Total area of the region is 55083 sq. km. The current administrative units and their land areas have been presented in Table 2.1.

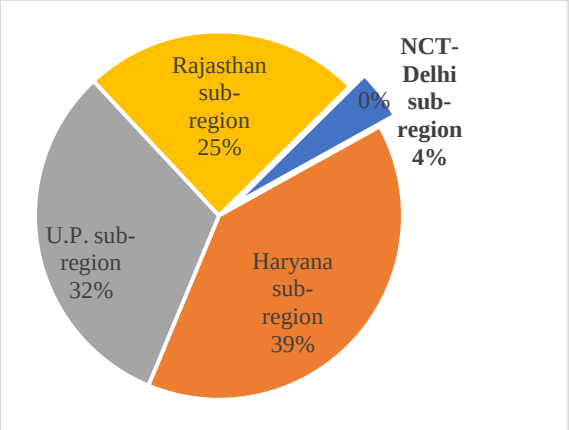
a) NCT of Delhi 1483 sq.km accounts for 2.7 percent of the total area of NCR.
b) Haryana Sub-region with an area of 25,327 sq.km accounts for 57.2 percent of the area of the State and 45.98 percent of the area of NCR comprising following fourteen districts: 1.Faridabad, 2.Gurgaon, 3.Rohtak, 4.Sonepat, 5.Rewari, 6.Jhajjar, 7.Mewat, 8.Palwal & 9.Panipat. 10. Bhiwani 11. Charkhi Dadri 12. Mahendragarh 13. Jind 14. Karnal
c) Rajasthan Sub Region (RSR) comprises of two districts Alwar, Bharatpur district which has an area of 13,447 sq.km. This accounts for 3.9 percent of the total area of the State and 24.5 percent of the area of NCR.
d) Uttar Pradesh Sub-region with an area of 14826 sq..km accounts for 6.15 percent of the area of the State and 26.9 percent of the area of NCR comprising the following eight districts: 1.Meerut, 2.Ghaziabad, 3.Gautam Budh Nagar, 4.Bulandshahr, 5.Baghpat & 6.Hapur. 7.Muzaffarnagar 8. Shamli

Table 1.1: Area, population of the sub regions of NCR and its percentage distribution

S. No.	Sub-regions	Area in Sq. Km.	Share of NCR area (in %)	Population in lakhs 2011)	Share of NCR population (in %)
1	Haryana	25327	45.98	164.3	28.25
2	U.P.	14826	26.91	187.1	32.17
3	Rajasthan	13447	24.41	62.2	10.7
4	NCT-Delhi	1,483	2.7	167.9	28.87
	NCR	**55083**	**100**	**581.5**	**100**

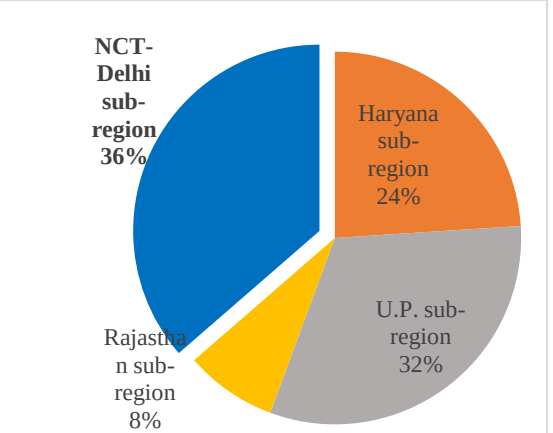
Source: Census of India 2011

Figure 1.1: Percentage Distribution of Constituent Areas of NCR, 2011



Source: Regional Plan for NCR 2021

Figure 1.2: Percentage Distribution of Population of NCR, 2011



Source: Census of India, 2011

Figure 1.3: NCR Map -2021

Source: Sub-Regional Plan for Rajasthan Sub-Region of NCR – 2021

1.2 NCRPB Act, 1985

In view of the unprecedented growth of population of Delhi and as envisaged in the MPD 1962 to plan Delhi in the regional context, the Parliament enacted the National Capital Region Planning Board Act in 1985 with the concurrence of the constituent States *"to provide for the constitution of a Planning Board for the preparation of a plan for the development of the National Capital Region and for coordinating and monitoring the implementation of such plan and for evolving harmonized policies for the control of land uses and development of infrastructure in the National Capital Region so as to avoid any haphazard development of Region and for matters connected therewith or incidental thereto."*

1.2.1 Provisions Related to Sub Regional Plan in the NCRPB Act, 1985

Section 17 of the Chapter V of The NCRPB Act, 1985 has the following provisions for the preparation of Sub-Regional Plan:

- Section17 (1): Each participating State shall prepare a Sub-Regional Plan for the sub-region within that State and the Union territory shall prepare a Sub-Regional Plan for the sub-region within the Union territory.

- Section 17 (2): Each Sub-Regional Plan shall be a written statement and shall be accompanied by such maps, diagrams, illustrations and descriptive matters as the participating State or the Union territory may deem appropriate for the purpose of explaining or illustrating the proposals contained in such Sub-Regional Plan and every such map, document, illustration and descriptive matter shall be deemed to be a part of the Sub-Regional Plan.

- Section 17 (3): A Sub-Regional Plan may indicate the following elements to elaborate the Regional Plan at the sub regional level, namely:

  a) Reservation of areas for specific land-uses which are of the regional or sub-regional importance;
  b) Future urban and major rural settlements indicating their area, projected population, predominant economic functions, approximate site and location;
  c) Road network up to the district roads and roads connecting major rural settlements;
  d) Proposals for the co-ordination of traffic and transportation, including terminal facilities;
  e) Priority areas at sub-regional level for which immediate plans are necessary;
  f) Proposals for the supply of drinking water and for drainage; and
  g) Any other matter which is necessary for the proper development of the sub-region.

1.3 Regional Plans

As per Section 7 of the NCRPB Act, 1985 the first Regional Plan-2001 was approved by the Board in November 1988 and notified on 23rd January, 1989 and the Regional Plan-2021, presently in force, was prepared and approved by the Board in the 28th meeting of the Board held on date 09.07.2005.

1.3.1 Regional Plan - 2001

The objective of the Regional Plan-2001 was ***to achieve a balanced and harmonious development of the region, leading to dispersal of economic activities and deflecting future in-***

migrants to Delhi, thereby leading to a manageable Delhi. Accordingly, the Regional Plan-2001, notified in January 1989, laid down the following development policies aimed at:

a) Relieving the capital city from additional pressures,
b) Avoid adding new pressures on the capital and
c) Remodel the pattern of settlements in the National Capital Region to enable them to play their assigned role.

In order to achieve these objectives, the Regional Plan proposed three policy zones namely NCT-Delhi, DMA and the Rest of NCR. The broad policy parameters for these zones are:

- NCT-Delhi to have restricted growth and decentralization of activities concentrated therein to the entire NCR.
- The DMA, (now CNCR) includes the controlled/development areas of the contiguous towns of Ghaziabad-Loni and NOIDA in Uttar Pradesh, Faridabad-Ballabhgarh complex, Gurgaon, Bahadurgarh and Kundli in Haryana.
- The Rest of NCR envisaged for induced development.

1.3.2 Regional Plan-2021

Actual population count and growth for 2011 indicate that the policy to contain the population of Delhi, and to harness the spread of the developmental impulse and agglomeration economies generated by Delhi for harmonized, balanced and environmentally sustainable spatio-economic development of the NCR with effective cooperation of the participating States have substantially been achieved. The broad objective of the Regional Plan-2021 "*for promoting growth and balanced development of the Region*" are to be achieved through:

i. Providing suitable economic base for future growth by identification and development of regional settlements capable of absorbing the economic development impulse of NCT-Delhi.

ii. To provide efficient and economic rail and road based transportation networks (including mass transport systems) well integrated with the land use patterns.

iii. To minimise the adverse environmental impact that may occur in the process of development of the National Capital Region.

iv. To develop selected urban settlements with urban infrastructural facilities such as transport, power, communication, drinking water, sewerage, drainage etc. comparable with NCT-Delhi.

v. To provide a rational land use pattern in order to protect and preserve good agricultural land and utilise unproductive land for urban uses.

vi. To promote sustainable development in the region to improve quality of life.

vii. To improve the efficiency of existing methods of resource mobilisation and adopt innovative methods of resource mobilisation and facilitate, attract and guide private investment in desired direction.

Keeping the above objectives in view, the Regional Plan-2021 has proposed the development of NCR through four policy zones namely- (i) NCT-Delhi, (ii) Central National Capital Region (CNCR), (iii) Highway Corridor Zone and (iv) Rest of NCR (Map 3.1 National Capital Region: Policy Zones) for which the following development policies have been envisaged.

The basic policy for NCT-Delhi (1,483 sq. kms) is to achieve ***"environmentally sustainable development/re-development, taking into account the limitation of developable land and water. No new major economic activities i.e., industries, wholesale trade and commerce, which may result in a large-scale job creation, both in formal as well as informal sectors, should be located in this zone. Only activities necessary to sustain the local population of NCT-Delhi should be permitted".*** In other words, the basic policy is to achieve environmentally sustainable development / re-development considering the limitations of land and water with significantly improved quality of infrastructure[1].

1.3.3 MPD 2021 - Frame Work for Sub- Regional development

As a follow up of the Regional Plan-2021 and in consonance with, under Section 17 of the NCRPB Act, 1985, a Sub-Regional Plan for Delhi is to be prepared by GNCT Delhi. It is suggested that a High-Level Group may be constituted by GNCT-Delhi to implement the policies of the Regional Plan and ensure timely preparation of the Sub-Regional Plan.

As already mentioned, Delhi has a limited area of 1483 sq. kms. Out of which about more than half of the area is already urbanized. For the remaining area, optimum utilization of land is required so that while providing for the urbanization requirements, the natural features like the ridge and other major green areas, defined water bodies and areas of ecological importance could be conserved.

With this background, followings have been suggested:

i. As per Regional Plan, no new Central Government and Public Sector Undertaking offices should be located in NCTD.
ii. Industrial growth in Delhi should be restricted to high-tech with emphasis on units, which require skill, less manpower and energy and do not create pollution / nuisance.
iii. Legal and fiscal measures should be adopted to restrict employment in industries and distributive trade.
iv. Major regional transport corridor and communication network needs to be strengthened to enhance economic development within the region and decentralization of the distributive trade.
v. The natural features such as Forest, Wild life Sanctuary, Ridge, River Yamuna and other water bodies should be conserved and kept free from unrestricted and unplanned urban development.

10. Vision of MPD 2021

Vision-2021 is to make Delhi a global metropolis and a world-class city, where all the people would be engaged in productive work with a better quality of life, living in a sustainable environment. This will, amongst other things, necessitate planning and action to meet the challenge of population growth and in-migration into Delhi; provision of adequate housing,

[1] *MPD-2021 modified up to 31/12/2018*

particularly for the weaker sections of the society; addressing the problems of small enterprises, particularly in the unorganized informal sector; dealing with the issue of slums, up-gradation of old and dilapidated areas of the city; provision of adequate infrastructure services; conservation of the environment; preservation of Delhi's heritage and blending it with the new and complex modern patterns of development; and doing all this within a framework of sustainable development, public private and community participation and a spirit of ownership and a sense of belonging among its citizens.

1.4 Vision of SRP 2021

Taking cognizance of the basic policies envisaged in Regional Plans of 2001 and 2021 the vision of Sub-Regional Plan 2021 for NCT Delhi aims at:

"*To make Delhi environmentally sustainable, liveable and inclusive city and to spread the development impetus of Delhi across the National Capital Region by improving linkages between the capital city and its region to achieve balanced development".*

1.5 Objectives

To fulfill the above vision, the SRP Delhi 2021 will have the following objectives:

1. To assess the existing scenario in order to suggest policies for dispersal of economic activities in line with Regional Plan-2021.
2. To study and evaluate the existing infrastructure gaps and suggest measures for improving the quality of life and better living environment while ensuring balanced development within the region.
3. To suggest policy framework for optimum utilization of land, natural resources and conservation of environmentally sensitive areas.
4. To evolve strategies for effective implementation of policies.

CHAPTER 2. PHYSICAL SETTING

2.1 Introduction

Delhi, the capital of Republic of India is an ancient and historic city which represents a perfect blend of traditional and modern architecture and culture. New Delhi is a reflection of modern India with the green Lutyens zone and diplomatic zones. Old Delhi gives an incredible picture of traditional and historical cultures of India. Through most of its history, Delhi has served as a capital of various kingdoms and empires. it has been captured, ransacked and rebuilt several times, particularly during the medieval period. Modern Delhi is a cluster of a number of cities spread across the Metropolitan Region. Over the years it has gained its functional significance not only as the administrative and judicial center of the country but also a place of commerce, education and health-care provision which transformed it as one of the most important fast-growing megacities of the country. Spread over an area of 1483 sq. kilometers, 216 meters above sea level, the city shares its boundary with two states – Haryana and Uttar Pradesh.

In 1992, Delhi was declared as a state under the National Capital Territory Act, 1991 resulting in a complex administrative structure with dual jurisdiction i.e. Union and State Government. Following the enactment of the National Capital Region Planning Board (NCRPB) Act in 1985 it has become the core constituent part of the National Capital Region (NCR) accounting for 2.7 percent of total area of the region.

The National Capital Territory of Delhi, which had recorded an extraordinary growth of population during 1941-1951, nearly doubling its population, continued to experience an average decadal growth rate of above 50 percent since 1951 except in the last decade (1991-2001) when it was about 47 percent. Growth rate has further decreased to about 21 percent during 2001-2011. Physical potential for further urbanization within the NCT is reducing although there is a virtual urban continuum between Delhi and the surrounding areas, which lie in the States of Uttar Pradesh and Haryana. With the imperatives of growth and development, the problems of Delhi have become complex, which have to be viewed both as a challenge in terms of the pressures of regular and floating population, as well as an opportunity in terms of planning and development in a regional context.

2.2 Location

NCT Delhi located in the north-central part of India and falls between 28°-24'-17" to 28°-53'-00" North Latitude and 76°-50'- 24" to 77°-20'- 37" East Longitude. NCT Delhi situated on the banks of Yamuna River and bounded by four districts (i.e. Sonepat, Jhajjar, Gurgaon and Faridabad) of Haryana from west and south-west edges and three districts (i.e. Baghpat, Gaziabad and Gautam Buddha Nagar) of Uttar Pradesh from north-east and east edges.

Figure 2.1: National Capital Region as per Regional Plan 2021

Source: (Draft Revised Regional Plan-2021 - National Capital Region)

2.3 Administrative setup.

The NCT Delhi is having duel jurisdiction i.e. Union and State Government. At the time of 1991 Census, Delhi was a single district territory. However, in 1996 the Government of NCT Delhi, through a gazette notification, created 09 districts and 27 sub-divisions and Population Census for the year 2001 was conducted for the same. Delhi was further divided into 11 districts in September-2012, however analysis has been done as per the Census 2011 information. NCT Delhi is comprised of nine districts, 27 sub-districts, 112 villages and 113 towns as per Census of India 2011.

Table 2.1: Districts and Sub- districts of NCT Delhi

S. No.	Districts	Area (In sq. km)	S. No.	Sub-districts	Area (In sq. km)
1	North West	443	1	Narela	263.74
			2	SaraswatiVihar	153.94
			3	Model Town	25.32
2	North	61	4	Civil Lines	53.13
			5	Sadar Bazar	3.39
			6	Kotwali	4.48
3	North East	62	7	SeelamPur	48.39
			8	Shahdara	5.41
			9	Seema Puri	8.2
4	East	63	10	Gandhi Nagar	4.43
			11	Vivek Vihar	21.88
			12	Preet Vihar	36.69
5	New Delhi	35	13	Connaught Place	7.64
			14	Chanakya Puri	19.65
			15	Parliament Street	7.71
6	Central	21	16	Darya Ganj	11.36
			17	Pahar Ganj	4.56
			18	Karol Bagh	5.08
7	West	130	19	Patel Nagar	46.93
			20	Rajouri Garden	10.43
			21	Punjabi Bagh	72.63
8	South West	421	22	Najafgarh	261.88
			23	Delhi Cantonment	67.57
			24	Vasant Vihar	91.55
9	South	247	25	Hauz Khas	150.15
			26	Defence Colony	36.77
			27	Kalkaji	60.08
	Total Area				1483

Source: Census of India 2011

Figure 2.2: Administrative Divisions of NCT of Delhi

Source: (Census of India 2011)

2.4 Regional Linkages

NCT Delhi embedded with strong connectivity via roadways, railways and airways to NCR and all the major cities and areas of the country, comprising of various Expressways, National Highways, State Highways, major district roads, other district road, Railway lines, Airports, etc.

2.4.1 Road

NCT Delhi is surrounded by Eastern Peripheral Expressway and Western Peripheral Expressway which creates the largest Ring Road around Delhi and strings Sonipat, Baghpat, Ghaziabad, Greater Noida, Faridabad, Kharkhoda, Bahadurgarh, Badli, Jhajjar, Manesar, Nuh, Sohna, Hathin, and Palwal. Delhi-Gurgaon Expressway connecting Delhi to Gurgaon and Delhi-Noida Direct Flyway (DND) connecting Delhi to Noida, are also functioning as regional connectivity. Yamuna Expressway connecting Greater Noida with Agra is another regional connectivity which is proposed to be linked to Eastern Peripheral Expressway via an interchange near Jaganpura-Afzalpur Village in Gautam Budh Nagar district. A new express way connecting Delhi to Meerut is under construction. It will enhance the regional connectivity.NCT Delhi is connected to various parts of country by five major National Highways i.e. NH-44 (Old NH-1) connects Sonipat, Panipat and further Panjab in the North, NH-44 (Old NH-2) connects to Faridabad, Palwal and further extended to Uttar Pradesh, Bihar, Jharkhand and West Bengal, NH-9 (Old NH-24) connects Ghaziabad and Lucknow Uttar Pradesh in the East, NH-48 (Old NH-8) connects Gurgaon, Rewari and further Mumbai via Jaipur in South-West and NH-9 (Old NH-10) connects Rohtak and further Punjab in North-West.

2.4.2 Railway

11. Indian Railways

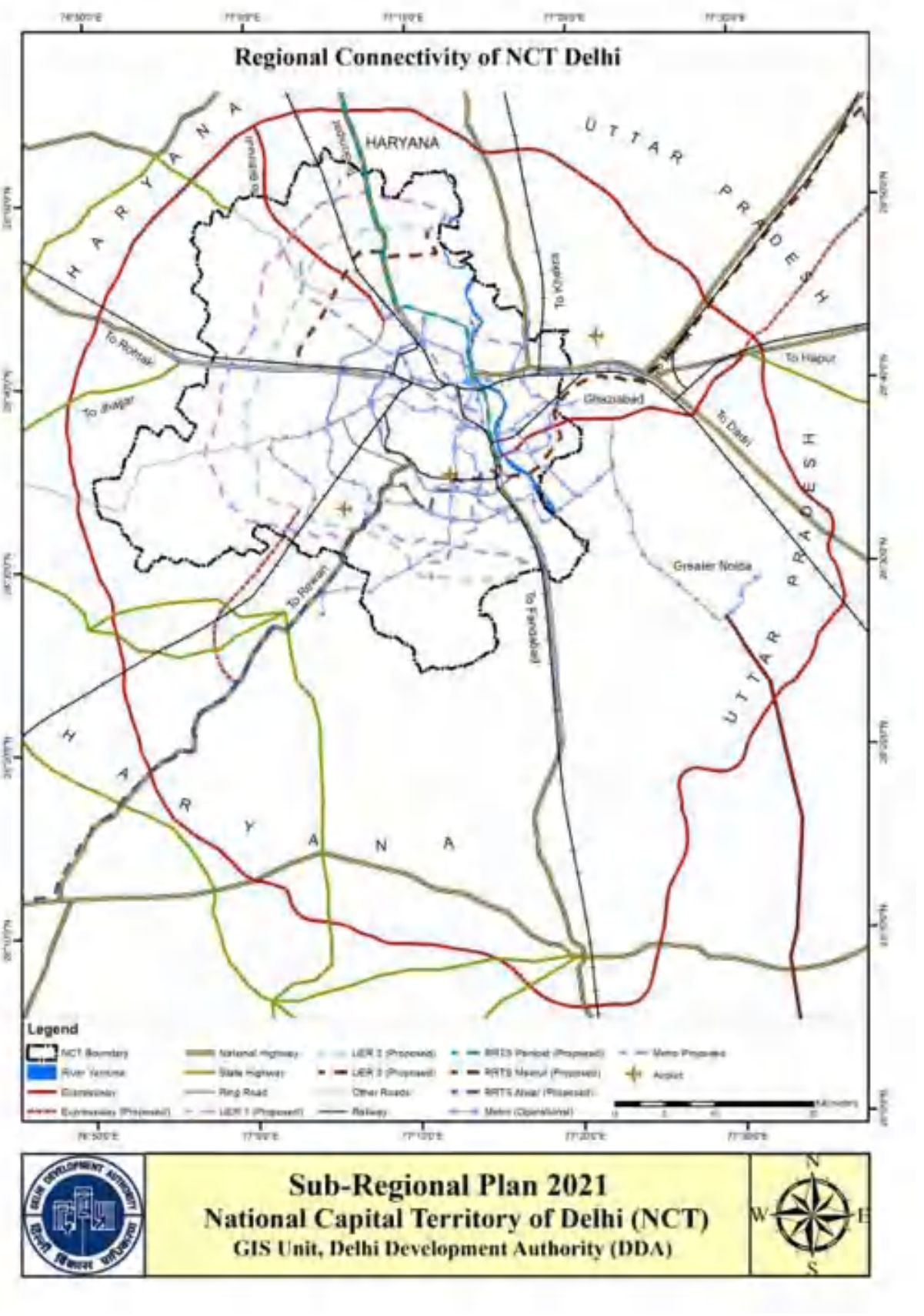
Delhi is the headquarter of the Northern Railways of Indian Railway and also a major railway junction having six major railway stations i.e. New Delhi, Old Delhi, Hazrat Nizamuddin, Anand Vihar, Delhi Sarai Rohilla and Delhi Cantt of NCT Delhi. The Rail network of NCT Delhi operates as a transit point for passengers and freight volumes moving between Punjab, Haryana, Himachal, J&K, Rajasthan on one side and rest of the country on the other. The following eight railway radials serves NCT-Delhi:

Table 2.2: Railway Network -NCT Delhi

S.no.	Regional Connectivity	To/From
i.	New Delhi – Faridabad – Palwal	Central & South India
ii.	New Delhi – Sonipat – Panipat	Northern States
iii.	New Delhi – Rohtak	Parts of Haryana & Punjab
iv.	New Delhi – Gurgaon – Rewari – Alwar	Western India
v.	New Delhi – Shahdara – Shamli	Western UP
vi.	Delhi – Ghaziabad – Khurja – Aligarh	Eastern India
vii.	Delhi – Ghaziabad – Hapur	UP and Uttaranchal
viii.	Delhi – Ghaziabad – Meerut	Western UP
ix.	Delhi – New Delhi – Nizamuddin – Patel Nagar – Delhi Kishanganj – New Delhi/DLI	
x.	Delhi – Shahdara/Sahibabad – Anand Vihar- New Delhi/Delhi	

Source: Functional Plan on Transport for National Capital Region-2032.

Figure 2.3:Regional Connectivity- NCT Delhi



Source: Functional Plan on Transport for National Capital Region-2032 n.d.

12. Metro connectivity

Delhi Metro is a rapid transit system serving Delhi and its satellite cities of Gurgaon, Noida, Faridabad, Ghaziabad, Bahadurgarh and Ballabhgarh in the National Capital Region of India. The network consists of nine lines, running 347.66 kilometers and serving 310 stations. The network developed was divided into four phases; Phase I containing three lines was completed by 2006, Phase II in 2011, Phase III is in the final stage and scheduled to be mostly completed by 2020 and Phase IV is expected to be completed by 2021.

Table 2.3: Delhi Metro lines providing regional connecting

S. No.	Delhi Metro Line Name	Metro Stations Origin /Destination	Connecting States
1	Red Line	Shaheed Sthal to Rithala	Ghaziabad, Uttar Pradesh
2	Yellow Line	HUDA City Centre to Samaypur Badli	Gurgaon, Haryana
3	Blue Line	Dwarka Sector 21 to Noida Electronic City	Noida, Uttar Pradesh
		Yamuna Bank to Vaishali	Ghaziabad, Uttar Pradesh
4	Violet Line	Kashmere Gate to Raja Nahar Singh	Ballabhgarh, Faridabad, Haryana
5	Green Line	Inderlok to Brigadier Hoshiyar Singh	Jhajjar, Haryana.
6	Pink Line	Shiv Vihar to Majlis Park	Loni, Uttar Pradesh
7	Magenta Line	Janakpuri West to Botanical Garden	Noida, Uttar Pradesh

Source: Delhi Metro Rail Corporation

13. Regional Rapid Transit System (RRTS)

The National Capital Region Planning Board (NCRPB), in order to enhance the connectivity within the NCR, has proposed to connect urban, industrial (SEZs/industrial parks), regional and sub-regional centers through a fast rail based Regional Rapid Transit System (RRTS). The NCRPB has decided to implement RRTS in the following three corridors on priority under First Phase:

- Delhi – Gurgaon – Rewari – Alwar: 164 Km.
- Delhi – Sonipat – Panipat: 103 Km
- Delhi – Ghaziabad – Meerut: 82 Km

Development and construction of Delhi-Gaziyabad-Meerut RRTS is under progress and it is likely to be operational by the year 2023.

2.4.3 Airway

NCT Delhi, equipped with Indira Gandhi International Airport (IGI Airport) located in south-west direction, is the most important airport not only in NCR but also in the country. In terms of traffic volumes, presently IGI Airport is the busiest airports in India and the seventh busiest airport in Asia. IGI Airport connects various parts of India by facilitating domestic flights and as well as international flights to outside India.

2.5 Physical Features

Although NCT Delhi comprises only 2.7 percent area of NCR, yet it is quite diverse in terms of its physiography and unique geomorphic features such as the river Yamuna, alluvial plains and the remnants of Aravalli range, popularly known as Delhi ridge.

Accordingly, NCT Delhi can be divided into three distinct physiographic parts - the Delhi ridge, the Yamuna flood plain and the plains. NCT- Delhi comprises of mostly alluvial plain land with a long rocky ridge extending roughly from north- east to south-west. Aravalli Hills enters the southern border and ends in the north of Delhi on the west bank of the Yamuna. The Ganga, Yamuna and the Hindon form the perennial drainage in the area. These rivers enter in NCR from the North and flow towards the South. The district falls in Yamuna sub-basin and forms a part of Ganga Yamuna Doab. The important tributary of Yamuna in NCR region is the Hindon, which rises from southern slopes of Shivalik in Saharanpur district of U.P. and ultimately meets the Yamuna downstream of Okhla in NCT- Delhi. The drainage in the southern and south-western part is mostly ephemeral. Physiographical, the area is flat as of the other areas of alluvial plain. Altitude ranges between 213 and 305 metres above sea level. The rest of the region is plain with a gentle slope of north-east to south and south-west. The main drainage channels of the area are Yamuna River which flows from North-West to South-East. The ridge constitutes the most dominating physiographic feature of this territory. It originating from the Aravalli Hills of Rajasthan and entering Delhi from the south, it extends in a north-eastern direction and encircles the city on the North-West and West. Whereas, the Yamuna Flood Plains is low- laying and sandy and subject to recurrent floods. This area is also called “Khadar”. During the rainy season the flood water inundates this region. The general slope of the land in NCT Delhi is from north to south.

Delhi comprises Alwar series of rocks. Lithologically, lenticular beds of sand in numbers one or more, with comparatively thick clay horizons intervening at different levels are encountered sub-surface during drilling. They are seen outcropping in the southern and south-eastern part of the city. The rest of the area is covered by Alluvium of variable thickness and composed of clays, silts, sands and subordinate gravels; pebbles inter bedded. The quartzite is hard, compact, massive and jointed outcrops with steep easterly or south-westerly dips.

The Yamuna Flood Plains is somewhat low- laying and sandy and is subject to recurrent floods. The mixture of sand and clay in equal proportions forms a good agriculture soil. During the rainy season; the flood water inundates this region. After the flood subsides, the moisture in the soil last for quite some time making the land more fertile. The relief and soil conditions cause restrict stagnation during rainy season. The tract lying to the north of the ridge and west of the grand trunk road which separates it from the Khadar is level Plain and is called “Bangar”. The rain water in bangar is drained by Najafgarh drain. The southern portion of land near Mehrauli and Tughlaqabad is known as “Kohi” (hilly). Leaving aside the Yamuna flood plains (khaddar) and the Ridge, the entire area of the NCT of Delhi is categorized as “Banagar” or the plains. A major portion of the area of NCT of Delhi is plain and on this, Delhi, New Delhi and Delhi Cantonment along with a vast stretch of numerous villages are located. The land of the plains is mostly fertile.

The soils of NCT of Delhi are generally of medium fertility. The soil formation is influenced by river Yamuna, the ridge and the south-westerly winds. The clay content generally varies from place to place and salinity is a great problem in the soil of the territory. The structure is mainly grained or weakly developed granular. They are sandy loam in texture and they become slightly

heavier with depth. The southern part of Delhi is formed of quartzite or sandstone and the alluvium brought by small streams.

2.6 Climate

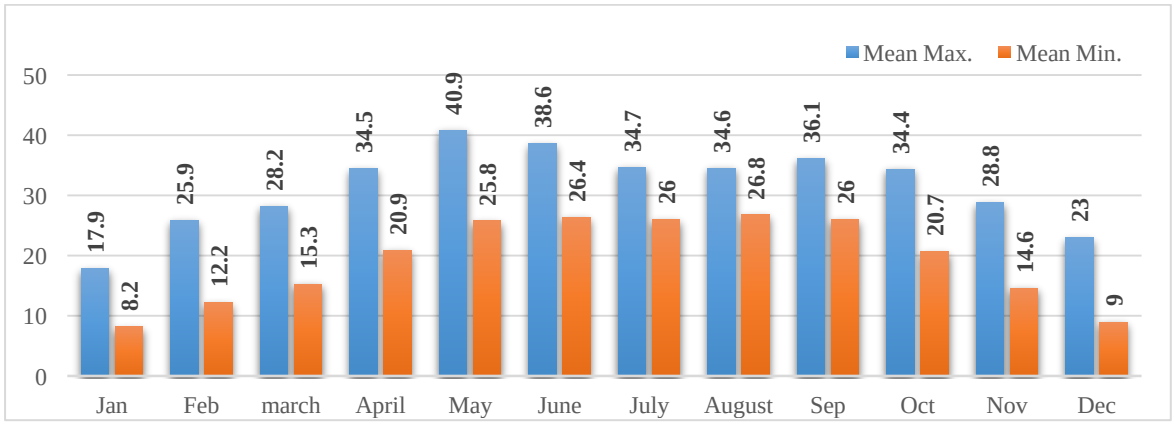
The climate of the NCT of Delhi is influenced by its island position with the desert of Rajasthan in the west and the Gangetic plains of Uttar Pradesh. The geography of the region plays pivotal role in shaping up the city's climate. Both summer and winter are severe. Only during the three monsoon months of July, August and September does the air of oceanic origin penetrate to this region and causes increased humidity, cloudiness and rain. The city is characterized by semi-arid climate with stark contrast in day and night temperatures, high saturation deficit and low to moderate rainfall. Delhi has three distinct seasons – summer, monsoons and winter with extreme temperatures and concentrated precipitation.

2.6.1 Temperature

Winter starts in November and peaks in January, with average temperatures around 6–7 °C. The summers start from the month of April and continue until the month of July. In summer, the heat wave is immense and the minimum and maximum temperature variation is 27°C -45 °C. Storms are common during summer in May and June when day temperature exceeds 40 °C.

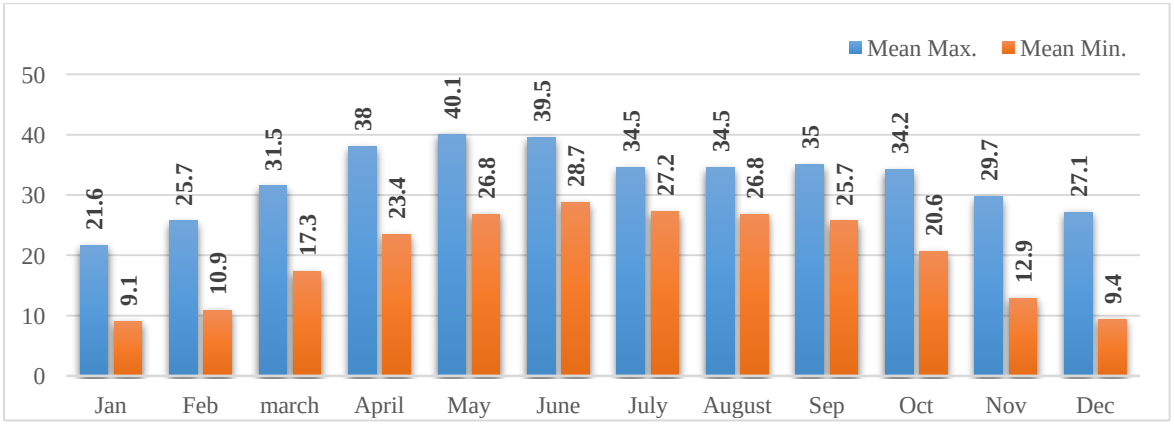
The climate of Delhi is extreme in both summer and winter with temperature variation from 44.2 °C to 27.6 °C and 22.2 °C to 3.5 °C respectively, whereas lowest and highest temperatures ever recorded is −2.2 and 48.4 °C (28.0 and 119.1 °F), respectively. The annual mean temperature is 25 °C (77 °F); monthly mean temperatures range from 13 to 32 °C (55°F to 90 °F).

Figure 2.4: Max. & Min. temperature, (2015)



Source: Indian Meteorological Department

Figure 2.5: Max. & Min. temperature (2016)



Source: Indian Meteorological Department

As per Figure 2.4 & Figure 2.5, in the month of May 2015, the average mean max temperature recorded was 40.9°C and average mean minimum in the month of January was recorded was 8.2°C. whereas in the month of May 2016, the average mean max temperature recorded was 40.1°C and average mean minimum in the month of January was recorded was 9.1°C.

2.6.2 Rainfall

The area receives average annual rainfall of about 611.8 mm. Rainfall is caused by depressions/cyclonic storms and low-pressure systems that form in the Bay of Bengal and Arabian Sea during monsoon season and travels over NCR area and yield very heavy rainfall over these areas resulting in flooding in Yamuna basin. The rainfall increases from west to east. About 80 percent of the annual rainfall is received during the monsoon months July, August and September. The monsoon starts in late June and lasts until mid-September, with about 292.5 mm1 of rain recorded in July 2016. It continues until the month of October. The rainfall pattern reveals that it remains maximum during the months of July and August. The mean annual rainfall data is 714 mm. About 87 percent of the annual rainfall is received during the monsoon months June to September. On an average, rain of 2.5 mm or more falls on 27 days in a year. Of these, 21.4 days are during monsoon months

Figure 2.6: Average Rainfall (in mm) in 2015

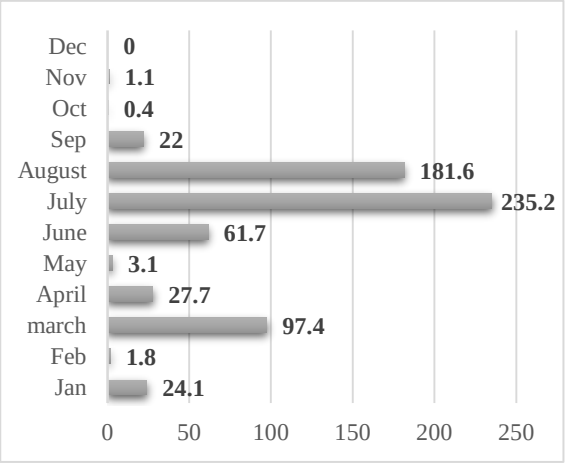
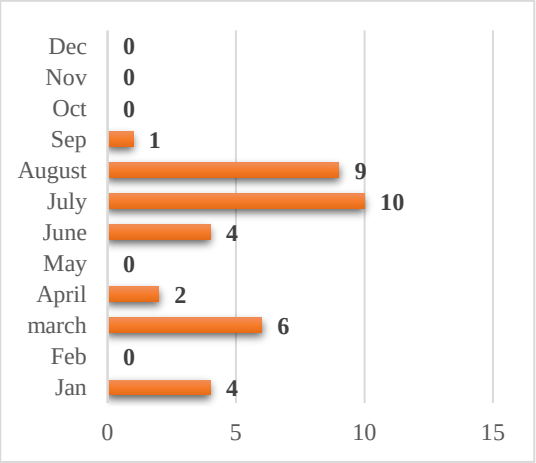


Figure 2.7: Number of Rainy Days (2015)



Source: Indian Meteorological Department

Figure 2.8: Average Rainfall (in mm) in 2016

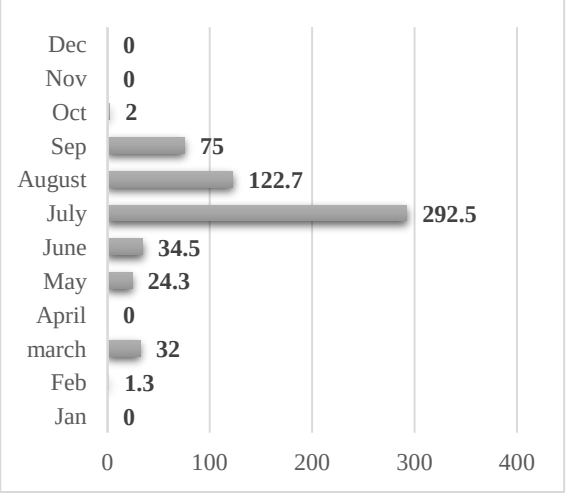
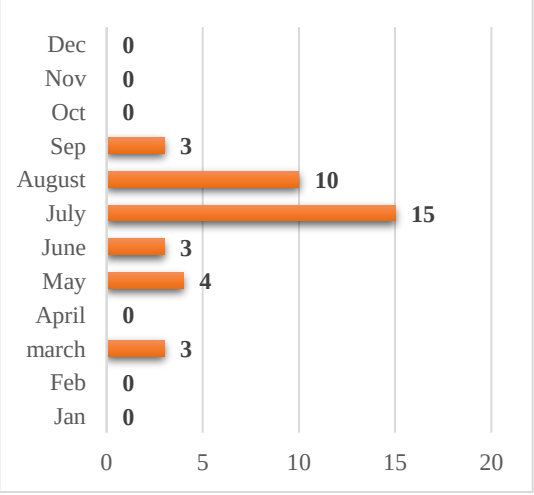


Figure 2.9: Number of Rainy Days (2016)



Source: Indian Meteorological Department

2.6.3 Humidity

Relative humidity varies from 33 percent to 73 percent in Delhi and observed minimum in dry weather months and maximum during monsoon months.

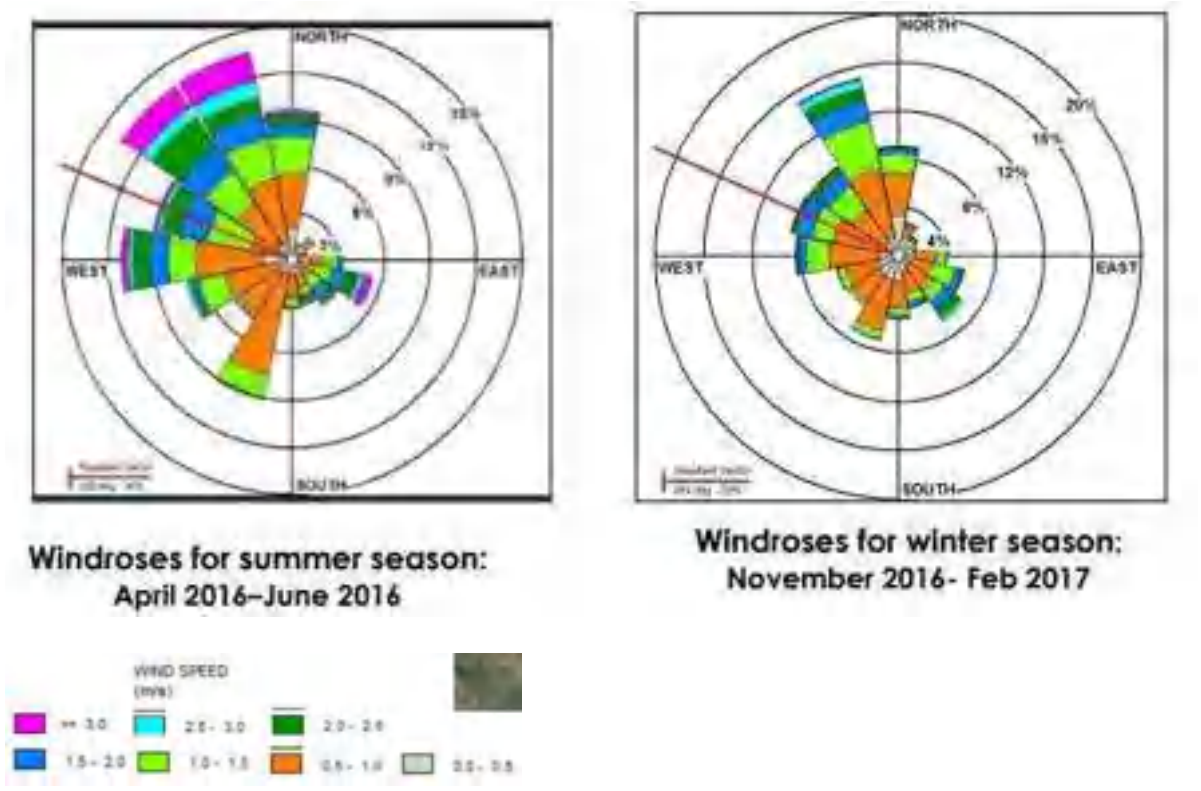
2.6.4 Wind Direction

Winds are generally light during the post-monsoon and winter months and are stronger during the summer. Except during the monsoon months, winds predominantly take the Westerly or North-Westerly direction and tend to be more northerly in the afternoons. Easterly and South-Easterly winds are more common in the monsoon months.

Western disturbances are shallow but extensive low-pressure systems and travel across the northern India from west to east. On an average, six western disturbances pass through the Northern region of the country each month during winter season, but all are not active. These disturbances have higher frequency in January and February over Haryana, Punjab, Himachal Pradesh & Western U.P. Hills and results in rainfall in plains and snowfall in higher reaches of hilly regions.

Dust storms during the period March to June is moderately strong westerly dry land winds prevail Thunderstorms and dust-storms increase in frequency with the progress of the season in West Uttar Pradesh and in the Kumaon Hills. The atmosphere becomes hazy. Occasionally in May and June, after extensive dust-storms in the west, the air over East and North Punjab and in Uttar Pradesh becomes charged with fine dust which reduces visibility considerably; this dust-haze often extends to heights over three km. Rainfall is rare in the plains in April and May. This is the season of dust storms and thunderstorms; earlier in the season there is little rain; but the associated rainfall increases as the season advances.

Figure 2.10: Wind Rose diagrams for summers and winters



Source: Automotive research Association of India, TERI, 2010

CHAPTER 3. DEMOGRAPHIC PROFILE AND SETTLEMENT PATTERN

3.1 Background

According to the Census of India 2011, population of NCT Delhi was 167,87,941 persons against the NCR's population of 581.5 lakh persons and had the second largest share of (28.87 percent) preceded by Uttar Pradesh sub-region (32.17 percent). Haryana sub-region (28.25 percent) and Rajasthan sub-region has the lowest share of (10.71 percent) of population in NCR region. NCT Delhi's share of population have decreased from 31 percent in 1981 to 28.87 percent in 2011.

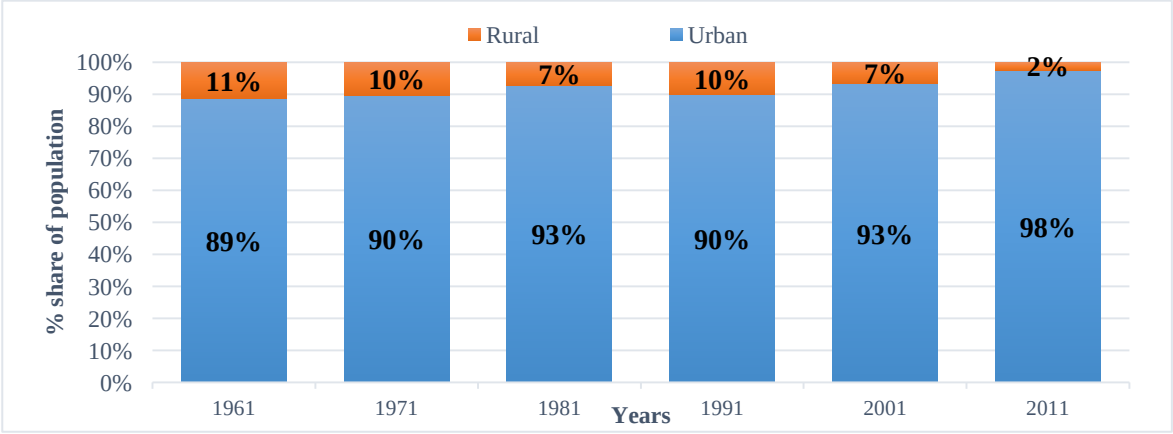
The NCR observed higher population growth rate of 24.2 percent than the national average growth rate of 17.64 percent during 2001-2011. Similarly, the share of urban population of NCR has increased from 45.9 percent in 1981 to 62.6 percent in 2011 which is also higher than the national average of 32 percent. The share of rural population has decreased from 54.1 percent in 1981 to 37.4 percent in 2011. Thus, NCR is becoming one of the fastest urbanizing regions of the country.

3.2 Demographic Profile

3.2.1 Population Distribution

NCT-Delhi is highly urbanized with 98 percent of its population living in urban areas as against the national average of 32 percent. The rural population of NCT Delhi has declined by 55.6 percent from 9.5 Lakh in 2001 to 4.20 lakhs in 2011, as most of NCT Delhi area has now been earmarked as urbanisable area as per Master Plan for Delhi-2021. This has resulted in drastic reduction of rural population from 11 percent in 1991 to only two percent in 2011 and correspondingly increase of urban population. It is anticipated that entire NCT Delhi will be urban after all the existing villages are declared as urban villages under the land pooling scheme in the proposed urbanisable areas as per Master Plan Delhi–2021 (Figure 3.1).

Figure 3.1: Trend of Urban and Rural Population share (1961-2011)



Source: Census of India 1961-2011

Table 3.1: District-wise distribution of Urban and Rural Population in NCT Delhi (2011)

S. No.	Districts	Total	Percentage of Urban Population	Percentage of Rural Population
1	**North West**	36,56,539	94.10	5.90
2	**North**	8,87,978	98.00	2.00
3	**North East**	22,41,624	99.00	1.00

S. No.	Districts	Total	Percentage of Urban Population	Percentage of Rural Population
4	**East**	17,09,346	99.80	0.20
5	**New Delhi**	1,42,004	100.00	0.00
6	**Central**	5,82,320	100.00	0.00
7	**West**	25,43,243	99.70	0.30
8	**South West**	22,92,958	93.70	6.30
9	**South**	27,31,929	99.60	0.40
	NCT Delhi	**1,67,87,941**	**97.50**	**2.50**

Source: Census of India 2011

North West district has the highest (51 percent) share of rural population followed by 34 percent population in South west district and the rest 15 percent rural population is distributed in other districts. New Delhi and Central districts have no rural population with 100 percent urban. The table below shows the district wise share of urban and rural population.

Table 3.2: District wise concentration of Urban and Rural Population in NCT Delhi 2011

S. No.	Districts	Total		Urban		Rural	
		Population	% share	Population	% share	Population	% share
1	**North West**	36,56,539	21.78	34,42,589	21.03	2,13,950	51.06
2	**North**	8,87,978	5.29	8,70,232	5.32	17,746	4.23
3	**North East**	22,41,624	13.35	22,20,097	13.56	21,527	5.14
4	**East**	17,09,346	10.18	17,05,816	10.42	3,530	0.84
5	**New Delhi**	1,42,004	0.85	1,42,004	0.87	-	0
6	**Central**	5,82,320	3.47	5,82,320	3.56	-	0
7	**West**	25,43,243	15.15	25,36,823	15.5	6,420	1.53
8	**South West**	22,92,958	13.66	21,49,282	13.13	1,43,676	34.29
9	**South**	27,31,929	16.27	27,19,736	16.62	12,193	2.91
	NCT Delhi	1,67,87,941	100.00	1,63,68,899	100.00	4,19,042	100.00

Source: Census of India 2011

3.2.2 Population Growth

According to the Census of India 2011, Delhi's population was 167.88 lakhs which was only 26.59 lakh in 1961. Thus, Delhi witnessed a phenomenal six times increase of population of 141.29 lakhs during the last 50 years and 29.37 lakhs during last 10 years (2001-11). Overall decadal growth rate of population of NCT Delhi during 2001-2011 was recorded at 21.2 percent, which has reduced substantially from 47 percent during 1991-2001 and 51 percent during 1981-

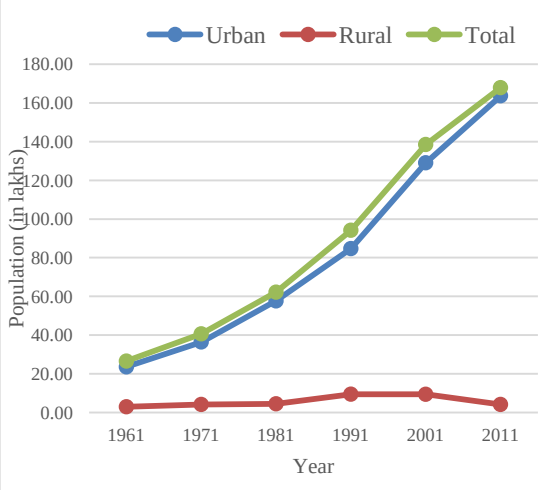
1991. During the same period decadal growth rate of urban population was 27 percent which has reduced from 52 percent in the previous decade whereas rural population has reduced by 55.6 percent during 2001-2011(Table 3.3, Figure 3.2 and Figure 3.3). In fact, the growth rate of population reduced in all the sub-regions during the last three decades. However, the growth rate of population in NCR has declined substantially from 37.6 percent in 1981-91 to 24.1 percent in 2001-11. The decreasing trend may be due to drastic reduction of natural growth rate and marginal decrease in migration over the years.

Table 3.3: Population and Growth Trend- NCT Delhi (1961-2011)

S. No.	Year	Population (in Lakhs)			Population Growth (in %)		
		Urban	Rural	Total	Urban	Rural	Total
1	**1961**	23.59	2.99	26.59	64	-2.5	52
2	**1971**	36.47	4.19	40.66	55	39.9	53
3	**1981**	57.68	4.52	62.20	58	8.0	53
4	**1991**	84.72	9.49	94.21	47	109.9	51
5	**2001**	129.06	9.45	138.51	52	-0.50	47
6	**2011**	163.69	4.19	167.88	27	-55.6	21

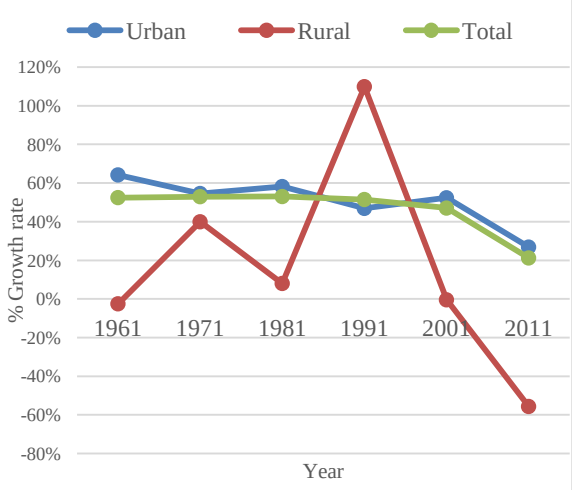
Source: (Census of India) 1961-2011

Figure 3.2: Population Trend- NCT Delhi (1961-2011)



Source: (Census of India) 1961-2011

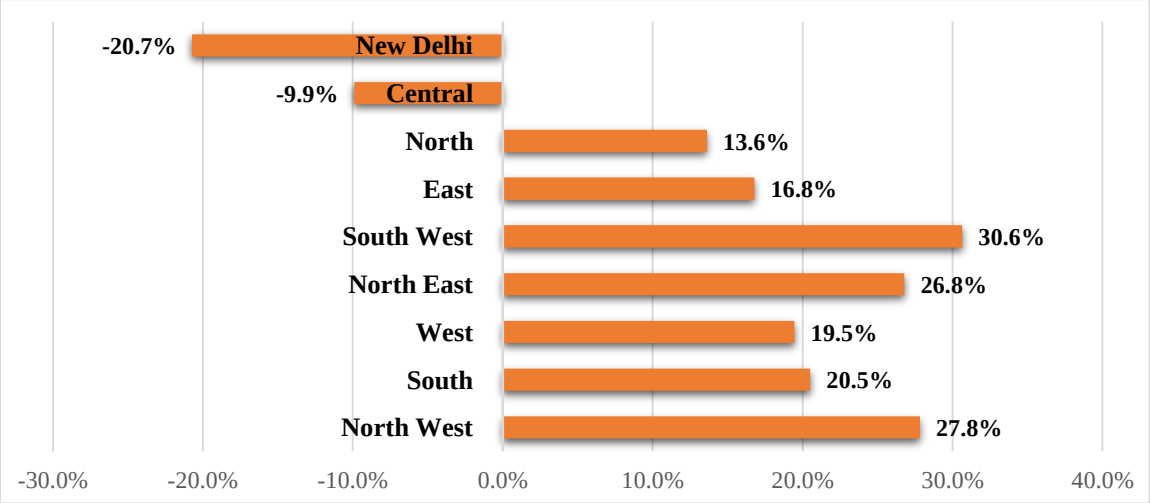
Figure 3.3: Population Growth Trend- NCT Delhi (1961-2011)



Source: (Census of India) 1961-2011

District wise growth of population reveals that Southwest, Northwest and Northeast districts witnessed high growth rate of 30.6 percent, 27.8 percent and 26.8 percent respectively followed by other four districts. The New Delhi and Central districts registered negative growth rate of -20.70 percent and -9.9 percent which may be due to the fact that migrant population is concentrated in the peripheral districts of Southwest, Northwest and Northeast rather than in the Central and New Delhi districts which attract less migration due to high cost of living being fully developed with better infrastructure (Figure 3.4).

Figure 3.4: District wise decadal growth rate of Population in NCT Delhi (2001-2011)



Source: Census of India (2001-2011)

3.2.3 Components of Population Growth

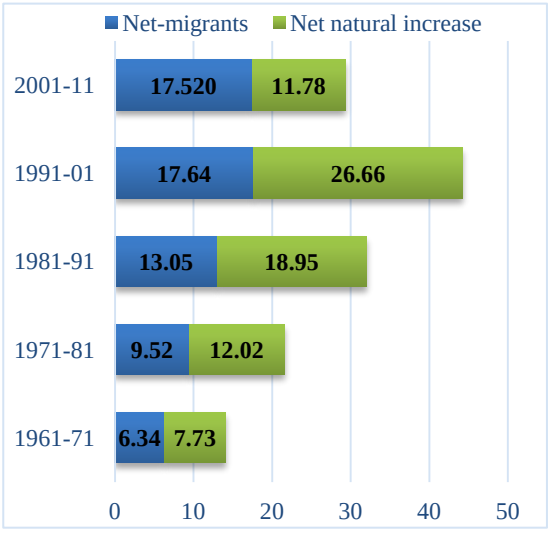
Natural growth and in-migration are the two main components of population growth. Analysis of migration data as published by Census of India shows that NCT Delhi received 25.21 lakhs in-migrants during the last 10 years (2001-11) and 7.69 lakhs people have out-migrated during the same period. Therefore, net migration to Delhi works out to be17.52 lakhs which accounts for 59.80 percent of the net population growth and the rest 40.20 percent is due to natural growth. As under Table 3.4, trend of migration pattern shows that net migration has steadily increased from 6.34 lakhs in 1971 to 17.64 lakhs in 2001. However, it marginally reduced to 17.52 lakhs in 2011 due to sudden increase of out-migration of 7.69 lakhs against 25.21 lakhs in-migration during 2001-11. It shows that the growth of net migration in Delhi has marginally reduced or stabilized during 2001-11. It still accounts for almost 60 percent of the net growth of population of Delhi. The considerable decrease of growth rate of population of Delhi from 47 percent during 1991-2001 to only 21.2 percent during 2001-2011 is mainly attributed to the drastic reduction of natural growth of population from 26.66 lakhs during 1991-2001 to 11.78 lakhs during 2001-2011 which works out to -55 percent reduction and accounts for 40.20 percent of the net population growth during 2001-2011 as against 60.20 percent during 1991-2001 (Table 3.4, Figure 3.5 and Figure 3.6).

Table 3.4: Trends of Population growth, Net-migration and Natural Growth in NCT during 1971-2011

S. No.	Year		1971	1981	1991	2001	2011
1	Population increase (in lakhs)		14.07	21.54	32.00	44.3	29.3
2	Migrants Component (in lakhs)	a) In-migrants	8.76	12.30	15.87	22.22	25.21
		b) Out-migrants	2.42	2.78	2.82	4.58	7.69
3	Net-migrants (a-b) (in lakhs)		6.34	9.52	13.05	17.64	17.52
4	Component of migrants in growth of population (in %)		45.10	44.20	40.80	39.80	59.80
5	Net natural increase (in lakhs)		7.73	12.02	18.95	26.66	11.78
6	Component of natural increase in growth of population (in %)		54.90	55.80	59.20	60.20	40.20

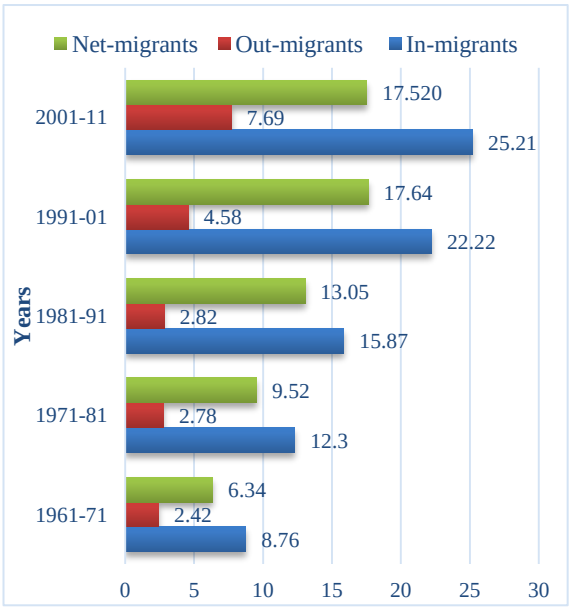
Source: Census of India 2011 & Regional Plan for NCR 2021

Figure 3.5:Trend of Net-growth of Population, Net-migrants and Natural Increase of Population in NCT Delhi (1961-2011) (in Lakhs)



Source: Census of India 1971-2011

Figure 3.6:Trend of Population Migration in NCT Delhi (1961-2011) (in Lakhs)



Source: Census of India 2011

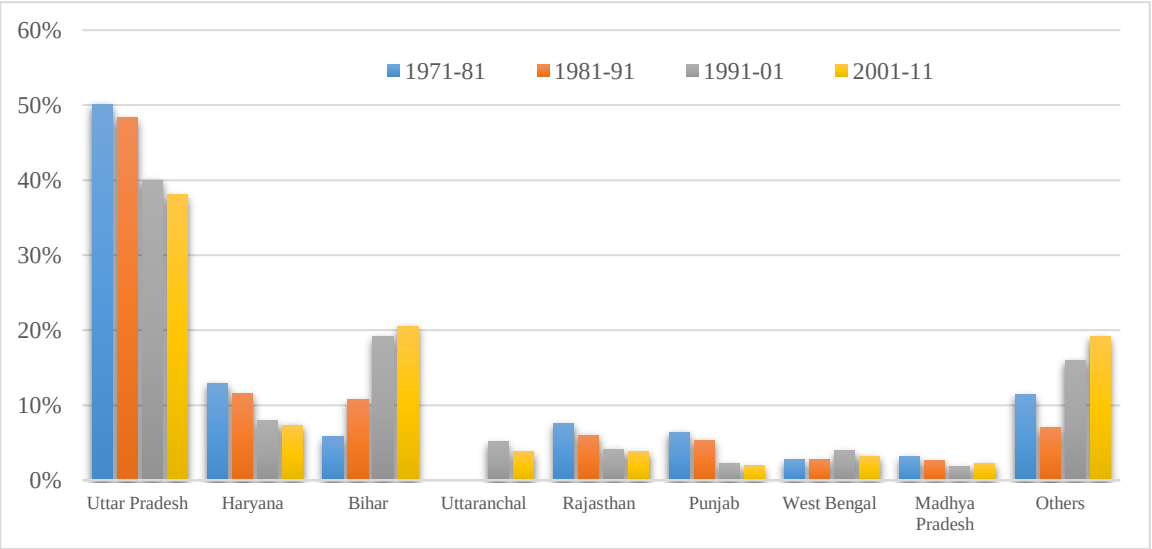
As per the migration data released by the Census 2011, out of the total 25.21 lakhs of migrants came to Delhi during the last 10 years, major share of migration of 9.59 lakhs (38 percent) and 5.16 lakhs (20 percent) are from the state of Uttar Pradesh and Bihar followed by Haryana (7 percent), Uttarakhand (4 percent), Rajasthan (4 percent) and West Bengal (3 percent). Rest 24 percent is from various other states. Although overall in-migration is steadily increasing, share of migration from Uttar Pradesh has declined from 50 percent in 1981 to 38 percent in 2011 and a considerable decline is observed since 1991 due to bifurcation of Uttarakhand from the state. However, share of migration from Bihar shot up from six percent in 1991 to 19 percent in 2011. (Table 3.5 and Figure 3.7)

Table 3.5: Trend of Migration from other states in NCT Delhi 1971-2011

S. No.	Place of last residence	1971-81		1981-91		1991-01		2001-11	
		Numbers	%	Numbers	%	Numbers	%	Numbers	%
1	Uttar Pradesh	6,16,021	50.1	7,65,151	48.3	8,89,857	40.0	9,59,658	37.8
2	Haryana	1,59,028	12.9	1,82,507	11.5	1,74,889	7.9	1,84,892	7.3
3	Bihar	70,904	5.8	1,69,445	10.7	4,24,093	19.1	5,16,632	20.4
4	Uttarakhand	-	-	-	-	1,13,519	5.1	96,244	3.8
5	Rajasthan	93,836	7.6	95,198	6.0	90,317	4.1	96,574	3.8
6	Punjab	78,671	6.4	83,684	5.3	47,984	2.2	48,742	1.9
7	West Bengal	33,154	2.7	43,096	2.7	86,249	3.9	79,681	3.1
8	Madhya Pradesh	37,709	3.1	41,815	2.6	40,442	1.8	56,527	2.2
9	Others	1,40,422	11.4	1,10,727	7.0	3,54,691	16.0	4,98,155	19.6
	Total	**12,29,745**	100.0	**15,85,770**	100.0	**22,22,041**	100.0	**25,37,105**	100.0

Source: Census of India 2011

Figure 3.7: Trend of In-migration from other states in NCT Delhi 1971-2011



Source: Census of India 2011

As per Census 2011, of the total 25.37 lakhs of in-migrants in NCT Delhi, 40.5 migrated with household and 28.1 percent migrated for seeking employment/work, 17.4 percent migrated due to marriage and the rest 14 percent migrated for various other reasons such as business, education etc. (Table 3.6 & Figure 3.8).

Overall trend shows that absolute number of migrants in search of employment / work has increased from 4.96 lakhs in1981 to 8.16 lakhs in 1991 but again it came down to 7.11 lakhs in 2011. Similarly, the share of migration for employment increased from 31.3 percent in 1981 to 37.6 percent in 1991 but it reduced to 28.1 percent in 2011. However, the people migrated to the city for business has drastically declined from 64,678 in 1981 to only 14,262 in 2011 and share of migration declined from 4.1 percent in 1981 to 0.6 percent in 2011 (Figure 3.9).

Overall analysis of trend shows that migration on account of employment and business is experiencing downward trend particularly post 1991 whereas people moving to the city with household is steadily increasing which comprises 40.5 percent of the total migration during 2001-11 (Table 3.6). This may be due to the fact that fresh migration in search of employment is gradually dipping but the older lone migrants who migrated to the city decades earlier are joined by their families. This is giving rise to mushrooming of informal settlements and unauthorized colonies particularly in the south and western part of Delhi.

Figure 3.8: Reasons for In -migration- 2011

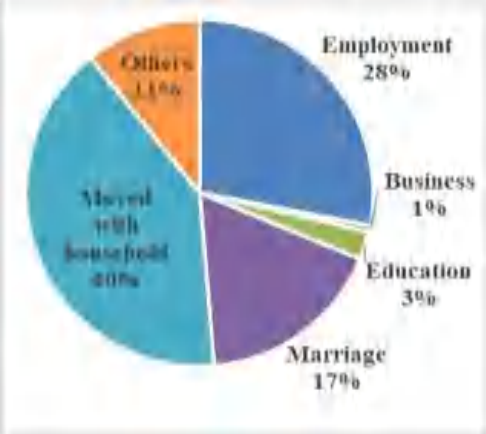
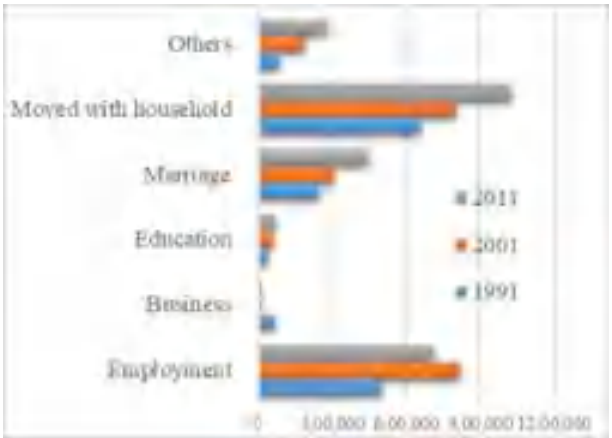


Figure 3.9: Trend of reasons of In-migration (1991-2011)



Source: Census of India 2011

Table 3.6: Trend of reasons of In-migration in NCT Delhi (1981-2011)

S. No.	Reasons of Migration	Migrants (1981- 1991)		Migrants (1991- 2001)		Migrants (2001- 2011)	
		No.	%age	No.	%age	No.	%age
1	Employment/ Work	4,96,731	31.3	8,16,174	37.6	7,11,990	28.1
2	Business	64,678	4.1	11,818	0.5	14,262	0.6
3	Education	36,192	2.3	58,146	2.7	66,844	2.6
4	Marriage	2,47,903	15.6	2,99,856	13.8	4,41,724	17.4
5	Moved with household	6,58,041	41.5	7,99,231	36.8	10,28,310	40.5
6	Others	83,947	5.3	1,87,535	8.6	2,73,975	10.8
	Total migrants	**15,87,492**	**100.0**	**21,72,760**	**100.0**	**25,37,105**	**100.0**

Source: Census of India 2011

In NCT Delhi, district wise distribution of migrants shows that 73 percent of migrants are concentrated in the south and western part of the Delhi. Northwest district has the highest share of 21.3 percent followed by Southwest district (20.1 percent), South district (19.2 percent) and West district (12.5 percent). Central and New Delhi districts have the lowest share of 1.4 percent, North district has four percent, East and Northeast districts have 10 percent each. Higher concentration of migrants in south and western part of NCT Delhi may be due to presence of large number informal settlements like unauthorized colonies which provide affordable housing facility for the migrants (Table 3.7).

Table 3.7: District wise distribution of migrants - 2011

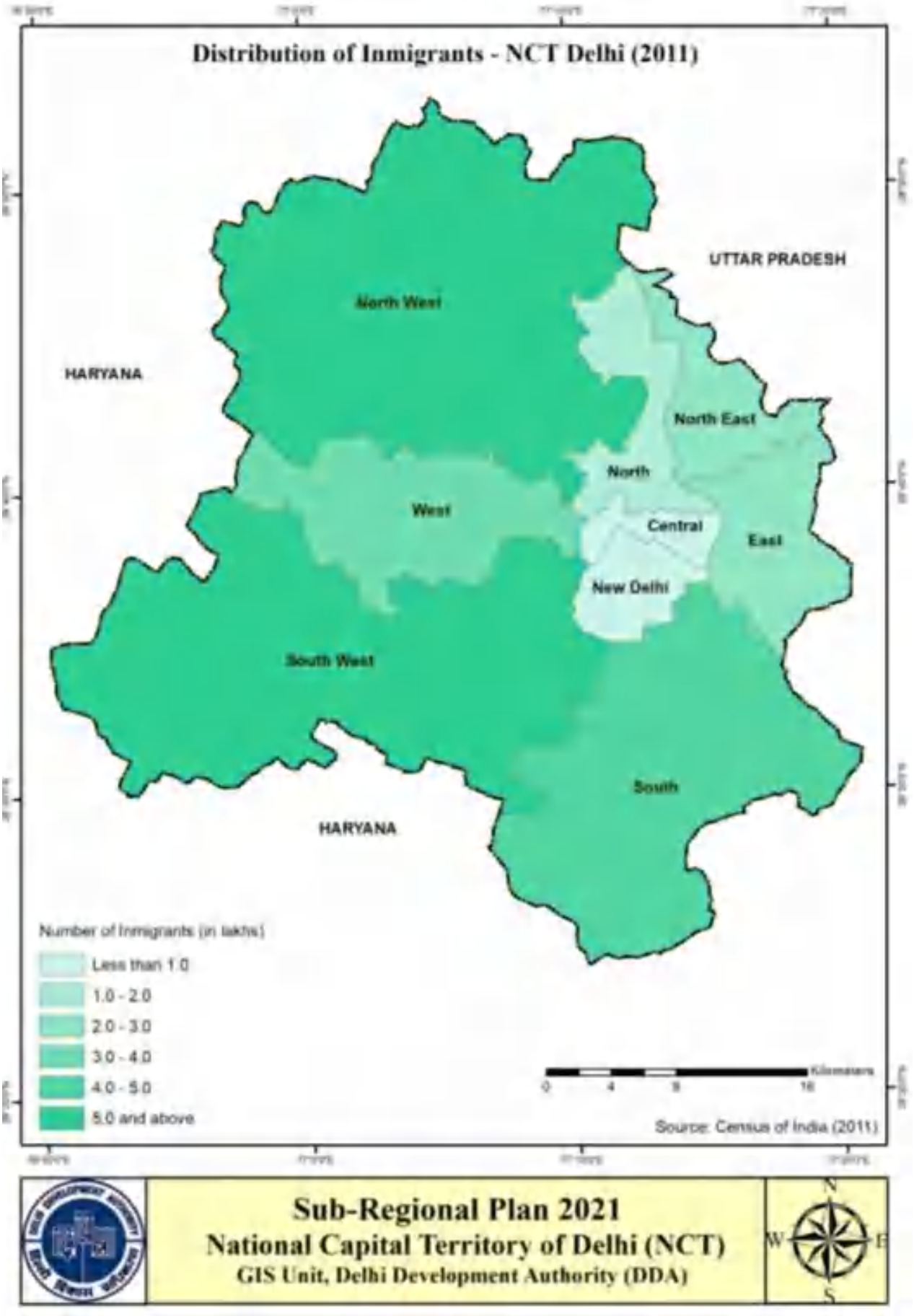
S. No.	Name	No. of Migrants 2011	District wise percentage share of Migrants
1	Central	35,519	1.4
2	New Delhi	35,519	1.4
3	North	1,01,484	4.0
4	North East	2,53,711	10.0

S. No.	Name	No. of Migrants 2011	District wise percentage share of Migrants
5	**East**	2,56,248	10.1
6	**West**	3,17,138	12.5
7	**South**	4,87,124	19.2
8	**South West**	5,09,958	20.1
9	**North West**	5,40,403	21.3
	NCT Delhi	**25,37,105**	**100**

Source: Census of India 2011

The increasing trend in migration is attributed to the fact that NCT Delhi has still been a more preferred destination for the migrants in search of livelihood owing to its relatively stronger economy in comparison to the rest of NCR. Nevertheless, contrary to the vision of NCRPB, Delhi continues to be the recipient of increasingly large government and private investments which result in largescale job creation having direct bearing on migration trend.

Figure 3.10: District wise in-migration in NCT Delhi 2011

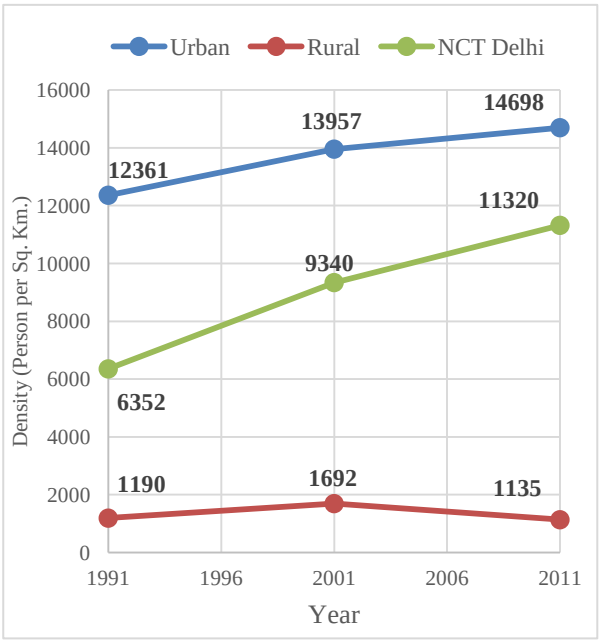


Source: Census of India 2011

3.2.4 Population Density

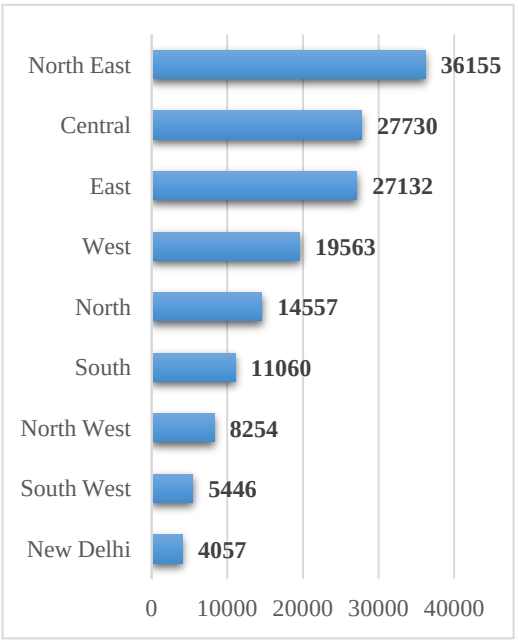
As per 2011 Census, the density of population in Delhi works out at 11,320 persons per sq. km. as against the national increase of 382 persons, which was the highest among all states and union territories during the year. Urban population density increased from 12,361 persons per sq. km. in 1991 to 14,698 persons per sq. km. in 2011. In rural area the population density decreased from 1,692 persons per sq. km. in 2001 to 1,135 persons per sq. km (Figure 3.11).

Figure 3.11: Population Density Trend 1961-2011 (Person per Sq. Km.)



Source: Census of India 2011

Figure 3.12: District wise Population Density (2011) (Persons per sq. km.)



Source: Census of India 2011

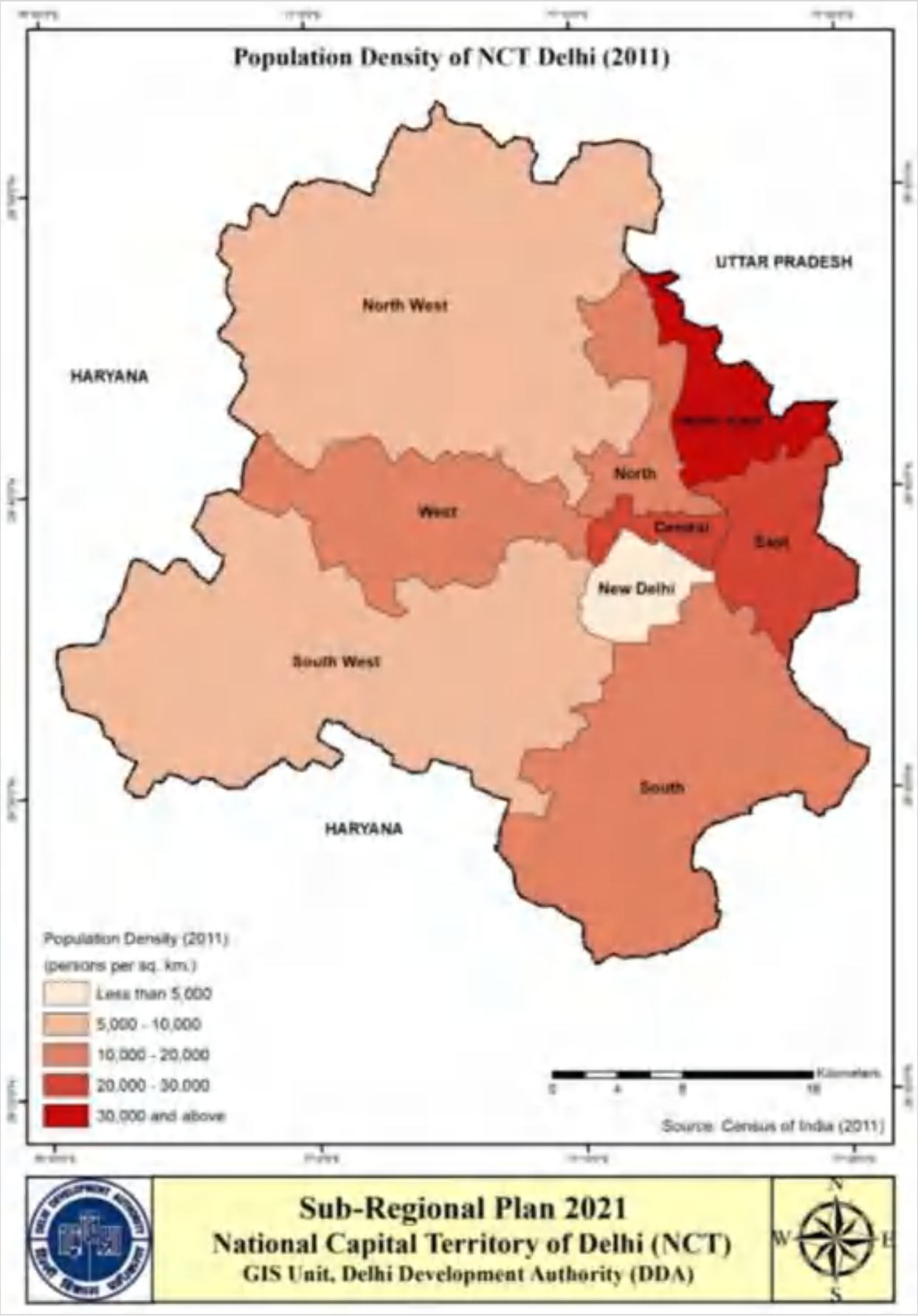
Among all the districts, the highest density of 36,155 persons per sq. km. is observed in North East district followed by Central district, East district, West district and the lowest density is observed in New Delhi and South west district. Figure 3.12 and Figure 3.13 shows the district wise density of population.

Table 3.8: District wise Population, Area and Population Density

S. No.	Districts	Population Density (in Person per sq. km.)		
		Total	Urban	Rural
1	North West	8,254	12,645	1,253
2	North	14,557	16,937	1,845
3	North East	36,155	46,867	1,471
4	East	27,132	27,193	13,074
5	New Delhi	4,057	4,057	-
6	Central	27,730	27,730	-
7	West	19,563	20,601	936
8	South West	5,446	8,040	935
9	South	11,060	11,630	927
	NCT Delhi	**11,320**	**14,693**	**1,136**

Source: Census 1991, 20001 and 2011

Figure 3.13: District-wise Population density (in Person per sq. km.) (2011)



Source: Census of India 2011

3.2.5 Literacy Rate

The literacy rate in the NCT Delhi sub-region as per 2011 Census is 86.2 percent against 79.2 percent for NCR and 74.0 percent for India. In 2001 the literacy rate of NCT Delhi was 81.67 percent in 2001. Which was much higher than the literacy rate of the NCR (74 percent) and also of India (64.8 percent) in 2001. Thus, NCT Delhi has higher literacy rate than the NCR and national average with 90.9 percent in males and 80.8 percent in females in 2011. Rural and urban literacy rates of NCT Delhi was 81.9 percent and 86.3 percent respectively in the same year. District wise literacy shows that except Northwest and Northeast districts all seven other districts have literacy rate higher than average literacy of the NCT Delhi highest being in East district and lowest is the North East district. Higher literacy in the NCT Delhi is mainly due to availability of education facilities at all levels throughout the state.

Table 3.9: District wise Literacy Rate in NCT Delhi (in percentage)

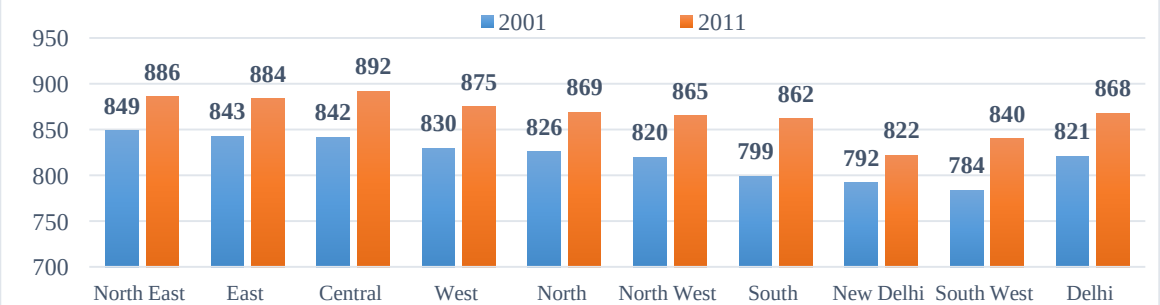
S. No.	District	Persons	Males	Females
1	**North West**	84.4	89.7	78.4
2	**North**	86.9	90.9	82.2
3	**North East**	83.1	88.8	76.7
4	**East**	89.3	93.1	85.0
5	**New Delhi**	88.3	92.2	83.6
6	**Central**	85.1	87.5	82.5
7	**West**	87.0	91.0	82.4
8	**South West**	88.3	93.1	82.5
9	**South**	86.6	91.7	80.6
10	**NCT of Delhi**	**86.2**	**90.9**	**80.8**

Source: Census of India 2011

3.2.6 Sex Ratio

According to the Census of India 2011, sex ratio in NCT Delhi is 868 females per 1000 males (2011), which is much below the national average figure of 940. The sex ratio of NCT Delhi increased from 821 in 2001 to 868 in 2011, Lower sex ratio in NCT Delhi may be linked to high level of migration of single male to the city in search of employment. District wise analysis shows that in 2011 New Delhi has the lowest sex ratio of 822 which was 792 in 2001 and the highest of 892 is in Central district which was 842 in 2001. In 2001 lowest sex ratio of 784 was in southwest district which increased to 840 in 2011. By and large sex ratio has improved in all the districts during 2001 and 2011which may be due to decline of migration for employment during 2001-11 and substantial increase of migration due to moving of household to Delhi since 2001. It may also be attributed to the banning of pre-natal sex determination and better control over female feticide cases. (Figure 3.14)

Figure 3.14: District wise Sex Ratio in NCT Delhi (females per 1000 males) (2001 & 2011)



Source: Census of India 2011

3.2.7 Age wise Population distribution

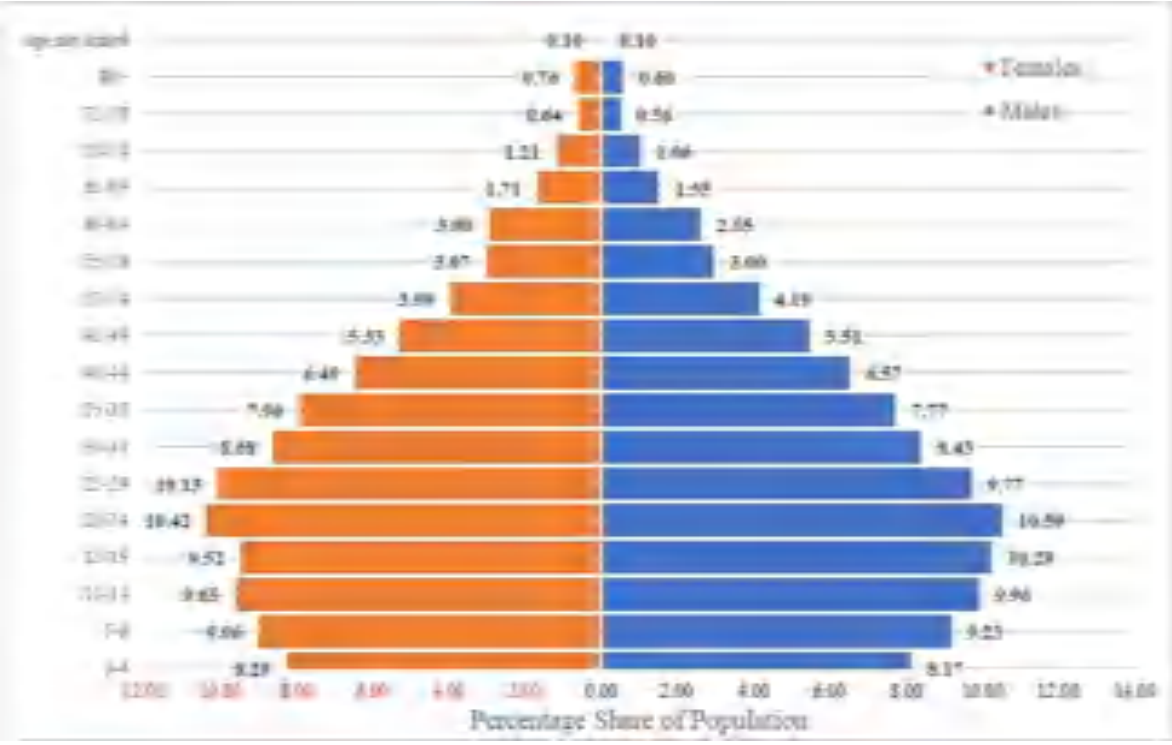
Trend of ageing population distribution of NCT Delhi shows that during 1991 34.8 percent of population was is the age group of 0.14 years which reduced to 32.4 percent in 2001 and 27.2 percent in 2011. This is mainly due to steady decline of birth rate in Delhi. At the same time the aged population of 40 years and above recorded an increase since 1991 to 2011. In rest of age groups not much change is witnessed. Table 3.10 shows age wise population distribution in NCT Delhi from the year 1991 to 2011.

Table 3.10: Age wise Population distribution In NCT Delhi (1991-2011)

S. No.	Age Group	1991		2001		2011	
		Number	%	Number	%	Number	%
1	**0-14**	32,73,482	34.8	44,92,939	32.4	45,65,319	27.2
2	**15-19**	9,14,871	9.7	14,27,979	10.3	16,67,375	9.9
3	**20-24**	9,82,866	10.4	14,26,860	10.3	17,64,060	10.5
4	**25-29**	9,56,788	10.2	13,58,925	9.8	16,68,326	9.9
5	**30-39**	14,38,035	15.3	22,11,006	16.0	27,53,943	16.4
6	**40-49**	8,67,731	9.2	14,32,467	10.3	20,08,410	12.0
7	**50-59**	5,04,149	5.4	7,59,505	5.5	11,96,361	7.1
8	**60 or more**	4,39,520	4.7	7,19,650	5.2	11,47,445	6.8
9	**Age not stated**	43,202	0.5	21,176	0.2	16,702	0.1
	Total	**94,20,644**	**100**	**1,38,50,507**	**100**	**1,67,87,941**	**100**

Source: Census of India 2011

Figure 3.15: Share of population by Age and Sex in NCT Delhi 2011



Children population of 0-14 age group comprising high share 27 percent, while teenage population of 15-19 years is 9.9 percent. The working age group of 20- 60 years have 55 percent share, while old age group from 60 years and above have only 6.9 percent share in total population (Figure 3.15).

3.2.8 Issues and Challenges

1. Share of population of NCT Delhi have increased from 31 percent in 1981 to 36 percent in 2011, while other sub regions of NCR i.e. Haryana, Rajasthan and U.P. observed decline in share of population in NCR. This trend is attributed to the fact that NCT Delhi has still been a more preferred destination for the migrants in search of livelihood owing to its relatively stronger economy in comparison to the rest of NCR. Nevertheless, contrary to the vision of NCRPB, Delhi continues to be the recipient of increasingly large government and private investments which result in largescale job creation having direct bearing on migration trend.

2. Growth rate of population reduced in all the sub-regions during the last three decades. However, the rate of growth of population in NCR has declined substantially from 37.6 percent in 1981-91 to 24.1 percent in 2001-11. Although growth rate is declining there is substantial increase in absolute numbers of population in all the sub-regions. During the last decade 2001-11 as much as 29 lakh persons were added in Delhi's population. The decreasing trend may be due to drastic reduction of natural growth rate and marginal decrease in migration over the years.

3. Drastic reduction of rural population from 11 percent in 1991 to only two percent in 2011 and Negative growth rate of 55 percent observed during 2001-11 (In absolute numbers 9.45 lakhs in 2001 to 4.19 lakhs in 2011). One of the reasons is that most of NCT Delhi area has now been earmarked as urbanisable area as per Master Plan for Delhi-2021. All the existing villages are declared as urban villages under the land pooling scheme in the proposed urbanisable areas as per Master Plan Delhi–2021

4. Trend of migration pattern shows that net migration has steadily increased from 6.34 lakhs in 1971 to 17.64 lakhs in 2001. However, it marginally reduced to 17.52 lakhs in 2011 due to sudden increase of out-migration of 7.69 lakhs against 25.21 lakhs in-migration during 2001-11.

5. Although overall in-migration is steadily increasing share of migration from Uttar Pradesh has declined from 50 percent in 1981 to 38 percent in 2011 and considerable decline observed since 1991 due to bifurcation of Uttarakhand from the state. However, share of migration from Bihar shot up from six percent in 1991 to 19 percent in 2011

6. District wise distribution of migrants shows that 73 percent of migrants are concentrated in the south and western part of the Delhi. Northwest district has the highest share of 21.3 percent followed by Southwest district (20.1 percent), South district (19.2 percent) and West district (12.5 percent). Central and New Delhi districts have the lowest share of 1.4 percent, North district has four percent, East and Northeast districts have 10 percent each. Higher concentration of migrants in south and western part of NCT Delhi may be due to presence of large number informal settlements like unauthorized colonies which provide affordable housing facility for the migrants.

7. Among all the districts, the highest density of 36,155 persons per sq. km. is observed in North East district followed by Central district, East district, West district and the lowest density is observed in New Delhi and South west district.

8. By and large sex ratio has improved in all the districts during 2001 and 2011which may be due to decline of migration for employment during 2001-11 and substantial increase of

migration due to moving of household to Delhi since 2001. It may also be attributed to the banning of pre-natal sex determination and better control over female feticide cases.

3.3 Settlement Pattern

3.3.1 Urban Settlement Pattern

As per Census 2011, urban population is 97 percent of total population and accommodating in 75 percent of the area under 113 towns of NCT Delhi. Out of 113 towns (3 Statutory and 110 Census Towns), 15 towns fall in Size Class I which include all the three Statutory Towns and 12 Census Towns. 21 Census Towns fall in Size Class II; 23 Census Towns fall in Size Class III. The maximum number of Census Towns, i.e., 33 falls in Size Class IV. In the remaining two Size Classes, viz., Class V and VI, the number of towns are 17 and four respectively.

Table 3.11:Urban Settlement by Population size and class in NCT Delhi

Sl. No.	Size Class of Town	Population Size	Number of Towns
1	Class I	100,000 and above	15
2	Class II	50,000 - 99,999	21
3	Class III	20,000 - 49,999	23
4	Class IV	10,000 - 19,999	33
5	Class V	5,000 - 9,999	17
6	Class VI	less than 5,000	4

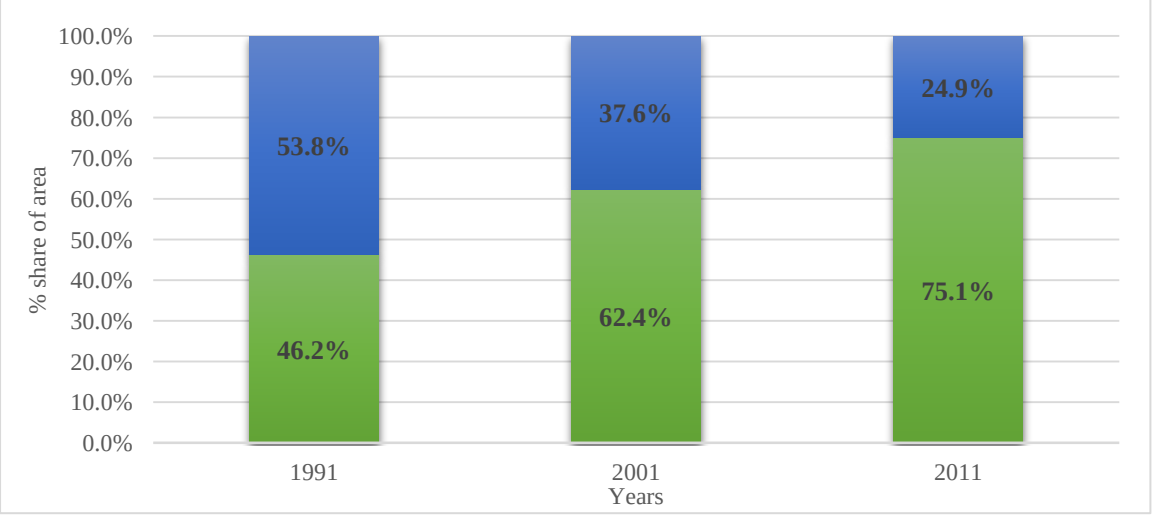
Source: Census of India 2011

There is only one Urban Agglomeration (UA) in Delhi which consists of three Statutory Towns and 107 Census Towns.

3.3.2 Rural Settlements

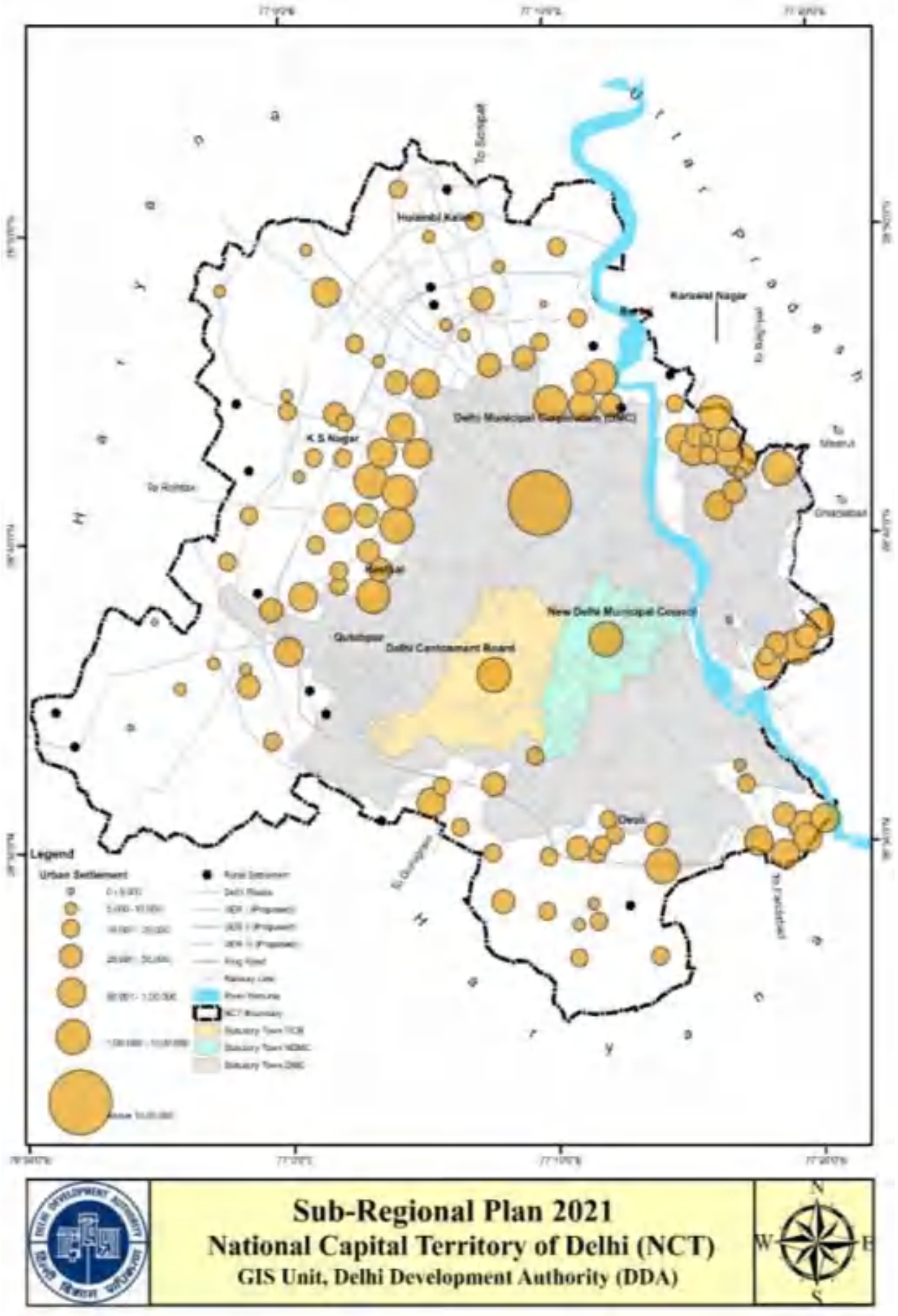
NCT Delhi observed reduction in its rural population and settlements. According to the Census of India, 54 percent area designated as rural area in 1991, which declined to 25 percent in 2011. Simultaneously, the number of villages were also reduced to 112 in 2011 from 300 in 1991.

Figure 3.16: Urban and Rural Area Trend in NCT 1991-2011



Source: Census of India, 1991, 2001 & 2011

Figure 3.17: Settlement Pattern in NCT Delhi (2011)



Source: Census of India 2011

3.3.3 Approach and Strategy for Settlement Planning

Strategies for the development of settlement system would be to harness the growth impulse of Delhi and to integrate the urban and rural settlements in the region. This could be attained by developing balanced settlement structure and mutually reinforcing system of urban and rural centers in NCR. Strategies to achieve these objectives would be as under:

- Development of a well-knit regional settlement system where Delhi and other towns in NCR would be allowed to grow as per their carrying capacity to harness the development potentials within the broad frame of Regional Plan.
- In order to make a significant impact of the large growing centre to act as catalyst for development in the National Capital Region. It is proposed to identify new Metro Centres/Regional Centres/other new townships for intensive development for attracting investment, generation of employment, creation of high-quality infrastructure, robust transport and communication linkages, development of high-quality residential areas, industrial and commercial complexes. The proposed new townships would be nodes along the key transport corridors, proposed expressways, orbital rail corridors and other suitable locations either on virgin land or as extension of existing settlement. New Towns will further ease out the pressure on NCT Delhi.
- Development of small and medium towns as Sub-regional centres or service centres. These towns would play an important role in supporting the socio-economic development in their surrounding areas by providing access to education and health facilities and agro-industries based on local resources.
- Rural development would be encouraged by providing facilities and services in appropriate hierarchy of service centres, which stimulate production and help in increasing the income of the population. This will facilitate diversifying the economy and to make villages attractive to live and work and help to check migration to urban centres.

3.4 Population Projection

3.4.1 Population Projection for NCT Delhi

As per Regional Plan for NCR 2021, the population projected for the year 2011 at NCR was 486.19 lakhs and for NCT Delhi it was 179.9 lakhs. As per the same report for the year 2021, NCR was projected with the population of 795.61 lakhs and NCT Delhi with 234.87 lakh for the year 2021 (Table 3.12). Based on this, the percentage share of NCT Delhi to the total NCR will decrease marginally from 37 percent in 2011 to 29.52 percent in the year 2021 (Table 3.12).

Table 3.12: Population Projected as per RP-2021

Year	NCR Population (in Lakhs)	NCT Delhi Population (in Lakhs)	Percentage of NCR Population
1981	**190.18**	**62.2**	**32.71**
1991	**264.46**	**94.2**	**35.62**
2001	**371.00**	**138.5**	**37.33**
2011(P)	**486.19**	**179.90**	**37.00**
2021(P)	**795.61**	**234.87**	**29.52**

Source: Regional Plan 2021 for NCRand Addendum to Regional Plan-2021 for NCR

As per Master Plan Delhi 2021, population projected was 182 lakhs for the year 2011 and 230 lakhs for the year 2021. However, reviewing the trends of population growth of NCT Delhi, a

comparative analysis of actual census population 2011 with the proposed population in the Regional Plan 2021 for the year 2011 indicates that only 93.34 percent in NCT Delhi and 94.71 percent in NCR, is achieved under actual Census population of 2011 (Table 3.13). As per Regional Plan 2021 (RP-2021) of NCR, the CNCR area which includes Bahadurgarh, Faridabad-Ballabgarh complex, Gurgaon-Manesar complex, Ghaziabad-Loni complex, NOIDA and Sonepat-Kundli complex, are contiguous to NCT Delhi. Table 3.13 shows that in the year 2011, Metro and Regional Centre's within CNCR area exceeded with 81 percent of proposed population as per RP-2021 as compare to actual population as per census of India 2011. Similarly, Metro and Regional Centre's of NCR outside CNCR area achieved only 82 percent of proposed population as compare to actual census population for the year 2011.

The difference between the proposed population of both NCR and NCT-Delhi vis-à-vis the actual Census population of 2011 is about 25.5 lakhs and 10 lakhs respectively. It may be attributed to the fact that NCT-Delhi grew at a slower rate than anticipated and other surrounding towns grew more than NCT Delhi.

Table 3.13: Actual & Proposed Population 2011 of NCT Delhi and NCR

S. No.	Discerption		NCT	NCR	Metro and regional center's within CNCR	Metro and regional center's outside CNCR
1	Actual Population as per Census of India (in Lakh)	2001	138.5	371.0	30.5	30.82
		2011	167.9	460.5	58.2	39.89
2	Proposed pop 2011 (R.P. 2021) (in Lakhs)		179.9	486.2	71.0	48.60
3	Actual census 2011 population as percentage of proposed population in the R.P- 2021(2011)		93.33%	94.71%	81.7%	82.1%

Source: Census of India 2011 and Regional Plan 2021of NCR

The NCR Planning board revised the population for NCR in the Regional Plan 2021 after the modification to the Regional Plan 2021 for NCR. The population for NCR is revised to 581.5 lakhs. The addendum to the Regional Plan for NCR 2021 states that

"Subsequent to the notification of RP-2021 on 17.09.2005, additional districts namely Bhiwani (including Charkhi Dadri) and Mahendragarh districts of the State of Haryana and Bharatpur district of the State of Rajasthan, were included to NCR vide Government of India, Gazette Notification dated 01.10.2013. Further, the districts of Jind & Karnal of the State of Haryana and Muzzaffarnagar district of the State of Uttar Pradesh were included in NCR vide GoI Gazette Notification dated 24.11.2015. The district of Shamli of the State of Uttar Pradesh was included in the NCR vide GoI Notification dated 16.04.2018. The total additional area of NCR is 20939 sq.kms".

CHAPTER 4. ECONOMIC SCENARIO

4.1 Introduction

Delhi is a prosperous state with the second highest per capita income in India. Delhi's per capita income is almost three times the national average. The average per capita income of Delhi remained more than three lakhs in two consecutive years i.e. 2017-18 & 2018-19. The per capita income at current prices reached Rs. 3,28,985 in 2017-18 as compared to Rs. 2,98,832 in 2016-17 and Rs. 2,73,301 in 2015-16. The advance estimate of per capita income of Delhi at current prices during 2018-19 is estimated at Rs. 3,65,529. Delhi's economy has a predominant service sector with its share of contribution to Delhi's Gross State Value Added (GSVA) and plays a pivotal role in the state economy, both in terms of employment generation and contribution to state income. More than 84 per cent of income in Delhi was from the service sector, 14 percent from the secondary sector and about two percent from the primary sector during the year 2018-19. The tertiary sector

In view of the constantly changing economic scenario of NCT of Delhi, it is imperative to analyses and assess the economic development trends, along with economic/fiscal policies and suggest future directions of growth.

4.2 Existing scenario

The Delhi Metro, Central NCR Metro extensions, Western Peripheral (KMP), Eastern Peripheral Expressways, Delhi-Mumbai Industrial Corridor (DMIC), Industrial Estates/Model Industrial Townships/SEZs and new towns etc., all the above have had a significant impact on the economy of NCT of Delhi. Tertiary sector in Delhi grew at a Compounded average growth rate (CAGR) (in Rs) of 14.34 percent from 2011-12 to 2018-19 while the secondary and primary sector grew at a CAGR of 15.46 percent and 3.05 per cent during the same time period.

Table 4.1: Delhi's contribution to Indian Economy (2018-19)

S. No.	Parameter	Delhi	India
1	GSDP as a percentage of all states GSDP	4.09	100
2	CAGR growth rate (%)	13	11.5
3	Per capita GSDP (in Rs.)	3,65,529	69,33,634

Source – Annual Report 2018-19, India Brand Equity Foundation,

Table 4.2 *Gross Domestic Product (GDP) of NCR and Sub-regions from 2004-05 to 2009-10 (at constant 2004-05 Prices) (in Rs. Cr.)

S. No.	Sub-Region/ District	Gross Domestic Product (GDP)					
1	Year	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
2	Uttar Pradesh	33,243.7	34,939.8	22,413.1	35,442.0	47,431.6	40,645.4
3	Rajasthan	7,742.0	7,742.5	9,045.1	9,357.6	11,010.9	12,190.1
4	Haryana	28,546.6	27,979.6	31,928.2	35,907.3	23,920.1	40,681.1
5	NCT Delhi	1,00,324.5	1,10,406.1	1,24,079.6	1,37,960.9	1,55,791.1	1,69,839.0
	Total NCR	1,90,992.1	2,09,154.5	2,37,682.5	2,61,417.1	2,88,726.2	3,19,347.4

*Source – Functional Plan for Economic Development of NCR (*The data is for the old areas of NCR which may be accepted aspolicies and proposals have already been provided in this document.)*

Table 4.2 shows that among all the sub-regions of NCR, NCT Delhi has been consistently performing far better with higher GDP. The sub-region wise GDP figures indicate that GDP of NCR doubled from 2004-05 to 2009-10 (at constant prices, i.e. 2004-05), in which NCT-Delhi account for the maximum share, followed by Haryana, Uttar Pradesh, and Rajasthan respectively. Hence as seen from above, the GDP of NCT-Delhi is almost equal to the combined GDP of other sub-regions.

During the period 2004-05 to 2009-10, GDP of NCT-Delhi has increased by about 1.7 times. Uttar Pradesh and Haryana sub-regions reported GDP trends on almost similar lines till 2006-07, after which the trend varied when Haryana sub-region started making better progress, probably due to heavy investments during this time in Gurgaon and Manesar, which in turn facilitated the increase in GDP for NCT Delhi as well. Till 2004-05, the difference in growth rate in GDP among the four sub-regions was comparatively narrow, which became wider after 2005-06 as seen in Table 4.3.

Table 4.3 GDP of NCR and its Sub-regions for 2021 & 2031 at Constant Prices (2004-05) (in Rs. Cr.)

S. No.	Sub-region/ District	GDP in 2009-10 at constant (2004-05) prices	CAGR between 2004-05 and 2009-10 %	Projected GDP for 2021	Projected GDP for 2031
1	**Uttar Pradesh**	50,645.3	8.78	1,27,868.7	2,96,772.4
2	**Rajasthan**	12,190.1	9.5	33,093.5	82,044.1
3	**Haryana**	86,673.0	11.7	2,94,845.3	8,97,361.0
4	**NCT Delhi**	**1,69,838.9**	**11.1**	**5,40,784.2**	**15,49,831.8**

Source: Directorate of Economic and Statistics, Rajasthan; Economic Survey of Delhi, 2012-13; Department of Economics & Statistics, Haryana; updes.up.nic.in; and Study on Economic Profile of NCR

As observed, NCT Delhi's CAGR is higher than the total of NCR. As per the latest additional data provided by GNCTD on the 04.09.2020, the latest figures of GSDP as advance estimates for 2019-20 is at Rs.6,34,407.69 crores as against All India GDP estimates for 2019-20 at Rs. 2,03,39,849 crores. This is much higher than what was predicted by the Directorate of Economic and Statistics for 2021 at Rs 5,40,784.2 crores. Which reiterates the fact that NCT Delhi is not only the fastest sub region of NCR but also has the most potential to go far beyond the other sub-regions and other states of the country.

4.2.1 Sectoral Composition of Gross State Value Added (GSVA)

As evident from the Table 4.4 below, Sectoral trends indicate that the tertiary sector is the major contributing sector to the GDP of NCT-Delhi sub-region (85 percent of total GDP) comprising primarily of transport, communications, real estate, financial services, wholesale trade and other business related services. The analysis of sector-wise contribution in Gross State Value Added also clearly reveals this fact. The contribution of the primary sector (comprising agriculture, livestock, forestry, fishing, mining & quarrying) to the total GSVA is continuously showing a declining trend during the last eight years, with some minor deviations.

The contribution from the secondary sector showed an increasing trend during the last five years. The composition of GSVA at current prices (2011-12) in three different sectors viz, primary, secondary and service sectors of Delhi during 2011-18 has been presented in Table 4.4.

Table 4.4 Sectoral Composition of GSVA in Delhi in percentage – (at current prices 2011-12)

S. No.	Years	Primary	Secondary	Tertiary	Total
1	**2011-12**	3.49	13.09	83.42	100
2	**2012-13**	2.93	14.17	82.9	100
3	**2013-14**	3.29	14.07	82.64	100
4	**2014-15**	2.79	12.26	84.95	100
5	**2015-16**	2.09	13.62	84.29	100
6	**2016-17**	1.74	13.79	84.29	100
7	**2017-18**	1.77	13.92	84.31	100
8	**2018-19**	1.88	14	84.12	100
9	**2019-20 (AE)**	1.96	13.52	84.52	100

Source: - Directorate of Economics and Statistics, Government of NCT of Delhi
(Additional data for per capita income of 2019-20 has been provided by GNCTD on the 04.09.2020)

During 2011-12, 83.42 per cent of Delhi's income was from the tertiary sector, 13.09 per cent from the secondary sector and less than four per cent from the primary sector. The contribution of the primary sector, which was 3.49 per cent during 2011-12, has come down to 1.88 per cent in 2018-19 at current prices. Concurrently, the contribution of the tertiary sector, recorded at 83.42 per cent in 2011-12, increased to 84.12 per cent in 2018-19 at current prices. The contribution of the secondary sector to the income of Delhi exhibited an increase from 13.09 per cent in 2011-12 to 14.00 per cent in 2018-19. As per additional data provided by GNCTD on the 04.09.2020 the latest Advance estimates of Sectoral composition of GSVA too shows similar trend of decrease in contribution of primary and secondary sector in Delhi's economy and the increase of contribution of tertiary sector to 84.52 percent. This shows the steady increase of the contribution of the tertiary/ service sector to Delhi's economy.

4.3 Occupational Structure

As per Census 2001, the population of Delhi was 138.50 lakh. In 2011 census, the population of Delhi increased to 167.88 lakh which indicates the fact that on an average, the population of Delhi increased at 2.12 per cent per annum during 2001-2011. As seen from Table 4.5, during the same period the proportion of the working population to the total population in Delhi increased at the rate of 0.46 per cent per annum.

Table 4.5 Workers and Non-Workers in India & NCT Delhi 1981-2011

Details	1981		1991		2001		2011	
	India	Delhi	India	Delhi	India	Delhi	India	Delhi
Total Workers	2,446.04 (35.70)	20.02 (32.19)	3,141.30 (37.11)	29.80 (31.63)	4,023.60 (39.11)	45.45 (32.82)	4,817.43 (39.79)	55.87 (33.28)
Non-workers	4,405.81 (64.30)	42.18 (67.81)	5,322.61 (62.89)	64.41 (68.37)	6,262.51 (60.89)	93.05 (67.18)	7,288.26 (60.21)	112.00 (66.72)
Total Population	6,851.85 (100.00)	62.20 (100.00)	8,463.91 (100.00)	94.21 (100.00)	10,286.11 (100.00)	138.50 (100.00)	12,105.69 (100.00)	167.87 (100.00)

Source: -Census of India, 1981, 1991, 2001& 2011
Note: - Figures in parenthesis relate to percentage to total.

From Table 4.5, it may also be observed that the work participation rate in Delhi during 1981 was 32.19 per cent, which reduced to 31.63 per cent in 1991 and slightly increased at 32.82 per cent in 2001 and in 2011 it is 33.28 percent. The growth of workers in Delhi during 1981-2001 was 6.35 percent per annum while non-workers were at 6.03 percent per annum. This was the same in the case as of the national level, where the growth of workers outweighs the growth of non-workers and the difference was worked out at 1.11 percent per annum during the same period. This clearly indicates the fact that the work participation rate has enhanced both at national level and Delhi level.

Now, Delhi is an almost fully urbanized state with the growth of workers and non-workers being higher than the national level. While the persons employed in the service sector and industrial sectors constitute a major share, the percentage of persons engaged in the primary agriculture sector is steadily decreasing.

4.3.1 Work Participation Rate (WPR)

NCR has recorded total 157.35 lakhs workers in 2011, out of which the highest numbers of workers (43.07 percent) are engaged in NCT-Delhi sub-region, clearly reflected from Table 4.6. Concurrently, as observed from Table 4.7, NCT-Delhi has the least proportion of workers engaged in the primary sector. Within the primary sector, share of cultivators and agricultural labourers has declined from 42.98 percent in 1971 to 25.53 percent in 2001, whereas the share of construction within secondary sector has significantly increased from 2.77 percent in 1971 to 16.2 percent in 2001. In 2011, share of marginal workers to total workers in NCT-Delhi has recorded the lowest share out of the entire NCR at 5.01 percent.

Table 4.6 Share of the sub-regions in total number of workers in NCR

S. No.	Year		2001	2011
1	NCR		1,29,72,094	1,57,34,929
2	NCT - Delhi sub-region	No. of workers	43,46,710	55,87,049
		% Share to NCR	0.3351	0.4307
3	Haryana Sub-region	No. of workers	34,14,662	36,69,197
		% Share to NCR	0.2632	0.2829
4	Rajasthan Sub-region	No. of workers	14,58,686	17,08,542
		% share to NCR	0.1124	0.1317
5	Uttar Pradesh Sub-region	No. of workers	37,52,036	47,70,141
		% share to NCR	0.2892	0.3677

Source: Census of India, 2001 & 2011

Workforce Participation Rate (WPR) in NCR for 2011 is 34.15 percent. It is observed that workforce participation trends in NCT-Delhi has slowed down during the period 1991-2001, whereas it has increased subsequently within the same period for Haryana, and Uttar Pradesh and Rajasthan sub-regions. But in the successive decade, i.e. 2001-2011, workforce participation rate in NCT-Delhi has increased, as this sub-region emerged as the more lucrative one out of them all.

Table 4.7 Workforce Participation Rate of India, NCR and sub-regions, 1971 to 2011

S. No.	Year	India	NCR	NCT Delhi sub-region	Haryana Sub-region	Rajasthan Sub-region	Uttar Pradesh sub-region
1	1971	34.2	27.4	**30.2**	25.02	26.4	27.2
2	1981	35.7	28.7	**31.51**	28.35	28.33	27.48

S. No.	Year	India	NCR	NCT Delhi sub-region	Haryana Sub-region	Rajasthan Sub-region	Uttar Pradesh sub-region
3	1991	37.4	29.17	**31.51**	28.35	28.33	27.48
4	2001	39.1	34.2	**29.14**	39.69	49.31	32.75
5	2011	39.2	34.15	**33.28**	33.26	46.5	32.73

Source: Census of India, 1971, 1981, 1991, 2001, 2011

From the Table 4.8 below, it may be inferred that one third of the total population in Delhi takes care of the remaining two-thirds of the population. It is called the dependency burden of the working class.

Table 4.8 Percentage Distribution of Workers by Industry Division, 2004-05 and 2011-12

S. No.	Industry	2004-05			2011-12		
		Male	Female	Persons	Male	Female	Persons
1	Agriculture and allied activities	0.5	2.0	0.7	0.2	0.0	0.2
2	Mining & Quarrying	0.0	0.0	0.0	0.0	0.0	0.0
3	Manufacturing	26.3	15.1	25.0	23.4	12.4	21.8
4	Electricity	0.1	0.0	0.1	1.6	0.0	1.3
5	Construction	6.9	3.8	6.5	4.7	0.5	4.1
6	Trade, Hotels & Restaurants	29.9	8.6	27.5	29.1	20.8	27.9
7	Transport, Storage & Communication	9.1	1.8	8.2	10.3	3.1	9.2
8	Finance, Real Estate & Business	8.3	6.0	8.0	15.1	15.3	15.1
9	Public Administration, Education, Health & Others	18.9	62.7	24.0	15.6	47.8	20.3
	Total	100	100	100	100	100	100

Source: Unit level data of National Sample Survey, 2004-05 and 2011-12

- Workers' involvement in tertiary or service sector was highest in Delhi followed by shares of secondary and primary sector respectively in 2011-12 as seen in Table 4.8.

- The five major industry categories providing employment, in descending order, were (i) Trade, hotel & restaurants; (ii) Manufacturing; (iii) Public administration, education, health & others; and (iv) Finance, real estate and business and, (v) Transport, storage and communications in 2011-12.

- Females were largely employed in two services industries in 2011-12, i.e. (i) public administration, education, health & others and (ii) trade, hotel & restaurants in 2011-12.

- Males were largely employed in (i) trade, hotel & restaurants and (ii) manufacturing.

- Highest increase in percentage of workers was observed in (i) finance, real estate and business, (ii) electricity and (iii) transport, storage and communications during 2004-05 to 2011-12.

- Highest decrease in percentage of workers was observed in (i) public administration, education, health & others, (ii) manufacturing, and (iii) Construction during 2004-05 to 2011-12.

The general phenomenon found in most of urbanized areas is that the percentage of persons engaged in the primary agriculture sector is substantially low. Delhi is also showing the same trend, with majority of the share of persons being employed in the service sector as seen in Table 4.10.

Table 4.9 Category-wise distribution of workforce in NCT Delhi -2011

S. No.	Category of Workers	Workers (Number)			% of Total Workers
		Male	Female	Total	
1	Cultivators	27,458	5,940	33,398	0.6
2	Agricultural Workers	31,352	8,123	39,457	0.71
3	House hold Industrial Workers	1,52,758	29,094	1,81,852	3.25
4	Other Workers	45,50,458	7,81,866	53,32,324	95.44
5	Total Workers	47,62,026	8,25,023	55,87,049	100

Source: - Delhi Statistical Hand Book, 2013; Census 2011

Table 4.10 District wise percentage distribution of workers by Occupation in NCT Delhi, 2001 and 2011

S. No.	District	2001					2011				
		Cultivator	Agriculture Labour	Household Industry	Other	Total	Cultivator	Agriculture Labour	Households Industry	Other	Total
1	Central	0.1	0.1	5.8	94.0	100	0.3	0.3	5.3	94.2	100
2	East	0.2	0.1	3.4	96.3	100	0.2	0.5	3.4	95.9	100
3	New Delhi	0.2	0.1	1.6	98.1	100	0.2	0.5	1.7	97.6	100
4	North	0.6	0.5	4	95.0	100	0.7	0.6	3.7	94.9	100
5	North East	0.3	0.1	5.5	94.1	100	0.3	0.4	4.6	94.7	100
6	North West	1.5	0.7	2.6	95.1	100	1	1.1	3	94.9	100
7	South	0.3	0.2	2	97.5	100	0.3	0.6	2.7	96.3	100
8	South West	2.3	0.6	2	95.0	100	1.2	1	2.3	95.5	100
9	West	0.4	0.1	2.9	96.6	100	0.3	0.5	3.3	95.8	100
	Total	0.8	0.3	3.1	95.7	100	0.6	0.7	3.3	95.4	100

Source: Census of India, 2001 and 2011

It may be inferred from Table 4.9 and Table 4.10 that female workers constitute a small percentage of workers during 2011 which approximated to 14 per cent of workers in Delhi. The major share of workers in Delhi was in the category of other workers, which includes all industrial and tertiary sector activities at it constituted 95 per cent.

- Among the workers the distribution by broad occupational category presents four types of activities, i.e. cultivators, agricultural labour, household industries, and other workers.
- Among workers, most of them were involved in other activities in Delhi in 2011.
- The percentage share of workers involved in household's industry marginally increased, while cultivator declined between 2001 and 2011.

- The workers in household industry were highest in central Delhi and lowest in New Delhi districts.

Table 4.11 Labour Force Participation Rate (LFPR) by Usual Principal and Subsidiary Status and Labour Force Estimate, 2004-05 and 2011-12

Year	LFPR			Labour Force (in millions)		
	Male	Female	Persons	Male	Female	Persons
Delhi						
2004-05	55.8	9	34.8	4.5	0.6	5.2
2011-12	54.8	11.2	35	5	0.9	5.9
All India						
2004-05	55.9	29.4	43	316	155.5	470.4
2011-12	55.6	22.5	39.5	351.5	133.8	484.7

Source: Unit level data of National Sample Survey, 2004-05 and 2011-12

- As seen from the Table 4.11, nearly three-fourths of the population was out of active labour force in Delhi in 2011-12.
- LFPR which is a measure of an economy's active workforce shows that there is a contrasting picture between Delhi and all India during 2004-05 and 2011-12 by which LFPR of Delhi was lower than that of all India in both 2004-05 and 2011-12.
- LFPR improved in Delhi but dropped at all India level during the period 2004-05 to 2011-12.
- Female LFPR was significantly lower in Delhi compared to all India level in both 2004-05 and 2011-12.
- Only around one million females were available for work compared to five million males in labour market in Delhi in 2011-12.

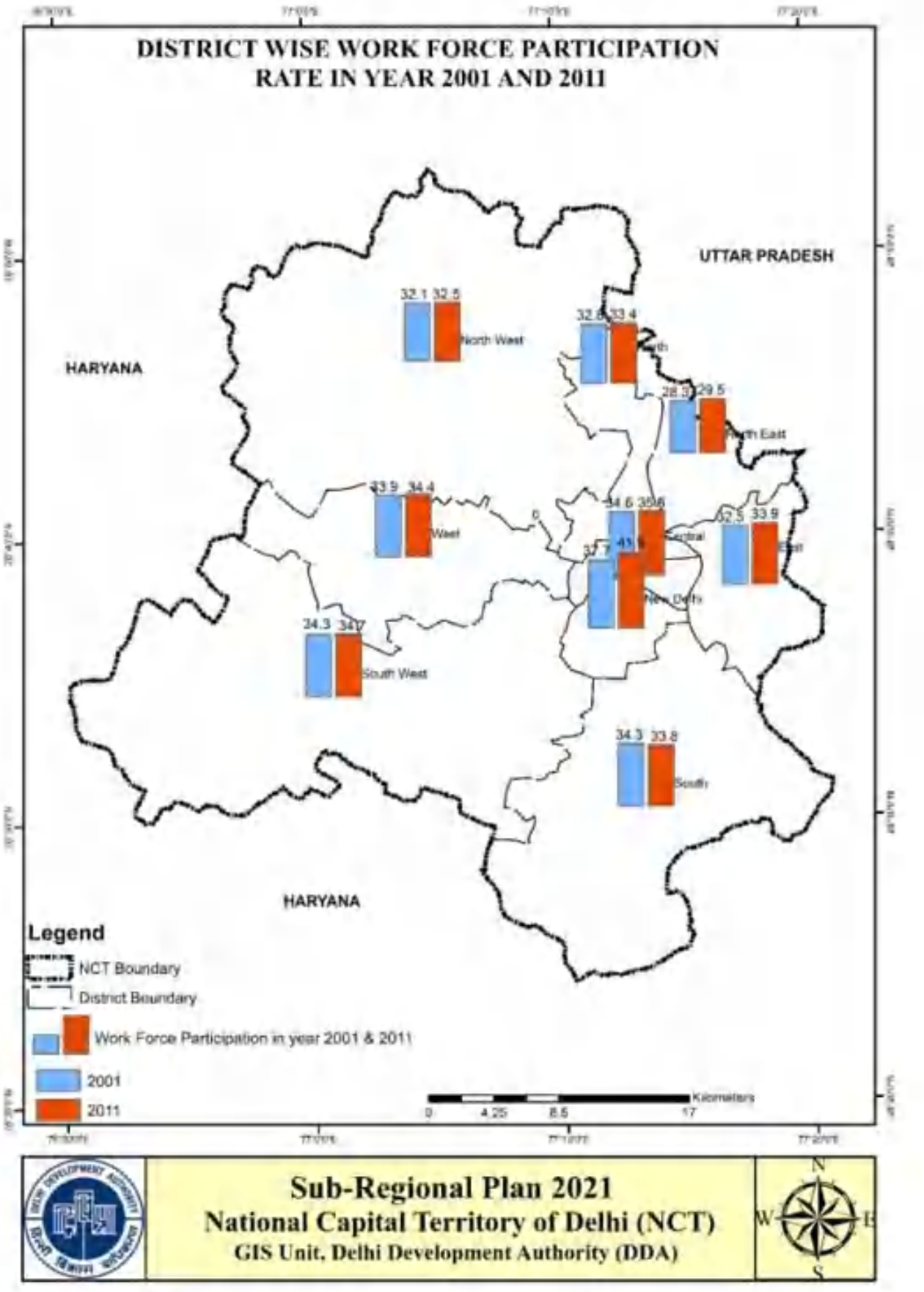
Table 4.12 District wise workers, 2001 and 2011 (in 000')

S. No.	District	2001			2011		
		Male	Female	Persons	Male	Female	Persons
1	**Central**	196	28	224	178	30	207
2	**East**	414	62	475	487	93	580
3	**New Delhi**	55	12	68	47	13	60
4	**North**	228	29	257	258	39	296
5	**North East**	456	44	500	594	67	661
6	**North West**	805	115	919	1,022	166	1,189
7	**South**	669	110	779	776	149	924
8	**South West**	521	82	603	668	127	795
9	**West**	617	104	721	733	142	874
S. No.	**Delhi**	3,960	585	4,545	4,762	825	5,587

Source: Census of India, 2001 and 2011

- Table 4.12, shows that New Delhi district of Delhi showed the lowest number of workers both in 2001 and 2011, owing to the aging population in this district.
- North East district of Delhi showed the highest number of workers both in 2001 and 2011.
- The number of workers in Central and New Delhi district of Delhi fell during the period 2001 to 2011.
- North West and South West districts of Delhi showed highest increase of workers in percentage term during 2001 to 2011 (32 percent).

Figure 4.1: District wise work force participation rate in year 2001 and 2011



Source: Census of India, 2001 and 2011

Table 4.13 District wise Work Force Participation Rate (WFPR) of Delhi, 2001 - 2011

S. No.	District	2001			2011		
		Male	Female	Persons	Male	Female	Persons
1	Central	55.9	9.4	34.6	57.7	10.8	35.6
2	East	52.1	9.2	32.5	53.7	11.6	33.9
3	New Delhi	55.3	15.6	37.7	60.2	19.7	41.9
4	North	53.2	8.2	32.8	54.2	9.4	33.4
5	North East	47.7	5.5	28.3	50	6.4	29.5
6	North West	51.2	8.9	32.1	52.1	9.8	32.5
7	South	53.1	10.9	34.3	52.9	11.8	33.8
8	South West	53	10.6	34.3	53.6	12.2	34.7
9	West	53.1	10.8	33.9	54	11.9	34.4
	Delhi	52.1	9.4	32.8	53	10.6	33.3

Source: Census of India, 2001 and 2011

- Table 4.13, shows that New Delhi district of Delhi showed the highest work force participation rate (WFPR) both in 2011 and 2001.
- North East district of Delhi showed the lowest work force participation rate both in 2001 and 2011.
- Male and female WFPR was also highest and lowest in New Delhi and North East districts respectively in both 2001 and 2011.
- WFPR increased most in New Delhi district of the state during 2001 to 2011.
- However, WFPR fell only in South Delhi district of the state during 2001 to 2011.

Table 4.14 Age Specific Work Force Participation Rates (WFPR) of Delhi, 2004-05 and 2011-12

S. No.	Age	2004-05			2011-12		
		Male	Female	Persons	Male	Female	Persons
1	0-4	0	0	0	0	0	0
2	5-9	0	0	0	0	0	0
3	10-14	0.3	0	0.2	0.6	0.3	0.5
4	15-19	15.1	2.4	9.8	23.7	3.1	15.4
5	20-24	50.5	20.2	35.5	71.1	13.6	47.6
6	25-29	88.2	16.7	56.5	88.7	16.7	58.1
7	30-34	99.1	16.1	59.6	100	4.8	57.1
8	35-39	99	15.3	59.6	99	19.4	61.3
9	40-44	100	20.4	63	96.7	27.7	63.9
10	45-49	98.3	8.7	54.4	100	17.1	66.3
11	50-54	93.4	19	64.2	91	7.5	47.5
12	55-59	86.1	17.4	54.2	70.7	6.3	38.4
13	59+	41.2	7.6	24.1	22.9	1.5	11.9
	Total of Delhi	52.7	10.7	33.7	53.4	8.5	33.2

Source: Unit level data of National Sample Survey, 2004-05 and 2011-12

- Analysis of Table 4.14, shows that the age-wise work force participation rate (WFPR) of Delhi showed inverted U shape curve with lower WFPR among children and older people, and higher WFPR among young and middle aged.
- Highest WFPR was observed among people from age group 25-49 years in 2011.
- In the working age group (15-59 years), the lowest WPR was observed among persons from age group 15-19 years, which was followed by persons from age group, 55-59 years in 2011.
- Among females the highest WFPR was observed in the age-group 40-44 years in 2011.
- WFPR increased among people in age group 20-24 years and 45-49 years during 2001 to 2011.
- WFPR declined among people in age group from 50+ age and 30-34 years during 2001 to 2011.

There is a decline in the overall female participation rates between 1983 and 2000 and a substantial decline in female subsidiary labour supply. These low levels have been attributed to the low levels of workforce participation and decline due to a mix of positive factors such as increased participation in education; cultural- aspirational sanctions whereby increased prosperity and household income leads to withdrawal of female workers; and labour market issues resulting in wage discrimination and barriers to entry into preferred jobs. Another explanation offered for weak female workforce participation is the absence of preferred job opportunities due to gender biases, suggesting that poor returns from the labour market, in combination with the availability

of another stable income stream through marital partners or other family members, causes women to avoid participating in the labour market.

Although women constitute a little less than half of the economically active population, but their contribution to economic activity is far below its potential. The progress toward gender equality with respect to participation in economic activities seems to have stalled, if not regressing.

4.4 Per capita income status of Delhi

Delhi's per capita income is almost three times the national average, both at current and constant prices. The per capita income of Delhi at current prices reached the level of Rs.3,28,985 in 2017-18, as seen in Table 4.15 and Table 4.16, as compared to Rs.2,98,832 in 2016-17 and Rs.2,73,301 in 2015-16. The advance estimate of per capita income of Delhi at current prices during 2018-19 has been estimated at Rs.3,65,529. As per the additional data provided by GNCTD on the 04.09.2020 the advance estimates for the year 2019-20 show that the per capita income of Delhi is Rs.3,89,143. Thus, the annual growth rate of per capita income of Delhi at current prices during the last seven years (2013-19) was configured to be 11.45 per cent, 11.15 per cent, 8.70 per cent, 9.50 per cent, 9.34 per cent, 10.09 per cent and 11.11 per cent over the previous year's respectively. As per the additional data provided by GNCTD on the 04.09.2020, the change in percentage in per capita income from 2018-19 to 2019-20 is 8.57 percent, which is lower than the previous change over previous year (2018-19) of 11.31 percent. This could be attributed to the fact that since overall increase in the unemployment in Delhi and increase in population has led to this resultant decrease in per capita income of Delhi.

Table 4.15 District and Sub-region wise Per capita income of NCR at constant (2004-05) Prices from 2004-05 to 2009-10

S. No.	District/ Sub-region	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
1	**NCT Delhi**	63,877	69,128	76,243	83,243	91,845	98,262
2	**Uttar Pradesh Sub-region**	25,540	25,685	31,745	32,607	33,271	35,036
3	**Haryana Sub-region**	44,895	54,487	59,179	63,788	67,633	74,457
4	**Rajasthan Sub-region**	38,758	42,431	47,672	50,819	54,945	59,264

Source: Uttar Pradesh <updes.up.nic.in>, Department of Economic and Statistical Analysis, Haryana; Directorate of Economics and Statistics, Rajasthan

As seen from Table 4.15 Haryana and NCT-Delhi sub-regions cater to industrial sector with presence of MNCs and MSMEs involved in production, manufacturing, IT and ITeS sector to a great extent contributing largely to GDP and thus raising the level of per capita income.

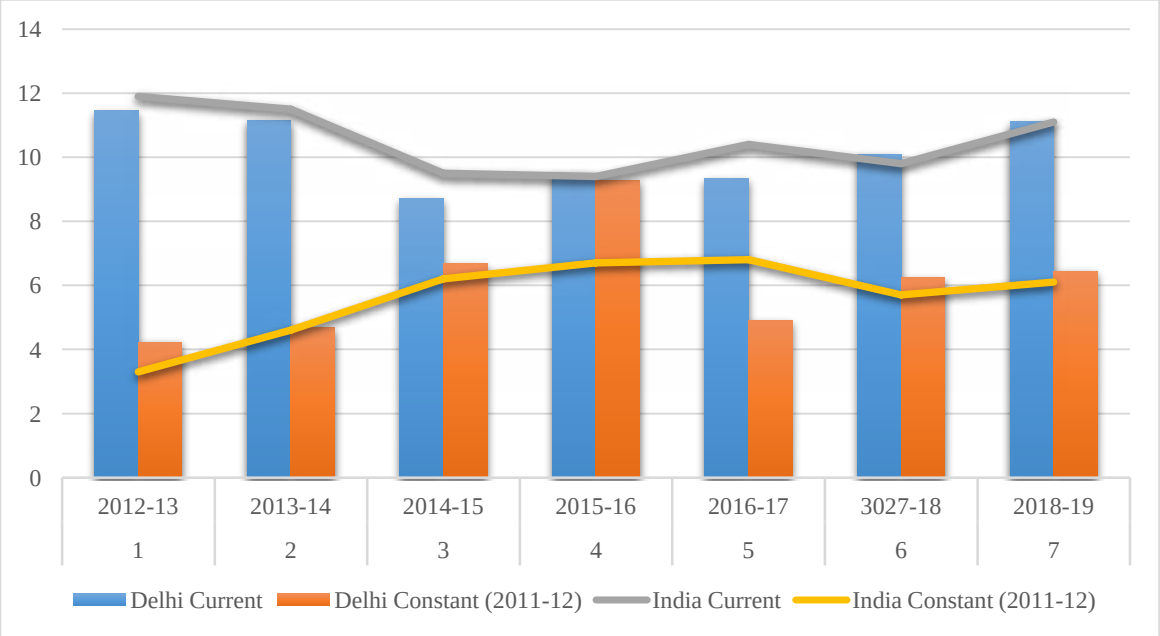
Table 4.16 Per Capita Income of Delhi and India during 2011-12- 2018-19 at Current prices (in Rs.)

S. No.	Years	Current Prices (Base Year 2011-12)	
		Delhi	All India
1	2011-12	1,85,361	63,462
2	2012-13	2,06,590	70,983

3	2013-14	2,29,619	79,118
4	2014-15 (4th RE)	2,49,589	86,647
5	2015-16 (3rd RE)	2,73,301	94,797
6	2016-17 (2nd RE)	2,98,832	1,04,659
7	2017-18 (1st RE)	3,28,985	1,14,958
8	2018-19 (AE)	3,65,529	1,25,397
9	2019-20 (AE)	3,89,143	1,34,226

Source: - Directorate of Economics and Statistics, Government of NCT of Delhi.
Note: - (4th RE) - Fourth Revised Estimates, (3rd RE) - Third Revised Estimates, (2nd RE) - Second Revised Estimates, (1st RE) - First Revised Estimates, (AE) - Advance Estimates.
** Projected on the basis of results of Population Census 2011*
(Additional data for per capita income of 2019-20 has been provided by GNCTD on the 04.09.2020)

Figure 4.2 Growth rate of Per Capita Income of Delhi and India from 2012-13 to 2018-19 in percentage



Source: - Directorate of Economics and Statistics, Government of NCT of Delhi.

In summation, the per capita income of Delhi at current prices increased from Rs.1,85,361 in 2011-12 to Rs.3,65,529 in 2018-19, recording an annual average growth rate at 10.19 percent.

4.4.1 Unemployment in NCT Delhi

The Annual report of the Periodic Labour Force Survey (PLFS) 2017-18 reports that the current unemployment rate of Delhi stands at 9.8 percent, 3.6 percent in the rural areas and 9.9 percent in the urban areas. In 2016, the estimated number of workers was at 57.75 lakh. The percentage of unemployed persons constitutes 3.06 per cent of the labour force.

Table 4.17 Educational Distribution of unemployed persons registered in Employment Exchanges in Delhi 2009-2017

S. No	Education	Below Metric	Metric, Higher Secondary	Graduates	Post Graduates	Diploma Holders	Total
1	**2009**	51,575	2,97,757	50,391	6,050	8,766	4,14,539
2	**2010**	73,259	2,96,047	86,394	14,323	23,361	4,93,384
3	**2011**	91,925	3,89,742	1,13,248	19,249	29,139	6,43,303
4	**2012**	1,06,362	4,67,479	1,38,683	24,491	37,554	7,74,569
5	**2013**	1,28,040	4,95,423	1,58,728	28,167	44,934	8,55,292
6	**2014**	1,37,158	6,16,019	1,80,021	31,839	52,532	10,17,569
7	**2015**	1,47,049	6,56,088	1,95,450	34,033	56,576	10,83,896
8	**2016**	1,44,774	6,86,859	2,09,762	36,403	60,098	11,37,896
9	**2017**	1,49,200	7,03,041	2,36,816	42,242	66,588	11,97,887

Source: - Delhi Statistical Hand Book, 2017.
*Note: * Diploma holders already covered under metric and intermediate, hence not included in grand total.*

It is evident from Table 4.17, that 29 percent of unemployed persons registered at an employment exchange in Delhi had the educational qualification of graduation and above – in the year 2017. More than 71 percent of unemployed persons registered in employment exchanges in Delhi were in the matriculate category or in the category of higher secondary level education. Hence, 30 percent of the workforce is qualified for occupations such as engineering, medicine, law, and consultancy.

Among all the states, Delhi has the largest share of skilled workforce, making it suitable for knowledge-based economic activities such as IT/ITeS, designing, R&D and financial services. The economy is not able to impart skill to the job seekers. People moving away from farm sector are joining the retail and transportation sector as it requires less skills than manufacturing. The lack of skill building isn't supplying high quality manpower to industries. It will limit the growth of firms in terms of revenue and value chain.

4.5 Primary Sector

The economy is undergoing rapid urbanization, and thus the returns from traditional agriculture are presently less attractive as compared to the high value of commercial horticulture and other high value-added agriculture activities. The Govt. of NCT of Delhi is, therefore, encouraging farmers to take-up vegetables, floriculture production, mushroom cultivation, Pisciculture etc.

4.5.1 Agriculture

The percentage distribution of Gross State Value Added (GSVA) of Delhi at 2011-12 prices showed a declining trend of agriculture and allied sectors. More clearly, the percentage contribution of the agriculture sector to GSVA of Delhi at current prices reduced from 0.94 percent in 2011-12 to 0.49 percent in 2018-19. The number of operational holdings in Delhi increased from 20,497 in 2010-11 to 20,675 in 2015-16. The increase in land holdings in Delhi worked out at 0.17 percent per annum. The operational area of Delhi decreased from 29,628.21 hectares during 2010-11 to 28,945.92 hectares during 2015-16. The reduction in operational area

during the last two agricultural censuses in Delhi was worked out at 0.46 percent per annum. This shows the consistent decline in the growth of agriculture and its allied fields in Delhi NCT. As per latest additional information given by GNCTD on the 04.09.2020 the advance estimates for 2019-20 of NSVA is 5.05 percent which is a major decrease from 11.65 in the previous year of 2018-19.

4.6 Secondary Sector

The Industrial Policy for Delhi 2010-21 aims to promote a transparent and business-friendly environment, promotion of non-polluting and clean industries, promotion of high-technology and skill industries to keep in-migration of unskilled labour to minimum, to develop a world-class infrastructure within planned industrial estates and regularized industrial clusters, promotion of cluster approach and walk to work concept, wherever possible, to facilitate business through procedural simplifications and e-governance measures.

GSVA at current prices as seen in Table 4.18, reveals the fact that contribution of Secondary Sector (comprising of Manufacturing, Electricity, Gas, Water Supply & Other Utility Services and Construction) in the economy has increased from 13.09 percent during the base year 2011-12 to 13.92 percent in 2017-18 (1st Revised Estimates) and to 14.00 percent in 2018-19 (Advance Estimates). At constant prices, the same trend is visible and the GSVA increased to 14.13 percent in 2018-19 (Advance Estimates) from 13.70 percent in 2017-18 (1st Revised Estimates).

Table 4.18 Gross State Value Added of Delhi at current prices regarding the secondary/ manufacturing sector

Year	Secondary Sector (in cr.)	Manufacturing (in cr.)	Total GSVA at Basic Prices (in cr.)	Total GSDP at Market Prices (in cr.)	%age share of Manufacturing in		%age share of Secondary Sector in GSVA
					Total GSVA	Total GSVA of Secondary Sector	
2011-12	39,682	18,907	3,03,232	3,43,798	6.24	47.65	13.09
2012-13	48,498	23,350	3,42,588	3,91,388	6.82	48.15	14.17
2013-14	54,262	25,338	3,85,931	4,43,960	6.57	46.7	14.07
2014-15 (4th RE)	53,247	23,385	4,34,241	4,94,803	5.39	43.92	12.26
2015-16 (3rd RE)	65,194	31,195	4,78,782	5,50,804	6.52	47.85	13.62
2016-17 (2nd RE)	73,504	33,026	5,32,961	6,15,605	6.2	44.93	13.79
2017-18 (1st RE)	82,924	35,955	5,85,949	6,90,098	6.03	43.36	13.92
2018-19 (AE)	94,022	40,557	6,71,821	7,79,652	6.04	43.14	14

Source- Economy Survey 2018-19
Estimation of GSVA by DES, (R) - Revised Estimates, (AE) - Advance Estimates

Manufacturing sub-sector is the largest contributor in the secondary sector in the economy of Delhi. GSVA from manufacturing was estimated at Rs. 35,955 crores and Rs. 40,557 crores at current prices during 2017-18 and 2018-19 respectively, with annual growths of 8.87 percent and 12.80 percent respectively over previous year's estimates. Similarly, Net State Value Added (NSVA) estimates are showing a positive growth trend at current prices and at constant prices. As per estimates for 2017-18, NSVA is to the tune of Rs. 32,568 crores with an annual growth of 10.14 percent over the previous year at current prices. As per advance estimates for 2018-19, NSVA was to the tune of Rs. 37,203 crores with an annual growth of 14.23 percent over the

previous year at current prices. As per latest additional information given by GNCTD on the 04.09.2020 the advance estimates for 2019-20 of NSVA is 9.77 percent which is a major decrease from the previous years.

The income from manufacturing has increased from Rs. 18,907 crores in 2011-12 to Rs. 40,557 crores in 2018-19. However, the percentage contribution of manufacturing to GSVA has decreased from 6.24 percent in 2011-12 to 6.04 percent in 2018-19. During the same period, the contribution of the secondary sector to the total GSVA of Delhi has increased from 13.09 percent in 2011-12 to 14.00 percent in 2018-19.

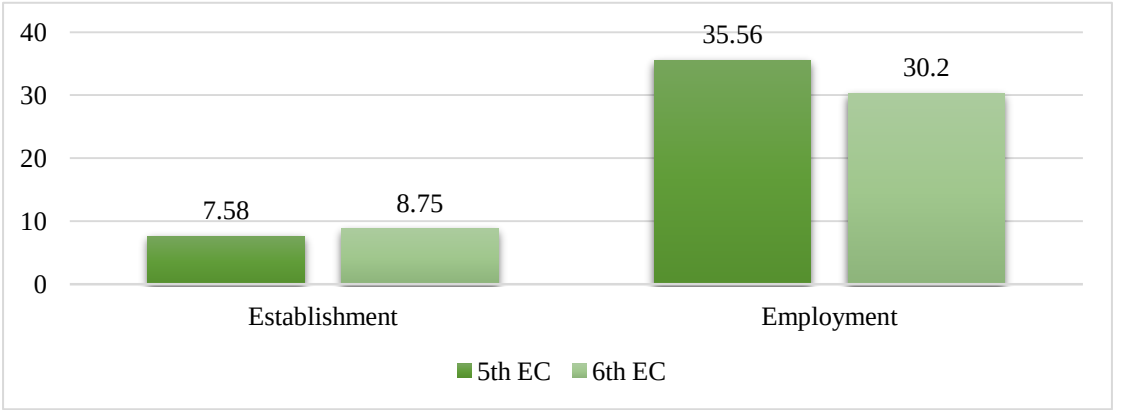
4.7 Tertiary Sector

Trade and commerce have played a pivotal role in promoting the growth of Delhi's economy by making a significant contribution in terms of GDP and gainful employment to a large section of society. Delhi is the biggest trade and consumption center in North India. It has attained the status of a major distribution center by virtue of its geographical location, historical factors, availability of infrastructure facilities etc.

Contribution of Tertiary Sector (comprising of Trade, Hotels & Restaurants, Railways, Transport, Storage, Communication, Financial Services, Real Estate, Ownership of Dwellings & Other Professional Services, Public Administration and Other Services) in the economy, which was 83.42 percent in the base year 2011-12 has increased to 84.12 percent during 2018-19 (Advance Estimates). The income from trade, hotels and restaurant in Delhi constituted Rs. 83,539 crores during 2018-19 at current prices, which is nearly 12.44 percent of Gross State Value Added of Delhi (base year 2011-12). More clearly this sector's contribution to Gross State Value Added of Delhi during the last seven years was more than 12 percent.

As per 6th Economic Census 2013, total establishments of 8.75 lakh were operating in Delhi, 1.42 percent was in rural areas and 98.58 percent in urban areas. It registered an annual growth rate of 1.94 percent, and a total of 1.18 lakh more establishments were added in the 6th Economic Census 2013 over the 5th Economic Census 2005 as seen in Figure 4.3. Out of the total establishment, 54.55 percent were Own Account Enterprises (OAE) and 45.45 percent were establishments with at least one hired worker. 30.20 lakh persons were employed in 8.75 lakh establishments with an average of 3.45 employees per establishment. Out of the total 0.9 percent, persons were employed in rural areas, whereas, 99.1 percent were engaged in urban Delhi. Also, it is pertinent to mention that 8.05 percent of the total establishments were managed by women entrepreneurs.

Figure 4.3 Growth of establishments and employment position in Delhi during 2005-13 as per the Fifth Economic Census (2005) & Sixth Economic Census (2013)



Source- Economy Survey 2018-19

Figure 4.4: District wise establishment and number of persons employed as per 6th economic census

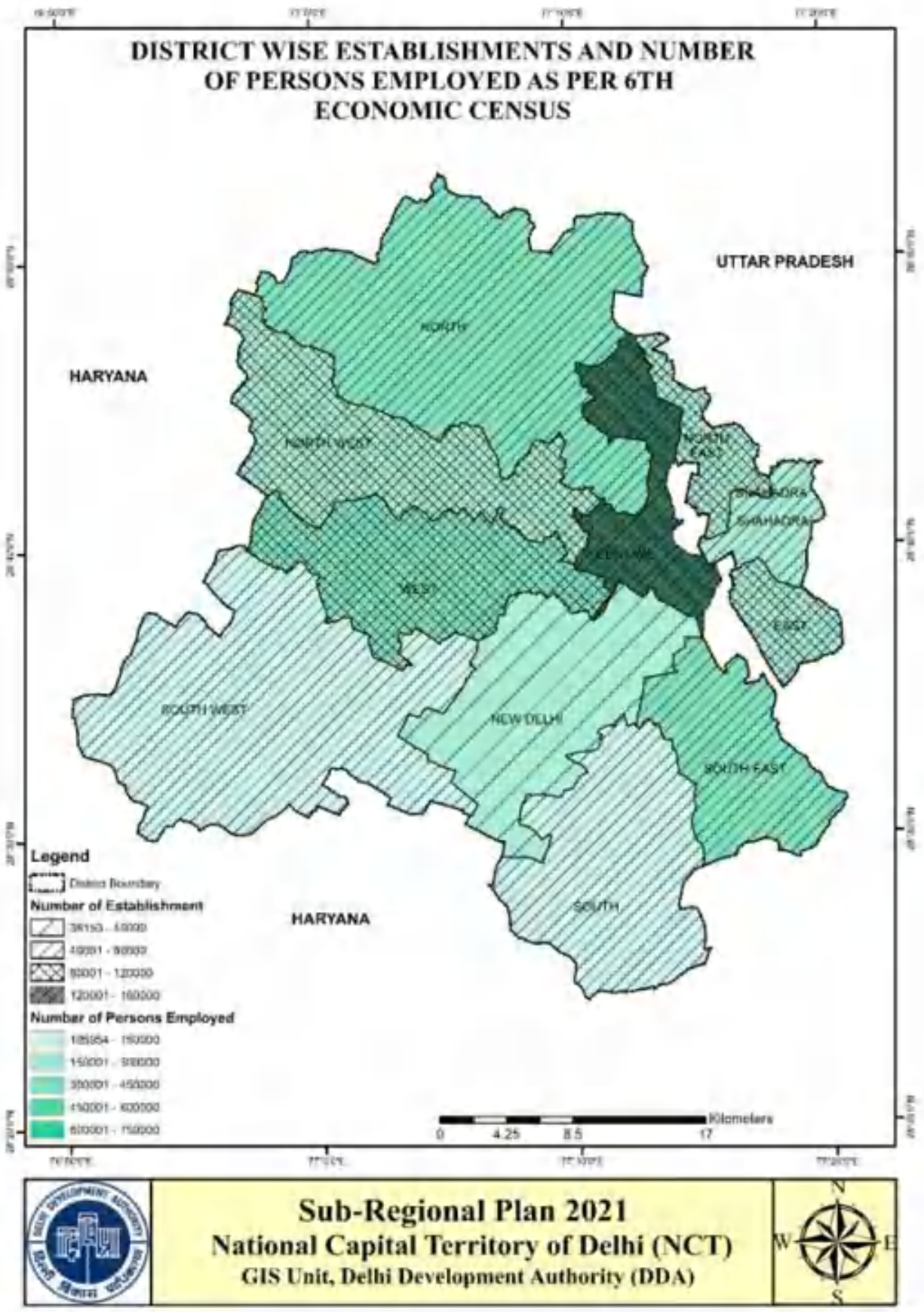


Table 4.19 District wise establishments and number of persons employed as per 6th Economic census in NCT Delhi

Districts	Establishments	No. of Persons employed
Central	1,50,671	5,99,058
West	1,06,726	3,13,574
North-West	93,297	2,86,189
North-East	86,597	1,83,313
East	80,061	2,15,979
South-East	75,049	3,52,562
North	73,724	3,18,960
Shahdara	71,738	2,29,663
South	57,126	1,45,304
South-West	42,166	1,05,954
New Delhi	38,153	2,69,225
Total	8,75,308	30,19,781

Source: - Delhi Statistical Handbook, 2018.

Table 4.20 Factories and estimated Workers Employed in NCT Delhi

S. No.	Years	Factories	Estimated Workers Employed
1	2007	7,793	3,59,126
2	2008	7,921	3,64,053
3	2009	7,997	3,67,611
4	2010	8,109	3,73,500
5	2011	8,219	3,78,361
6	2012	8,557	3,92,270
7	2013	8,821	4,03,270
8	2014	8,968	4,16,927
9	2015	8,954	4,15,278
10	2016	8,978	4,16,833
11	2017	9,059	4,20,156

Source: - Delhi Statistical Handbook, 2018.

As shown in Table 4.20, the number of working factories in Delhi increased from 7,793 in 2007 to 9,059 in 2017. Likewise, the estimated workers employed in these factories increased from 3,59,126 in 2007 to 4,20,156 in 2017. It has been observed that during the period 2007 to 2011, number of industrial units as well as employment in NCT Delhi has increased at a slow rate. This may be in compliance with the Supreme Court order in 2005 relating to closure/shifting of various polluting industries from NCT-Delhi. This may also be attributed to the inability of the units to comply with the safety standards stipulated by Central Pollution Control Board and Delhi

Pollution Control Committee. A number of industrial units in Delhi have shifted to the neighbouring States. Apart from the regulatory and administrative intervention that imposed significant restriction on the expansion/ growth of large/medium scale industries in NCT-Delhi, the lack of regulation and powerful market forces in SSI and tiny sector has led to a rise to a laissez-faire situation which led to the mushrooming of tiny and small industries especially in the unorganized sector. On an average, 46 persons were working in each factory in Delhi. This has impacted the growth of factories in Delhi during the last ten years, as only 1,266 additional units have been added in the last ten years, hence shows a very slow pace of growth.

4.7.1 Industrial Clusters in NCT of Delhi

Delhi has emerged as a key redistribution center due to its strategic geographical location and infrastructure. The wholesale markets in Delhi deal in 27 key commodities consisting of textiles, auto parts and machinery, stationery, food items, and iron and steel, as per the Master Plan document 2021 of DDA. The trade & commerce segment in Delhi is also vital due to its substantial contribution in terms of tax revenues and employment generation. Delhi has 29 planned industrial areas and four flatted factories complex as shown in Table 4.21. Further, 22 non-conforming industrial clusters have been informed for development.

Delhi State Industrial Infrastructure Development Corporation (DSIIDC) is the agency for development, operation, and maintenance of all industrial estates in Delhi. With the onerous responsibility of fulfilling the dreams of industrial entrepreneurs of Delhi, relocation of industries has been the prime concern of DSIIDC. Under the directions of Hon'ble Supreme Court, the Commissioner of Industries, Govt. of Delhi had formulated the scheme of "Relocation of Industries" in the year 1996. The rationale of the scheme is to reposition and manage the operation and maintenance of industrial units working in the non-conforming/residential areas of Delhi to conforming areas in NCT of Delhi.

Table 4.21 Industrial clusters in NCT Delhi

S. No.	Industry	No. of units	Employment (direct)	Turnover (in Rs. cr)
1	Auto Components	1,500	50,000	297.2
2	Chemicals	339	3,562	337.02
3	Engineering Equipments	2,691	47,000	2,000
4	Food Products	432	1,939	594.28
5	Textiles including garments	1,901	1,32,000	921.32
6	Cosmetic & Packaging	240	7,200	100
7	Plastic products	746	16,478	54.22
8	Rubber products	178	18,684	192.64
9	Sanitary Fittings	100	900	30
	Printing & Packaging, Naraina	450	5,000	400

Source – Cluster Observatory, MSME Foundation

Figure 4.5 Industrial clusters along transport corridors

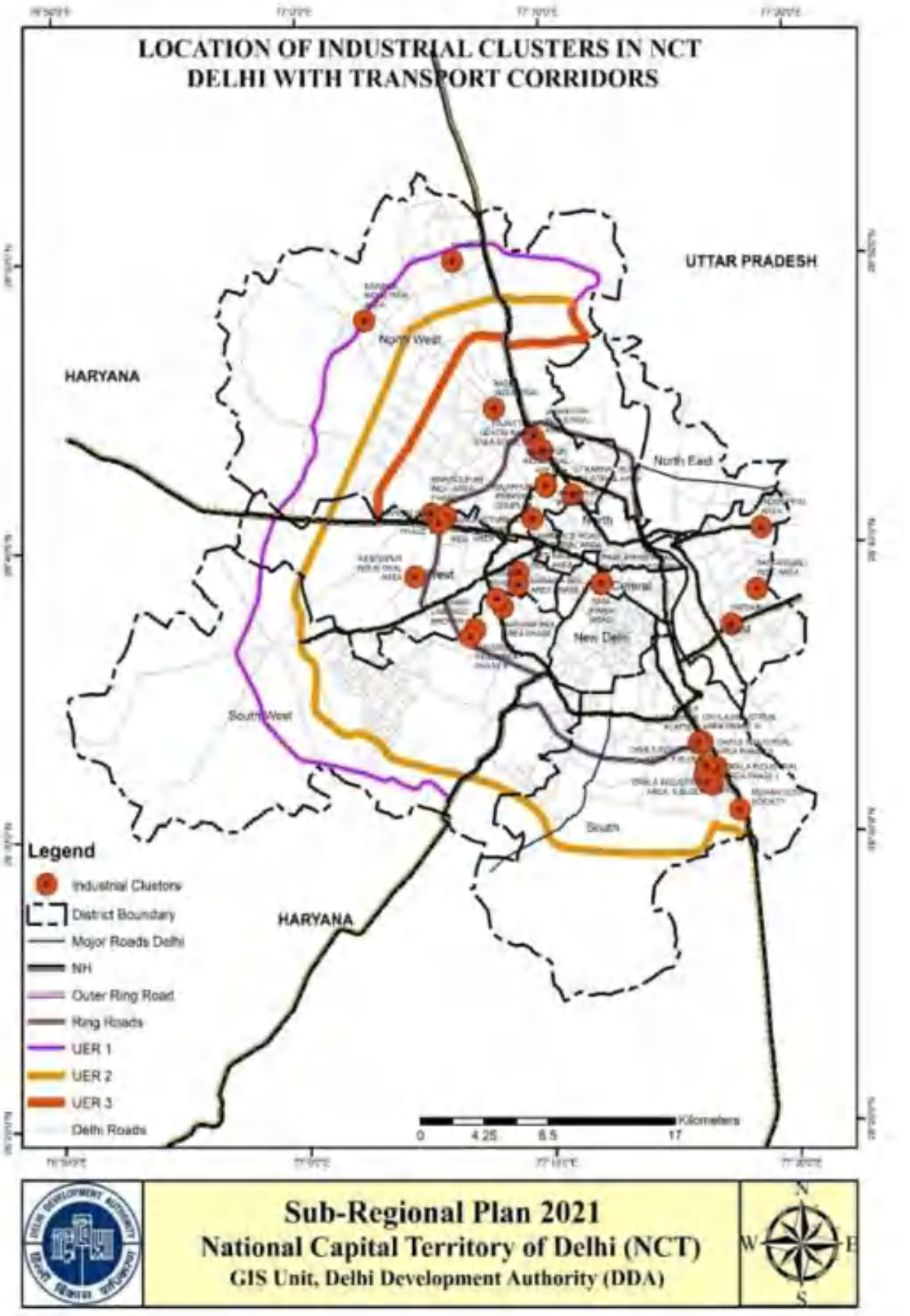


Table 4.22 Status of Industrial Areas in Delhi

S.No.	Name of Industrial Area	Land acquired (in hectare)	Land developed (in Hectare	Prevail-ing Rate Per Sqm. (in Rs.)	No. of Plots	No. of allotted Plots	No. of vacant plots	No. of units in production
1	Bawana	778	778	-	16,312	16,312	-	16,312
2	Narela	247	247	-	1,813	1,813	-	1,813
3	Okhla Indl Area Ph-III	60 acres	60 acres	-	163	163	-	163
4	Patparganj	130 acres	5,261	-	500	500	-	500
5	Badli Ph-I and II	76 acres	76 acres	-	369	369	-	369
6	Okhla Ph-I and II	50 acres	50 acres	-	126	126	-	126
7	Functional Indl. Estate for Electronics S block, O.I.A. Ph –II	12.5 acre	12.5 acre	-	104	104	-	104
8	Functional Indl. Estate for Electronics A block, O.I.A. Ph –II	9 acres	9 acres	-	76	76	-	76
9	Rani Jhansi Road	-	-	-	395	395	-	395
10	Rani Jhansi road flatted factories	-	-	-	571	571	-	571
11	Okhla flatted factories	-	-	-	294	294	-	294
12	G. T. Karnal Road	-	-	-	-	352	-	-
13	Wazirpur Indl. Area	-	-	-	-	858	-	-
14	Wazirpur Ph-IV	-	-	-	-	767	-	-
15	Wazirpur Printing complex	-	-	-	-	16	-	-
16	Lawarance Road Indl. Area	-	-	-	-	332	-	-
17	Rajasthani Udyog Nagar	-	-	-	-	81	-	-
18	S.M.A. Society	-	-	-	-	116	-	-
19	S.S.C.I.	-	-	-	-	78	-	-
20	Keshopur (Tennries)	-	-	-	-	104	-	-
21	Mangolpuri Indl. area Ph-I	-	-	-	-	252	-	-
22	Mangolpuri Indl. area Ph-II	-	-	-	-	971	-	-
23	Manufacturing Udyog Nagar Indl. Area	-	-	-	-	278	-	-
24	Kirti Nagar Indl. Area	-	-	-	-	941	-	-
25	Rewari Line Indl. area Ph-I	-	-	-	-	386	-	-
26	Mayapuri Ph-II	-	-	-	-	1,853	-	-
27	Naraina Indl area Ph-I	-	-	-	-	397	-	-
28	Naraina Indl area Ph-II	-	-	-	-	154	-	-

S.No.	Name of Industrial Area	Land acquired (in hectare)	Land developed (in Hectare	Prevail-ing Rate Per Sqm. (in Rs.)	No. of Plots	No. of allotted Plots	No. of vacant plots	No. of units in production
29	Naraina W.H.S	-	-	-	-	766	-	-
30	Okhla Indl Area Ph-I	-	-	-	-	1,163	-	-
31	Okhla Indl Area Ph-II	-	-	-	-	855	-	-
32	Mohan Coop. society	-	-	-	-	384	-	-
33	Patparganj Indl. Area	-	-	-	-	4	-	-
34	Jhilmil Indl. Area	-	-	-	-	234	-	-
Note: At present, Delhi has 32 planned Industrial Estates and flatted Factory Complexes. 21 Industrial Estate under DDA and the rest are under DSIIDC and Industry Department.								

Source: S.No. 1 to 11 Industrial areas O/o the Commissioner of Industries & DSIIDC and S.No. 12 to 34 Industrial areas under Delhi Development Authority.

DDA has 23 Industrial Estates. The allotment of industrial plots was made under different schemes mainly by shifting of industries from non-conforming to conforming areas up to 1976 and also by way of auction. No auction of industrial plots was held during the last 10 years and this was mainly due to the Supreme Court Judgment in which the available industrial plots are being asked by the Delhi Govt. for relocation of industries from non-conforming area. Scheme for conversion of leasehold to freehold has been extended to industrial plot.

Such industrial clusters contribute to innovation in the following ways –

- By providing easier and faster access to new processes needed for innovation.
- By proceeding faster with innovations due to the proximity of potential suppliers.
- By making the services of specialized professionals easily available.
- By identifying new technological, operating and delivery opportunities.
- By direct observation of other firms.

The planned industrial estates have poor infrastructure and suffer from water logging, bad quality roads and encroachments. The industrial areas notified for regularization are erstwhile residential areas, where the non-conforming manufacturing and commercial activities proliferated unchecked. These industrial areas are in even worse conditions, they are highly congested with very narrow roads, negligible open spaces and other facilities.

4.7.2 NCT Delhi level Markets

City level wholesale markets cater to the needs of population at local level. These markets of medium size are dispersed throughout the city to enable even distribution of commodities from these complexes to the retail outlets. Most of the existing planned markets and warehousing were developed in early seventies for specific commodities. Due to their proximity to residential area, these markets need to be redeveloped to overcome the environmental and traffic problems. A list of the city level markets in NCT Delhi is as shown in Table 4.23.

Figure 4.6 City level markets along transport corridors in NCT Delhi

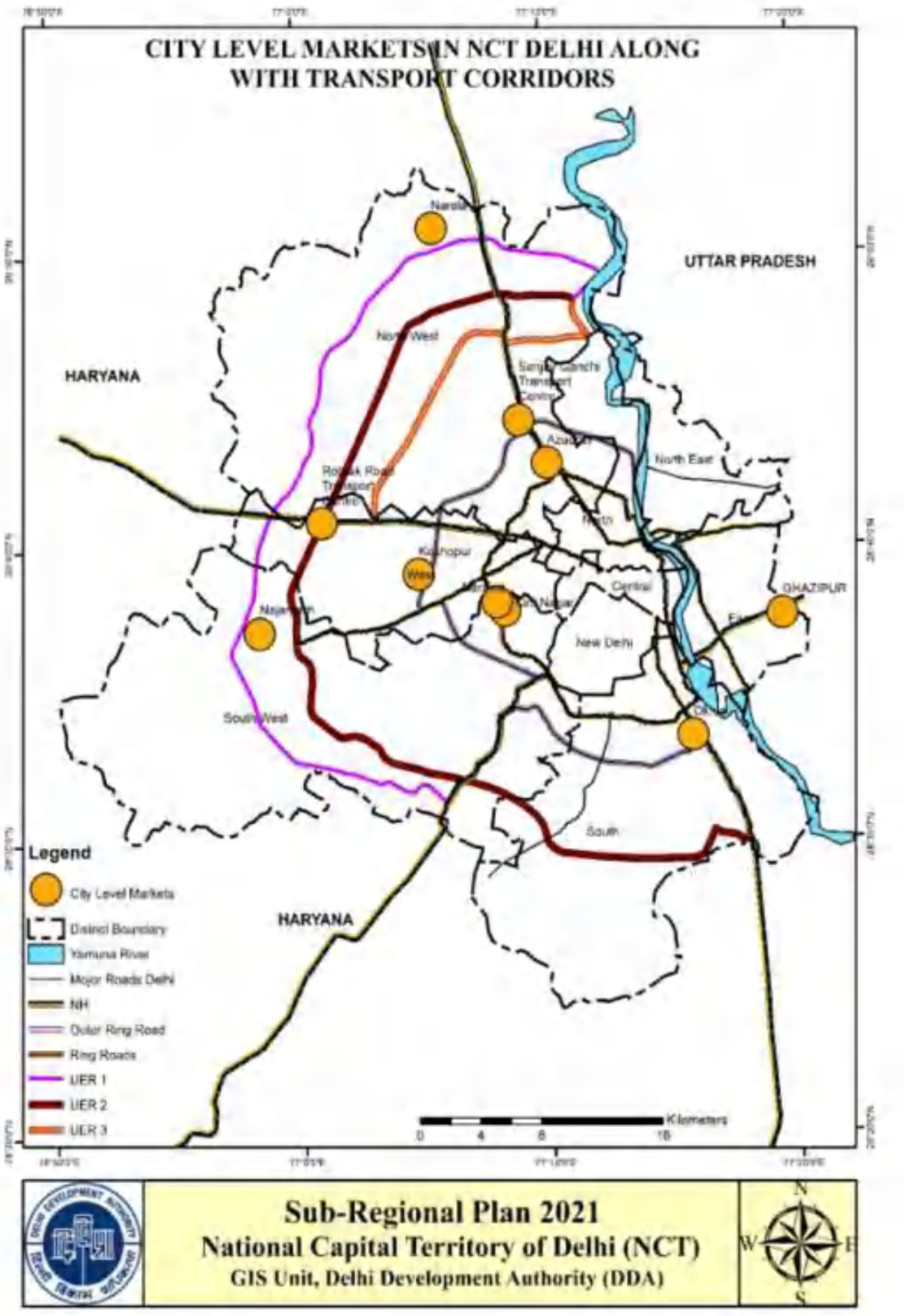


Table 4.23 City Level Markets in NCT Delhi

S No.	Location	Commodity / Activities
1	Azadpur	Fruit and Vegetable
2	Okhla	Fruit and Vegetable
3	Keshopur	Fruit and Vegetable
4	Naraina	Iron and Steel
5	Sanjay Gandhi Transport Centre	Transport/ Warehousing
6	Rohtak Road Transport Centre	Transport/ Warehousing
7	Narela	Food grains
8	Najargarh	Food grains
9	Kirti Nagar	Timber

4.7.3 Industrial estates developed

The Delhi Industrial Development, Operation & Maintenance, Act, 2010 notified on 8th June 2010, has come into force with effect from 28th March 2011 to place all industrial areas under DSIIDC. The DSIIDC has created industrial development, operation and maintenance fund with 74 crore of seed capital for the discharge of its function under the Act. Rules under the Delhi Industrial Development, Operation and Maintenance Act, 2010 have been notified on 11th November 2011. Government of India has directed the Delhi Municipal Corporation to hand over the industrial estates for maintenance to DSIIDC. Hon'ble L.G. had also ordered the transfer of industrial estates from Municipal Corporation of Delhi and Delhi Development Authority to DSIIDC.

14. Operation and Maintenance of Industrial Estates

In order to maximize efficiency with the available resources, the Government has decided to develop and maintain industrial infrastructure on a Public-Private Partnership basis. Two industrial estates namely Bawana and Narela selected as a pilot project for maintenance of industrial estates on the PPP model under a BOT concession are being maintained by a private partner for 15 years.

Operation and maintenance of Bawana and Narela Industrial Areas have been handed over to the concessionaires on PPP mode. Estimated infrastructure development cost is of 230 crores. Govt. had approved redevelopment and up-gradation of roads & drains in 10 industrial areas at a cost of about 169 crores during 2014-15.

15. Development of Industrial Clusters in Non-Conforming Areas

There are 29 approved industrial areas and four flatted factory complexes in Delhi. However, many industries are functioning in non-conforming areas. Hon'ble Supreme Court in a PIL ordered the closure of all industrial units that have come up on or after 1st August 1990 in residential/ non-conforming areas and other impermissible industries in violation to the provision of Master Plan.

With a view of ensuring minimum dislocation of the cluster of industries, operating in residential/ non-conforming areas, 22 non-conforming industrial clusters having 70 per cent concentration have been notified by the Government for redevelopment. The redevelopment process involves preparation of development plans for the area which includes widening of roads, laying of services, development of open space, parking etc. It needs to be carried out in accordance with the guidelines prepared and notified for this purpose by the Government. The industrial association of

the respective area will have to own the responsibility for the preparation and implementation of the Redevelopment Plan for their area.

4.7.4 Delhi State Industrial & infrastructure Development Corporation (DSIIDC)

DSIIDC was incorporated as a company and registered under Companies Act, 1956 in February, 1971 with the main objectives of aiding, counseling, assisting, financing, projecting and promoting the interests of small industries in Delhi and providing them with the capital, credit, resources and technical and managerial assistance for the successful execution of their work and business. At the time of registration, it was known as Delhi Small Industries Development Corporation Limited. However, now it is called 'Delhi State Industrial & Infrastructure Development Corporation Limited'

16. Institute of Gem and Jewellery

Delhi State Industrial & Infrastructure Development Corporation (DSIIDC) has set up National Institute of Gem and Jewellery. The institute is currently providing training in various short-term certificate courses such as Basic Jewellery Designing, Computer Aided Design (CAD) for Gems & Jewellery, Diamond Identification and Grading Coloured Gemstone Identification, Costume Jewellery making as well as a six-month diploma in Gemmology and Jewellery Designing.

17. Delhi Khadi and Village Industries Board

Delhi Khadi & Village Industries Board was established in the year 1983 under Himachal Pradesh Khadi and Village Industries Board Act 1966 as extended to Delhi. The main aim of the Board is to promote and popularise Khadi & Village product and create awareness among the masses and also to generate employment. At present, the Board is implementing two employment generation schemes namely Rajiv Gandhi Swavlamban Rozgar Yojna of GNCTD and Prime Minister Employment Generation Programme- KVIC, Government of India.

18. Rajiv Gandhi Swavlamban Rozgar Yojna (RGSRY):

Rajiv Gandhi Swavlamban Rozgar Yojna has been designed, developed and promoted by the Delhi Khadi and Village Industries Board, with the help of Government of National Capital Territory of Delhi, to provide sustainable self-employment opportunities to the school and college dropouts above the age of 18 years to individual entrepreneurs, trade professional, artisans, etc.

Under this scheme financial assistance in the shape of loan up to three lakhs is provided with 15 percent subsidy component of the project cost subject to a ceiling of Rs. 7,500 per entrepreneur.

19. Prime Minister Employment Generation Programme (PMEGP):

This scheme was introduced by the Ministry of Micro Small and Medium Enterprises, Government of India with a view to generating employment opportunities in the country. Khadi and Village Industries Commission is the nodal agency for implementation of the scheme in the country as a whole and state KVIC & DIC in Delhi, Delhi Khadi and Village Industries Board is nominated as the nodal agency to implement the scheme in the rural as well as in urban areas along with state officials, KVIC. The maximum cost of the project per unit admissible to each entrepreneur under the scheme is 25 lakhs. There are no income criteria for applying for a loan under the PMEGP scheme. The rate of subsidy differs depending on the category of the applicant along with the area where he/ she wants to establish the unit.

Under this scheme the applications are placed before the District Task Force Committees (DTFC) headed by Deputy Commissioner of the concerned district and after the recommendation of DTFC the cases are forwarded to the banks for their evaluation and sanction. After sanction, the Bank disburses the amount to the beneficiaries and claims the margin money component from the designated bank.

4.7.5 Potential Industries

20. Development of Multilevel Manufacturing Hub at Rani Khera, Mundka

DSIIDC is coming up with a multilevel manufacturing hub for the development of non-polluting light and service industries with World Class facilities, in an area of approximately 147 acres at Rani Khera, located on Mundka- Rohtak road, Delhi. As per the zonal plan of DDA, the land is under Zone-M, which is the Manufacturing (Light & Service Industry) Zone. The area is to be developed with state-of-the-art facility, which will be a multilevel Manufacturing Hub.

The project is expected to generate employment for nearly 1.50 Lakh people and employment for the neighbouring agglomeration. The project envisages the development of approximately 70 percent of the land as an open area, out of which 40 percent will be a green area. Thick plantation has been envisaged to give greenery to the premises to enrich the environment. The tentative cost of the project is 5,000 crores and built up the area as per proposed FAR is 8,92,584 sqm which includes 19 industrial buildings, 06 warehouse buildings, five other industrial buildings and other miscellaneous provisions.

21. Knowledge-Based Industrial Park at Baprola, Delhi

DSIIDC is developing Knowledge-Based Industrial Park at Baprola in an area of approximately 55 acres. The estimated project cost is about Rs. 2,575 crores. The project will cater to the specific needs of Information Technology, ITeS Industry, Media, Research & Development, Gems & Jewellery and other business services. The project is expected to provide direct employment to about one lakh persons and indirect employment to about 1.70 lakh persons.

Industrial buildings are proposed to be developed as a green building with the target of four-star GRIHA rating. All industrial and commercial buildings shall be centrally air-conditioned. The tentative cost of the project is Rs 2,175 crore and the total built-up area of the project is 2,23,339 sqm.

22. Development of a New Industrial Area at Kanjhawala

DSIIDC intends to develop an integrated industrial township at Kanjhawala. The proposed project shall be a major **Greenfield Project** spread over in an area of 920 acres. The project will spearhead the industrialization of North West Delhi and also create vast employment opportunities for people directly and indirectly. The Project will be developed in consonance with the Master Plan for Delhi 2021 and Industrial Policy for Delhi 2010-21.

23. Ease of Doing Business

Based on the performance of Delhi and Mumbai, India has improved its rank from 130 to 100 as per the Doing Business Report 2018 and from 100 to 77 as per the Doing Business Report 2019. Thus, India has improved its rank by 53 positions during the last two years in ease of doing business. The Government of NCT of Delhi has undertaken critical actions for starting a business

such as construction permits, ease in procuring GST registration, ease in getting electricity connection, online payment of taxes, stamp duty etc.

4.7.6 Banking

The objective of Financial Inclusion is to extend financial services to the unserved population which is an important tool to unlock a region's growth potential. According to 2011 Census of India, 71.5 percent of households avail banking services in NCR while 58.7 percent households avail banking services in India as seen in Table 4.24.

Table 4.24 Percentage of people availing banking services in NCR

Area	Total No. of Households	Total No. of Households Availing Banking Services	Percentage of Households Availing Banking Services
India	24,66,92,667	1,44,81,4788	58.7
NCR	86,72,889	62,04,024	71.5

Source – Census of India, 2011

Table 4.25 Sub Region wise Percentage of households availing banking services

Sub Region	Total No. of Households	Total No. of Households Availing Banking Services	Percentage of Households Availing Banking Services
NCT Delhi	33,40,538	25,95,302	77.7
Haryana	20,44,045	14,20,497	69.5
Rajasthan	6,28,913	3,74,196	59.5
Uttar Pradesh	26,59,393	18,14,029	68.2

Source – Census of India, 2011

Among the NCR sub region NCT of Delhi has the highest percentage of 77.7 percent households availing banking facilities, followed by Haryana. Out of the total number of households availing banking services in the NCR, the share of NCT Delhi is 42 percent which is seven times higher than the Rajasthan sub region, as in Table 4.25. Table 4.26 too clearly indicates that the growth of nationalized bank branches is far higher than other banks. This is due to the high trustworthiness and bankability factor that nationalized banks enjoy versus private banks.

Table 4.26 Number of Banks in Delhi. 2011-2014

S. No.	Category	2011	2012	2013	2014
1	State Bank of India & its Associates	451	462	487	499
2	Nationalised Banks	1,573	1,667	1,773	1,882
3	Other Scheduled Commercial Banks	706	772	818	868
4	Regional Rural Bank	0	0	0	0
	Total	2,730	2,901	3,078	3,249

Source: Reserve Bank of India

4.8 State Economic Policy

DSIIDC is responsible for the distribution of funds to the developer agency under the Assistance to States for Developing Export Infrastructure & Allied Activities (ASIDE) scheme upon approval of a project. State Level Export Promotion Committee (SLEPC) has been constituted to draw export policy & action plan & approve infrastructure projects for financial assistance under ASIDE scheme of Central Government, which has been elaborated in Table 4.27.

Table 4.27 Key agencies for policy action and their description

S. No.	Key Agency	Description
1	Delhi Financial Corporation (DFC)	Provides financial assistance for industrial and commercial activities in the state.
2	Delhi State Industrial and Infrastructure Development Corporation Limited (DSIIDC)	Providing infrastructure and marketing facilities to industries.
3	Delhi Khadi and Village Industries Board	Financial assistance to specific types of small-scale industries (khadi and village industries).
4	The Department of Industries, Government of NCT of Delhi	Serves as the nodal agency to plan, promote and develop industries in the state.

Source - DSIIDC

As per the new Industrial Policy for Delhi 2010-21, the Government is keen on developing and promoting the hi-tech, sophisticated, knowledge-based IT and ITeS industries in the state. For this, the Government has planned to set up 'Centre of Excellence' to promote innovation and entrepreneurship in the sectors. In the first half of 2018, startups in Delhi-NCR received the highest funding of Rs. 18,396 cr and by end of 2018 the Tech startups in Delhi-NCR grabbed 224 deals for the year 2018.

The real estate market in Delhi is lucrative and attracts investors from India and abroad. Owing to the advanced infrastructural base, the city meets the requirements of a profitable investment. Real estate sector contributed around 28.49 percent to Delhi's Gross State Value Added (GSVA) in 2018-19. Housing sales in Delhi-NCR market increased by seven percent year-on-year between Jan-Sep 2018.

Table 4.28 Expenditure on Various Programme/ Project in NCT of Delhi in Rs. crores

S. No.	Sector	Expenditure	Expenditure (provisional)	Scheme/ Programme/Project
1	**Years**	**2015-16**	**2016-17**	**2017-18**
2	Agriculture & Allied Services	4.72	3.43	26
3	Rural development	105.19	130.28	614
4	Minor irrigation & flood control	48.54	59.21	90
5	Energy	235.51	187.77	295
6	Industries	59.81	7.2	31
7	Transport	3,504.03	2,739.92	3,056
8	Science, Technology & environment	37.92	33.71	90
9	Secretariat Economic Services	6.52	1.98	11
10	Tourism	19.61	8.08	117
11	Civil Supplies	0.69	1.66	12
12	General education	2,654.59	3,124.78	2,970

S. No.	Sector	Expenditure	Expenditure (provisional)	Scheme/ Programme/Project
1	**Years**	**2015-16**	**2016-17**	**2017-18**
13	Technical Education	268.36	259.62	363
14	Art & Culture	32.38	49.91	104
15	Sports & Youth Services	45.16	52.15	88
16	Medical	1,693.83	1,736.83	2,151
17	Public Health	331.01	342.85	476
18	Water-Supply & Sanitation	1,723.93	1,384.65	1,755
19	Housing	245.13	134.81	251
20	Urban development	1,303.95	1,674.36	2,117
21	Welfare of SC/ST/OBC/Minorities	284.13	105.58	400
22	Labour & Labour welfare	40.24	24.88	110
23	Social Welfare	737.82	804.25	1,272
24	Nutrition	265.63	208.3	380
25	Jail	55.43	64.28	65
26	Public works	230.59	254	234
27	Other Administrative services	454.47	221.15	550
28	Women & child welfare	576.68	650.61	872
29	Total	14,960.54	14,266.25	18,500

Source – Delhi Statistical Hand Book 2017

As seen in Table 4.28, compared to sectors such as transport, education, urban development, the service sector hasn't received as much funds as it should have, especially since NCT of Delhi is now a predominantly service led economy.

Major initiatives taken by the government to promote Delhi as an investment destination are:

- The Delhi government has set up a Business Facilitation Council (BFC) to facilitate single-window clearances from various departments for establishing industrial enterprises in a time-bound manner.

- Small-scale industries registration has been simplified and replaced by memorandum under Micro, Small & Medium Enterprises Development Act 2006. Further, filing of the memorandum is optional for micro, small and medium manufacturing enterprises, and micro and small service enterprises.

- State Level Export Promotion Committee (SLEPC) has been constituted to draw export policy and action plan and approve infrastructure projects for financial assistance under Assistance to States for Developing Export Infrastructure and Allied activities (ASIDE) scheme of the Central Government.

- According to the Delhi 2021 Master Plan, special emphasis has been laid on improved solid-waste management policies. The short-term goals are capacity building with respect to financial services and performance management, effecting trial runs of collection and waste-reduction schemes, developing transport, landfill sites and transfer stations for waste and focusing on biomedical and hazardous waste management programmes.

4.9 Projects boosting Local Economy

4.9.1 Delhi – Mumbai Industrial Corridor (DMIC)

In 2007, the Government of India (GoI) announced the concept of Delhi Mumbai Industrial Corridor (DMIC) Project as the first Industrial Corridor in 2007. The project aims to create smart, sustainable industrial cities by leveraging the high speed, high capacity connectivity backbone provided by the Western Dedicated Freight Corridor (DFC) to reduce logistic costs in an enabling policy framework. A special purpose vehicle i.e. Delhi Mumbai Industrial Corridor Development Corporation (DMICDC) Limited was accordingly incorporated in January, 2008 for the development and implementation of DMIC project. The current equity shareholders in DMICDC include Government of India (49 percent), represented through the Department of Industrial Policy & Promotion (DIPP), Japan Bank for International Cooperation (JBIC) (26 percent) and financial institutions such as Housing and Urban Development Corporation (HUDCO) (19.9 percent), India Infrastructure Finance Company Limited (IIFCL) (4.1 percent) & Life Insurance Corporation (LIC) (1.0 percent).

The backbone of the DMIC would be the Dedicated Freight Corridor (DFC) starting from Dadri near Delhi to Jawaharlal Nehru Port Trust near Navi Mumbai, as seen in Figure 4.7. It aims to cut logistics costs, which is the lifeline of manufacturing industries that are expected to come along the proposed industrial corridor. Estimating an influence zone covering about 150-200 km on either side of the DFC, the project has an influence area covering approximately 4,36,486 square kilometres which amounts for about 14 per cent of the total geographic area of the country. Major clusters identified for residential development includes: Area between the National Capital Region and Jaipur: Major cities in this region are Delhi, Rewari, Ghaziabad, Agra, Faridabad, Meerut, Gurgaon, Aligarh, Noida and Jaipur.

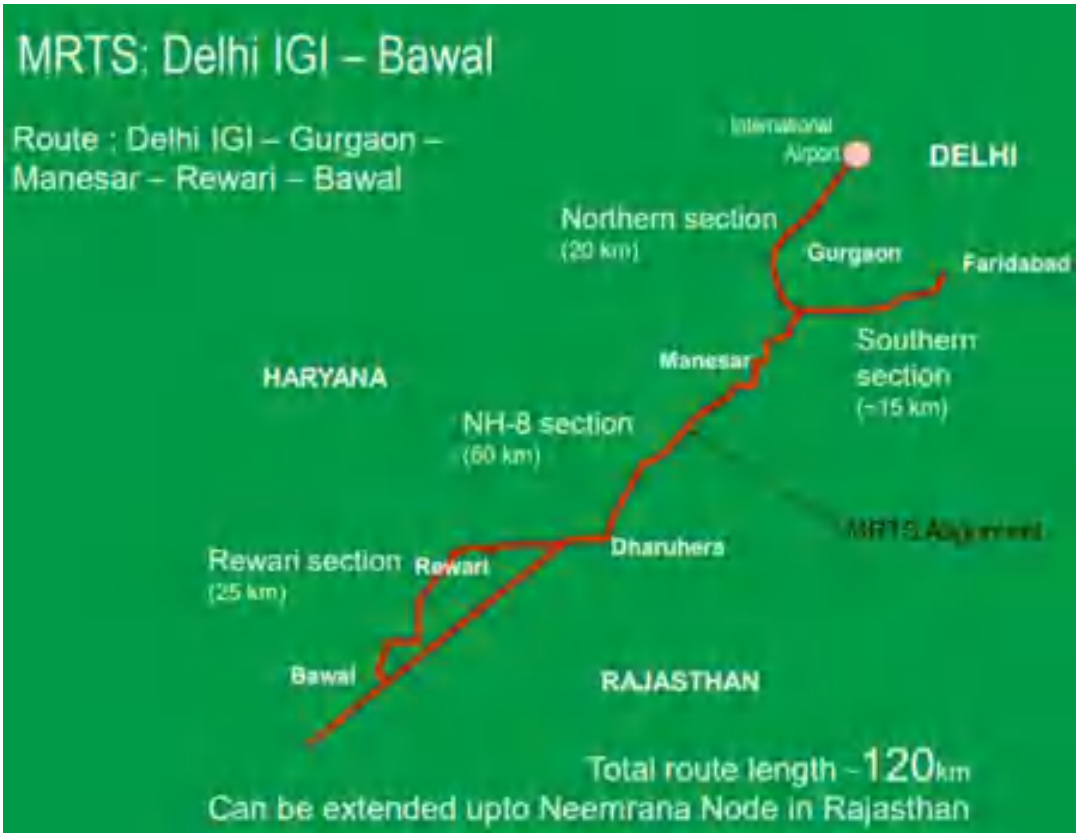
Figure 4.7 Delhi Mumbai Industrial Corridor (DMIC) influence zone

Source – Government of India Department of Industrial Policy and Promotion

The three investment regions under the proposed DMIC project namely Manesar-Bawal Investment Region (MBIR) as in Figure 4.8, Khushkhera – Bhiwadi - Neemrana Investment

Region (KBNIR) and Dadri-Noida-Ghaziabad Investment Region (DNGIR) and the DFC project have the potential to boost the manufacturing sector both in terms of output and employment. These projects emphasise on expanding the manufacturing and services base and develop the corridor stretches as "Global Manufacturing and Trading Hubs".

Figure 4.8 MRTS - Delhi IGI - Bawal



Source: DMICDC website

4.9.2 Amritsar-Delhi-Kolkata Industrial Corridor

The Amritsar- Delhi- Kolkata Industrial Corridor (AKDIC) as shown in Figure 4.9 is a gigantic project aimed at developing an Industrial Zone spanning across seven states in India. It has been approved as of 20 January 2014 by the Government of India to boost manufacturing sector and agro-processing plants in the country. The Eastern Dedicated Freight Corridor (EDFC) (backbone railway of the Amritsar Kolkata Industrial Development Corridor) will extend from Ludhiana in Punjab to Dankuri near Kolkata. The AKDIC will spread across 20 cities which will include the Indian States of Punjab, Haryana, Uttar Pradesh, Uttarakhand, Bihar, Jharkhand and West Bengal. The cities to be covered are Amritsar, Jalandhar, Ludhiana, Ambala, Saharanpur, Delhi, Roorkee, Moradabad, Bareilly, Aligarh, Kanpur, Lucknow, Prayagraj, Varanasi, Patna, Hazaribagh, Dhanbad, Asansol, Durgapur and Kolkata.

The corridor will be built along the 1839 km long EDFC. It will also leverage the Inland Waterway System being developed along the National Waterway-1 which extends from Allahabad to Haldia. The ADKIC would be implemented in a phased manner and would comprise a belt of 5,50,000 sq. km under influence.

Figure 4.9 Amritsar-Delhi-Kolkata Industrial Corridor

Source – Punjab Bureau of Industrial Promotion (http://www.investpunjab.gov.in/Static/IndustrialCorridor)

4.10 FDI Inflows and Investents

Foreign Direct Investment (FDI) flows are usually preferred over other forms of external finance because they are non-debt creating, non-volatile and their returns depend on the performance of the projects financed by the investors. FDI also facilitates international trade and transfer of knowledge, skills and technology. In a world of increased competition and rapid technological change, their complimentary and catalytic role can be very valuable.

Table 4.29 Sectoral Distribution of Foreign Direct Investment in Delhi

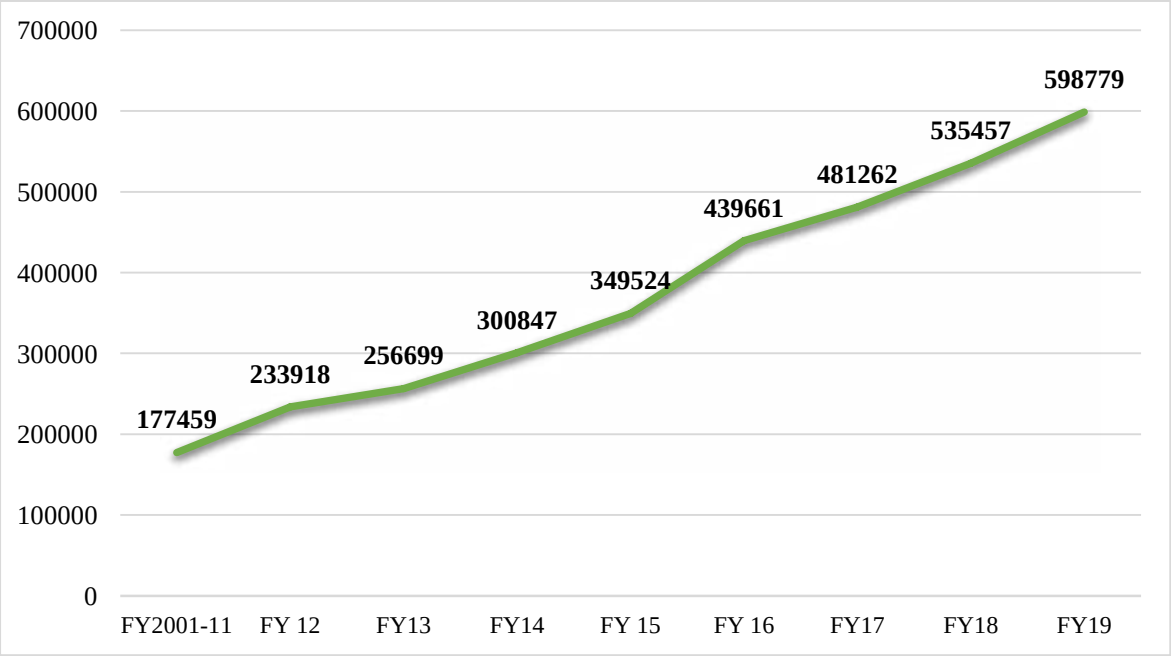
S. No.	Sector/ Industry	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-01
1	Chemicals & Allied products	17	18	16	9	15	9	19	8	7
2	Engineering	25	8	15	18	35	20	21	21	14
3	Domestic Appliances	6	1	12	0	1	2	0	0	0
4	Finance	1	10	11	19	11	5	9	1	2

S. No.	Sector/ Industry	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-01
5	Services	1	5	11	7	1	11	18	7	12
6	Electronics & Electrical equipment	12	14	6	9	7	22	11	11	11
7	Food & Diary Products	10	11	7	6	12	4	1	8	4
8	Computers	3	2	1	4	3	5	5	6	16
9	Pharmaceuticals	1	12	1	4	2	1	1	3	3
10	Others	25	19	19	24	14	22	13	35	30
11	Total	100	100	100	100	100	100	100	100	100

Source – Report of the steering group on foreign direct investment, Planning Commission, Govt. of India, August 2002.

According to the Department for Promotion of Industry and Internal Trade (DPIIT), cumulative FDI inflows to Delhi[1] during April 2000–March 2019 amounted to Rs.5,98,840 cr. as shown in Figure 4.10. As seen in Table 4.29, besides engineering, computers and electronics, the service sector is one of the leading sectors that are attractive for FDI.

Figure 4.10 Cumulative FDI equity inflows in Delhi since 2000- 2019 in Rs. cr



Source – Report of the steering group on foreign direct investment, Planning Commission, Govt. of India, August 2002.

4.10.1 Employment Projection – 2021

The participation rate (Working Population/ Total Population X 100) for the last two decades for Delhi is as given below in Table 4.30.

Table 4.30 Participation Rate in NCT Delhi of Male – Female 1991-2001

Year	Male	Female	Total
1991	28.8	3.7	32.5

Year	Male	Female	Total
2001	28.3	4.4	32.72
2011	52.99	10.58	33.28

Source – Census of India and projection by MPD - 2021

With the generation of employment in different sectors, the participation rate for 2021 would be 38.1 percent in NCTD, as shown in Table 4.31. This would generate a total work force of 79.4 lakhs.

Table 4.31 Projected Work Force for NCTD – 2021

S. No.	Sectors	In Lakh	in %
1	Agricultural etc.	0.62	0.8
2	Manufacturing, Processing, Servicing, Repairs, Household Industry	0.32	0.4
3	Other than household Industry	16.57	20.9
4	Construction	5.69	7.1
5	Trade and Commerce	23.93	30.2
6	Transport, Storage &		
7	Communication	5.89	7.4
8	Other Services	26.38	33.2
9	Total	79.4	100

Source – Census of India and projection by MPD – 2021
Other services include central govt., quasi govt., Delhi admin, local bodies and private sectors etc./

If the present trends are allowed to continue, Delhi is likely to have a much lower work force (about 21 percent) in the industrial sectors. To retain its functional balance, it would be necessary for the city to maintain the decline in industrial employment through measures proposed for Regional and Sub- Regional development.

4.11 Policies and Proposals

- NCT Delhi being one of the best performing metro regions in the globe should be used to as a focal point to trigger pace of economic development in the entire NCR. Special emphasis should be given to service sector and selective high value manufacturing sector (electronics etc.) which needs to be linked with a network of subsidiaries operating in the rest of the NCR.

- Central NCR (outside NCTD) should adopt a two-pronged strategy supplementing specific initiatives for NCTD and other towns in the sub region. NCTD should focus more on services and environment friendly manufacturing using vertical factories and headquarters of economic establishment in the rest of the NCR.

- Commercial activities in Delhi are mainly regulated by the Master Plan provisions. But, given its status as a metro city with good infrastructure. Delhi is fast turning into a commercial hub. There is thus a need to focus our approach towards resolving issues relating to commercial enterprises.

- Activities such as organized retail are becoming more significant, leading to challenges regarding creation of adequate infrastructure for organized retail in terms of modern

warehousing and cold-chain facilities. There is a need for a specific department to look at challenges posed by increasing number of commercial enterprises coming up in Delhi.

- There is a need for integrated freight complexes and wholesale markets along transit nodes, especially along the DMIC corridor, UER 1, 2 and 3 along with the Eastern and Western Peripheral Roads.

- Delhi has the largest share of skilled workforce, making it suitable for knowledge-based economic activities such as IT/ITeS, designing, R&D and financial services, which should be encouraged when proposing for new industrial hubs.

- Upgradation and modernization of existing industries. Accordingly, fiscal and policy incentives are proposed under the Industrial Policy for Delhi, which would also include the recognition and inclusion of new industries.

- The following items/products have got good potential to be manufactured in Delhi –

  - Gems & Jewellery
  - Handloom, Handicrafts & Decorative Items
  - Artificial Jewellery making
  - Khadi and Village industries
  - Bakery Products
  - Electrical Home Appliances
  - Packaged Food Products
  - Plastic Products, Water purifiers
  - Flavours
  - Perfumes
  - Fragrance & Deodorants
  - Garments
  - Steel Furniture & Office Furniture
  - CFL Lamps
  - Invertors & Batteries
  - Hosiery & allied Products
  - Detergent & cosmetic products
  - Leather goods
  - Leather Garments
  - Packaging Units
  - Printing
  - Optical lenses
  - Board & paper corrugation
  - Non PVC Footwear
  - Leather footwear
  - Corrugated Boxes
  - Leather Bags and accessories
  - Plastic Containers
  - Plastic films and bags
  - Steel Fabrication

- Hence, promote hi-tech and low volume- high value-added industries, which are not labour intensive.

- Provide suitable incentives and disincentives, and other measures, for shifting and relocation of industrial units not conforming to the land use norms.

- Industry and academia should come together to design syllabus and curriculum to enhance the employability of the youth of Delhi.

- Review, and possibly widen, the scope of permissibility of household industrial units' subject to adherence to pollution control norms and environmental considerations, fire safety regulations and other relevant factors, particularly the aspect of infrastructure services.

- Promote traditional industries like Khadi, handloom and Handicrafts by creating linkages with fashion design industry and provision of institutional and marketing support.

- Map existing training and institutional resources for purpose of National Skill Development Mission and proposed Delhi Skill Development Mission.

- The state of the industrial properties underlines the need for urgent action towards effective operation and maintenance of existing infrastructure and redevelopment. These areas should be redeveloped as per guidelines of DDA.

- MPD 2021 has directed that industrial clusters notified for regularization should be redeveloped within a period specified by DDA or concerned local bodies, failing which the unit's operating in those areas will have to be relocated to conforming areas.

- The DSIIDC along with the local bodies may keep a strict tab on the redevelopment activities in these areas and the industry licenses for the units continuing to operate in non-conforming areas after the specified time would not be renewed.

- RRTS project has the potential to improve the growth prospects and income in the entire region especially of the towns not part of CNCR.

- NCT Delhi should have its own Integrated Logistics Action Plan (ILAP) in line with initiatives taken by respective states.

CHAPTER 5. TRANSPORT

5.1 Background

Transportation is an important sector for achieving development objectives of any area. Its role in enabling and directing urban development has always been appreciated. The Regional Plan 2021 envisages the following basic objectives for the Transport Plan:

"*The objective of the Transport Plan is to promote and support the economic development of the region and relieve the Capital of excessive pressure on the infrastructure including traffic congestion. It is to provide accessibility to all the parts of the region and discourage the transit of passengers and goods through the core area of NCT-Delhi by providing bypasses and thereby opening areas for economic development of the rest of the region."*

As mandated in the NCRPB Act 1985, the NCRPB prepared the 'Functional Plan of Transport for National Capital Region-2032' for the area of NCR covered under RP-2021. The objective is to provide an adequate, accessible and affordable Integrated Multi Modal Transport System to the people of this region to cater the needs of the passengers, goods and services of NCR in an equitable and sustainable manner. An attempt is being made to integrate the objectives of both the plans i.e. Regional Plan 2021 and functional Plan of Transportation 2032 for the purpose of analyzing the transport sector issues in the NCT-Delhi.

5.2 Existing Transport System

The vast transport network of National Capital Region is 'radial' in nature. It contains a good road network and rail corridors to cater the intra-city and inter-city commuters and long-distance traffic. It comprises of a road network of about 36,305 km, a large fleet of buses (registered in NCR), a rail network of more than 1000 km and an International Airport.

5.2.1 Registered Vehicles

NCT Delhi has the highest number of registered vehicles (88.5 lakhs) with escalating growth rate amongst the metro cities in India followed by Bengaluru (55.6 lakhs), Chennai (49.3 lakhs), Gr. Mumbai (25.7 lakhs) and Hyderabad (23.7 lakhs). Delhi had a registered vehicle population of 104 lakhs in 2016-17 having increased from 32.1 lakh in 2001, adding up of 72.7 lakhs vehicles in NCT Delhi during the period with a compound annual growth rate (CAGR) of 7.21 percent. However, CAGR of commercial vehicles (8.3 percent) is higher than the growth rate of private vehicles (8.1 percent). While, private vehicles (i.e. Cars and Two Wheelers) comprised of 94 percent and only six percent vehicles are commercial vehicles (i.e. Auto rickshaw, Taxies, Buses, Good Vehicles and E-rickshaw) to the total vehicle population. Maximum share is of Two-wheelers (64 percent) followed by Passengers cars (30 percent) and Commercial vehicles (6 percent). However, Delhi have also accounted for a new category of e- rickshaws of about 29,690 under registered vehicles during 2016-17. Table 5.1 shows the growth trend of registered vehicles in Delhi.

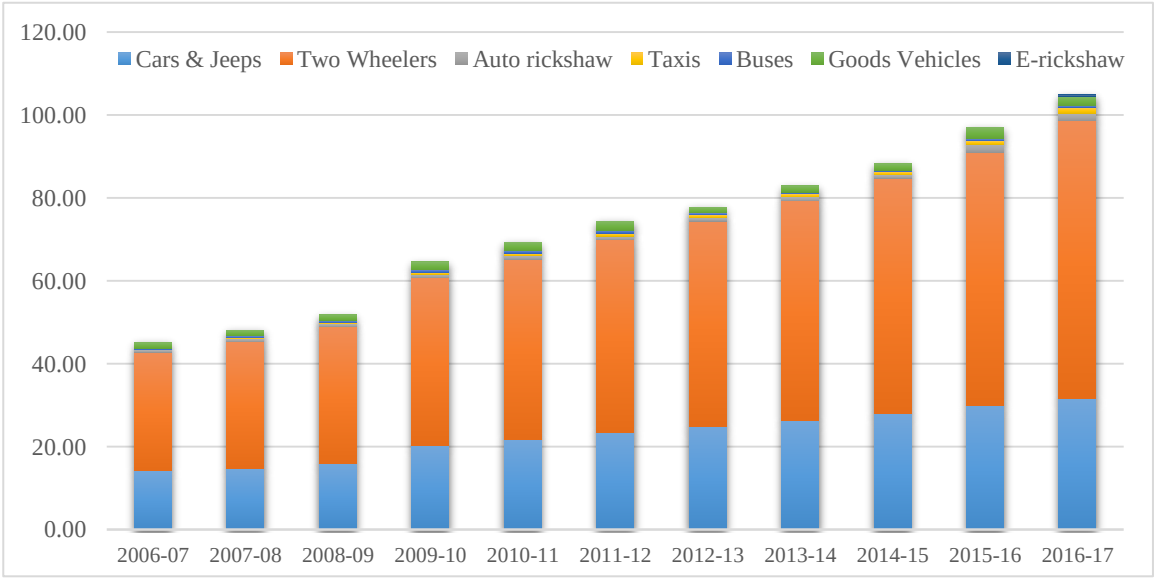
Table 5.1: Number of Registered Vehicles in NCT Delhi (2006-2017) (In Lakhs)

Year/ Category	Cars & Jeeps	Two Wheelers	Auto rickshaw	Taxis	Buses	Goods Vehicles	E-rickshaw	Total
2006-07	14.32	28.44	0.54	0.14	0.24	1.41	0.00	45.08
2007-08	14.67	30.63	0.74	0.21	0.44	1.42	0.00	48.09
2008-09	15.90	33.00	0.74	0.25	0.47	1.50	0.00	51.85
2009-10	20.14	40.55	0.86	0.45	0.58	1.93	0.00	64.52
2010-11	21.73	43.42	0.88	0.58	0.61	2.09	0.00	69.33
2011-12	23.43	46.44	0.88	0.70	0.64	2.29	0.00	74.38
2012-13	24.74	49.63	0.87	0.70	0.40	1.41	0.00	77.74

2013-14	26.29	52.98	0.92	0.79	0.41	1.55	0.00	82.93
2014-15	27.91	56.81	0.82	0.80	0.33	1.62	0.00	88.27
2015-16	29.87	61.04	1.98	0.91	0.44	2.81	0.00	97.05
2016-17	31.53	67.08	1.74	1.48	0.38	2.32	0.30	104.53
2017-18	32.46	70.78	1.13	1.18	.35			109.86
2018-19	32.49	75.56	1.13	1.09	.32			113.91

Source: Delhi Statistical handbook 2017 and Transport Department, Govt. of N.C.T. of Delhi.

Figure 5.1 Trend in registered vehicular growth in NCT Delhi (2000-2017) (in Lakhs)



Source: Delhi Statistical handbook 2017 and Transport Department, Govt. of N.C.T. of Delhi.

Table 5.2: No. of Private Vehicles (Car & TW) per 1000 persons

S. No.	Year	2000-01	2010-11
1	**No. of Private Vehicles (Car & TW)**	29,20,838	65,15,726
2	**Population (Census 2011)**	13850507	16787941
3	**Households (Census 2011)**	2554149	3340538
4	**No. of vehicles per 1000 persons**	211	388
5	**No. of Vehicles per Household**	1.1	2.0

Source: Estimated using secondary data from Census of India 2001 & 2011 and Economic Survey 2018-19.

It is observed that, growth of vehicular population increased drastically in NCT Delhi during last decade 2001-11, as vehicles per 1000 persons increased from 211 vehicles per 1000 persons in 2001 to 388 vehicles per 1000 persons in 2011. Similarly, the number of vehicles per household has increased from 1.1 in 2001 to 2.0 in 2011. Massive vehicular population of NCT Delhi ultimately adding to traffic congestion especially during peak hours causing loss of valuable man hours.

5.2.2 Existing Road Network

MPD 2021 defines road hierarchy in terms of NHs (90m above and not less than 60m within the city), Arterial roads (above 30m), Collector (12-30m) and Local streets (9-12m).

Existing road network of NCT of Delhi consists of both ring – radial road pattern. Broadly, the road network is designed for regional, intra - city and local traffic comprising of expressways, National Highways, ring roads and other urban roads. The total road length (km. lane) which was 14,316 km in 1981 increased to 28,508 km in 2001 and 33,198 km in 2014 respectively. Also,

Delhi has the highest road density of 2,103 km/100 sq.km followed by Haryana (59.30 km./100 sq.km.). Rajasthan and UP sub-regions have almost same road density of 51 km/100 sq.km.

The radials road network of NCT Delhi is comprised of National highways such as NH-44 (Old NH-1) towards north direction, NH-44 (Old NH-2) towards southern direction, NH-9 (Old NH-24) towards East direction, NH-48 (Old NH-8) in South-West direction and NH-9 (Old NH-10) in North-West direction. Apart from these Eastern Peripheral Expressway and Western Peripheral Expressway surrounding NCT Delhi are falling outside the boundaries which creates the largest Ring Road around Delhi and have been planned as regional bypasses and became operational recently. Additionally, Delhi Gurgaon Expressway, Yamuna Expressway, Delhi Meerut Expressway and Delhi Gr. Noida Flyway are also connecting Delhi with the region.

The two Ring roads of NCT Delhi, Inner Ring Road and Outer Ring Road constitute a distinct feature of the road network in Delhi, which also serve the daily inter-city commuters, having a combined length of 87 km. Also, in order to address the increasing traffic volume Urban Extension Roads (UER) I & II as part of Delhi Master Plan 2021 have been planned as new ring roads which are yet to be completed. In fact, the alignment of UER II has been designed to connect NH-1, NH-2, NH-8 and NH-10, passing through Dwarka, Najafgarh, Rohini and Narela.

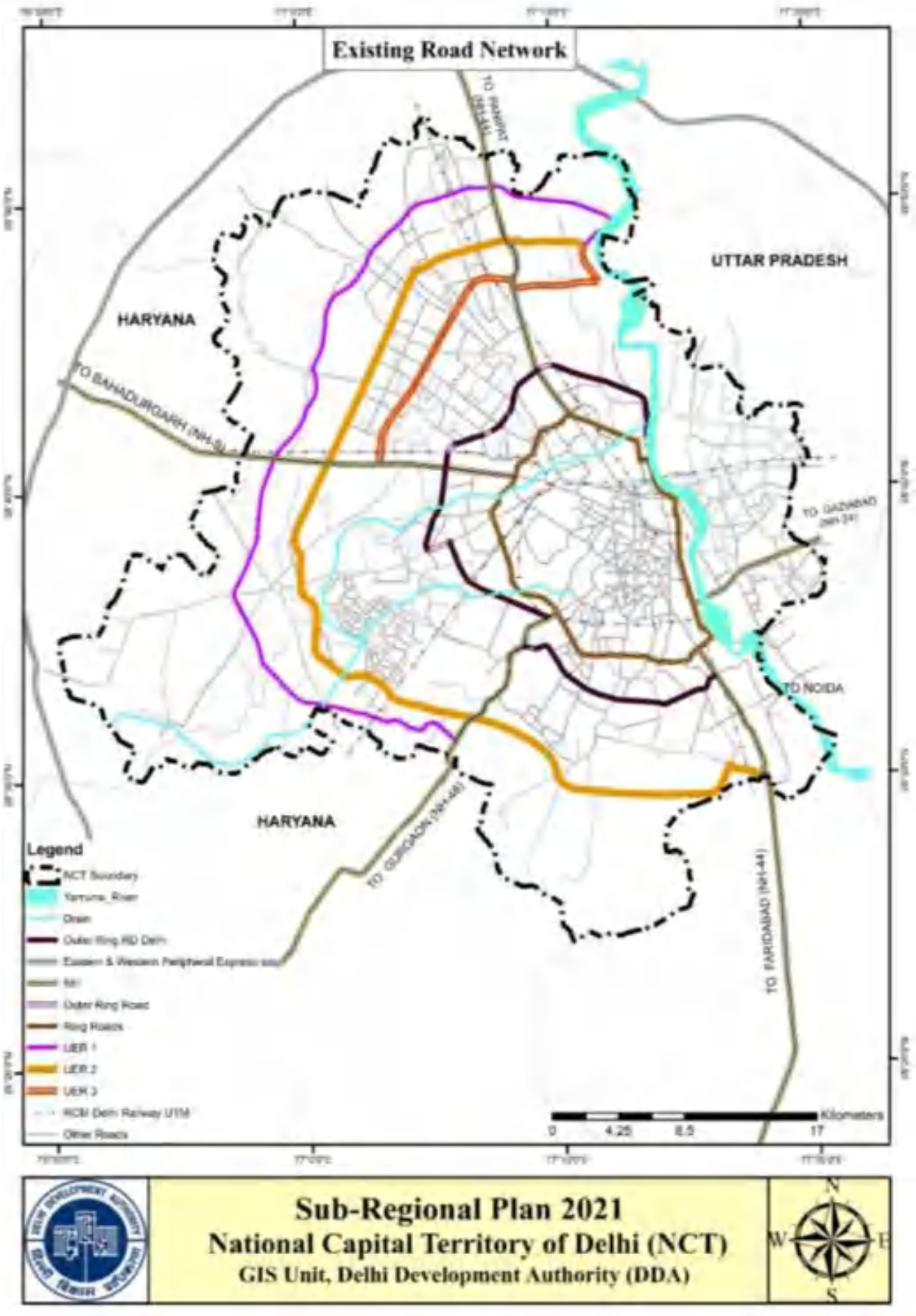
Road network in Delhi is being developed and maintained by multiple agencies such as National Highway Authority of India (NHAI), Public Works Department (PWD) of NCT Delhi, Municipal Corporations of Delhi, New Delhi Municipal Council (NDMC), Delhi Cantonment Board (DCB) and Delhi Development Authority (DDA) (Table 5.3). Jurisdiction wise road length of agencies are given in Table 5.3.

Table 5.3: Growth of road network in Delhi-agency-wise (in lane km.)

Sl. No.	Agency	2017-18
1	East DMC	512
2	South DMC	9592
3	North DMC	3273
4	New Delhi Municipal Council	1290
5	Public Works Deptt. (Delhi Govt.)	
	a. National Highway	430
	b. Other Roads	6308
6	DSIIDC	1537
7	I&FC	294
8	DDA	435

Source: Economic Survey of Delhi, 2018-19

Figure 5.2: Existing Road Network NCT Delhi



Source: Review Report of the Study Group - III (Transport): 2nd Review of Regional Plan-2021

5.2.3 Flyovers and Bridges

At present there are 85 numbers of flyovers including elevated roads of Barapullah Phase-II and Signature Bridge and RUB/ ROB has been completed at various places in Delhi. Elevated roads from Madhuban Chowk to Mukerba Chowk, Vikas Puri to Meera Bagh, Mangolpuri to Madhuban Chowk, Wazirabad to Mukerba Chowk have been opened for public.

5.2.4 NMT & Pedestrian Facilities

NMT i.e. walk, bicycle and cycle rickshaw modes are green modes of transport that are low carbon (or mostly zero-carbon) emitting, do not consume energy or cause pollution and in addition provide social equity and employment. Facilities for walk and bicycle should be citywide to assure the commuter that he can complete his journey all the way by walk or bicycle if he so chooses. Electronic Cycle rickshaw is a public mode of transport and best suited to provide the last mile connectivity as a part of an integrated citywide multimodal public transport network. NMT should get first priority in infrastructure development and funding. Funds allocation for major transport infrastructure should be linked to achieving targets for creating facilities for NMT.

NMT, which is envisaged to play critical role in the future as a link to public transit systems, as outlined in Delhi Master Plan -2021, also needs critical attention. With a mixed type of fast-moving traffic on the roads, travel by bicycle and rickshaws is very unsafe. As per MPD-2021, approximate 35 percent of population of Delhi owns cycles, only a fraction of them use cycles for commuting due to the lack of safe cycling facilities or cycle-parking facilities.

The modal share of walking and bicycling in Delhi's trips was very substantial. A survey of passenger trips was also done by RITES in 2001, which recorded 33 percent trips as walking trips and 3.6 percent as bicycling trips. In 2007-08, RITES carried out another Transport Demand Forecast Study- "without walk trips" which concluded that the share of bicycle in modal split increased from 5.3 percent to 6.8 percent. (DIMTS, 2011). Wilbur Smith Associates and Ministry of Urban Development (2008) found the modal share of walking and bicycling in Delhi to be 21 percent and 12 percent respectively. This was crucial as walking and bicycling were also the most prominent modes used by the urban poor in Delhi. At main arterial roads, there are very few pedestrian crossings and a few over bridges or subways. Approximately 83 numbers of foot over Bridges have also been completed at various places in Delhi by end of 2018.

5.2.5 Rail Network

In the National Capital Territory of Delhi both intercity and intra-city passenger movements are being catered to by the existing rail network comprising the Regional and Ring Rail Systems respectively. While, Delhi is the headquarter of the Northern Railways of Indian Railway and also a major railway junction having six major railway stations i.e. New Delhi, Old Delhi, Hazrat Nizamuddin, Anand Vihar, Delhi Sarai Rohilla and Delhi Cantt of NCT Delhi.

Table 5.4: Railway Network -NCT Delhi

S.no.	Regional Connectivity	To/From
1.	New Delhi – Faridabad – Palwal	Central and South India
2.	New Delhi – Sonipat – Panipat	Northern States
3.	New Delhi – Rohtak	Parts of Haryana & Punjab
4.	New Delhi – Gurgaon – Rewari – Alwar	Western India
5.	New Delhi – Shahdara – Shamli	Western UP

S.no.	Regional Connectivity	To/From
6.	Delhi – Ghaziabad – Khurja – Aligarh	Eastern India
7.	Delhi – Ghaziabad – Hapur	UP and Uttaranchal
8.	Delhi – Ghaziabad – Meerut	Western UP

Source: Functional Plan on Transport for National Capital Region-2032

Table 5.5: Following sub sections complete the rail network in NCT Delhi

i.	Delhi – New Delhi – Nizamuddin – Patel Nagar – Delhi Kishanganj – New Delhi/DLI
ii.	Delhi – Shahdara/Sahibabad – Anand Vihar- New Delhi/Delhi

Source: Functional Plan on Transport for National Capital Region-2032

A total of 837 trains, including long distance passenger trains along with 114 EMU trains (suburban trains) are operated through the three major railway stations of Delhi that is Old Delhi, New Delhi and Hazrat Nizamuddin. Apart from this, a large number of goods trains are also operated into and out of NCR. There is substantial daily commuter traffic from the adjoining areas of Delhi observed travelling between Delhi and NCR.

Table 5.6: Commuter Train Services for Different Stations in NCR

Sl. No.	Section	Type of Trains	Length in Kms
1	Delhi-Ghaziabad	EMU, MEMU,	20
1A	New Delhi-Ghaziabad	Conventional	25
2	Delhi-Palwal	EMU, MEMU, Conventional	60
3	H. Nizamuddin-H. Nizamuddin (Ring Rail)	EMU	35
4	Delhi-Rewari/ Alwar	Conventional, DMU	82
5	Delhi-Shakurbasti-Rohtak	EMU, Conventional	70
6	Delhi-Subzimandi-Panipat	EMU, MEMU, Conventional	88
7	Delhi-Ghaziabad-Meerut	Conventional, DMU	68
8	Delhi-Shamli	Conventional, DMU	87

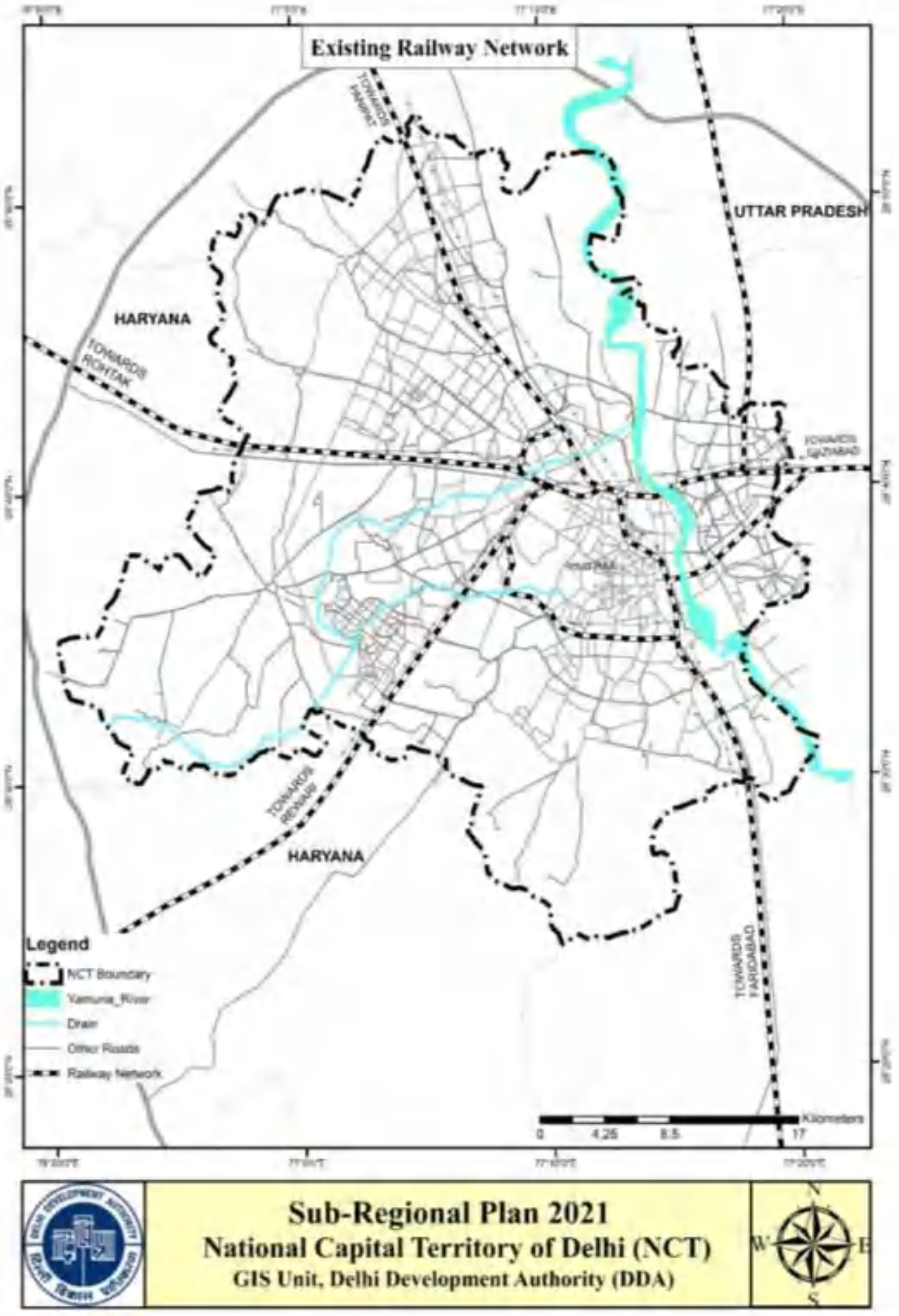
Source: Land-use and Transport Planning: Review of Regional Plan w.r.t. Transportation

Delhi ring railway is currently one of the most under-utilized public transport systems of Delhi. The existing 34 km long Delhi Ring Railway runs parallel to Ring Road and passes through several places, such as Safdarjung, Chanakyapuri, and Sorojini Nagar. The line was created in 1975 for the easy movements of goods trains in the city. During the 1982 Asian Games, the 35-km-long system was upgraded, with the addition of 24 trains.

During the 1980s and 1990s, the line was very popular among government servants as it crosses through areas like Lodhi Colony which has several government offices and quarters nearby. But despite lower fares, a perceived lack of safety and no upgrades to the existing line has meant passengers slowly migrated to alternative modes of transport. As the number of passengers reduced, so did the services. From 24 a day, the number of services reduced to eight and then to 4.

It is still a very affordable mode of transport for long distance commuters due to its speed and low cost. However due to bad connectivity to the station areas, lack of integration with Metro and bus stops, etc. it is not considered a desirable option for long distance commutes. This rail infrastructure highly understands and needs special attention to make it usable and attractive for the passengers to ease out the pressure on adjoining roads.

Figure 5.3: Existing Rail Network NCT Delhi



Delhi area handles tremendous volumes of coaching and freight traffic. The freight traffic has also grown at a fast pace. Delhi Area is a complex network of railway lines with coaching and freight traffic pouring in and out of eight radials. A large volume of traffic terminates within the area, but an equally large volume of traffic moves across from one radial to another. There are three main goods terminals at Tughlakabad, Shakurbasti and Delhi Kishanganj. Tughlakabad harbours an International Container Depot (ICD) which has grown at a fast pace and is already bursting at its seams. It handles a growing volume of domestic container traffic as well and is also the only marshalling yard now operational on Northern Railway. Two electric loco sheds, one at Tughlakabad and the other at Ghaziabad and two diesel loco sheds, one at Tughlakabad and the other at Shakurbasti are also situated in NCTD.

The operational problems confronting Delhi Area arise mainly from over-saturation of line capacity in certain sections like Delhi – Ghaziabad, Delhi –Shakurbasti and Delhi – New Delhi – Sahibabad etc. These are not only hindering traffic flows but could put future growth of traffic in jeopardy. Unfortunately, these congested sections pass along heavily built up urban areas. Capacity expansion of these sections is either physically impossible or prohibitively expensive. However, these sections should be protected from encroachment and illegal trespassing and upgrading, strength for better utilization.

NCT, has been witnessing a stupendous growth in passenger train handling. Till early, 60s, Old Delhi Station was the only (BG) coaching terminal. In the last 40 years, New Delhi, Nizamuddin and Anand Vihar stations have assumed a greater importance. In terms of passenger trains, the three terminals have seen remarkable growth.

5.2.6 Public Transport

Public transport in Delhi has two major components viz. bus transport and metro rail. These two major transport systems are playing a vital role in facilitating public transport in Delhi. In fact, both the systems are the lifeline of people of Delhi. At present, the daily ridership of Delhi Metro is 60 lakh in the year 2019-20. However, daily average passenger ridership on DTC and cluster buses is 29.86 lakh.

24. Mass Rapid Transit System (MRTS)

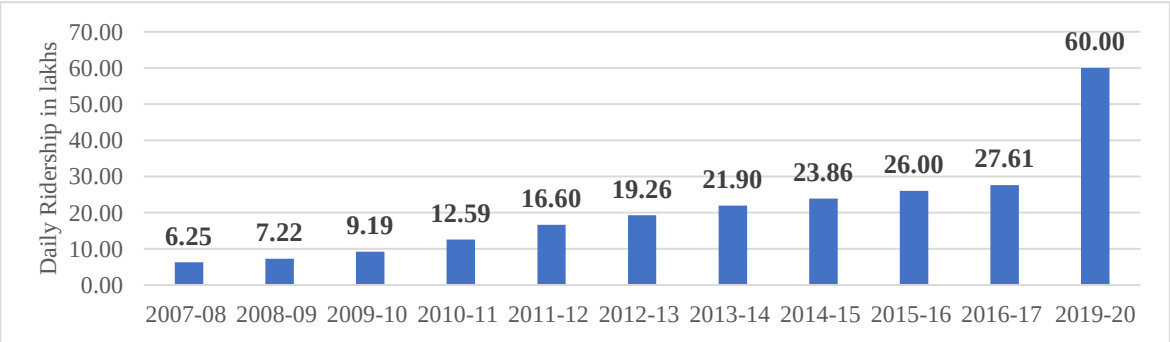
The Delhi MRTS project is being implemented by the Delhi Metro Rail Corporation (DMRC) Ltd. set up in May 1995 with equity participation by the GOI & GNCTD in the ratio of 50:50, i.e., equal participation. Presently, Delhi Metro has an operational network covering 348 km approx. Delhi and NCR (Gurgaon & Noida) with 254 operational stations.

Table 5.7: Average Daily Ridership Delhi Metro (2007-2018) (in Lakhs)

S. No.	Year	Average Daily Ridership
1	2007-08	6.25
2	2008-09	7.22
3	2009-10	9.19
4	2010-11	12.59
5	2011-12	16.60
6	2012-13	19.26
7	2013-14	21.90
8	2014-15	23.86
9	2015-16	26.00
10	2016-17	27.61
11	2017-18	25.38
12	2019-20	60.00

Source: Economic Survey of Delhi, 2018-19 & Delhi Metro Rail Corporation

Figure 5.4: Ridership/Day (in Lakhs)



Source: Economic Survey of Delhi, 2018-19 & Delhi Metro Rail Corporation

**the sudden increase in daily ridership in 2019-20 is resultant of opening of new metro lines and stations.*

The Delhi Metro is being built in phases with total length of:

i. Phase I completed 58 stations and 65.0 km of route length of which 13.0 km is underground and 52 km on surface or elevated. The inauguration of the Dwarka corridor of the Blue Line marked the completion of Phase I in October 2006.

ii. Phase II of the network comprises 124.6 km of route length and 85 stations, and is fully completed, with the first section opened in June 2008 and the last line opened in August 2011.

iii. Phase-III includes 11 extensions to the existing lines as well as building two ring lines (Pink and Magenta lines). Phase-III has 28 underground stations, two new lines and 11 route extensions, totalling 159.57 km. with 108 stations is completed and commissioned, while balance 3.08 km. with two stations is in progress.

iv. Phase IV with three routes (two extensions and one new line) with total length of 61.679 km. and 46 stations were approved in March 2019 and expected to be completed by 2025 (Table 5.8).

Table 5.8: Metro Corridors Operational and Proposed in NCR

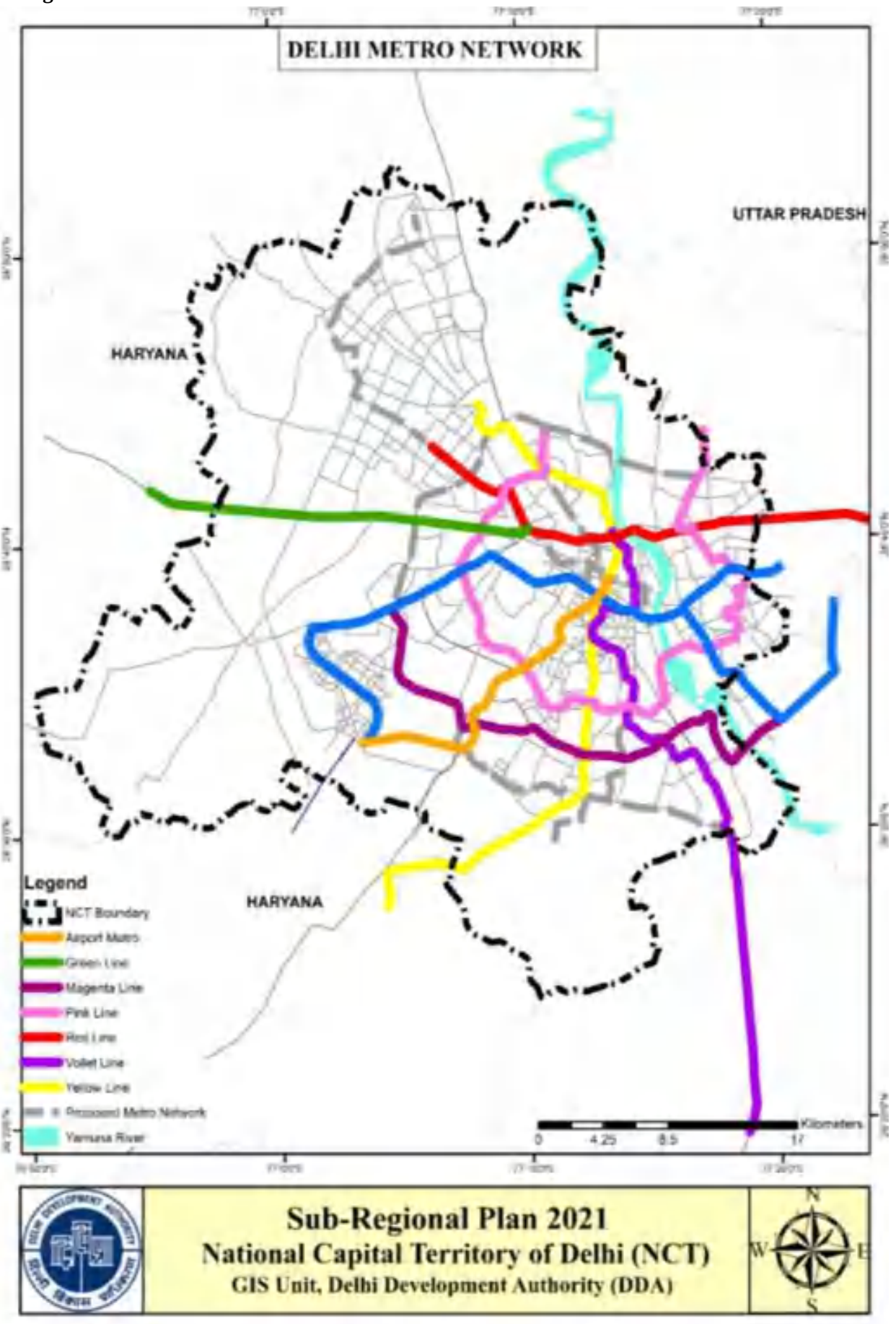
Line No.	Line Name	Stations	Length (km)	Terminals	
Phase 1 Network					
1	Red Line	6	8.30	Shahdara	Tis Hazari
		4	4.10	Tis Hazari	Trinagar (Now Inderlok)
		8	8.90	Inderlok	Rithala
2	Yellow Line	4	4.00	Vishwa Vidyalaya	Kashmere Gate
		6	6.84	Kashmere Gate	Central Secretariat
3	Blue Line	22	22.90	Dwarka	Barakhamba Road
		6	6.50		Dwarka Sector 9
		3	2.80	Barakhamba Road	Indraprastha
Sub total		**59**	**65.00**		
Phase 2 Network					
1	Red Line	3	3.09	Shahdara	Dilshad Garden
2	Yellow Line	5	6.36	Vishwa Vidyalaya	Jahangirpuri
		9	14.50	Huda City Centre	Qutab Minar
		1		Chhatarpur	
		9	12.53	Qutab Minar	Central Secretariat
3	Blue Line	1	15.07	Indraprastha	Yamuna Bank
		10		Yamuna Bank	Noida City Centre
		2	2.76	Dwarka Sector 9	Dwarka Sector 21
4	Blue Line Branch	6	6.17	Yamuna Bank	Anand Vihar ISBT

Line No.	Line Name	Stations	Length (km)	Terminals	
		2	2.57	Anand Vihar ISBT	Vaishali
5	Green Line	14	18.46	Inderlok	Mundka
		2		Ashok Park Main	Kirti Nagar
6	Violet Line	13	13.60	Central Secretariat	Sarita Vihar
		3	4.20	Sarita Vihar	Badarpur
Airport	Orange Line	4	22.70	New Delhi	Dwarka Sector 21
		2		Dhaula Kuan & Delhi Aerocity	
Sub total		**86**	**124.90**		
Phase 3 Network					
1	Red Line	8	9.56	Dilshad Garden	Shaheed Sthal(New Bus Adda)
2	Yellow Line	3	4.37	Jahangirpuri	Samaypur Badli
		1	1.06	Samaypur Badli	Siraspur
3	Blue Line	6	6.68	Noida City Centre	Noida Electronic City
5	Green Line	7	11.18	Mundka	Brigadier Hoshiyar Singh
6	Violet Line	7	9.37	Central Secretariat	Kashmere Gate
		9	13.88	Badarpur	Escorts Mujesar
		2	3.21	Escorts Mujesar	Raja Nahar Singh
7	Pink Line	12	21.56	Majlis Park	Durgabai Deshmukh South Campus
		6	8.10	Durgabai Deshmukh South Campus	Lajpat Nagar
		15	17.80	Trilokpuri Sanjay Lake	Shiv Vihar
		5	9.70	Lajpat Nagar	Mayur Vihar Pocket I
		0	1.50	Mayur Vihar Pocket I	Trilokpuri Sanjay Lake (Expected : June 2020)
8	Magenta Line	2	3.96	Kalindikunj	Botanical Garden
		23	34.27	Janakpuri West	Kalindi Kunj
9	Grey Line	3	4.30	Dwarka	Najafgarh
		1	1.18	Najafgarh	Dhansa Bus Stand Expected : December 2020)
Airport	Orange Line	1	1.88	Dwarka Sector 21	ECC Centre (Expected : December 2020)
Sub total		**108**	**158.57**		
Phase 4 Network					
1		15	20.20	Aero City	Tughalakabad
2	Magenta line	25	28.92	Janakpuri West	R. K. Ashram
3	Pink Line	6	12.54	Mukundpur	Maujpur
Sub Total		**46**	**61.66**		
Total		**300**	**410.54**		

Source: Delhi Metro Rail Corporation ltd.(http://www.delhimetrorail.com/project_updates.aspx)

Regional Plan-2021 for NCR proposed the extension of Delhi Metro Rail System to NCR towns. Accordingly, it has now been extended to Noida, Gurgaon, Ghaziabad, Faridabad and Bahadurgarh.

Figure 5.5: Delhi Metro Network



25. Bus Transport System

The Intercity buses between NCT Delhi and NCR/other states are also operated by the Uttar Pradesh SRTC (UPSRTC), Haryana Roadways (HR), PEPSU Road Transport Corporation (PRTC), Punjab Roadways (PR), Himachal RTC(HRTC), J&K RTC (JKRTC), Rajasthan State RTC (RSRTC), etc., besides some buses operated by private persons.

Apart from this, Delhi Transport Corporation (DTC) also operated its bus services with 3951 buses during 2017-18, on existing network of 453 city routes and eight NCR routes. About 191 km per bus per day is vehicle utilization with fleet utilization of 85.7 percent. In the year 2017-18, daily average passengers have declined to 29.86 lakhs from previous years. DTC operates two types of buses, the Red colored buses (Air Conditioned) and Green colored buses (Non-Air Conditioned). DTC has also been operating International Bus Service on Delhi – Lahore & Delhi – Kathmandu routes. Daily average passengers were about 30 lakhs during 2017-18. Common Mobility Cards have been implemented in all DTC Buses. Automated fare collection system through electronic ticketing machines is being rolled out. The performance of DTC during 2005-06 to 2017-18 is presented in Table 5.9.

Table 5.9: Performance of Delhi Transport Corporation (DTC)

S. No.	Years	Fleet (In no's)	Fleet Utilization (In percent)	Vehicle Utilization (Km/Bus/Day)	Daily Average Passengers (In Lakh)
1	2005-06	3469	90.51	226	30.52
2	2006-07	3444	81.47	199	26.77
3	2007-08	3537	82.47	177	24.04
4	2008-09	3804	77.03	171	22.62
5	2009-10	4725	80.99	184	24.16
6	2010-11	6204	75.03	185	30.32
7	2011-12	5892	84.27	199	44.2
8	2012-13	5445	85.77	202	46.77
9	2013-14	5223	85.51	190	43.47
10	2014-15	4712	83.99	188	38.87
11	2015-16	4352	83.63	191	35.37
12	2016-17	4027	85. 12	199	31.55
13	2017-18	3951	85.69	191	29.86
14	2018-19	3849	84.62	195	30.15

Source: Economic Survey of Delhi, 2018-19

The Government of NCT of Delhi initiated the Scheme in 2011-12 for Corporatization of Private Stage Carriage Service to substitute the Blue line private stage carriage system under the Public Private Partnership (PPP) model. Under this scheme, 657 stage carriage bus routes of Delhi have been divided into 17 distinct clusters. Presently, approximate1744 cluster buses are operating in 08 clusters in the NCT of Delhi. Electronic Ticketing Machine based Automatic Fare Collection System in Cluster Buses has been fully implemented. Further, Common Mobility Card (Delhi Metro Smart Card) has been successfully implemented in all the cluster buses to promote digital transaction in fare collection from passengers.

Table 5.10: Performance of Cluster Buses

S. No.	Years	Fleet (No)	Fleet Utilization (In percent)	Vehicle Utilization (Km/Bus/Day)	Daily Average Passengers (In Lakh)
1	2013-14	1090	93.5	218.4	6.36
2	2014-15	1402	97.3	217.6	9.95
3	2015-16	1490	98.8	214.5	10.61
4	2016-17	1651	98.1	210.1	10.25
5	2017-18	1744	97.1	205.2	11.65
6	2018-19	1803	98.66	211.02	12.24

Source: Economic Survey of Delhi, 2018-19, DIMTS Ltd.

Master Plan of Delhi- 2021 suggested five ISBTs for Delhi. The major inter-state bus terminals (ISBT) operated by Delhi Transport Infrastructure Development Corporation Limited (DTIDC) include, Maharana Pratap Inter State Bus Terminus, Kashmere Gate, Veer Hakikat Rai Inter-State Bus Terminus, Sarai Kale Khan and Swami Vivekanand Inter State Bus Terminus, Anand Vihar. Two more ISBTs are proposed to be constructed at Dwarka and Narela. ISBT, Kashmere Gate has been renovated and made operational with state-of-the-art facilities in May' 2013. Process for the renovation of ISBTs at Anand Vihar and Sarai Kale Khan will be initiated by PWD. The work of Sarai Kale Khan ISBT is proposed to be undertaken in two phases.

DTC has 43 bus depots and 26 bus terminals, and with the new acquisition of a bus fleet under the cluster scheme and purchase of new buses by DTC, the Transport Department will require additional bus depots. Due to the scarcity of land, the statutory authorities are pressing hard to have multi-level bus depots in place of the conventional bus depots. Bus Depots at Dichaun Kalan, Bawana Sector 1, Rani khera 1, 2, 3 and Dwarka Sector 22 have been constructed. Bus Depot at Rewla Khanpur and Kharkhri Nahar is also almost completed. Further bus depots at East Vinod Nagar, Bawana sector 5, Gumanhera, Mundela Kalan, Rohini Sector-37 and Burari are under progress (Economic Survey of Delhi, 2018-19).

5.2.7 Intermediate Public Transport (IPT)

NCT Delhi has a variety of para-transit modes varying from metro feeder buses, cycle rickshaws, auto-rickshaws, e rickshaws, minivans, etc. These modes function as the major feeder services for the high-speed metro rail system of the city, and commuters are dependent on these feeder services for first and last mile connectivity. However, due to the lack of focus on efficient last mile connectivity, these feeder services are generally unreliable, uncomfortable, unorganized and often dangerous. Unorganized IPT System leads to the encroachment of carriageway which leads to traffic congestion near transport interchanges i.e. Metro Stations & bus stops.

As per the report of Centre for Public Policy Research (CPPR) "An Assessment of the Intermediate Public Transport (IPT) Sector in India". In Delhi, more than 70 per cent of metro users mentioned issues related to last mile connectivity, and the average time spent and cost incurred in commuting the last mile is considerably high (more than 15 minutes). More than 55 per cent of private vehicle users cite reasons directly or indirectly related to first or last mile connectivity for not utilizing the Delhi metro. About 58 per cent of them are willing to use the metro if sufficient first/ last mile connectivity in the form of efficient feeder services are provided

along with park and ride facilities. This clearly indicates the lack of importance given to first and last mile connectivity in the overall functioning of a public transportation system.

5.2.8 Airport

Indira Gandhi International Airport (IGIA) is the primary civil aviation hub for India and the National Capital Region of India. It is spread over an area of 5106 acres (2066 Ha), situated in Palam, South-West of New Delhi. IGI Airport is the busiest airport in India in terms of passenger traffic and second busiest in term of cargo traffic. The overall airport infrastructure has the capacity to handle 62 MPPA (Million Passengers per annum) and Cargo handling capacity of 1.5 MMTPA.

It handled around 69.90 Million Passengers and 1,031,659 Tons of Cargo in the year 2018. It has three operational runways with a peak hour handling capacity of 82 aircrafts movement in Nov, 2016. There are three separate terminal areas for domestic passengers, international passengers and cargo. Only 1,907 acres is currently in use. The international passenger traffic at Delhi airport is observed to be 30 percent of the total passenger traffic. However, the international cargo traffic is 65 percent of the total cargo traffic. IGI Airport handles more than 1100 aircraft movements daily. In addition to seven domestic carriers, it is severed by 56 international carriers.

5.2.9 Freight transport

26. Dedicated Freight Corridors (DFC)

In view of growing demand of high speed and high capacity trains, Indian Railway proposes to segregate passenger and goods train movements. It is proposed to develop dedicated fright corridors with high geometric, engineering and other standards. The goods trains are proposed to run at an average speed of 50-60 kmph (maximum speed 100 kmph), with a heavier axle load of 32.5 tonnes and a longer tracking load of 15,000 tonnes. The train lengths would be longer (1500 meters) with a new wagon design with increased height and width that would enable double stack container service. presently, two corridors namely Western Dedicated Freight Corridor and Eastern Dedicated Freight Corridor have been approved for development.

The western corridor covers a distance of 1483 km of double line electric (2 X 25 KV) track from JNPT to Dadri via Vadodara-Ahmedabad-Palanpur-Phulera-Rewari. In addition, a single line connection of 32km long from proposed Pirthala Junction Station (near Asaoti on Delhi-Mathura line) to Tughlakabad is also proposed to be provided.

27. Integrated Freight Complex

Apart from the road system, the IFCs need to be integrated with the regional rail system. IFCs at all the regional urban nodes integrated with the Outer Grid Road/Expressway Systems are proposed. They are namely Sonipat, Baghpat, Bahadurgarh, Ghaziabad, Jhajjar, Gurgaon, Bulandshahr, Palwal and other towns like Alwar, Behror, Shahjahanpur or Neemrana. Master Plans need to be reviewed and revised to provide for their land use allocating adequate extent of land and integrating the same with intra-urban transport network system.

28. Logistics Hubs/Inland Container Depots/Yards

Dadri-Noida-Ghaziabad Investment Region is one amongst the seven Investment Region that are to be developed along with support infrastructure as part of first phase of DMIC project. It

is one of the key nodes as it is located at the termination of Western Dedicated Freight Corridor and also links the proposed Eastern Dedicated Freight Corridor.

The proposed two Dedicated Freight Corridors (DFC) viz. Eastern and Western DFC run through the region and meet at Dadri through feeder. In addition to the rail terminal at Dadri, a major Logistics Hub/ Container Yard need to be developed at Dadri. Presently there are a number of Inland Container Depots (ICDs) along existing rail network at following locations:

i. Loni
ii. Dadri
iii. Tuglakabad
iv. Faridabad
v. Patli
vi. Garhi Harsaru

5.3 Road Safety

In 6,515 accidents on Delhi's roads last year, 1,690 persons were killed and 6,086 were injured. It clearly reflects about 4.6 person killed and 18 persons injured on every day on Delhi roads. While the number of deaths rose by 6.7 percent over the previous year, the accidents dipped by 2.4 percent and injuries by 7.8 percent. The speeding caused more than 44 percent of all 1,690 accidental deaths on Delhi's roads last year even as the national capital accounted for the most road fatalities among all Indian cities in the last two years.

S. No.	Year	Total Accidents		Persons Injured		Persons Killed	
		Numbers	% increase	Numbers	% increase	Numbers	% increase
1	2008	8435		7343		2093	
2	2009	7516	-10.9	6936	-5.5	2325	11.1
3	2010	7260	-3.4	7108	2.5	2153	-7.4
4	2011	7280	0.3	6975	-1.9	2110	-2.0
5	2012	6937	-4.7	6639	-4.8	1866	-11.6
6	2013	7566	9.1	7098	6.9	1820	-2.5
7	2014	8623	14.0	8283	16.7	1671	-8.2
8	2015	8085	-6.2	8258	-0.3	1622	-2.9
9	2016	7375	-8.8	7154	-13.4	1591	-1.9
10	2017	6673	-9.5	6604	-7.7	1584	-0.4
11	2018	6515	-2.4	6086	-7.8	1690	6.7

Source: Delhi Traffic Police

5.4 Traffic and Travel Characteristics

5.4.1 Passenger traffic Characteristics

29. Average Daily Traffic (ADT)

As Functional Plan on Transport for NCR-2032, it was observed that NCR is a high movement area with high intensity traffic of all types. It shows that 2,21,575 vehicles (3,50,694 PCUs) enter and exit NCR (Outer Cordon) on an average per day (2007). In NCR, National

Highways account for 75 percent (vehicles) of the total traffic volume. The traffic volume increased to 2,72,891 vehicles (3,87,565 PCUs) at the Middle Cordon (CNCR boundary); and reached a high of 12,10,896 vehicles (12,27,873 PCUs) at Inner Cordon (NCT-Delhi boundary).

The traffic volume was 12,10,896 vehicles (12,27,873 PCUs) at NCT-Delhi boundary, of which 11,07,043 are of passenger modes and 1,03,853 are of goods modes. Out of 11,07,043 of the passenger modes, cars accounted for a maximum share (60.7 percent) followed by 2- wheelers (33.4 percent). Autos accounted for 3.6 percent and Buses for 2.3 percent (Figure 5.6).

Figure 5.6: Model split of Passenger mode.

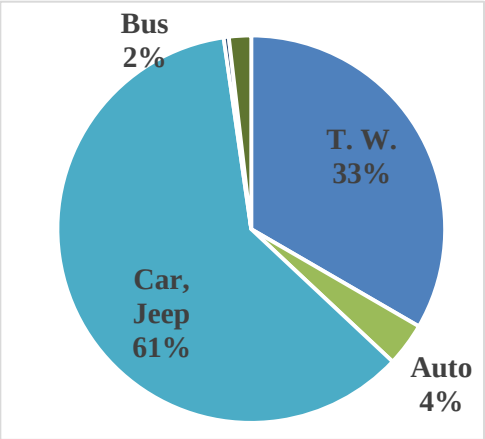
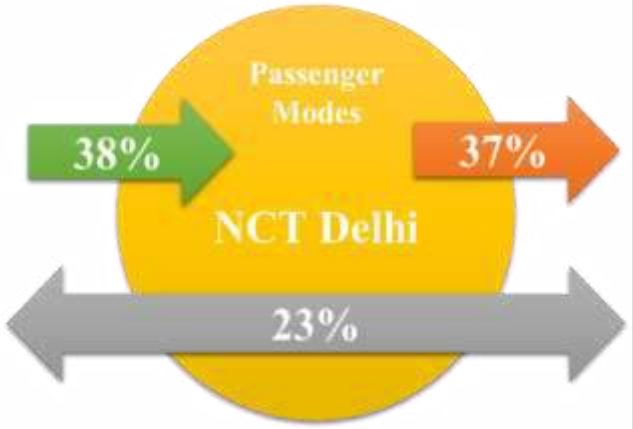


Figure 5.7: Inter-city movement pattern of Passenger Mode in NCT Delhi



Source: Functional Plan on Transport for National Capital Region-2032

The interspatial movement pattern shows that about 37 percent of passenger modes were destined outside NCT Delhi and 38.4 percent passenger modes destined to within NCT Delhi, while 22.9 percent passenger modes observed to be originated and destined from outside of NCT Delhi in a day. In the out bound passenger modes of NCT Delhi, the Interestingly share of movements between NCTD and Rest of NCR (36.21 percent) were almost equal to that between NCTD and CNCR (36.20 percent). The share of internal movements within the boundaries of NCT Delhi is observed negligible (2 percent) (Figure 5.7).

30. Volume / Capacity Ratio

As per the survey conducted by RITES for Government of Delhi in 2007, V/C ratio varied between 1.01 to 2.83 on major roads in Delhi which is higher than 0.7 for urban roads as envisaged in IRC- 106-1990. Table 5.11 showing V/C ratio on some of the important roads in Delhi.

Table 5.11: Volume-Capacity Ratio on Delhi Roads

S. No.	Name of Location	V/C
1	D.B. Gupta Road (near Police Station)	2.83
2	Mahatma Gandhi Road (near Venkteswara College)	2.09
3	Swarn Jayanti Marg (near Dhaula Kuan)	2.08
4	Shakurpur Road (near Britania Chowk)	2.03
5	Mathura Road (near New Friends Colony)	1.94
6	Guru Gobind Singh Marg (near Tibbia College)	1.83
7	Vivekanand Marg (near Minto Bridge)	1.79

S. No.	Name of Location	V/C
8	Dr. B.R. Ambedkar Marg (near Madangir)	1.61
9	Qutabgarh Road (near Krishna Vihar)	1.55
10	Parpar Gunj Road (near Choudhary Hospital)	1.43
11	Outer Ring Road (near Soami Nagar)	1.40
12	Shaheed Jagat Narayan Marg (near Sarvodaya Hospital)	1.39
13	G.T. Road (near Jahangirpuri Ind. Area)	1.38
14	Rao Tula Ram Marg (near Hanuman Mandir)	1.38
15	Shivaji Marg (near Uttam Nagar West Metro Station)	1.37
16	Olf Palame Marg (near Malai Mandir)	1.34
17	M.G. Road (near Rajghat)	1.34
18	Outer Ring Road (near Santom Hospital)	1.28
19	Mehrauli Badarpur Road (near Pushpa Vihar Sec-2)	1.27
20	Deen Dayal Upadhyay Marg (near ITO)	1.26
21	Dr. K.B. Hedgewar Marg (near Peera Garhi)	1.26
22	Rohtak Road (near Engineering College)	1.23
23	Rohtak Road (near Maharaja Surajmal Stadium)	1.18
24	Mayapuri Road (near DMS Colony)	1.11
25	Mandir Marg (near DAV School)	1.03
26	Outer Ring Road (near Nirankari Satsang Ground)	1.01
27	Maharaja Aggarsen Marg (near District Park)	1.01
28	Loni Road (near Jyoti Nagar East)	0.94

Source: RITES Study 2010

31. Occupancy

The average occupancy of two wheelers, three wheelers, and Car/Jeep were 1.59, 2.93 and 2.79 respectively. Buses showed a lower occupancy level 39.77 and mini buses also showed a much lower occupancy level 11.18.

32. Trip Length Frequency

Buses had the longest trip length (121.86) as compared to other modes. In the observed passenger mode trips, about 84 percent of the total trips were less than 50 km in length. While, the trip length of passenger modes observed as 87 percent of 2-wheelers were in the band 0-25 km, 89 percent of 3-wheelers had distributed trip lengths up to 100 km and buses had fairly distributed trip lengths up to 250 km.

33. Vehicle Trip Purpose

'Work' and 'Business' were the major purposes accounting for 32 percent and 23 percent of the total trips respectively. Social trips were also high at 13.0 percent. Education trips were low (2.3 percent). By mode, share of two wheelers, three wheelers, cars and mini buses for 'work' and business' purpose were reasonably high.

5.4.2 Travel Pattern Characteristics

As per the study conducted by RITES in 2010, NCT Delhi observed with total 151 lakhs person trips in which Intra-City motorized person trips were 117 lakhs in 2007 and 33.4 lakh Inter-city trips per day. In the modal share private modes (i.e. Two wheeler & Cars) were contributing 41 percent of trips and public transport modes (i.e. Auto, Bus, Metro, Trains) had only 59 percent share.

Table 5.12: Daily Trips with modal share in 2007 as per RITES Study 2010.

S No	Mode	Daily Trips	Share (%)
1	Car	2902120	19.2
2	Two Wheeler	3250755	21.5
3	Auto	1028622	6.8
4	Bus	7276892	48.2
5	Metro	552745	3.7
6	Train (Intra Delhi)	89623	0.6
	Total Trips	15100757	100

Source: Transport Demand Forecast Study and Development of an Integrated Road cum Multi-modal Public Transport Network for NCT of Delhi, 2010.

As per Modal Split (2001) among the vehicular trips, maximum 60 percent trips are being performed by buses, which include chartered and school buses. The personalized modes of transport are carrying about 35.9 percent of vehicular trips. In the total trips, 77 percent trips were having intra-city movement and only 23 percent trips were observed with inter-city movement (Table 5.13).

Table 5.13: Intra-city and inter-city trips in NCT Delhi

S No.	Mode	Total Daily Trips	Intra-city trips		Inter-city trips	
			Daily Trips	Share (%)	Daily Trips	Share (%)
1	Car	29,02,120	18,06,380	62.2	10,95,740	37.8
2	Two-Wheeler	32,50,755	29,76,832	91.6	2,73,923	8.4
3	Auto	10,28,622	5,18,329	50.4	5,10,293	49.6
4	PT	79,19,260	63,69,088	80.4	15,50,172	19.6
Total		**1,51,00,757**	**1,16,70,629**	**77.3**	**34,30,128**	**22.7**

Source: Transport Demand Forecast Study and Development of an Integrated Road cum Multi-modal Public Transport Network for NCT of Delhi, 2010.

Different studies conducted so far on Transportation, Planning and Traffic engineering indicates that the per capita trip rate (PCTR) (excluding walk trips) has increased from 0.72 in 1981 to 0.87 in 2001. Maximum trips observe for the Educational (38 percent) purpose followed by work (30 percent), Business (15 percent) and other (15 percent) (Table 5.14).

Table 5.14: Trips by purpose (2007)

S. No.	Purpose	No of Trips	Percentage share
1	Work	3565076	30.7
2	Business	1744187	15.0

S. No.	Purpose	No of Trips	Percentage share
3	Education	4493185	38.7
4	Other	1816619	15.6
	Total	**11619067**	100.0

Source: Transport Demand Forecast Study and Development of an Integrated Road cum Multi-modal Public Transport Network for NCT of Delhi, 2010.

5.4.3 Freight movement Characteristics

Out of 1,03,853 goods mode crossing at NCT Delhi boundaries, 30.5 percent modes were destined outside NCT Delhi, which is very high. Apart from this It is also observed that 38.6 percent of goods mode were entering Delhi and 29.9 percent of goods mode were originated and distend outside the NCT Delhi boundaries. The significant share of outbound originated & destined movements stressed the need for a bypass orbital road system around NCTD. The share of internal movements within NCT Delhi boundaries were observed negligible (one percent) and has hence been excluded in further analysis. However, out of 1,03,853 goods mode, 2/3 Axle Truck had the maximum share (55 percent) followed by LCVs (37.3 percent), MAVs (5.0 percent) and tractors (2.7 percent) accounted for a low share (Figure 5.8 & Figure 5.9).

Figure 5.8: Model split of Goods mode.

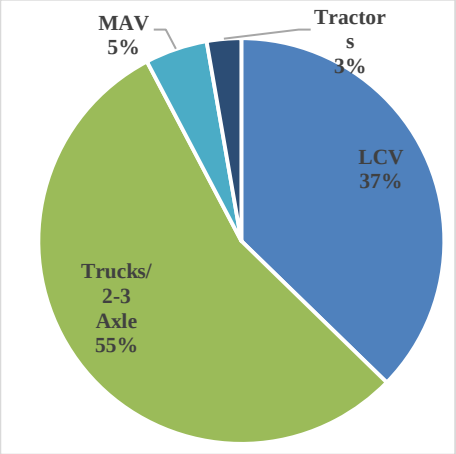


Figure 5.9: Inter-city movement pattern of Goods Mode in NCT Delhi

Source: Functional Plan on Transport for National Capital Region-2032

In goods vehicles, a high share of modes (ranging from around 30-33 percent in MAVs and 2/3 axle trucks to around 40 percent in Tractors and LCVs) were empty. Excluding empty vehicles, the average load of MAVs was 10.3 tonnes and 2/3 Axle Trucks was 7.8 tonnes. About 27.2 percent of the MAVs were found to carry loads greater than 15 tonnes. Agricultural tractors were generally found to carry loads up to five tonnes. Fruits & Vegetables and Building Materials were the major commodities carried by the different types of goods modes. A high share of MAVs carried Petroleum Products (12.8 percent) and Manufacturing products (11.2 percent). A high proportion of Tractors carried Petroleum products (15.0 percent) and Milk, Poultry, Livestock (12.6 percent). The observed trip length shows that, MAVs had the longest trip length of 163 km followed by 2/3 Axle Trucks at 139 km. The trip length for LCV and Tractor was 96 km and 84 km respectively.

Presently the goods carried by rail from the neighboring areas terminate at the following places.

i. Iron and Steel at Tuglaqabad (Bahadurgarh) thereafter by road to Naraina

ii. Food Grains at Delhi Cantt., Narela, Ghevra
iii. Fruits and Vegetables at Naya Azadpur
iv. Fuel at Shakur Basti
v. Cement at Shakur Basti, Naya Azadpur, Safdarjung Rail siding.

5.5 Travel Demand Forecast

The travel demand forecasting indicates estimated number of people or vehicles utilizing various transportation facilities in the future. It can be applied under variety of situations with different modes of transport, from estimating traffic volumes on a specific segment of road or highway, to passenger volumes on a city's buses etc.

In NCT Delhi, the phenomenal increase observed in growth of the vehicular population from 2001 to 2017 with the CAGR of 7.21 percent. However, there has been a rise in per capita trip rate (excluding walk trips) from 0.72 in 1981 to 0.87 in 2001 and expected to increase by 1.2 per capital trip rate by 2021. As per the Transport Demand Forecast Study (TDFS) undertaken by GNCTD and approved by the UTTIPEC in 2011, it is seen that between 2001 and 2008, the private motor vehicle trips have increased from 28 percent to 35 percent and non-motorized vehicle trips from nine percent to 15 percent, however bus trips decreased from 60 percent to 42 percent of the total number of trips. The Master Plan Delhi 2021 recommends following Modal Split projected for 2011 and 2021:

Table 5.15: Modal Split for public and private modes

S. No.	Mode	Modal Split (%)		
		2001 (Actual)	2011	2021
1	Public Transport (including Rail/ Light Rail /MRTS/IRBT/Bus/ Tram)	64.1	70.25	80
2	Personal modes (including Personal Fast Modes/ Hired Fast Modes/ Hires Slow Modes/Bicycle)	35.9	29.75	20

Source: Master Plan Delhi 2021

Similarly, the observed increase in per capita trip rate and population growth translates into an increase from 45 lakh trips to around 118 lakh trips in 2001 and 144 lakh trips till 2008 as estimated under Master Plan Delhi 2021. Therefore, based on the rate of increase in the number of trips between 1981 and 2001/2011, that the total trips would rise to 280 lakhs by the year 2021, including 257 lakhs motorized trips and 23 lakh non-motorized trips.

Table 5.16: Estimated Trips in Delhi in 2021 (MPD 2021)

S. No.	Modes	Number of trips (in lakhs)	% Share
1	Metro	108	38.6
2	Buses & Train	98	34.9
3	Private Modes	51	18.4
4	NMT	23	8.1
	Total	**280**	**100.0**

Mass Rapid Transit System may be defined as any system with capacity to carry greater than 10,000 persons per hour per direction. The Metro Rail System is one of the most important component of a Mass Rapid Transport System (MRTS) in the City. The Metro Rail network for the entire city has been identified in various phases, which comprises of a network of underground, elevated and surface corridors aggregating to more than 300 Kms. and is expected to carry 108 lakh daily passengers with an average trip length of 15 Km. by 2021.

5.6 Issues and Challenges

1. Amongst metro cities in India NCT Delhi has the highest number of registered vehicles (88.5 lakhs) in the year 2014-15, followed by Bengaluru (55.6 lakhs), Chennai (49.3 lakhs), Gr. Mumbai (25.7 lakhs) and Hyderabad (23.7 lakhs).
2. Growth of vehicular population increased drastically in NCT Delhi during last decade 2001-11,
    - Private vehicles (Cars & T.W.) per 1000 persons increased from 211 (2001) to 388 (2011)
    - Private vehicles per household has increased from 1.1 in 2001 to 2.0 in 2011
    - Private vehicles (i.e. Cars and Two Wheelers) comprised of 94 percent and only six percent vehicles are commercial vehicles (i.e. Auto rickshaw, Taxies, Buses, Good Vehicles and E-rickshaw) to the total vehicle population.
    - Road network increased very marginally (about 2.3 percent) while number of registered vehicles increased drastically (about 19.6 percent) during 2010-2013
    - Massive vehicular population of NCT Delhi ultimately adding to traffic congestion especially during peak hours causing loss of valuable man hours
3. Ring railway system is currently one of the most under-utilized public transport systems of Delhi. It is still a very affordable mode of transport for long distance commuters due to its speed and low cost
    - Due to bad connectivity to the station areas, lack of integration with Metro and bus stops, etc. and it is not considered a desirable option for long distance commutes
4. Even after the introduction of Phase 3 - Metro daily average ridership slightly declined to 25.38 lakhs, may be due to increase in fare and created unaffordability for urban poor.
5. More than 70 percent of metro users mentioned issues related to last mile connectivity, and the average time spent and cost incurred in commuting the last mile is considerably high (more than 15 minutes).
    - With a mix of slow and fast moving traffic on the roads, travel by bicycle and rickshaws is very unsafe
    - NMT and Pedestrian infrastructure inaccessible, faulty and not as per standards
    - Lack of safe cycling or cycle-parking and pedestrian facilities
6. DTC fleet and average passengers reduced by 33 percent and 32 percent respectively from year 2011-12 to 2017-18.
7. In 6,515 accidents on Delhi's roads last year, 1,690 persons were killed and 6,086 were injured. About 4.6 person/day killed and 18 person/day injured.
8. Multiple agencies involved in development, operations, & maintenance of transport

9. About 41 percent trips by personal mode (Cars-19 percent & T.W.-21.7 percent) contributing to congestion, while observed V/C ratio varied between 1.01 to 2.83 on major roads in Delhi

5.7 Proposals & Strategies for NCT Delhi under different reports

5.7.1 Road System

In order to reduce the congestion on the existing roads, additional/alternative linkages and Express Corridors need to be identified. Some such urban relief roads identified and has been mentioned under RP-2021 and MPD-2021. A hierarchical classification comprising Regional Expressways, Regional Arterials, Regional Sub-Arterials, Regional Collectors / Distributors and Regional Access Roads is proposed. At the second level, the existing radial National Highway corridors converging into Delhi and circular National Highways are proposed to be developed as part of Regional Arterials.

The two major expressways were proposed in the Regional Plan-2021, consists of namely Kundli-Manesar-Palwal (KMP) Expressway (Western Peripheral Expressway) and Palwal-Ghaziabad-Kundli Expressway (Eastern Peripheral Expressway) are falling outside the NCT Delhi boundary. The two Expressways are having length of 135 km of each part and become operational by 2017. These two expressways create largest ring around NCT Delhi and enabling bypass movements entering in NCT Delhi.

Table 5.17: Status of various projects falling in and around NCT Delhi

S.No.	Project name	Present Status	Implementing Agency
1	Western Peripheral Expressway	Implemented	HSIDC, Govt. of Haryana
2	Eastern Peripheral Expressway	Implemented	NHAI, MoRT&H
3	Present ring road, outer ring road, and five National Highways (radial roads) up to CNCR towns to be developed as per expressway standards.	• NH-8 (Delhi-Gurgaon) has been implemented • NH-24 (Delhi-Ghaziabad) is under implementation • Remaining yet to be implemented	• NHAI • MoRT&H • NHAI/PWD, Delhi
4	Elevated Road connecting Delhi with Faridabad near Badarpur	Implemented	• NHAI
5	Ghaziabad-Meerut Expressway	Under implementation	• NHAI

Source: Regional Plan 2021

Regional plan 2021 contains proposal of phase-wise programme for development of Regional Arterial roads in NCR, under which five regional arterials were falling in NCT Delhi connecting to NCR network. Table 5.18 shows the details of the same.

Table 5.18: Phase-wise Programme for Development of Regional Arterials

S. No.	Regional Arterials	Length (km)	ROW (m)	Existing Configuration	Phase-I 2012-17 (lanes)	Phase-II 2017-22 (lanes)
1	Delhi-Panipat (NH-1)	84	100	6	8	10
2	Delhi –Ghaziabad (NH-24)	21	100	4	8A	10

S. No.	Regional Arterials	Length (km)	ROW (m)	Existing Configuration	Phase-I 2012-17 (lanes)	Phase-II 2017-22 (lanes)
3	Delhi-Faridabad-Ballabgarh-Palwal (NH-2)	60	100	4	8	10
4	Delhi-Gurgaon (NH-8)	30	100	8	10B	10
5	Delhi-Bahadurgarh (NH-10)	28	60	4	6	8

Source: Functional Plan on Transport for National Capital Region-2032

However, for intra city movements, MPD 2021 also provided some recommendation to strengthen the road transport system. It also highlighted that critical issues such as absence of a secondary road network system resulting in restricted distribution of traffic over a network and concentration of even local traffic on arterial roads, resulting in congestion on these roads.

Therefore, in line with MPD 2021, following policies should be focused in order to reduce congestion on the existing roads and to identify additional/ alternative links and access corridors to augment the current network, with the following measures:

i. Augmentation of road network to distribute high traffic volume over multiple roads, instead of stand-alone corridor / junction capacity improvement strategies. Road networks to be planned with a vehicular route network of approximately 250 m c/c, as also specified in the NMSH parameters, 2011. Additional pedestrian/ NMT thoroughfares should be provided as required.

ii. Road networks/ alignments need to be planned with minimum disruption of existing settlements/ structures and environmentally significant areas sensitive to such development.

iii. All roads to be cleared from impediments and developed as per street design regulations.

iv. Area level parking management should be taken up as part of network improvement for effective utilization of the capacity of roads to augment the network.

v. In urban extension, alignment of all right-of-way should be based on ground realities to minimize disruption to existing settlements. The right-of-way of Zonal Plan roads may be reconsidered as required, if network augmentation as per above criteria is achieved through a greater number of roads with smaller ROWs.

vi. All UERs to be designed and implemented with a mass transit system such as a Metro, LRT, BRT etc.

vii. The institutional mechanism for long term, regular maintenance and management of roads is to be strengthened by all road owning and maintaining agencies. Maintenance of road and transport infrastructure should be part of construction and retrofitting.

viii. Intersections and crossings are the most crucial components of a road network system as they allow directional traffic to move through the junctions, resulting in complex movements and conflict points for MV, NMV and pedestrian traffic. Therefore, it is felt that intersections must be designed to reduce delays and increase safety for all road users, with a priority to non-motorized and public transport modes by considering the design of intersections with proper signalization and signage, markings.

5.7.2 Rail Network

The railways proposals of Regional Plan 2021and Functional plan for transport 2032 such as eight radial corridors of RRTS and two Orbital Rail corridors, attempts to create the rail connectivity between NCT Delhi and neighbouring towns (CNCR) along with the rest of NCR.

34. Regional Orbital Rail Corridor

The earlier Orbital Corridor proposed in Regional Plan for NCR-2021 has been revised and following two Orbital Rail corridors have been proposed:

i. ***Regional Orbital Rail Corridor (RORC):*** The Regional Orbital Rail Corridor (RORC) connecting Panipat-Gohana-Rohtak-Jhajjar-Rewari-Palwal-Bhiwadi-Khurja-Bulandshahr-Hapur-Meerut-Panipat will enables the movement of passenger and goods at the regional level avoiding Delhi area.

ii. ***Inner Regional Orbital Rail Corridor (IRORC):*** five following rail lines within NCR have been proposed to strengthen the connectivity of the rail system, which will form Inner Regional Orbital Rail Corridor (IRORC).

- Sonepat-Jhajjar line, new line.
- Jhajjar-Gurgaon line, new line.
- Gurgaon-Faridabad line, new line.
- Faridabad-Dadri line, new line.
- Dadri-Ghaziabad-Meerut line, existing line.
- Meerut-Sonepat line via Baghpat, new line

35. Regional Rapid Transit System (RRTS)

Functional Plan on Transport for NCR 2032 recommended Rapid Rail Transit System (RRTS) corridors with high speed, high frequency regional rail based commuter transit system along dedicated tracks, with electrification and modern signal and communication systems to enable safe, high speed, high frequency services in NCR. Accordingly, Government of India joined hands with four State Governments; Delhi, Uttar Pradesh, Haryana and Rajasthan to create a joint sector company - National Capital Region Transport Corporation (NCRTC) for implementation of RRTS. NCRTC is mandated for designing, developing, implementing, financing, operating and maintaining RRTS projects in the NCR of India

RRTS project has been included in the National Infrastructure Pipelines (NIP), recently finalised by the Task Force headed by Secretary, DEA and unveiled by the Hon'ble Finance Minister. Furthermore, the project included a medium-term measure in 'Comprehensive Action Plan' (CAP) for Air Pollution Control in Delhi & NCR and forms an integral part of recommendation of High-Powered Committee on Decongesting Traffic in Delhi.

RRTS is a rail based high-speed transit system with a design speed of 180 kmph and an average speed of 100 kmph. It will be the fastest, most reliable, comfortable and safest mode of commuter transport in NCR. Such high-speed seamless connectivity will not only reduce pollution and congestion in NCR but will also drive balanced and sustainable urban development in the region.

RRTS is planned with total eight corridors connecting NCT Delhi to the region and expected to cater the travel demand of 19,54,574 passengers per day by the year 2032. The first phase of the system is planned with three corridors connecting NCT Delhi to Panipat in Haryana, Meerut in

U.P. and Alwar in Rajasthan with expected to carry about 12,67,493 passengers per day, while second phase is planned with another five routes connecting NCR and expected to cater 6,87,081 passengers per day (Table 5.19).

A common seamlessly integrated, inter-operable elevated terminus station is being developed at Sarai Kale Khan in Delhi, where all three RRTS corridor of Phase I will converge. The Sarai Kale Khan RRTS station layout will facilitate seamless movement of trains/ passengers amongst three RRTS corridors including multi-modal integration with ISBT, Nizamuddin railway station, Sarai Kale Khan Metro station. Similarly, Anand Vihar RRTS station is being developed to enable integration with other modes of transport such as metro lines, railway stations, ISBT. The city level network in RRT project catchment area includes metro systems and bus systems.

The proposed corridors radiate from National Capital Territory Delhi (NCTD) across the NCR area and terminate at Rest of NCR (RNCR) towns which are the exit nodes of NCRThe corridor-wise details of Regional Rapid Transit System (RRTS) corridors is shown in Table 5.19.

Table 5.19: Travel Demand and Phasing of RRTS Corridors

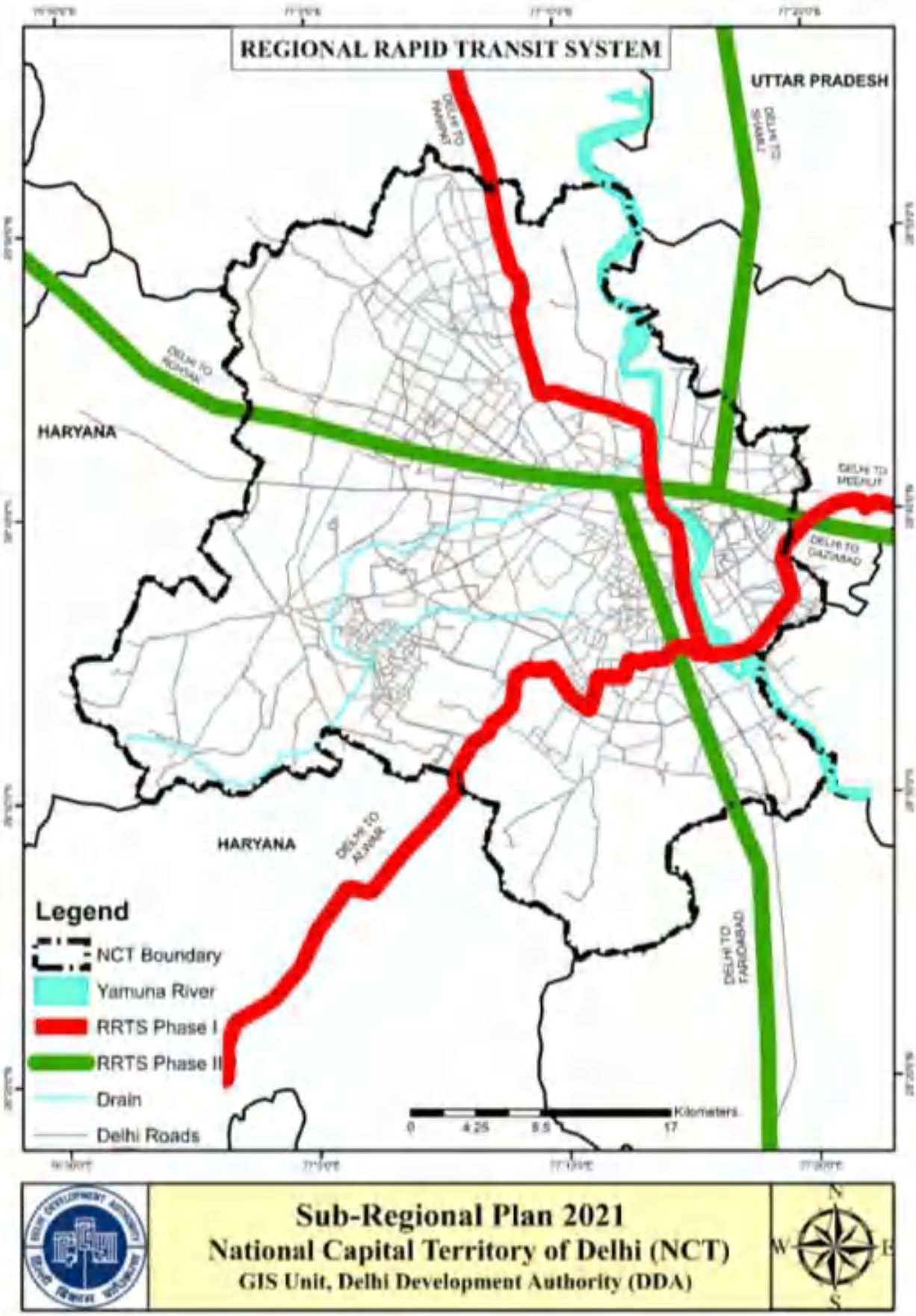
Sl. No.	Regional Rapid Transit System		Length (km)	Estimated Travel time (Mins)	No. of Stations	Travel Demand, 2032 (Passenger Trips per Day)	Status
Phase I (2012-2017)							
1	Delhi – Panipat		103.02	72	17	273264	DPR under consideration of State Governments of Delhi and Haryana for approval
2	Delhi – Meerut		82.15	60	24	385586	Construction in progress
3	Delhi – Alwer	Delhi-SNB	107.10	75	16	608643	Pre-construction activities in progress. DPR approved by States and under consideration of Government of India
		SNB-Sotanala	33.3	23	4		DPR under Consideration of Government be of Rajasthan for approval
		SNB-Alwar	-	-	-		DPR to be prepared
Phase II (2017-22)							
4	Delhi-Shahdara-Baraut		56	-	-	48223	-

Sl. No.	Regional Rapid Transit System	Length (km)	Estimated Travel time (Mins)	No. of Stations	Travel Demand, 2032 (Passenger Trips per Day)	Status
5	Delhi – Hapur	57	-	-	114213	-
6	Delhi – Khurja	83	-	-	229134	-
7	Delhi – Ballabgarh – Palwal	60	-	-	214123	-
8	Delhi – Rohtak	70	-	-	81388	-
	Total Length	**640**	**-**	**-**		**-**

Source: Functional Plan on Transport for NCR-2032 & National Capital Region Transport Corporation

Further, RRTS will bring significant direct benefits such as reduced travel time, reduced vehicle operating costs, reduced accident, pollution and road congestion, and economic benefits such as agglomeration benefits, improved productivity, and induced employment contributing to the GDP of NCR. Further, Annexure I contain detailed information of RRTS.

Figure 5.10: RRTS Proposed and Finalized Routes for First and Future Phases



Source: National Capital region transport corporation

36. Ring Rail

MPD 2021, also proposed following strategies to improve the ridership on Ring Rail in NCT Delhi:

a) Restructuring land use around:

i. Anand Parbat
ii. INA Colony
iii. Pusa Institute
iv. Kirti Nagar

b) Accessibility improvement and augmentation of infrastructure on ring rail stations:

i. Shivaji Bridge
ii. Bhairon Marg
iii. Kasturba Nagar (Sewa Nagar)
iv. Lajpat Nagar
v. Kirti Nagar
vi. Shakur Basti
vii. Sarai Rohilla

c) Provision of Halt Stations on ring rail at the following locations:

i. Moti Bagh
ii. Bhairon Road
iii. Hans Bhawan (ITO)
iv. Ganesh Nagar
v. Preet Vihar
vi. Shyamlal College

The interchange points of Regional Rail, MRTS, Ring Rail and any other future rail network should be developed as interchange stations/ convergence zone where guidelines for multi-modal integration are to be followed. The changeover facilities should integrate ISBTs/ local bus stands/ feeder buses/ IPT modes, wherever feasible, and they should also include approach roads, pedestrian walkways, parking areas for various modes including feeder buses/ IPT modes and adequate public conveniences, etc.

5.7.3 Air Transport

NCT Delhi having Indira Gandhi International Airport (IGIA) become the hub for all the air movement i.e. International, Domestic and cargo movements in northern India. In line with the same, strategic proposals for expansion plan of IGIA, “Taj International Airport” in Jewar NOIDA Uttar Pradesh and creating Hisar Airport as a major Integrated Aviation Hub to accommodate the future air travel demand expected to land in NCT Delhi. Further, following are the details regarding the aviation proposals:

37. Expansion Plan of IGI:

To cater to growing air traffic demand the current expansion project is proposed to augment the required airport infrastructural capacity to handle forecasted passengers, aircrafts and cargo growth by expanding its terminal, runway, taxiways, cargo and associated facilities of airport.

Post the expansion, IGI Airport will have the capacity to handle 109 MPPA from the existing 62 MPPA. The proposed expansion will be carried out in three phases as Phase 3A (during 2016-2020), Phase 3B (during 2021-2025) and Phase 4 (during 2026-2034) as per requirements. The cost of overall infrastructural capacity development is estimated as Rs. 16,000 Crores, will be applied as per the needs of development program.

- **Phase 3A - 2016-2020:** The major development projects would be the expansion of Terminal 1, fourth runway, eastern cross field taxiway, aprons, expansion of cargo, MROs and other airfield improvements, improvements to central spine road and northern access road, reconfiguration of Terminal 3 and the Automatic Passenger Mover (APM) connecting the two precincts. A series of airfield improvements will be implemented with the existing runway system to maximize existing capacity.
- **Phase 3B - 2021-2025:** The major development projects will be various airfield improvements, the first stage of Terminal 4 and Terminal 3 Pier C reconfiguration. Terminal 4 will be a domestic terminal, equipped with 38+ Code C and E MARs gates, thereby providing domestic carriers the flexibility to up gauge aircraft. The terminal head house will require a total area of about 151,464 m2 and the two angled piers, an area of about 60,000 m2. The capacity of Terminal 4 is pegged at 34 MPPA. Stage 1 of Terminal 4 would be constructed in 2024 along with the entire landside support system. Half the head-house of Terminal 4 and Pier Zulu would be constructed to cater to a demand of about 17 MPPA. Terminal 4 will be accessed from the main Central Spine Road by an elevated flyover which passes over the ground-level Terminal 3 exit roadway. An 8-level car park, with two underground levels will serve the Terminal 4 public parking demand.
- **Phase 4 - 2026-2034:** By 2034, the expected annual throughput will grow to around 109 MPPA. A large proportion of this growth will be accommodated by making use of currently unused capacity outside the peak periods. The major development projects will be Terminal 3 Pier E and final stage of Terminal 4. Pier C of Terminal 3 would be partitioned to accommodate international flights on the west face. The east face of Pier C will accommodate domestic operations. Access to Pier C domestic side, Pier D and newly constructed Pier E will be from the infill. Pier E (a new pier with 12 Code C PBB's and two remote stands) will be constructed to accommodate domestic operations.

The Government of Uttar Pradesh has proposed construction of a new Greenfield International Airport at Jewar in Gautambudha Nagar, and the Ministry of Civil Aviation has accorded in principle approval for the project based on the recommendations of the Steering Committee on Greenfield Airports.

38. Proposal of "Taj International Airport" in Jewar NOIDA Uttar Pradesh

Taj International Airport is a proposed international airport to be constructed in Jewar (56 kilometres (35 mi) from Noida) in Gautam Budh Nagar district of Uttar Pradesh. The Noida International Airport will be located 72Kms from IGI Airport and 65 Kms from Hindon Air Force station Ghaziabad. Yamuna Expressway Industrial Development Authority (YEIDA) is the implementing authority of the project. An area of 3000 hectares has been notified for the airport which will be developed in phases. An area about 1000 hectares will be developed in the first phase at an estimated cost of Rs 10,000 crores. There will be one runway in the first phase. Three more runways will be developed in subsequent phases. The total cost of development of all phases is expected to be around Rs 15-20,000 crores. The airport is expected to cater to 30-50 million passengers per year over the next 10 to 15 years. Land is acquired by the State Govt. and the development of project site is likely to start soon.

39. Hisar Airport a major Integrated Aviation Hub

Hisar Airport is a proposed to be upgraded and it is 160 km from IGI Airport at Delhi, and is being promoted as a major integrated aviation hub with passenger, cargo, MRO and aviation industrial manufacturing facilities. In 2002, the Delhi Flying Club (DFC) shifted all its flying activities and aircraft to Hisar from Safdarjung Airport in Delhi. In August 2012, the Directorate General of Civil Aviation approved a state government plan to develop the airport to allow domestic airline services.

5.7.4 Mass Transit System (Metro)

As per MPD 2021, It is expected to carry 108 lakh daily passengers with an average trip length of 15 Km. by 2021. Phase I and Phase II of the network are already implemented and operational. Phase III is under implementation and Phase IV is in the planning stages. MPD estimates that about 60 percent of the urban area will be within 15-minute walking distance from the proposed MRTS stations, after full development of the system. To achieve the above potential impact of the Metro Rail System a number of measures are envisaged to be taken up as:

i. Preparation of detailed plans to facilitate and encourage direct pedestrian access to the Metro Rail System/ Station.

ii. Preparation of detailed multi-modal transport plans with reference to each major Metro Station, with particular reference to bus transport routes, which could provide interlinkages and feeder arrangements.

iii. Parking arrangements for all modes at Metro Stations, in particular for IPT and NMT modes along with all conveniences required for metro commuters.

iv. Provision of Park and Ride facilities at identified points from where feeder bus services would be available, or convenient direct pedestrian access would be feasible.

v. For any green open space / recreational areas taken up by DMRC for construction purposes, adequate compensation of green space must be provided by DMRC by providing public spaces within the metro station plot / premises, so that local population may also be served.

5.7.5 Bus

In line with MPD 2021, following are major strategies essential to improve Bus transport in NCT Delhi:

i. Bus routes in Delhi need to be rationalized to connect to Metro/ MRTS/ RRTS stations as well as local/ city level destinations to provide convenience to all bus commuters

ii. Park and ride facilities will have to be developed at important bus terminals

iii. New bus terminals need to be planned and developed in strategic locations, to make the use of public transport convenient for all commuters

iv. On all new arterial roads, road owning agencies to incorporate provision for MRTS, NMV lanes and footpaths, in addition to motor-vehicle lanes, as per the street design regulations.

5.7.6 Other Transport Proposals of MPD 2021

40. Integrated Multi Modal Transport System

Establishment of a single authority is the need of the hour for planning / development of an integrated system, implementation and enforcement of the policies.

41. Intermediate Public Transport

There should be vigorous effort to reduce private vehicle dependency and increase facility of public transport in all areas of the city. In areas that are not served by buses within 500 M walking distance from homes, alternative planned IPT systems need to be introduced to better serve the population.

42. Transportation Areas for Special Areas

In order to manage the additional traffic of Metro stations at Old Delhi, Chandni Chowk and Chawri Bazar declared as special areas, the following management measures are required to be taken:

i. Need based traffic circulation schemes integrating various modes.
ii. Improvement of major road stretches and intersections like Ajmeri Gate, Fountain Chowk, Fatehpuri Chowk, Kaudia Pul, Khari Baoli, etc.
iii. Removal of encroachments from footpaths to facilitate smooth pedestrian movement.
iv. The movement of heavy vehicles will continue to be banned in the Walled City.

However, for the servicing of this area light commercial goods vehicles may be allowed during the night. All congested market streets should be strengthened and restructured for pedestrian movement during day times.

43. Freight Transport

A high intensity of goods movement by road and rail systems is envisaged in and around NCT Delhi. It includes consignments to a variety of destinations within and outside the region. Therefore, there is a need to develop Integrated Freight Complexes (IFCs) at the outer edge of the NCT Delhi at the location of interface of the regional and urban network systems. Apart from the road system, the IFCs need to be integrated with the regional rail system. Master Plan for Delhi-2021 has proposed the following five IFCs for the integration of goods movement by road and rail in Delhi. These IFCs are required to meet the need for Delhi and need to be implemented expeditiously.

i. Madanpur Khadar (NH-2)
ii. Ghazipur (NH-24)
iii. Narela (NH-1)
iv. Dwarka (NH-8)
v. New site in Urban Extension (Rohtak Road) Tikri Kalan

Following Logistic Hubs/Container Yards are proposed in National Capital Region:

i. Rewari (along western DFC)
ii. Khurja (along eastern DFC)

The proposed tentative locations of distribution centres are as follows:

i. Greater Noida
ii. Asaoti/ Pirthala
iii. Dharuhera
iv. Rohtak (along ORC)
v. Panipat (along ORC)
vi. Meerut (along ORC)
vii. Hapur (along ORC)

44. Highway Facility Centres

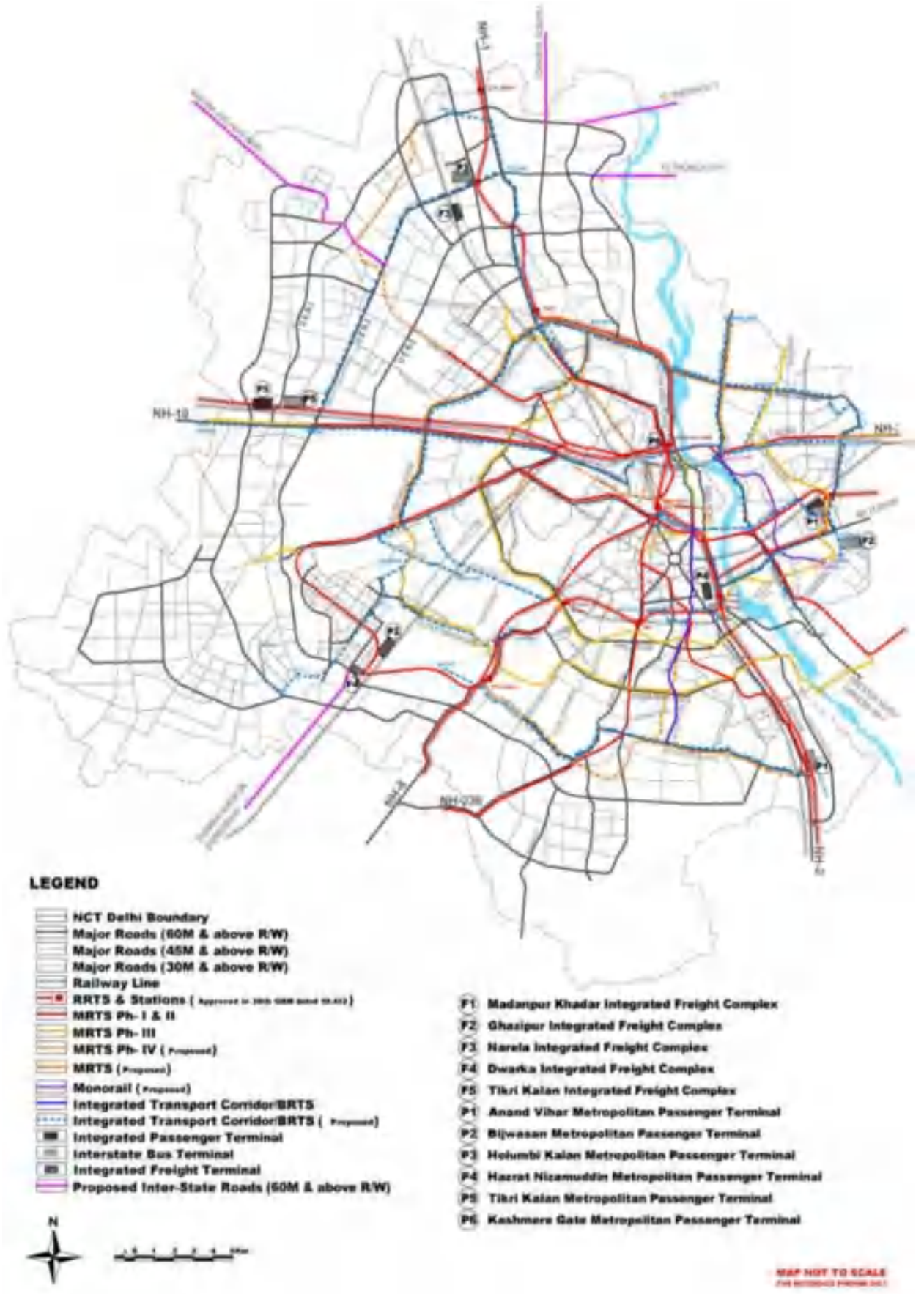
The Highway Facility Centres (HFC) needs to be planned and developed on a comprehensive basis. The HFC's need to include parking, fueling, servicing and repairs, telephone and telecommunication, restaurants and motels, medical, police, godown, weigh bridge, entertainment, banking (ATMs), and a host of other needed services. These HFCs need to be developed along the highways, spread over an area of five to 10 ha, with a spacing of 50-60 km.

45. Road Traffic Safety Strategies

In order to minimize the number, frequency and severity of accidents in NCR, the following policies and proposals are made:

i. Provision of adequate and effective traffic control and safety devices during construction and maintenance activities.
ii. Provision of road side amenities for pedestrians, cyclists and other special road users such as rickshaws, vans, buses, trucks, etc.
iii. Adoption of Intelligent Transport Systems (ITS) for road & road environment and traffic guidance.
iv. Implementation of the guidelines for road safety prepared by Indian Road Congress (IRC).

Figure 5.11: Proposed Sub- regional Transport Network for NCT Delhi as per MPD 2021



Source: Master Plan Delhi 201 (modified up to 31/12/2018)

5.8 Policies and Proposals :

1. Regional transport system strengthening:
   i. All the rail and road movement not intended to originate/destined to/from NCT Delhi must be bypassed.
   ii. All the IFCs/ICDs/Logistics parks must be relocated on the fringe area to restrict the heavy truck movement within NCT Delhi and connecting them with railway network. Further distribution of goods within NCT Delhi to major market locations may be facilitated using local railway network and light weight vehicles (LCVs).
   iii. Direct link may be proposed to connect Indira Gandhi International Airport (IGIA) and proposed Jewar International Airport, to provide connectivity between the two airports and to divert the potential traffic movement of passengers and cargo to /From Delhi.
   iv. Existing site of Safdarjung Airport may be developed for operations of air taxies for local air movement, emergency services i.e. Health facilities, VIP movements etc. and supporting Infrastructure may be created such as Helipads on such Institutions buildings to connect with the service. Further a detailed study may be carried out to examine the feasibility of the proposals.
2. Regulations for registration of new private vehicle:
   i. Restrict the registration of new private vehicles (i.e. Car & T.W.)
   ii. Revise and phasing out the registration period for old vehicles.
   iii. Delhi may adopt “Vehicle Quota System” practice of Singapore, under which the government controls the vehicle population based on traffic conditions. It fixes an annual limit on the number of vehicles that can be purchased in Singapore. The target growth rate is determined annually which depends upon traffic conditions and the rate at which old vehicles are taken out of use. The prospective buyer bids for certificates of entitlement which are available by vehicle category. Each buyer is allowed to submit only one bid.
   iv. Higher rates of parking and congestion fee for some selected areas may also be required as an incentive for use of public transport and discouragement for use of personal vehicles
   v. Purchase and registration of new vehicle should be allowed on the basis of availability of parking spaces within the buyers’ premises.
2. Reviving Ring Rail system by improving the infrastructure, and remove encroachments:
   i. Establish institutional mechanism for O&M.
   ii. Improvement of frequency and service
   iii. Multi modal integration with Metro, Bus transport, Auto, E-rickshaws, Pedestrian Infrastructure etc.
3. Strengthen public bus fleet and improvement on frequency and services to enable the recommended PT share of 80 percent in total trips for the year 2021
   i. All the bus stops must be equipped with passenger information system (PIS), Recharge facilities, routes & bus stops map information etc.
4. To promote NMT and pedestrianization for safe and seamless movement

i. Dedicated lanes must be planned for pedestrian movement to reduce conflicts between different modes and road accidents.

ii. Provision of NMT and Pedestrian Infrastructure on all categories of urban roads, terminals, Bus/ Metro station etc.

iii. NMT should play the role of Last mile connectivity and also as an independent mode of transport for short trips

5. Multi modal integration:

   i. Development of interchange facilities among different public transport modes i.e. Metro, Buses, Feeder buses, IPT, Auto rickshaws, etc.

   ii. Provision of effective last mile connectivity i.e. Pedestrian& Cycling lanes and facilities, E-rickshaws, Cycle rickshaws etc.

   iii. Single card payment system for all public modes i.e. Metro, Railways, Buses, Auto Rickshaws, etc. must be implemented.

   iv. Establishment of a single authority for planning/development of an integrated system, implementation and enforcement.

6. Planning intervention:

   i. Land Pooling scheme/new development/ redevelopment must be planned to ease pedestrian/cyclist/NMT movement to connect public transit system.

   ii. Exclusive Residential/Plotted residential development areas must be discouraged.

7. Some additional measures such as restriction on car ownership, congestion pricing etc. may be adopted when adequate and convenient integrated public transport at place and thus alternative to car use is available.

8. Imposing policies to reduce and restrict petrol & diesel-based vehicles and to promote the usage of clean fuel vehicles and creation of support infrastructure i.e. CNG, Electrical, Hydrogen in NCT Delhi.

9. All the Govt and private offices recommended to provide common pooling service for their employees from home to office and visa-versa. and flexible office timings may provide to decongest the peak hour traffic load.

10. A detailed study may be conduct to prepare a Comprehensive Mobility Plan for NCT Delhi. It must include Transport Infrastructure and Traffic Management Plan for Delhi.

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CHAPTER 6. POWER

6.1 Introduction

Enhanced accessibility and consumption of power has become a pre-requisite for economic development and shown linkages to a remarkable impact not only on the lifestyles of the inhabitants but also helped to augment better levels on the Human Development Index. Existing and new infrastructure along with development of new industries perform better when there is adequate supply of power. NCT Delhi is the heart of northern India in terms of administrative and commercial establishments. It can safely be called a city of international importance. Such a world class city demands world class infrastructure which in turn needs to be served with un-interrupted power supply. The per-capita consumption of power by the consumers in Delhi was more than 1,561 units per annum as against the national average of 1,122 units in 2016-17. The Energy News Monitor published by the Observer Research Foundation mentions that, the National capital consumes more power than the combined demand of Mumbai and Chennai and thrice that of Kolkata. This shows how easily one can draw parallels between power consumption and quality of life. Rapid population growth and expected higher per capita income will lead to increase in demand of power; hence one can safely assume that the level of energy consumption of the region directly depends on the economic growth.

6.2 Existing Power Supply Situation

Central Electricity Authority (CEA) is an organization originally constituted under Section 3(1) of the repealed Electricity (Supply) Act, 1948, since substituted by Section 70 of the Electricity Act, 2003. It was established as a part-time body in 1951 and made a full-time body in 1975. The functions and duties of CEA are delineated under Section 73 of the Electricity Act, 2003. Ever since 1st July 2002, Delhi has successfully privatized and decentralized the power distribution in Delhi. The power establishment of Delhi after unbundling of Delhi Vidyut Board (DVB), a new department under the name and style of State Load Dispatch Centre (SLDC) under Delhi Transco Limited was created, as an Apex body to ensure integrated operation of the power system in Delhi. Earlier the department was part of O&M Department of Delhi Transco Ltd / Delhi Vidyut Board. The main Gas power generation companies are Indraprastha Power Generation Company Limited (IPGCL) and Pragati Power Corporation Limited (PPCL), East Delhi Waste Processing Company Ltd (EDWPCL) (Waste to Energy Plant), Timarpur Okhla Waste Management Company Ltd. (TOWMCL) (Waste to Energy plant), Delhi Municipal Solid Waste Processing Company Ltd (DMSWPCL) (Waste to Energy plant).

The transmission is controlled by SLDC Department under the Delhi Transco Limited, and five DISCOMs namely BSES Yamuna Power Ltd. (BYPL), BSES Rajdhani Power Ltd (BRPL), TATA Power Delhi Distribution Ltd. (TPDDL), New Delhi Municipal Council (NDMC) and Military Engineering Service (MES). The State Load Dispatch Center (SLDC) Department of Delhi is the State Transmission Utility responsible for augmenting and maintaining existing Transmission system. It started function on the 1st January 2004. The SLDC, Delhi is the apex body to ensure integrated operation of the power system in the Delhi. It is responsible for discharging various functions specified under as per Section 32 of Indian Electricity Act 2003.

Figure 6.1: Power Distribution in NCT Delhi via DISCOMS

In the second phase of power reforms undertaken in Delhi, the power purchase agreements executed by DESU / DVB / DTL have been reassigned to Distribution Licensees / Deemed Distribution Licensees from 01.04.2007. Subsequently, Intrastate ABT has also been introduced in Delhi w.e.f. 01.04.2007 which is first in the country. Delhi State Electricity Regulatory commission has subsequently come out with Delhi Grid code (DGC) notified in official Gazette on 22.04.2008.

The existing scenario of power supply in the NCT Delhi is explained by the following main activities-

- Power Generation
- Power Transmission
- Power Consumption

6.2.1 Power Generation by conventional methods

The power supply position of Delhi has been viewed in terms of peak demand experienced and met by individual DISCOMs. The maximum demand experienced by individual DISCOMs has been presented in Table 6.1. It can be seen that all the DISCOMs have been able to meet the peak demand in their respective command areas. Thus, on peak demand front, Delhi can be placed in comfortable position based on data furnished by SLDC.

Indraprastha Power Generation Company Limited (IPGCL) and Pragati Power Corporation Limited (PPCL) are managing the power plants in Delhi having a total installed generation capacity of 1983.2 MW. The Badarpur power plant has been shut down as of 15th October 2018 and as per MoHUA has now been given the nod to be converted into an eco-park. A 1,500 MW Coal Based Indira Gandhi Super Thermal Power Plant has been set-up in Jhajjar, Haryana by Aravali Power Company Private Limited, which is in joint collaboration with IPGCL, HPGCL and NTPC Limited. The plant became commercially operational on 26th April 2013, and the power generated by this is jointly shared by Delhi and Haryana. The Plant, under Stage-I, has three units of 500 MW capacity, and all the units have been fully commissioned. There is a future provision of augmenting the capacity by 1,320 MW (2 x 660 MW) under Stage-II.

The available generation capacity (installed as well as allocated share) for the State of Delhi as on 31st March 2015 was 7,587 MW. In order to meet the estimated increased demand for providing 24x7 power supply in the state of Delhi, the state based DISCOMs have already planned availability of necessary power through own generating stations, renewable energy sources, central generating stations and long term FPAs in a phased manner.

Regarding various DISCOMs, it is to be noted that other than TPDDL, all other DISCOMs face a shortfall in the range of 7.40 percent to 23.44 percent in terms of peak demand during the period FY 2015-16 to FY 2018-19. During this period, TPDDL has surplus peaking availability in the range of 7.64 percent to 14.17 percent. During FY 2016-17, MES has 6.24 percent deficit in energy availability, however during the period FY 2017-18 to FY 2018-19 they have availability of surplus energy in the range of 4.47 percent to 12.17 percent

Table 6.1 Effective Generation Capacity versus installed capacity within Delhi

S. No	Power Station	Power Generated in 2016-2017 in MW	Power Generated in 2017-2018 in MW	Power Generated in 2019-2020 in MW	Gross Generation in MUs	Plant Availability Factor in %age	Plant Availability Factor for FY 2019-20 (%age)
1	Rithala	94	94	0	0.00	-	-
2	Rajghat Power House	135	135	0	0.00	-	-
3	IP Gas Turbine Power Station	270	270	270	501.50	83.07	86.46
4	Pragati Stage-I	330	330	330	1529.30	92.64	96.95
5	Badapur Thermal Power Station*	705	705	0	0	36.64	-
6	Bawana CCGT (Pragati Power Station -III)	1371	1371	1372	4013.90	74.11	89.25
7	Timarpur Okhla Waste Management Ltd	16	16	16	163	-	
8	Delhi Municipal Solid Waste Management Ltd.	24	24	24	110	-	
9	East Delhi Waste Processing Company Ltd.	10	10	10	24	-	
	Total	2955	2955	2024	6341.7		

Source: Delhi Transco Limited, Delhi SLDC, Annual report 2017-18, Power generated in 2019-20 data provided by IPGCL and PPCL

**Permanently shut down since 18th October 2018.*

From the above Table 6.1, one can see that Bawana Combined Cycle Gas Turbines (CCGT) is underperforming, due to the unavailability of gas as a fuel to run this gas station. Rithala CCGT which was mainly set up for enhancing the power availability to Delhi during the Commonwealth Games was shut down in early 2018 due to the unreasonableness and lack of transparency in its operation. Similar fate was met by the Rajghat Power House in 2015 and this 45-acre land is now slated to become a 5,000KW energy producing solar park.

As per data provided by IPGCL and PPCL, their three power plants (Sl. No. 3, 4, 6 from Table 6.1) have achieved more than 85 percent Plant Availability Factor in 2019-20. With present installed capacity, IPGCL and PPCL are able to meet around 50 percent of the average electricity consumption of Delhi. However, they are generating around 17.55 percent of the average electricity consumption of Delhi due to the Non availability of the adequate Domestic gas. 1371.2 MW PPS-Ill, Bawana plant has very efficient and advanced class gas turbines with pollution levels much below the permissible limits, but it too is facing shortage of Domestic gas for Module-I1.

6.2.2 Power generation using Renewable sources

An urgent increase in Renewable Energy is required in India to combat climate change, reduce air pollution and enhance energy security. Delhi is in a land-locked position, thus, the high cost and paucity of barren land within its borders, and low potential for wind or hydro power. In

general, the energy utilities (DISCOMS) pay more to meet short-term demand surges, raising the average cost of power, hence Delhi as evident in Table 6.2 must focus on rooftop solar as its primary source of renewable energy. Delhi needs to reduce its reliance on conventional energy while increasing its energy security and lowering average energy prices in the long term.

Table 6.2: Installed Capacity of Renewable Energy

Solar Generation	118.35 MW
Waste to energy	52 MW (Timarpur-Okhla - 16 MW, Ghazipur - 12 MW, Narela-Bawana - 24 MW)
Total	170.35 MW

Source: Economic Survey 2018-19 (as of 31.12.2018)

46. Solar Energy

Delhi is highly favourable for solar power generation as the city receives high solar irradiation with 250-300 days of clear sun in a year. The city's total solar potential is as high as 2.5 GW with roof-top space availability for solar panels at an estimated 31 sq. km. Delhi has the potential to cut its electricity expense, improve energy security, and shave off over 10 percent of peak demand by 2025, reducing the need for new PPAs. Of this potential, 26 percent is in the government/public sector, 25 percent in commercial/ industrial sector, and 49 percent in domestic sector.

Solar energy is the need of the hour since there is a huge difference between the peak demand in summers and winters. This peak demand curve incidentally matches the energy generation curve of solar power plants, making solar a preferred choice for energy generation in the NCT of Delhi. To this end, the government released the Delhi Solar Power Policy, 2016, effective from 27.09.2016, which is applicable to solar installations with capacities of one kW or more. Delhi Govt. formed Energy Efficiency and Renewal Energy Management Centre (EE&REMC) to work as 'State Designated Agency (SDA) to coordinate, regulate and enforce Energy Conservation Act, 2001 in Delhi in association with Bureau of Energy Efficiency (BEE). The Centre as 'State Nodal Agency (SNA), has to implement new and renewable energy projects in the city of Delhi in association with Ministry of New & Renewable Energy (MNRE), Govt. of India. The policy focuses on promoting investments under multiple financial models such as capex and renewable energy service company (RESCO) models. The policy includes generation targets, regulations, mandates and incentives. It applies to all electricity consumers and entities that develop and operate power projects in Delhi.

The DERC also formulated the Delhi Electricity Regulatory Commission (Group Net Metering and Virtual Net Metering for Renewable Energy) Guidelines, 2019, which implemented the concept of Group Net Metering and Virtual Net Metering framework. Group Net Metering is which is applicable to all the consumers of NCT of Delhi, and Virtual Net Metering Framework shall be applicable for residential consumers, Group housing societies, offices of Government /Local Authorities and Renewable Energy Generators registered under Mukhya Mantri Kisaan Aay Badhotari Yojna.

Given that one MW of solar requires 4-5 acres of land, ground-mounted solar is not a feasible option for Delhi, due to land constraints. Hence, rooftop solar is being heavily promoted to harness the region's huge solar potential. The detailed tables of additional data are included in Annexure K.

6.2.2.1.1 ***Roof top solar Plan***

Under the budget for 2018-19, the Government of Delhi has proposed a number of initiatives to increase the share of renewable energy and decrease the dependence on fossil fuels. It has committed to procure at least 1,000 MW of power from wind and solar energy sources. The NCT has 118.35 MW of installed solar capacity and 52 MW of installed waste-to-energy capacity as of July 2018, and total installed capacity of renewable energy as per 2017-18 Economic Census was 167.845MW as seen in Table 6.2. As per the latest comments received from Department of Power, GNCTD, the installed capacity of renewable energy as of June 2020 is 167.845MW, thus taking the total installed capacity of renewable power to 219.845MW, as against 170.35MW.

Under the budget for 2020-21, the Government of Delhi has proposed a number of initiatives to increase share of renewable energy and decrease the dependence on fossil fuels. Delhi Discoms have committed to procure at least 2090 MW (Wind-750 MW & Solar-1340 MW) of Renewable Power from wind and solar energy sources. As per the above mentioned latest comments received from GNCTD about 51.5 MW (Government Buildings 21.5 MW and Residential Sector 30 MW through Discoms) of solar capacity is in the pipeline. As per Delhi Solar Policy all Government Buildings having area 500 Sq. mt. or above are mandatorily install Solar Photovoltaic (SPV) panels.

It has also proposed to develop the New Delhi Municipal Council (NDMC) area as Solar City by installing Solar Photovoltaic (SPV) panels on the rooftop of Govt. buildings, Metro Stations, Bus Stops, etc. Govt. of India approved for installation of Grid Connected Rooftop Projects in NCT of Delhi. Solar installations are being promoted in housing societies. A new scheme namely, "Mukhyamantri Agriculture-cum-Solar Farm Scheme" has been approved by the Delhi Cabinet on 24.07.2018 to promote and increase solar power generation by incentivizing the installation of solar panels on raised structures without affecting farming activities.

Delhi Solar Energy Policy 2016

Delhi is under approval Stage. Many initiatives have been taken and provisions kept in the policy for promoting use of Solar Energy in the state. Some key points are mentioned below-

- Generation Based Incentives (GBI): The State shall offer a limited-time GBI for net metered connections in the domestic/ residential segment only.
- Exemption from the payment of Electricity Tax and Cess
- Exemption on conversion charges: Residential consumers opting to implement solar plants to sell power to the grid shall be exempted from conversion charges of house tax to commercial tax.
- Exemption on VAT and entry tax
- All solar power systems shall be treated as 'Must Run' power plants and shall not be subjected to Merit Order Rating (MOR) / Merit Order Dispatch (MOD) principles.
- Transmission charge: There shall be no Transmission Charges for solar plants commissioned within the state during the Operative Period of the Policy.
- CDM (Clean Development Mechanism) benefit
- To increase the solar uptake in Delhi, the government is planning to introduce a group net metering policy targeted at state-run schools, markets and other government buildings.

Table 6.3 Rooftop solar energy targets for NCT of Delhi in MW

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Energy in MW	35	119	312	606	991	1,275	1,503	1,690	1,850	1,995

Source – Delhi Solar Policy 2016

As mentioned above in Table 6.3, 69.57 MW of energy has been recorded to be produced using solar energy in NCT of Delhi and 70 MW of energy is in the pipeline, as against the target set by the Delhi Solar Policy 2016, which was 312 MW. Clearly, enough initiatives have not been taken to propel the transition from non-renewable sources of electricity to renewable sources.

For consumers in residential complexes, schools, hospitals, and municipal buildings, a solar rooftop demand aggregation programme is planned to be implemented in the RESCO mode. It will benefit consumers with an expected aggregated demand of 40 MW. The government believes that the RESCO model will make it easier for the residential segment to adopt rooftop solar, as it will minimize the upfront capital expenditure for homeowners.

6.2.2.1.2 ***Initiatives taken at DISCOM level in NCT Delhi***

BRPL initiative in Solar Roof Top:

BRPL has been working pro-actively to facilitate the implementation of solar rooftop installations by consumers in its license area. It has the highest number of net-metering installations in Delhi, 63 as on 31st Dec 2015 with an installed capacity of 3.636 MW. GERMI has collaborated with BRPL too for technical collaboration and has empaneled competent vendors to provide support to interested consumers. BRPL has been carrying out the following activities:

- Regularly conducting interactions with consumers to create awareness on net-metering
- Dedicated trained Team
- Procedure on website and training to customer care
- Application fees through Bill
- Free service to certify protection and inverter output quality
- BRPL has also contracted 20MW each from Solar Energy Corporation of India (SECI) under the Jawaharlal Nehru National Solar Mission (JNNSM) Phase-II, Batch-I scheme of SECI which is available.

BYPL Initiative in Solar Roof Top

- BYPL has installed generation of 354KW solar power from 1257 rooftop solar panels installed at eight of its offices. All BYPL grids are slated to go green with this solar generation.
- Partnering with consumers on “Solar Rooftop Lease Model’ under deliberations
- BYPL has been procuring 20MW from SECI under the JNNSM Phase-II, Batch-I scheme and available power from waste to energy stations.
- The installed capacity of rooftop solar in BYPL’s license area is about 22MWp.
- BYPL has also signed various PFAs for procurement of 550 MW Solar/ Wind power with SECI, whose projects shall commence from 2021-22.

TPDDL Initiative in Solar Roof Top

TPDDL is offering its services for further facilitating Solar Project implementation.

- To facilitate the consumers for installation of Solar Projects, TPDDL has undertaken open competitive Techno-Commercial Bidding procedure for empanelling implementation agencies who will install Solar Projects on turnkey basis with optional comprehensive AMC for Solar Plants for 5 / 7 or 10 years.
- TPDDL has also contracted 20MW each from SECI under the JNNSM Phase-II, Batch-I scheme of SECI which is available.
- They have also tendered another 180 MW Solar Power.

47. Bio-mass Power

Delhi generates 10,050 tonnes of waste per day. Of this, 50 percent or 4,900 tonnes waste is treated every day in three waste to energy plants. While the plant at Ghazipur has a capacity to process 1,200 metric tonnes of garbage per day to produce 12 MW of electricity, the Okhla plant turns 1,500 metric tonnes of waste daily into nine MW of electricity. The plant at Narela Bawana has a capacity to process 2,000 metric tonnes of waste to generate 20 MW of electricity.

The NDMC is starting the construction of the city's fourth waste to energy plant in Bhalswa. The civic agency has awarded the contract to the Essel Group, which will set up the plant on 12 acres of land, next to the Bhalswa landfill. The deadline for commissioning the plant is August 2020, but the company will start collecting garbage for generating electricity from the next year onwards.

As per a study conducted by the Shriram Institute for Industrial Research, Delhi, in May 2017, biodegradable waste in Delhi constituted 55-60 per cent of the total waste. The calorific value of mixed waste was 1,274 - 1,324 kCal per kg, lower than the value set by the SWM Rules at 1,500 kCal per kg. In fact, according to GIZ's Waste to Energy Guidelines, 2017, a calorific value of 1,600 kCal per kg is required to run waste to energy plants without the use of any auxiliary fuel. This is one of the many issues faced in the waste to energy segment. The segment is lagging on both technology adoption and policy implementation fronts.

6.2.3 Power Transmission

Delhi Transco Limited is the State Transmission Utility of the National Capital Territory of Delhi. It is responsible for transmission of power at the 220KV and 400KV level, besides up-gradation, operation and maintenance of extra-high voltage (EHV) network as per system requirements. The SLDC's mission is to facilitate intra and interstate transfer of power in coordination with NRLDC (Northern Regional Load Dispatch Centre). In all there are four number of 400 KV and thirty-six 220 KV substations that are associated with transmission lines. The existing network consists of a 400 KV ring around the periphery of Delhi interlinked with the 220 KV network spread all over Delhi as shown in Figure 6.2. The network utility and availability are detailed in Figure 6.2 and Table 6.4.

In Inter-State Transmission System (ISTS) system, Power Grid Corporation of India Limited (PGCIL) & Delhi Transco Limited (DTL) have already undertaken/planned a number of transmissions works in consultation with Central Electricity Authority (CEA) for further strengthening & augmenting the capacity and to ensure better connectivity of Delhi Grid with National Grid for providing reliable and quality power supply to the citizen of Delhi.

Table 6.4: Network of Delhi Transmission Utility 2017-18

S. No.	Details	400 KV Level	220 KV Level
1	Number of Sub Stations	4	36

S. No.	Details	400 KV Level	220 KV Level
2	Transformation Capacity (in MVA)	5,410	12,440
3	Transmission Lines (Length in Ckt.Km.)	249.192	824.22

Source – Delhi Transco Limited, Delhi SLDC, Annual report 2017-18

The performance of the transmission utility during the last eight years, the system has improved mainly in system availability which as per the latest additional data provided by IPGCL and PPCL is 98.953 percent for the year 2019-20, reduction in transmission losses, a significant reduction of load shedding etc. The performance of Delhi Transco Limited is shown in Table 6.5.

Table 6.5: Performance of Delhi Transco Limited 2010-11 to 2017-18

S. No.	Details	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
1	Peak Demand met (in MW)	4,720	5,028	5,642	5,653	5,925	5,846	6,261	6,526
2	Load Growth (in %)	7.1	6.5	12.21	0.19	4.81	-1.33	-1.7	4.06
3	Energy Consumption (in MUs)	25,581	25,593	27,235	28,021	29,035	29,416	30,797	31,874
4	Shedding (in MUs)	74	83	138	77	117	42	32	19
5	Shedding as % of Energy Consumption	0.29	0.32	0.51	0.27	0.4	0.14	0.1	0.06
6	Transmission Losses (in %)	1.28	1.2	1.17	0.95	0.69	0.85	0.98	0.79
7	System Availability (in %)	98.58	98.38	97.17	97.43	98.6	99.03	98.01	99.37

Source – Delhi Transco Limited, Delhi SLDC, Annual report 2017-18

The peak demand met increased from 4,720 MW in 2010-11 to 6,526 MW in 2017-18. The energy consumption recorded an average annual growth of approximately 3.66 percent. It is pertinent to mention that the system availability is mostly equal if not more than 97 percent in the last eight years. As per the additional data provided by IPGCL and PPCL, the peak demand of Delhi for 2019-20 has been mentioned as 7409 MW on the 02.07.2020. It is also imperative to mention that the system availability as per latest data provided state it to be close to 98.953 percent. All the above figures point at the increase in efficiency in the power network and increase in system availability. The detailed tables of additional data are included in Annexure L.

As per the Table 6.5 above, during the period 2010-11 to 2017-18, the number of consumers of electricity in Delhi increased from 40.47 lakh to 57.55 lakh. The information regarding a number of consumers of electricity in Delhi during 2010-18 is as follows in Figure 6.3

Figure 6.2: Power Transmission Network with location of generation points and 220kvA and 400 kvA stations

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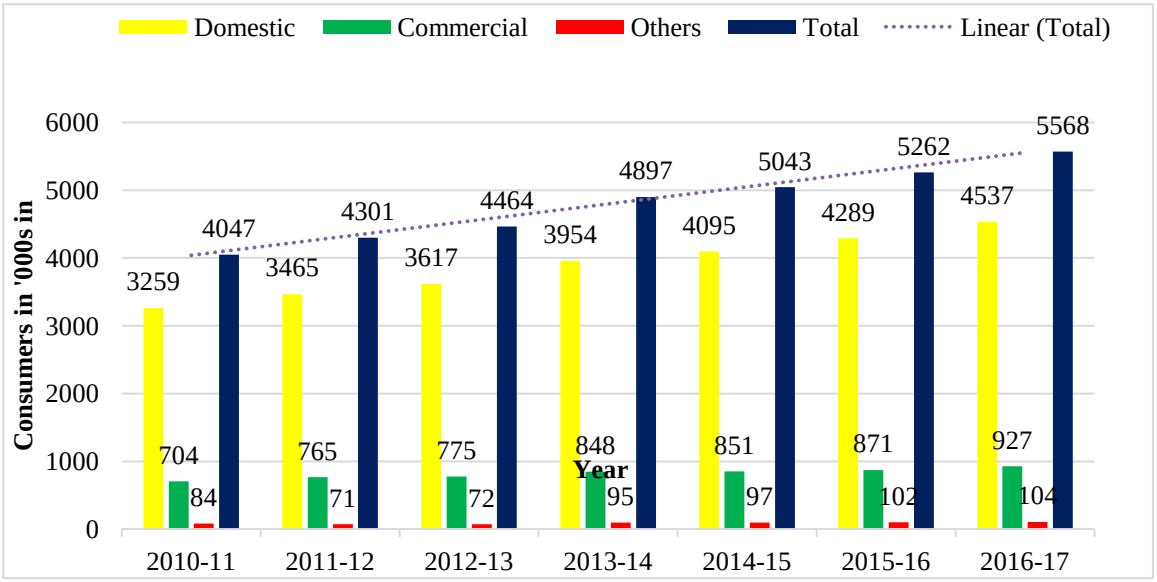
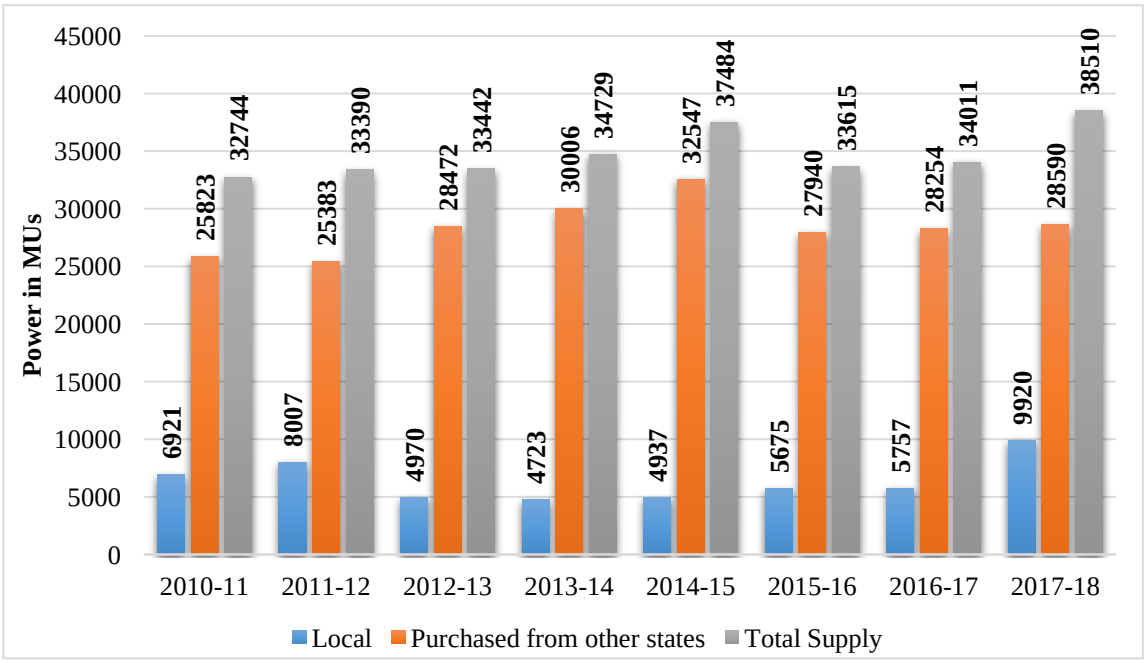
Figure 6.3: Growth of number of Consumers of Electricity in Delhi in '000s



Source – Delhi Statistical Handbook

According to the Economic Survey Report of 2018-19, the number of electricity consumers in Delhi has grown by 71.92 percent during the last ten years of which the electricity consumers in domestic sector alone have increased to 17.08 lakh consumers from 2010-11 to 2017-18. While all other consumers mentioned in the chart showed an up and down situation in the period covered, especially in the industrial sector.

Figure 6.4: Power purchase in Delhi (in MUs)



Source – Economic Survey of Delhi 2018-19

The supply of electricity in Delhi periphery increased from 32,744 million units in 2010-11 to 38,510 million units in 2017-18 as seen from the Figure 6.4. The total power purchase in Delhi has grown by 55.38 percent during the last 10 years. The power purchased in Delhi has increased from 25,823 MU in 2010- 11 to 28,590 MU in 2017-18. Only 25.76 percent of total power purchase is sourced from own generation by Delhi Govt. Power Plants, whereas 74.24 percent is

purchased from Central Govt., i.e. Jhajjar power station (APCPL), Sasan power station, Nathpa Jhakhri power station and other sources such as National Thermal Power Corporation Limited (NTPC) Stations, National Hydroelectric Power Corporation (NHPC) and Tehri Hydro Development Corporation Limited (THDC) stations as shown in Table 6.6.

Table 6.6: Allocation of power to Delhi Licensees DISCOMS from various sources

S. No.	SOURCES	LICENSEES/ DISCOMS of NCT Delhi					
1		BRPL	BYPL	TPDDL	NDMC	MES	Total
2	Badarpur TPS*	33.42	18.99	22.77	17.73	7.09	100
3	Rajghat Power House*	43.92	25.4	30.68	0	0	100
4	IP Gas turbine station	61.031	8.589	30.25	0	0	99.87
5	Pragati	28.29	16.07	19.28	30.3	6.06	100
6	Dadri TH-I	48.694	9.488	25.284	16.534	0	100
7	Bawana	31.13	18	21.75	7.3	1.82	80
8	Singrauli	19.76	49.56	30.68	0	0	100
9	Sasan	14.832	54.488	30.68	0	0	100
10	Aravali Jhajjar	57.89	11.43	30.68	0	0	100
11	Dadri TH-II	43.92	25.4	30.68	0	0	100
12	Tehri HEP	69.317	0	30.683	0	0	100
13	Koteshwar	69.32	0	30.683	0	0	100
14	Rihand-III	43.92	25.4	30.68	0	0	100
15	NHPC Stations	69.32	0	30.68	0	0	100

Source – 24x7 Power for All, a joint initiative of Government of India and Government of Delhi, 2016
**Permanently shut down*

As mentioned above, majority of the power is procured from the neighbouring states for Delhi's consumption. Most of these power networks are fed from two sources to maintain redundancy, but it is not possible near/ at border areas. Hence there is a need for encouraging exchange of power from neighbouring state to improve reliability and continuity in power transmission.

6.2.4 Power consumption

Delhi, being an urban place with high load density, has seen the electricity consumption increasing from 25,581 MUs in 2010-11, to 30,370 MUs in 2016-2017 and further to 31,875 MUs in 2017-18 as seen in Table 6.7.

Table 6.7: Power availability versus Consumption

S. No.	Power Availability versus Consumption	2016-17	2017-18
1	Availability in MW	6,080	6,651
2	Shortage (-) or Surplus (+) in MW	-181	125
3	Percentage Shortage (-) or Surplus (+)	-2.89	1.92
4	Maximum Energy consumption in a day in MUs	130.58	136.816
5	Energy Consumed during the year in MUs	30,790	31,875

Source – Economic Survey of Delhi. 2018-19

Load shedding by the various DISCOMS occur because of points like grid restrictions, or constraints in system. It reduced considerably from 31 MW in 2016-2017 to 19 MW by 2018-

2019. Delhi is the first state in the country to prepare Islanding scheme to meet the essential and critical load in case of crises due to Grid collapse.

Latest figures from BSES show that Delhi has shown a record high of 7,400 MW of peak power demand, which is an increase of over 250 percent of the peak demand of 2,879 MW in 2002. This shows how skewed the projection of 9,948 MW for the year 2021 is, which was made in the Regional Plan 2001. It is important to note that according to the Table 6.8 below, if Delhi has a peak demand of 7,400 MW already, then the projection of requirement of 7,471 MW for the year 2021-22 is grossly incorrect.

In the areas of BRPL covering localities in south and west Delhi, the peak demand is expected to touch 3,200 MW in 2019 as against 3,081 MW in 2018. In the areas of east and central Delhi where power is supplied by BYPL, the peak demand may go up to 1,640 MW as against 1,561 MW in 2018. In the north and north west Delhi areas, where power is supplied by TPDDL, the peak demand is likely to be 2,150 MW as against 1,861 MW in 2018.

Volume III of the 19th Electric Power Survey (EPS) of India Report covers the demand forecast of the NCT Delhi. In this report the projected maximum demand for electricity in Delhi to be 6,764 MW by the end of March-2019 as shown in the Table 6.8 below, in continuation to this the forecast of energy requirement made in the report indicates that the total demand may go up to 7,471 MW by 2021-22. But, as per latest data furnished by IPGCL & PPCL the peak demand met as of July 2019 was already a staggering 7409 MW. This goes to show that in the next coming years the power requirement of Delhi is slated to increase manifold.

Table 6.8 Energy requirement and Peak Load/ Demand forecast for NCT Delhi

S. No.	Year	2018-19	2021-22
1	Energy requirement in MUs	33,391	36,884
2	Peak Demand met in MW	6,764	7,471

Source – Volume III, Electric Power Survey (EPS) of India Report, Central Electricity Authority

6.3 Aggregate Technical and Commercial Losses (AT&C) in Delhi

Aggregate Technical and Commercial Losses (AT&C) is the difference between energy units put into the system and the units for which the payment is collected or in simpler words which is the difference between the amount of energy released and the amount which is billed. Transmission and distribution loss do not capture losses on account of non-realization of payments. AT&C loss is the actual measure of overall efficiency of the distribution business as it measures both technical as well as commercial losses. The main reasons for technical losses may be due to overloading of existing lines and substation equipment, the absence of upgradation of old lines and equipment, low HT: LT Ratio, poor upkeep and maintenance of equipment, non-installation of capacitors for power correction, etc.

On the contrary, commercial losses are due to pilferage, low metering/ billing/ collection efficiency, theft, tampering of the metering system, low accountability of employees, the absence of energy audit and accounting through IT intervention etc. After reforms in the power sector the AT & C losses in Delhi reduced significantly from 52 percent in the pre-reform era to 9.41 percent in 2017-18 as shown in Table 6.9.

Table 6.9: AT & C Losses in Delhi – Post Power Sector Reforms Period 2010-18 (in %age)

S. No.	Year		BYPL	BRPL	TPDDL
1	2010-11	Target	22.00	17.00	17.00

S. No.	Year		BYPL	BRPL	TPDDL
		Achieved	21.95	18.82	14.15
2	2011-12	Target	18.00	15.00	15.33
		Achieved	22.07	18.11	11.49
3	2012-13	Target	16.82	14.16	12.50
		Achieved	22.14	17.74	10.73
4	2013-14	Target	15.66	13.33	12.00
		Achieved	22.19	16.93	10.35
5	2014-15	Target	14.50	12.50	11.50
		Achieved	18.93	13.65	NA
6	2015-16	Target	13.33	11.67	9.80
		Achieved	15.56	12.08	8.80
7	2016-17	Target	NA	NA	10.50
		Achieved	12.70	10.69	8.59
8	2017-18	Target	13.33	NA	NA
		Achieved	10.41	9.42	8.40

Source – DERC, Websites of Discoms of Delhi

A new scheme namely "Integrated Power Development Scheme (IPDS) has been launched (earlier known as Restructured Accelerated Power Development and Reforms Programme (R-APDRP)) by Government of India with an objective to reduce Aggregate Technical and Commercial (AT & C) losses. It aims to establish IT-enabled energy accounting/auditing and to improve the collective efficiency of power transmission. It also targets at strengthening of the sub-transmission and distribution network in urban areas, metering of distribution /feeders/ transformers /consumers in urban areas and rooftop solar panels.

6.4 Electricity theft

Ever since the privatization of the power sector, the monetary losses due to power theft have come down by over 50 percent. At the time of privatization, the losses were around 60 percent and now they have been curbed to fewer than nine percent. Power theft results in Rs 400 crore of annual losses to power supplying authorities in Delhi.

Power theft is rampant in areas of North, West, East and Central Delhi like Najafgarh, Jaffarpur, Mundka, Karawal Nagar, Seelampur, Mandawali, Chandni Mahal, Nand Nagri, Yamuna Vihar, Daryaganj, Dallupura, Old Seelampur, Khichripur, Shastri Park, Baljeet Nagar, Sabhapur village, Burari, Jahangirpuri, Wazirabad and Shaheen Bagh. In these areas, the Aggregate Technical & Commercial (AT&C) losses range between 25-40 percent.

Latest data from Tata Power Delhi Distribution Limited (TPDDL) that caters to 70 lakh customers had posted Rs.150 crores losses in the year of 2018. They have begun flying nano drones to catch culprits and monitor transmission and distribution networks to detect faults and fix supply disruptions. These drones are being used for the maintenance of power lines, poles and towers to provide better service to customers. The discom used nano-drones in two pilot projects at Ashok Vihar and Ranibagh in April-May 2018 to study their viability for surveillance of grids, sub-transmission lines network and grid equipment. Usage of drones helps in close-up, detailed imagery of installations, scanning potential defects for maintenance personnel. Drones can also capture tower and pole images from various angles, giving a fuller picture, which is often not possible with other inspection methods. The process will enhance the capturing of more credible

data which can in turn help in making better decisions while minimizing the downtime during maintenance and any contingencies.

BSES has finalized a programme to use drones for asset mapping and network monitoring through thermos-scanning. A large part of BSES' area comes under the no-flying zone. Because of this, using drones for controlling power theft has limited use in its area. But, still, like TPDDL, BSES too is contemplating the use of drones to control power which are not under the no-flying zone. This is in addition to already using the tool of Lok Adalats for redressal of power theft cases. Over 22 special Lok Adalats have been organized in association with Delhi State Legal Services Authority (DSLSA), and have resolved over 37,000 cases.

Installing smart meters help put a check on meter tampering. The prepaid smart meters have digital cards which can be recharged like mobile phones, DTH service, etc. one can detect tampering and the suspect's meter can be stopped remotely, the distribution firms can detect unusually heavy demand, which may point to tapping of wires.

Organised theft of power in Delhi for charging of e-rickshaws too has become a serious issue. There are over one lakh e-rickshaws plying on the city roads and only one-fourth of them are registered, despite a subsidy scheme of the government. Considering that most of the e-rickshaws are not registered, the collective loss of all three discoms due to charging through illegal connections is around Rs 150 crore. The lack of proper charging facilities has led to organized rackets of power theft in prominent parts of the city, especially in areas close to metro stations.

6.5 Supervisory Control and Data Acquisition (SCADA) and Communication

To facilitate constant access to real-time data of the entire network, Supervisory Control and Data Acquisition (SCADA) system has been implemented. SLDC has the state of art Load dispatch center having SCADA (Supervisor Control and Data Acquisition System) for retrieving information from generating stations and grid sub stations consisting of analog data (like Mega Watt, Voltage, Current, MVar) and digital status of various elements (like Circuit Breaker, Isolator etc.) for real time monitoring and control of grid, enabling it to operate safely, securely and economically. The data from sub-station is received through an existing communication ring comprising of Optical ground wire and Microwave links.

6.6 Government expenditure in Energy Sector

Investment in the energy sector by the Govt. of Delhi is only for augmentation of transmission and transformation capacity and power generation. Investment by the government in this sector during the last five year showed an up and downward trend. During the year 2010-11, the energy sector in Delhi has a total budget share of Rs. 250.83 crore, which increased to Rs. 421 crores in 2018-19 (RE) as seen in Table 6.10 and Figure 6.5.

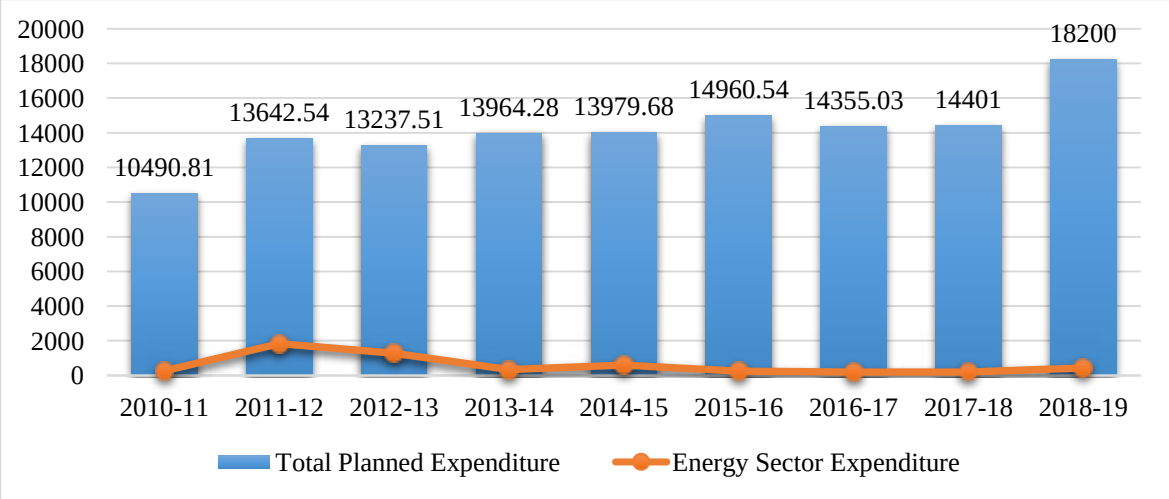
Table 6.10: Expenditure incurred by Govt. of Delhi in energy sector vis. Total expenditure

S. No.	Years	Expenditure incurred in Rs. cr.		
		Total Plan Expenditure	Energy Sector Expenditure	% of Energy Expenditure to Total Plan Expenditure
1	2010-11	10,490.81	250.83	2.39
2	2011-12	13,642.54	1,833.26	13.44
3	2012-13	13,237.51	1,271.61	9.61
4	2013-14	13,964.28	326	2.33

5	2014-15	13,979.68	581.26	4.16
6	2015-16	14,960.54	235.52	1.57
7	2016-17	14,355.03	187.77	1.31
8	2017-18	14,401	221.85	1.54
9	2018-19	18,200	421	2.31

Source – Economic Survey report 2018-19

Figure 6.5: Total expenditure incurred by Delhi Govt. vs expenditure in energy sector in Rs cr



Source – Economic Survey report 2018-19

As seen from the above Figure 6.5 , that the expenditure incurred by the Delhi government in the energy sector is showing a net downward trend. It is true that Delhi is nearly 100 percent electrified, but we need to shift the focus from non-renewable energy sources to renewable sources of electricity to

achieve sustainability and lower our dependence on fossil fuels. The shift from fossil fuel electricity production to alternate sources like waste to energy would entail additional funds from the government, but they would reap much more benefits.

6.7 On-going and Proposed Power Generation Projects

As the demand for power increases, the demand for improved infrastructure for power also increases. For improving the power conditions in Delhi, all the three companies are augmenting infrastructure like power transformers, extra high voltage cables, installation and 11 KV feeders, shunt capacitors, etc.

A new 750 MW Gas Based Combined Cycle Gas Turbine (CCGT) Pragati-II Power Project at Bamnauli is proposed to be set up by Pragati Power Corporation Limited (PPCL). The project has been kept on hold by the Government due to the non-availability of gas. The strengthening of Sub-transmission and distribution network including metering in Jhajjar, Rohtak, Panipat and Sonipat Circles of Haryana (under IPDS) by Uttar Haryana Bijli Vitran Nigam (UHBVN) is underway.

6.7.1 Future Transmission Expansion

According to the latest BSES reports, DISCOMS are to get up to 865 MW (BRPL 550MW, BYPL 315 MW) of power through banking arrangements. BRPL is also set to get

100MW from wind power to mitigate the power demand and supply gap. In order to meet the future requirement of power in Delhi, various new and augmentation transmission network projects (400/220 KV) costing approx. 4,600 crores for adding 7,680 MVA transformation capacity at 220 KV level and 6,815 MVA (including 4,000 MVA of inter-state transmission system (ISTS) substations) at 400 KV level in the network are envisaged in Business Plan for the period up to 2022 for improving the reliability of power supply in Delhi.

The need of the hour is to have liberalized retails power markets. The consumers should have the choice for choosing their source of energy or a distribution sector that gives them choices. These allow individual consumers to choose their retailers. Retail choice can drive down costs and increase consumer access to clean energy.

6.8 Energy Conservation Measures via DSM Regulations

To mitigate shortfall in peak demand, Private DISCOMs/ NDMC would have to effectively plan through comprehensive power procurement initiatives on short term, medium term & long-term basis and look for procurement of power either through competitive bidding or through other sources. At the same time, the deficit in peak demand can be effectively reduced through proper implementation of Demand Side Management (DSM), energy efficiency measures and implementation of solar roof top generation in the respective DISCOMs area. DSM involves planning, implementation and constant monitoring of various activities that are designed to encourage consumers to modify their electricity consumption patterns, both with respect to timing and level of electricity demand/consumption for use of electricity in an optimal and efficient manner. DSM Regulations are a step forward in this regard that provides frame work for designing, development implementation of DSM related activities.

- DISCOM/GNCTD is required to give more preference to Hydro Power in order to improve the hydro-thermal generation mix. This will not only help in eliminating the peak shortage of Delhi but will also balance the energy supply & demand scenario. With increasing importance being given to low carbon growth these days, the cheapest and more affordable option to overcome the energy deficit is DSM and implementation of energy efficiency measures in various sectors such as agriculture, municipalities, Commercial buildings, domestic sector & industrial sector etc. The DSM has been traditionally seen as a means of reducing peak electricity demand.

- SLDC/distribution companies are required to firm up plan to purchase power on real time basis based upon the prevailing power demand observing the merit order protocol i.e. cheaper to costlier generation in order to optimize the power purchase cost.

- DISCOMs are required to firm up plan for disposing surplus power on short term/ medium term basis through bilateral arrangements and power exchange and earn revenue. They should also explore the option of selling the surplus power to needy states at slightly higher than variable cost in order to recover some part of fixed cost and reduce the tariff burden. Alternatively, the surplus energy to the extent possible can be banked with other states having different seasonal demands. This banked energy can be used by DISCOMs when demand of energy of other states gets reduced.

- The Domestic Efficient Lighting Programme (DELP) seeks to promote high quality LED lighting in the domestic sector by overcoming the high first cost barrier. DELP will enable sale of LED bulbs from designated places at a cost that is much less than the market price of Rs. 350 - 450 as replacements of Incandescent Lamps (ICLs). The programme will reduce connected load and will lead to substantial saving (up to 23

percent of domestic lighting load of 12,292 MU during FY 2014-15) in annual energy consumption.

6.8.1 Strategies for power management and energy conservation

Following strategies are suggested for power management and energy conservation –

- Coal plants will need to operate in a flexible mode. Delhi can also explore the idea of expansion of natural gas infrastructure. For example, in California, where natural gas has enabled the power system infrastructure to tolerate an extremely high penetration of renewables. In addition, expansion in the field of nuclear energy could increase Delhi's clean power supply.

- Focus more on innovations and renewable sources of energy and to enable it to grow further. For example, where the instantaneous generation of renewables on a hot June day could greatly exceed the entire power demand of the state. To accommodate this excess energy, the grid will need flexibility. Strengthening transmission too can add flexibility.

- Demand flexibility is extremely crucial. Flexible demand can match up with variable supply. Demand response is one solution. For example, you can get several industrial plants to shut off their chillers at the same time when demand peaks. Demand flexibility can also be achieved with electric vehicles, which might pay a higher rate to charge during peak hours.

- Embedded generation availability within the state is critically required for reliable and efficient operation of Delhi Islanding scheme during grid disturbance in northern region It is worth mentioning that, the state of Delhi has about 1,697 MW gas based embedded generation capacity which is not being utilized optimally because of non-availability of full quantity of cheaper gas. This leads to generation of power by arranging costlier spot R-LNG gas resulting in higher cost of generation and ultimately less prioritization in scheduling by SLDC/DISCOMs as per merit order. All gas-based stations are capable to operate at full load meeting the normative parameters of DERC/CERC. Proper utilization of these plants will help in reducing the peak shortage, transmission system constraints, system losses& reduce per unit cost of generation from these plants. Due to non-scheduling of the power by DISCOMS being slightly costly, the plant run at low PLF which in turn affect the efficiency and further make it expensive.

6.9 Energy Policies and Initiatives

6.9.1 Nation Smart Grid Mission (NSGM)

- Smart metering Pilot projects undertaken by Reliance at three pilot sites- Delhi, Mumbai and Gujarat. At Delhi, the pilot project used the technology of 6LoWPAN = IPv6 over Low Power Wireless Personal Area Network which was standardized by IETF (Internet Engineering Task Force).

- Smart Metering Pilot implemented using Programmable Logic Controllers (PLC) Technology at – Tata Power Delhi Distribution Limited (TPDDL). Tata Power Delhi Distribution Limited (TPDDL), previously North Delhi Power Limited (NDPL) which as earlier mentioned is a joint venture between Tata Power and Delhi Government is among

the earliest adopter of Smart Grid approach. They have collaborated with General Electric (GE) for using various Smart Grid approaches for efficient distribution of electricity.

- HCL Technologies Limited (HCL) has partnered with Echelon (A Smart Grid Product Development Company) for providing smart metering and network infrastructure services. It has also roped in Oncor as a client for its Smart Grid infrastructure services.

- Green Business Certification Inc. (GBCI) and India Smart Grid Forum (ISGF) announced collaboration on sustainable power systems in India and Southeast Asia designed to accelerate market transformation of smart grid technologies and sustainable power systems in the region through GBCI's PEER (Performance Excellence in Electricity Renewal) program. PEER is designed to measure and improve sustainable power system performance. Through PEER certification, power grids have an opportunity to gain a competitive advantage by differentiating their performance, documenting the value produced and demonstrating meaningful outcomes to accelerate transformation of the electricity sector in the market place. Under the U.S.-India Energy Dialogue, the Energy Department's Office of Energy Efficiency and Renewable Energy (EERE) is promoting U.S. demand response technologies in India by supporting a partnership between the Lawrence Berkeley National Laboratory (LBNL), the Indian utility Tata Power Delhi Distribution Limited (TPDDL), and Honeywell. The U.S.-India collaboration is demonstrating Demand Response (DR) technologies in a pilot program involving 167 buildings with more than 25 MW of enrolled peak load in Delhi.

6.9.2 Government of NCT of Delhi (GNCTD) Initiatives

- Mandatory use of Compact Fluorescent Lamp and Electronics Chokes in Govt. Building/Govt. aided institution/Boards, Corporations. Thrust is now being given on LED lamps and street lights.

- Mandatory use of ISI marked Motor pump sets, Power capacitor, Foot/ Reflex valves in Agriculture Sector.

- Policy/programmes for Solar power generation are under consideration.

- Policy on solar lighting of monuments and waste to energy Projects.

- Installation of Rooftop Solar Plant will result in reduction of Peak Demand, especially during summer season and moreover high valued PPAs to overcome demand deficit can be avoided.

6.9.3 Street Lighting National Programme (SLNP)

Govt. of India also launched Street Lighting National Programme (SLNP) along with UJALA to increase energy efficiency in lighting by replacing conventional street lighting by LED based Efficient Lighting in the country. Under Street Lighting National Programme (SLNP), 3.5 crore (35 Million) conventional street lights are targeted to be replaced with smart and energy efficient LED street lights. Energy Efficiency Services Limited (EESL), a government company under the administrative control of Ministry of Power is designated as the implementing agency for UJALA & SLNP.

Under Street Lighting National Programme (SLNP), about 38.75 lakhs energy efficient street light have been installed in the country by 10th Nov, 2017 which on an average result into savings of 1.5MU energy per day and avoiding 135 MW peak demand.

6.9.4 Bachat Lamp Yojana (BLY)

TPDDL had signed a tripartite agreement with BEE & C Quest Capital to implement Bachat Lamp Yojana (a CDM based scheme launched by BEE). The scheme aimed at large scale replacement of incandescent bulbs in households by CFLs. Under BLY, CFLs were offered at Rs. 15 in exchange of working Incandescent bulbs for residential consumers. Project completed in six Districts and over eight lakhs CFLs had been distributed under the scheme.

6.9.5 Unnat Jyoti by Affordable LEDs for All (UJALA)

Govt. of India launched Unnat Jyoti by Affordable LEDs for All (UJALA) in 2015 to increase energy efficiency in lighting by replacing the inefficient conventional incandescent bulbs in domestic sector and conventional street lighting by LED based Efficient Lighting in the country. Under UJALA, 77 Crore incandescent bulbs in the Country are targeted to be replaced by high quality LED bulbs.

Energy Efficiency Services Limited (EESL), a government company under the administrative control of Ministry of Power is designated as the implementing agency for UJALA. Under UJALA, about 27.4 crores LED bulbs have been distributed by 10 Nov 2017 in the country, which on an average result into savings of 35,600 MUs energy per year, thereby avoiding 7,128 MW in peak demand. Delhi recorded a distribution of 7,466,923 LED bulbs, which have saved its inhabitants 9,69,707 MWh in energy. It saved 388 crores in cost and 7,85,463 tons of carbon di oxide reduction.

6.9.6 Department for International Development (DFID) funded Appliance Replacement Program

TPDDL in association with Bureau of Energy Efficiency (BEE) and ICF International (consultant) developed an Appliance Replacement program for old Refrigerators and Air conditioners. DFID (A UK grant agency) agreed to fund the project. Under the scheme, star rated refrigerators and ACs were offered at discounted rates (against the prevailing Market Operating Prices) & existing appliances were bought back for the safe disposal.

- Appliance Replacement Program was launched in association with LG, Voltas & Godrej to promote Star Rated Appliances- ACs & Refrigerators. Under the program, consumers were offered exchange scheme, under which existing old Refrigerators and Air Conditioners can be replaced with new Energy Efficient BEE Star Rated Refrigerators & ACs.

- TPDDL initiated the replacement of conventional lighting with efficient lighting (LED applications), appliance replacement program for refrigerators & air conditioners, automated demand response etc.

- Rebate based AC Replacement Program. It is observed that the share of the domestic category in the total sanctioned load stands at 55 percent. Around 60 percent domestic consumers own Split or Window ACs. 80 percent of these AC units are either non-star or less than three stars. Night time system peak load is majorly attributed by domestic AC

load. TPDDL has developed a unique energy efficiency program "Replacement of non-star rated AC with BEE five Star rated/ Inverter Technology AC".

- Total 9,089 number of non-star rated AC has been replaced under AC replacement scheme till the validity of the scheme which expired on August 31, 2016. This has led to load reduction of 5.94 MW and savings of seven MUs annually. This would have environmental impact of reducing 1,781.15 MT of carbon di oxide.

- Sample data of customers who joined the AC scheme in August'15 showed that their aggregated Maximum Demand Indicator (MDI) for the months April'16 to August'16 has been reduced in comparison to period April'15 to August'15.

6.9.7 Renewable Purchase Obligation (RPO)

Every obligated entity shall purchase electricity (in kWh) from renewable sources, at a defined minimum percentage of the total energy consumption under the Renewable Purchase Obligation. Based on DERC "RPO" and "REC" Regulations, the Commission has set a total "RPO" target as 11.80 percent of energy consumption and Solar "RPO" target as 0.45 percent of energy consumption for FY 2018-19.

6.9.8 Measures for Reduction of AT&C Losses

- 100 percent metering and improving billing & collection efficiency
- Metering of all 11 KV feeders & Distribution transformers for energy auditing
- Augmentation of overloaded distribution system under various schemes
- Implementation of High Voltage Distribution System (HVDS)
- Use of Arial bunched Conductors (ABC)
- IT initiative like SCADA, GIS, AMR etc.

Tata Power Delhi Distribution (TPDDL) has launched a smart grid project involving setting up of radio frequency mesh communication project in its licensed area of 510 sq. km in north and northwest Delhi. The project will help TPDDL to provide greater service options to customers and accurate information on their energy consumption patterns, helping them to manage their usage more efficiently and improve overall reliability by reducing outage time. The project will also help in enhanced monitoring and control points throughout TPDDL's network on real time basis and will aid in reduction of commercial losses.

This approach has made the Smart Metering project feasible as most of the state utilities are not in a position for such rollouts due to their financial constraints. Now, all the enablers including standards and financial modals for implementing smart metering in the country are in place, Delhi needs to take initiatives for implementation of Smart Metering in the respective Discoms.

- Segregation of rural & agriculture feeders

- Online feeder data on power portal

6.9.9 Islanding Scheme

A gird collapse, like the one that happened on the 31st July 2012 where nearly 620 million people across 19 states and three Union Territories plunged into darkness, is the worst-case

scenario for a country. The way a blackout can be prevented in real time through controlled segregation of a system into a number of viable islands together with generation and/or load shedding forms the backbone of Islanding. The nature and location of any fault that warrants such islanding can be ascertained in real time through monitoring the active-power (megawatt) flows at both ends of several pre-specified lines.

This is in addition that this utility along with generation and transmission projects being on the terrorist threat list, does not help our power sector. When the grid malfunctions, we need alternative source of energy to feed the grid using a renewable energy source or micro grids.

TPDDL is working on a pilot project that can be scaled up for isolating such important installations and services. In India, only Mumbai and Kolkata have such an islanding infrastructure in place. The European Union funded pilot project in the works by TPDDL is in collaboration with French utility Enedis, Schneider Electric, data analytics firm Odit-e and Helsinki based VaasaETT for setting up defence mechanisms such as islanding by leveraging solar power and battery storage. TPDDL is trying to start with a transformer wherein the demand is 400kWh catering to around 1,000 households. Here, the batteries would be there along with the solar generation. So, in case of any eventuality, this system would be able to sustain the load of that distribution transformer.

Such islands would not only isolate the fallout of a grid disturbance (causing a blackout), but also restricting it to a particular region and simultaneously allow essential service such as water-supplies, telecom infrastructure, hospitals, airports or metro rail network to function.

6.10 Policies and Proposals

- Government of India along with the Delhi government need to collaborate to facilitate utilization of embedded generation capacity of Delhi, which is not being optimally utilized due to non- scheduling of power by DISCOMs / SLDC as per merit order. Ministry of Petroleum & Natural Gas need to be requested for allocation of domestic gas at administered price to Delhi to meet the natural gas requirement for the projects.

- Besides implementing pilot schemes for power islanding, there is a need for internal generation of Delhi to supply power to its essential services such as metro-rail, airport, hospitals, water supply, telecom infrastructure whenever the grid collapses. This is not possible due to issues pertaining to availability of technology and systems not been designed for isolating themselves. Microgrids should be implemented to allow for intentional islanding, wherein in the case of an outage, a microgrid controller disconnects the local circuit from the grid on a dedicated switch and forces the distributed generator to power the entire local load.

- In the Delhi Metropolitan city, high cost is being charged by Railways for providing right of way (way leave charges for underground cables), which results in high consumer tariff. GOI, MoP may take up with Ministry of Railways for reduction in this ROW cost.

- Shown below is the map of the existing and proposed power transmission planning map for Delhi by the DERC. It clearly shows the need for upgradation of certain 220kVa substations to 400kVa substations. Similarly, upgradation of existing 400kVA to 630 kVA substations in high energy consumption areas will help avoid power overloading. Apart from these upgradations, several additional transformers also need to be installed to mitigate power overloading. Modern techniques such as Smart grids, Net metering,

virtual net metering is proposed for Load Management to flatten the load curve and reduce the peak demand in the system to a manageable proportion, vis-à-vis the availability in the grid.

- A new policy may also be proposed to encourage mixed land use in order to ease the load curve. For example, In Delhi an area for office (e.g. CGO complex), market (e.g. chandni chowk), industries (e.g. Bawana), education (say north campus) the Load curve i.e. load vs time of day depends upon activity. So, the network has high load for few an hours and rest of time there is absence of load. For example, an office complex has high load in day time and minimal load in night but for residential areas it is the other way. Hence in order to have uniform load throughout the day and to avoid peak demand scenarios it is advised to have mixed land use/ activities in every colony. This will also in turn ease the transport load.

- Replacing sick cables/ single line cables with double cables will not only help curb transmission losses but will also improve in the overall efficiency of the electricity network.

- The need to install AMR (Automated Meter Reading) based energy systems at distribution transformers. In addition, several projects like Smart Feeder, Advanced Meter Infrastructure (AMI), Advanced Communication Infrastructure, Broadband over Power Line (BPL), Mobile Workforce Management (MWM), DR (Demand Response) Management, DER (Distributed Energy Resources) Management, Advanced Asset Management (AAM), Enterprise Application Integration (EAI), etc., should be lined up for future execution to enhance energy efficiency.

- Regular energy audits should be carried out. Apart from these audits, rating design of energy efficient buildings by site planning, heights, form, construction and materials and reducing energy demand by passive micro-climatic design approach, intelligent energy controls, heat recovery, landscape, opening design, furnishings, etc., are the critical considerations that have been identified, and must be considered while granting electricity connections. While this is being presently done by agencies such as GRIHA, LEED, there is a need to co-relate these ratings with incentives that could be granted

- A set of dedicated police stations can be set up to overlook cases pertaining to complaints against DISCOMS, power thefts etc. This could be made a part of the corporate social responsibility (CSR) initiative of private companies.

- DSM has a major role to play in deferring high investments in generation, transmission and distribution networks. Thus, DSM applied to electricity systems shall provide significant economic reliability and efficiency.

- Environmental benefits as shown in table below. Opportunities for reducing energy demand are numerous in all sectors and many are low-cost, or even no cost items that most enterprises or individuals could adopt in the short term, if good energy management is practiced.

Table 6.11: Installed Capacity of Renewable Energy in different sectors

S. No.	Sector	DSM Technique	Energy saving Potential as % of total consumption	Investment/MU of savings (INR Crores)

S. No.	Sector	DSM Technique	Energy saving Potential as % of total consumption	Investment/MU of savings (INR Crores)
1	**Agriculture**	Replacement with Energy efficient pump Sets	27	1.5
2	**Domestic**	Replacement of ICLs with LED bulbs	23	0.8
3	**Commercial building**	Retrofitting of Energy efficient equipment	15	1.5
4	**Public water Works**	Replacement with energy efficient Pumps	26	0.6
5	**Municipal Street lighting (MSL)**	Replacement of existing street light with LEDs	51	2

Source – 24X7 Power for All (DELHI), June 2016

- To implement the Domestic Efficient Lighting Programme (DELP) replacement of inefficient equipment / appliances with energy efficient ones for the domestic, commercial buildings and municipalities. These can be undertaken by the State Government. at no upfront cost by using the Energy Service Company (ESCO) model. The model is based on the concept of promoting Performance Contract mode where the company invests in any project by entering into a contract agreement with the facility owner which is recovered through the savings accrued due to reduced electricity bills.

- There is a need to focus more on innovations and focus renewable sources of energy and to enable it to grow further. For example, where the instantaneous generation of renewables on a hot June day could greatly exceed the entire power demand of the state. To accommodate this excess energy, the grid will need flexibility. Strengthening transmission too can add this flexibility. Organizing "Suryamitra" training programs in Delhi state in collaboration with National Institute of Solar Energy (NISE) and The Energy Resources Institute (TERI), which would not only enable widespread awareness of the benefits of turning to renewable sources of electricity. There is a need to encourage market-based approaches and public-private partnerships to drive demand and adoption, with minimal use of State Government subsidies.

- The SNA should develop a specific website for consumers who are interested in Rooftop Solar. This would not only help an existing or new consumer assess the monetary aspects of its installation, list of contacts to get started, current incentive schemes, resources for finding financial loans, solar integrators and service providers but also help assess his ultimate gains whether monetary or positive environmental impact over a said period of time.

- Increasing the efficiency of waste to energy plants by working on lack of proper collection, segregation, treatment and power generation practices, i.e. waste management. Efficient waste segregation would help ensure that the waste sent to incinerators has the required calorific value.

- Need for power exchange at medium level of voltage between Delhi and its neighbouring states. Normally all assets in the power network are fed from two sources to maintain redundancy. This becomes difficult in and at border areas. Hence alternate sources can be

procured to fill in the gaps from the neighbouring states to improve the grid's reliability and to maintain redundancy, making interstate power exchange the need of the hour.

- Electrical infrastructure needs to be reformed to integrate DER (Distributed Energy Resources). Impact of unmanaged DER can have a lasting effect on the grid stability. DERs can include behind-the-meter renewable and non-renewable generation, energy storage, electric vehicles and other controlled loads (separately metered appliances like hot water systems). Common examples of DERs include rooftop solar units, battery storage, electric vehicles (EV) and EV chargers, and demand response applications. These separate elements work together to form distributed generation.

- There is a need for taking robust steps in space allocation for utilities especially in upcoming colonies or in those colonies wherein the demand has increased due to subsequent increase in the FAR. Nearly 1000 locations have been earmarked in Delhi where there is a need for land for new power infrastructure to augment the network.

- Earmarking of EV charging stations is very crucial and important. High traffic roads must be avoided and it must be ensured that these stations are marked equitably on the specific EV charging network. Provision for battery storage should be made mandatory at these stations. It is suggested that appropriate policies and proposals are suggested at the appropriate planning levels and thus to be included in the master plan, Zonal Development Plan and Local Area Plan.

CHAPTER 7. WATER

7.1 Introduction

Water consists of water resources and its quality for the inhabitants of NCT Delhi. Its study is important from the point of view to assess the sufficiency of water resources for the needs of the population. Due to high water consumption of the urban populace, Delhi is a heavily water stressed state. The Central Ground Water Board (CGWB), Ministry of Jal Shakti, Government of India monitors this resource on the surface and below. The National Commission for Integrated Water Resource Development under the Ministry of Jal Shakti, states that the water requirement of the Country by 2050 in high use scenario is likely to be 1,180 billion cubic metres (BCM) whereas the present day availability is 695 BCM. The total availability of water possible in the country is still lower than this projected demand at 1,137 BCM. Delhi has several sources of water.

7.2 Existing Surface Water Sources within Delhi

Delhi is a riparian state of the River Yamuna which is the only river flowing through the NCT of Delhi. This river constitutes the primary source of water supply to NCT Delhi. Water is extracted from the river at HathniKund Barrage through Western Yamuna Canal traversing Haryana and is supplied to Delhi through the Delhi Tail Distributary at Haiderpur and Chandrawal Water Treatment Plants (WTP).

In addition, the river water is abstracted at Wazirabad Barrage within the NCT for Wazirabad WTP. The NCT of Delhi also accesses water from the Ganga River and Indus Basin. The Delhi Jal Board (DJB), a public water utility, is responsible for production and distribution of drinking water in the NCT of Delhi. Presently about 93 percent of households are covered through piped water supply. Present potable water supply by Delhi Jal Board is about 935MGD, which gives per capita average availability of 185 LPCD for the estimated population of 230 lakh for 2021.

7.2.1 River Yamuna

The Yamuna River as shown in Figure 7.1 is a natural source of water that enters north of Palla Village, at an altitude of 690 feet above sea level, and leaves it near Jaitpur below Okhla at an altitude of 650 feet above the sea level. It flows for 54 kms from Palla to Badarpur in Delhi and 22 kms from Wazirabad to Okhla. Yamuna River in Delhi accounts for only two percent part of its total length. However, 70 percent of the total pollution in the River Yamuna is contributed by Delhi.

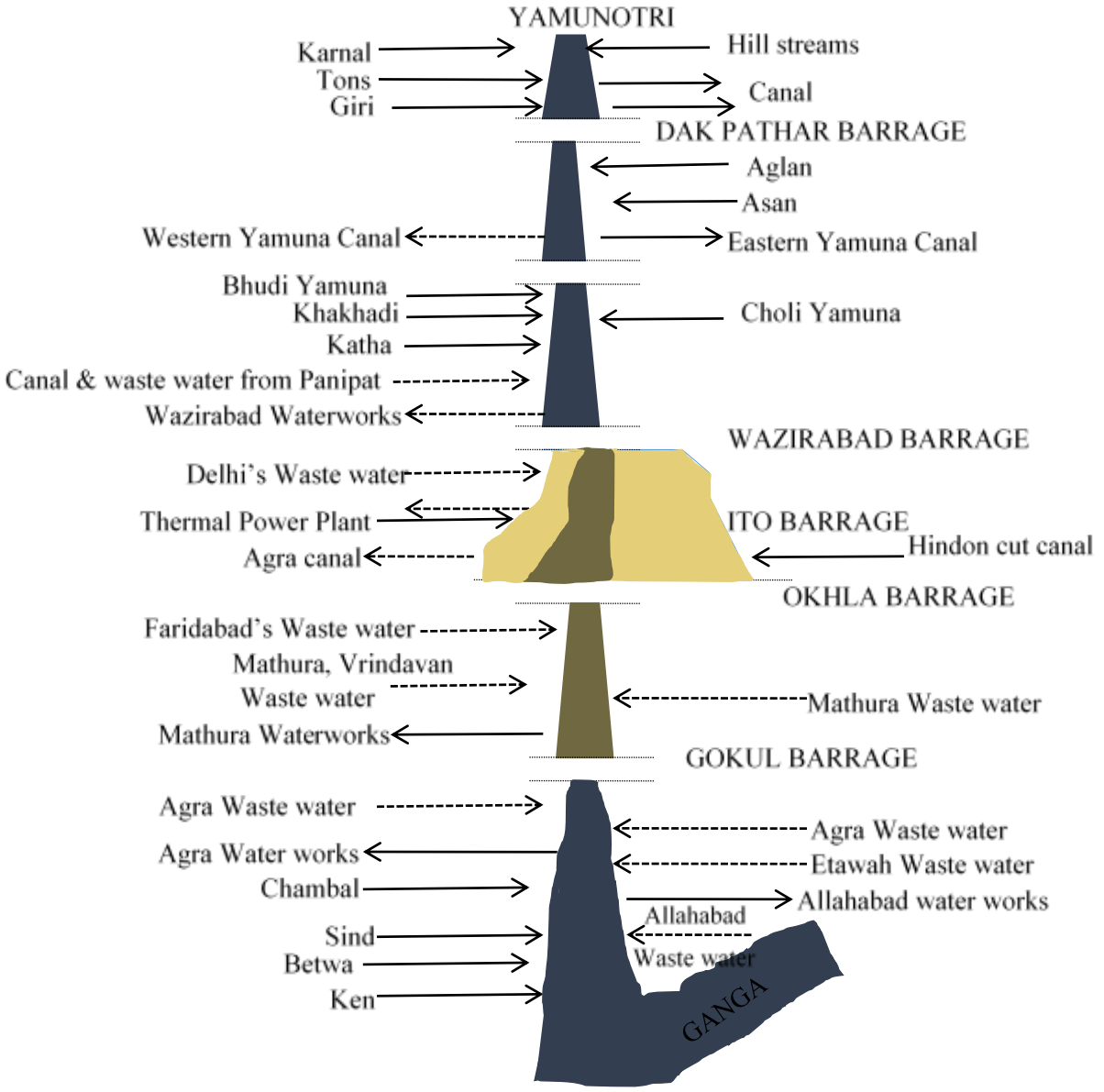
While the census indicates that 83 percent of Delhi's households used treated tap water as a primary potable water source, only half (51 percent to be precise) of the slum households have any water source within their house premises, which reflects the insufficient availability and overreliance on unreliable shared sources of water.

Figure 7.1 River Yamuna O Zone

Source: Zonal Development Plan, Zone O, 2010

During the rainy season, the river expands considerably in breadth but in dry season, the river gets reduced in breadth over a period of nine months of the year, the river has no fresh water downstream of Wazirabad and the only flow available is sewage, both treated and untreated, flowing through 18 drains that join the river Yamuna during its journey through Delhi. Figure 7.2 below depicts the flow path of river Yamuna in Delhi.

Figure 7.2 Path of River Yamuna from its origin to its confluence with Ganges

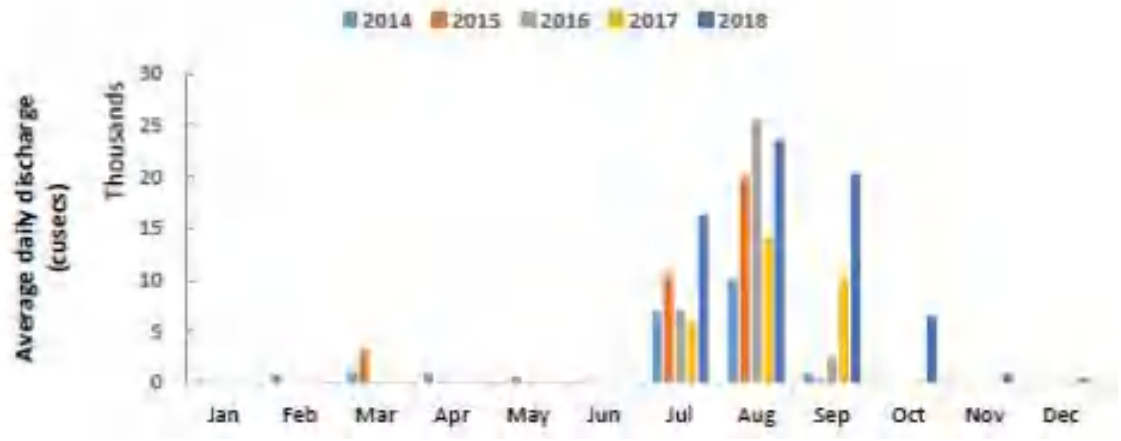


Source: Water quality status of Yamuna River, 2016, CPCB (MoEFCC)

48. Flow of the river

Yamuna is a perennial river. However, there is no flow in the river downstream of Wazirabad during lean season. Presently Haryana is releasing about 352 cusec of water in the main course of River Yamuna, downstream of the Hathnikund Barrage. Figure 7.3 below throws light on the inter-annual trend of water discharged from the Hathinikund Barrage through the year.

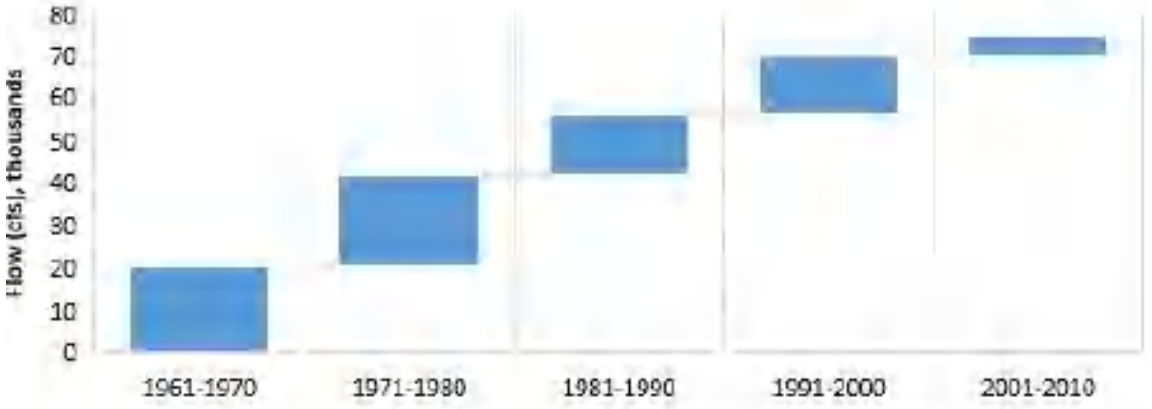
Figure 7.3 Inter- annual trend of discharge at Wazirabad



Source: Yamuna River Project

The river flow in Yamuna has decreased over past few decades as seen in Figure 7.4 below. The increasing encroachment to the river flood plains increases ecological damages while simultaneously increases potential hazards to the existing population and its urban infrastructure.

Figure 7.4 Trend of decadal flow in the Yamuna in Cubic feet per sec (cfs)



Source: Yamuna River Project

49. Upper Yamuna Agreement

In view of water scarcity and competing demands, the basin states viz. Uttar Pradesh Haryana, Rajasthan, Himachal Pradesh and National Capital Territory of Delhi had concluded an agreement (on 12th May, 1994) regarding allocation of surface flow of Yamuna on the basis of mean year availability up to Okhla. Among the basin states Delhi has been allocated 724 Million Cubic Metres (MCM) of water resources of river Yamuna annually. According to the agreement the states have agreed that a minimum flow shall be maintained downstream of Tajewala as well as downstream of Okhla headwork throughout the year from the viewpoint of ecological considerations. As upstream storages are built up progressively the extent of minimum flow will be raised up to 10 cumecs in a phased manner in proportion to the completion of upstream storages. The interim seasonal allocation of the annual utilizable flow of river Yamuna for Delhi is shown in Table 7.1. The interim seasonal allocation shall be gradually modified as the upstream reservoirs come up to reach a magnitude of 724 MCM.

Table 7.1 Seasonal Allocation of Yamuna Waters (MCM)

	July-October	November- February	March- June	Annual
Delhi	580	68	76	724

Source- Ministry of Jal Shakti

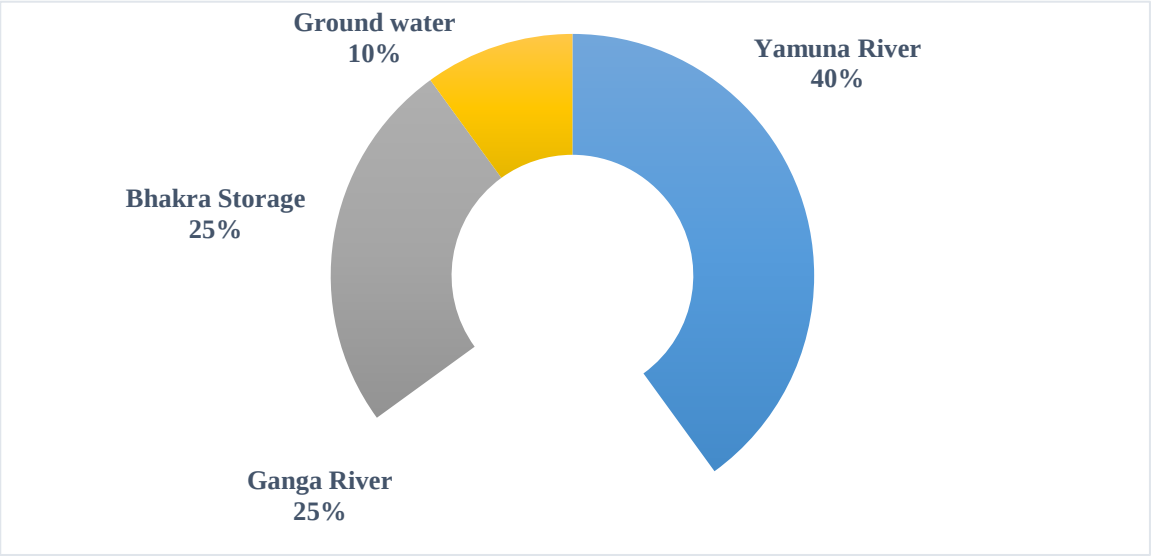
Here it may be pointed out that the present utilization of the allocation in the monsoon season is only 282 MCM and thus 298 MCM goes unutilized for lack of storage capacity in the NCT Delhi or by way of non-existent upstream reservoirs in the Himalayas. Also, under the Upper Yamuna Agreement, Delhi is bound to return 250 MGD (1.14 MCM) of treated effluent into the river between Wazirabad and Okhla barrage.

7.3 Water supply to NCT Delhi

7.3.1 Water Sources

Present estimated population in Delhi is about 200 lakh and potable water is supplied through water supply network comprising of about 14500 km long pipelines and more than 117 primary underground reservoirs (UGRs). Present average potable water productions is 935 MGD with raw water. available from various. sources; (i) Yamuna and Ravi-Beas Water (389+ 221 =610MGD), Ganga Water (253MGD) and Ground Water (90 MGD). The production of potable water has increased progressively with commissioning of Water Treatment Piants at Sonia Vihar (140MGD) in 2006, Dawarka (SOMGD), Okhla (20MGD) & Bawana (20MGD) in 2015. Delhi Jal Board was able to commission Water Treatment Plants at Dawarka, Okhla & Bawana because of the commissicring of efficient conveyance system to carry allocated Yamuna and Ravi-Beas Water to Delhi from Munka to Haiderpur, known as Carrier Lined Channel (CLC)/ Munak Canal.

Figure 7.5 Water sources for NCT Delhi



Source – Safe Water Network Delhi City 2016

7.3.2 Water Reservoirs

As per the Yamuna Water Sharing Agreement signed in May, 1994 the proposed construction of Renuka Dam, Kishau Dam, Lakhwar Vyasi Dam is aimed for the city to get its due share of water in Yamuna Water. Renuka Dam will provide around 275 MGD of water to the city. About 372 MGD of water will be obtained from Kishau reservoir and 135 MGD from

Lakhwar Vyasi reservoir. The agreement on water sharing for construction of Renuka Dam, Kishau Dam are signed by the basin states and the agreement for construction of Lakhwar Vyasi Dam has also been signed by the Basin States. The approved allocation of water from Yamuna River is as shown in Table 7.2.

Table 7.2 Approved Allocation of water from Yamuna River to States in BCM

S. No.	States	Allocation (BCM)			Total (BCM)
		July to Oct.	Nov. to Feb	March to June	
1	Haryana	4.107	0.686	0.937	5.73
2	Uttar Pradesh	3.216	0.343	0.473	4.032
3	Rajasthan	0.963	0.07	0.086	1.119
4	Himachal Pradesh	0.19	0.108	0.08	0.378
5	Delhi	0.580 (Consumptive 1926+495 return flow) or 2421 cusec	0.068 (Consumptive 231+495 return flow) or 726 cusecs	0.076 (Consumptive 255+495 return flow) or 750 cusecs	0.724 (Consumptive 806+495 return flow) or 2350 cusec

Source – Delhi Jal Board
Note – BCM = Billion Cubic Metre

7.3.3 Delhi Jal Board (DJB)

The Delhi Jal Board has been constituted under the Delhi Water Board Act, 1998 (Delhi ACT No.4 of 1998). Delhi Jal Board is responsible for treatment, supply and distribution of water in Delhi. Functions of Delhi Jal Board also include collection, treatment and proper disposal of sewage. Bulk Supply of water is made for the areas under the jurisdiction of New Delhi Municipal Council, Delhi Cantonment Board/Military Engineering Services and DDA for further distribution by these authorities. About 93% of the population in NCT of Delhi is covered through piped water Supply network and remaining population is served through water tankers. Present potable water supply by Delhi Jal Board is about 935MGD, which gives per capita average availability of 18S5LPCD for the estimated population of 23millions for 2021. Surface (river) raw water to Delhi is available from various Sources; (i) Yamuna and Ravi-Beas Water (1133cusec/610MGD), Ganga Water (470cusec/253MGD). DJB production of 935 MGD also includes 90 MGD Ground Water. The Production of potable water has increased progressively with commissioning of Water Treatment Plants at Sonia Vihar (140MGD) in 2006, Dwarka (SOMGD), Okhla (20MGD) & Bawana (20MGD) in 2015. DJB was able to commission Water Treatment Plants at Dwarka, Okhia & Bawana because of the commissioning of efficient conveyance system to carry allocated Yamuna and Ravi-Beas Water to Delhi from Mundka to Halderpur, known as Carrier Lined Channel (CLC)/ Munak Canal. There are 09 water treatment plants and about 4400 numbers of tube-wells across Delhi, which are being operated by Delhi Jal Board for supply of potable water, meeting the standards as per BIS 10500-2012. Present optimum Production is about 935mgd including about 90mgd from ground water resources. Seven water treatment plants of DJB i.e. Wazirabad, Chandrawal, Haiderpur, Nangloi, Owarka, Bawana, and Okhla, requiring 610mgd (1133 cusec) for production of 595 MGD of potable water are dependent on supply of raw water from Haryana which include Ravi -Beas water from BBMB.

Out of the 1796 unauthorized colonies, a total of 1617 Numbers of Unauthorized Colonies have been covered with piped water supply network. Out of these, water supply has been released in

1568 colonies and another 49 colonies will be notified shortly for supply of water. Works are in progress in another 33 colonies. Some of the unauthorized colonies and habitations have come up on the government/ forest
lands etc., where extension of piped water supply infrastructure is dependent on their legality and extant policies of the Government. However, Delhi Jal Board is supplying drinking water through water tankers in all such areas, where piped water supply network has not been extended so far. More than 1000 water tankers are deployed on need basis and their movement is regularly monitored. To meet the demand -supply gaps, DJB has managed to improve upon its working and monitoring vis-s-vis water management DJB has launched "Seva App" for bill generation, online payments and the resolution of inflated bills to deliver efficient and transparent services and to instill more confidence in the citizens of Delhi.

Table 7.3 Water Resources of Delhi Jal Board (DJB)

S. No.	Resources	Quantity (MGD)
1	Yamuna River	375
2	Ganga River	240
3	Bhakra Storage	218
4	Ground Water/Ranney well/ Tube well	80
	Total	913

Source – Delhi Jal Board

Table 7.4: Approved budget outlay of DJB for 2020-21

S.No	Particulars	State Share (Rs. In lakhs)	Central Share (Rs. In lakhs)	Total (Rs. In lakhs)
1	Water Sector	162,440.00	-	162,440.00
2	Sewer Sector	220,960.00	34,000.00 (YAP-III)	254,960.00
3	Namami Gange Project	-	3,200.00	3,200.00
	Total	383,400.00	37,200.00	420,600.00

Source – Delhi Jal Board

Table 7.5 Approved Budget Outlay for Delhi Jal Board in 2017-18 in Rs. cr.

Particulars	Outlay 2016-17	Expenditure 2016-17	Approved Outlay 2017-18
Water Supply	1,060	850.15	939
Sanitation	704	510.5	737
YAP -III	2	NA	8.4
JNNURM	200	24	10
NRCP-CSS	10	NA	60
TOTAL	1,976	1,384.65	1,755

Source – Delhi Jal Board

Besides the above, budget of Rs 350 crore has been provided for water subsidy under the policy of 20 kiloliters free water a month scheme which has benefitted around 12.5 lakh consumers.

7.4 Water Demand Analysis

Present water demand for Delhi is approximately 1200MGD (S450MLD) and for projected population of 23 Million for 2021, it works out to 1380MGD (6265MLD) @ 60GPCD. Present potable water production by Delhi Jal Board is 935MGD. Given the limited availability of raw water to Delhi, water demand of potable water for domestic use need to be rationalized and progressively reduced to SOGPCD (225LPCD) by use of non-potable recycled water of desired quality standard in toilet flushing. Water demand for industrial process water & horticulture/gardening purposes will also need to be necessarily met out from recycling of waste water of desired quality standards. It may be noted that one gallon (UK) equals 4.546 litres.

Table 7.6 Drinking water demand of Delhi NCT

Sub-region	Drinking water Requirement (mld)	
	2001	2021
NCT Delhi	5450	6265

Source – Regional Plan NCR, 2021

Also as seen in Table 7.7, DJB detailed the water requirement norms as 172 lpcd for domestic purposes, 47 lpcd for industrial purposes, three lpcd for fire protection, 52 lpcd for floating population, totaling to 274 lpcd, which comes to 227 lpcd.

Table 7.7 Details of Water Requirement Norms – Delhi Jal Board (DJB)

S. No.	Details	Requirement of Water
1	Domestic	172 LPCD
2	Industrial, Commercial and Community requirement based on 45,000 litres per hectare per day	47 LPCD
3	Fire protection based on one percent of the total demand	3 LPCD
4	Floating population and special uses like Hotels and Embassies	52 LPCD
	Total	**274 LPCD**
	Per capita requirement	**(60 GPCD/227 LPCD)**

Source – Delhi Jal Board
Note – 1 Gallon = 3.7 Litres

As seen in Table 7.8, Master Plan of Delhi - 2021 prepared by Delhi Development Authority proposed water requirement with the norm of 80 gallon per capita per day (GPCD), out of which 50 GPCD is for a 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.

Table 7.8 Water requirement norms as per Master Plan of Delhi 2021

S No.	Norms	Quantum (GPCD)		Sources of Non-potable Water
		Potable	Non-potable	
1	Domestic @50 GPCD	30	20	--

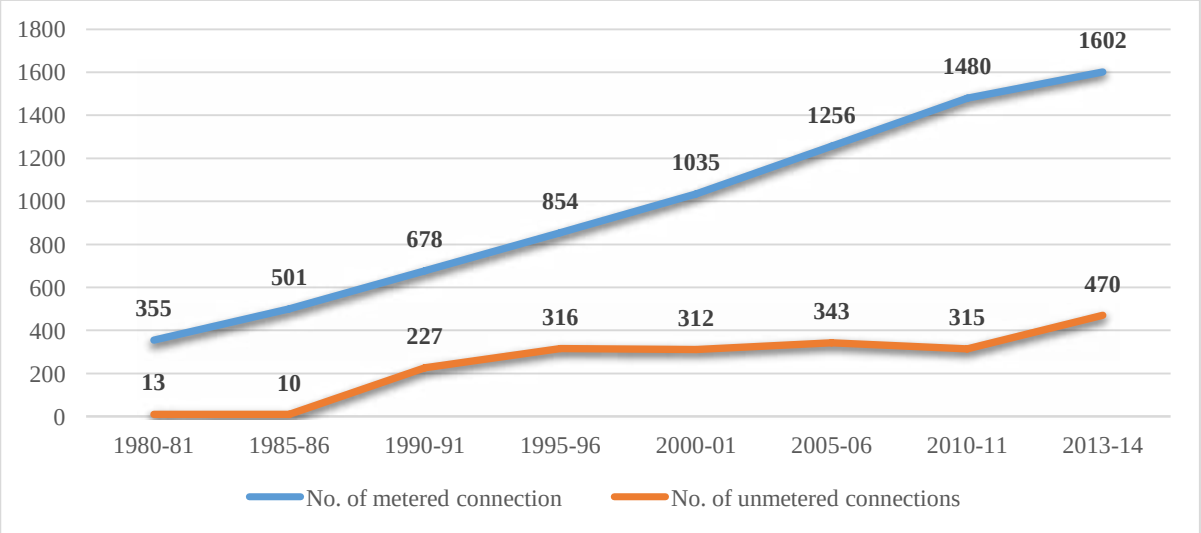
	Residential	30	20	Recycling & Permissible Ground Water Extraction at Community Level
2	Non-domestic @30 GPCD	5	25	
	a. Irrigation, Horticulture, Recreational, Construction, Fire @ 6.65 LPCD	-	10	Recycling from Sewerage Treatment Plants (STPs) and Permissible Ground Water extraction
	b. Public, Semi-Public, Industrial and Commercial	5	15	Recycling from Common Effluent Treatment Plants (CETPs)
Total @ 80 GPCD/ 302 LPCD		**35**	**45**	

Source – Delhi Jab Board
Note – 1 Gallon = 3.7 Litres

7.5 Water Supply analysis

As per the 2011 Census, 33 lakh households were in Delhi, out of which 27 lakh households were provided with piped water. About five lakh households received water supply through tube wells/deep bore hand pumps/public hydrants and the remaining 1.6 lakh households depended on other sources like rivers, canals, ponds, tanks, springs, etc.

Figure 7.6 Number of metered and unmetered tap connections in Delhi (in 000s)



Source – Water Policy for Delhi

Table 7.9 Distribution of Households by availability of drinking water facility and source in Delhi in 2011

S. No.	Source and Availability of Drinking Water	Households (%)
I.	**Sources**	
1	Piped Water Supply System	81.3
	a. From Treated Source	75.2
	b. From Untreated Source	6.1
2	Covered Well	0.1
3	Hand pump	5.3
4	Tube Well	8.4
5	Tank, Pond, Lake	1.2

S. No.	Source and Availability of Drinking Water	Households (%)
6	Other Sources	3.7
II.	**Availability**	
1	Within the Premises	78.4
2	Near the Premises	15.4
3	Away	6.2

Source – Census 2011

As seen in Table 7.9 as of 2011, almost half of these households rely on tanker water as their potable water source (and another quarter on municipal water taps). A significant share of over 800 tankers are owned and hired by DJB to serve the urban poor. However, tanker water is quite expensive for the water utility and there is also the risk of contamination, making it potentially unsuitable for potable purposes. Using a bore well or tube well is also quite common in slums, but for non-potable purposes; groundwater in Delhi is affected with above-permissible limits of geogenic contaminants like fluoride and nitrates.

Tanker water supply is a critical lifeline of water supply to the urban poor in Delhi. A significant share of over 800 tankers is owned and hired by DJB to serve the urban poor. However, tanker water supply is quite expensive for any water utility and there is always the risk of contamination, from lack of cleaning, etc., making it potentially unsuitable for potable purposes. Thus, DJB had piloted a water treatment kiosk project to assess the feasibility of this solution to serve the urban poor.

As seen in Table 7.9 and Table 7.10, Census 2011 numbers reflect similar levels of water supply to all housing categories including slums. Availability of water in the premises of households living in planned colonies is reported at 78 percent compared to just 51 percent in slums. This suggests that water supply sources are being shared among households in the slums. Also, there are about 33.41 lakh households in Delhi of which 27.16 lakh households are provided water through a piped water supply system which means that 81.30 percent of households in Delhi are covered by a piped water supply. However, out of the 81.30 percent of households, 75.20 per cent are covered through a source which is treated while 6.10 per cent households have supply to piped water from an untreated source. This suggests that the sources in slum households are shared. Community level taps being shared between 10 and 30 households for one to two hours of water supply. With the gap in water supply to slum households, tanker water supply is a critical lifeline for Delhi's urban poor.

Table 7.10: Status of Water Supply in Delhi in 2018

S. No	Components	Status in 2018
1	Projected Census Population (Total) (million)	18.75
2	Projected Demand for Water (mgd)	1140
3	Projected Supply of Water (mgd)	935
4	Water Supply in Un-served Areas (Length of water line in km)	1127
5	Households with Access to Tap Water (%)	83.42
6	Households with Access to handpump	12.3

S. No	Components	Status in 2018
7	Households with Access to Water Tankers (%)	4.28
8	Households with Access to Water within Premises (%)	83.42
9	Households with Access to Water near Premises (%)	12.3
10	Households with Access to Water away from Premises (%)	4.28
11	Households with Access to Tap Water from Treated Sources (%)	83.42

Source – Economic Survey 2017-18
Note: Mgd – million gallons daily, Based on per capita supply norm: Planned areas: 50 gpcd (228 lpcd), NDMC area: 75 gpcd (320 lpcd), Outer Delhi: 35 gpcd (160lpcd), Gpcd = gallon per capita daily, lpcd = litre per capita dail, 1 Gallon = 3.7 Litres

As per the Table 7.10, the Economic Survey of 2017-18 mentions that about 83.42 percent households of Delhi now have access to piped water supply. Water production during the summer season is being maintained at 895 MLD per day consistently. Present production of potable water is 935MGD and is supplied through water supply network of about 14500 KM pipe line and more than 117 Primary UGRs. Further more than 1000 water tankers are deployed on daily basis with multiple trips for supplying potable water in the areas which are not having piped water supply network and In the water deficit areas. Delhi Jal Board is progressively extending piped water supply network in unauthorized colonies. A total of 1617 Numbers of Unauthorized Colonies have been covered with piped water supply network and out of these, water supply has been released in 1568 colonies upto August,2020.

Table 7.11: Category-wise water connections, sales and percentage of sales in NCT Delhi

S. No	Category	Connections (in lakh)		Sales (MGD)		% of Sales	
		2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
1	Domestic	20.85	21.62	382.78	386.29	90.94	91.72
2	Commercial & Institutional	0.8	0.8				
3	Supply to NDMC & MES	02+02=04 (Bulk Connections)	02+02=04 (Bulk Connections)	38.13	34.88	9.06	8.28
	Total	**21.65**	**22.45**	**452.15**	**421.17**	**100**	**100**

Source – Delhi Jal Board

As seen from the Table 7.11, it is evident that the bulk of the water, more than 90 percent, is supplied to the domestic, commercial and institutional categories of connections in NCT Delhi.

Table 7.12: Potential Water Rechargeable Areas (in sq. kms) in NCT Delhi

Sub-region	Flood Plain & River Bed	Ox-bow lake	Paleo-Channel	Valley Fill	Lake, tank & Pond	Total
NCT-Delhi	25	0	2.5	0	5.5	33

Source – Regional Plan NCR, 2021

Table 7.12 helps explore the long-term solution to include construction of upstream reservoirs to store excess water during monsoon for use in the lean period and inter-basin transfer of water such as the Sarda-Yamuna link canal which envisages transfer of surplus waters of Sarda River for meeting various requirements in U.P., NCT-Delhi.

7.6 Demand Projections

Water demand projections were done by various agencies and consultative group for 2021. Table 7.13 shows various agencies in addition to the DJB have prepared projections of water demand for Delhi targeting the year 2021, including Japan International Cooperation Agency (JICA), Tata Consulting Engineers Limited (TCE), and National Capital Region Planning Board (NCRPB).

Water demand for projected population of 23 Million in 2021 @ 60GPCD works out to 1380MGD (6265MLD). Given the limited availability of raw water to Delhi, water demand of potable water for domestic use need to be rationalized and progressively reduced to 50GPCD (225LPCD) by use of non-potable recycled water of desired quality standard in toilet flushing. Water demand for industrial process water & horticulture / gardening purposes will need to be necessarily met out from recycling of waste water of desired quality standards. DDA has envisaged projected population of 300 lakh for MPD -2041 and potable water requirement @ 50GPCD works out to 1500 MGD.

A twin - pronged strategy has to be adopted to augment water resources for Delhi, which focuses on the augmentation of both, ground-water and river (surface)-water resources. Emphasize is also needed for enhanced water conservation measures, rainwater harvesting initiatives, restoration of water bodies, efficient water distribution management etc.

Table 7.13: Water demand Projections for 2021

S. No.	Parameters	JICA Study Team	DJB	TCE	NCRPB
1	**Population (Million)**	26	23	23	23.48
2	**Net Per Capita (GPCD)**	52	-	-	-
3	**Leakage (GPCD)**	8 (18%)	Incl. in gross	Incl. in gross	-
4	**Gross per Capita (GPCD)**	60	60	51	50
	Demand (MGD)	1,560	1,380	1,170	1,174

Source – Water Policy for Delhi

Table 7.14: Projected domestic water demand based on projected population

S. No.	AGENCY	Supply Norm (LPCD)	2021 (Population 23 Million), in MGD	2031 (Population 25 Million), in MGD	2051 (Population 27 Million), in MGD
1	**DDA (CPHEEO)**	172	868 MGD	942 MGD	*1,018 MGD
2	**National Water Commission**	160	807 MGD	877 MGD	947 MGD
3	**NCRPB**	225	1,150 MGD	1,250 MGD	1,332 MGD

Source – Water Policy for Delhi

Proposed source of water supply in Delhi: Several other dams are proposed in the Himalayas, from which NCT Delhi will retrieve a share of water; all of them are facing a certain degree of uncertainty. These are the Renuka Damon Giri River, a tributary of River Yamuna in Himachal Pradesh; Kishau Dam on River Tons, a tributary of River Yamuna in the Dehradun districts of Uttarakhand; Lakhwar Vyasi Dam on River Yamuna in the Dehradun districts in the state of Uttarakhand; and the Sarda-Yamuna Link, which involves the Pancheshwar and Pooranagiri dams

on the River Sarda at the Indo-Nepal border. However, even if some of them do materialize, Delhi is unlikely to face a water shortage from a raw water perspective. It would be up to DJB to augment their water treatment capacity to serve the populations of Delhi. A consolidated projected domestic water demand-based projection is shown in Table 7.14.

7.7 Water treatment

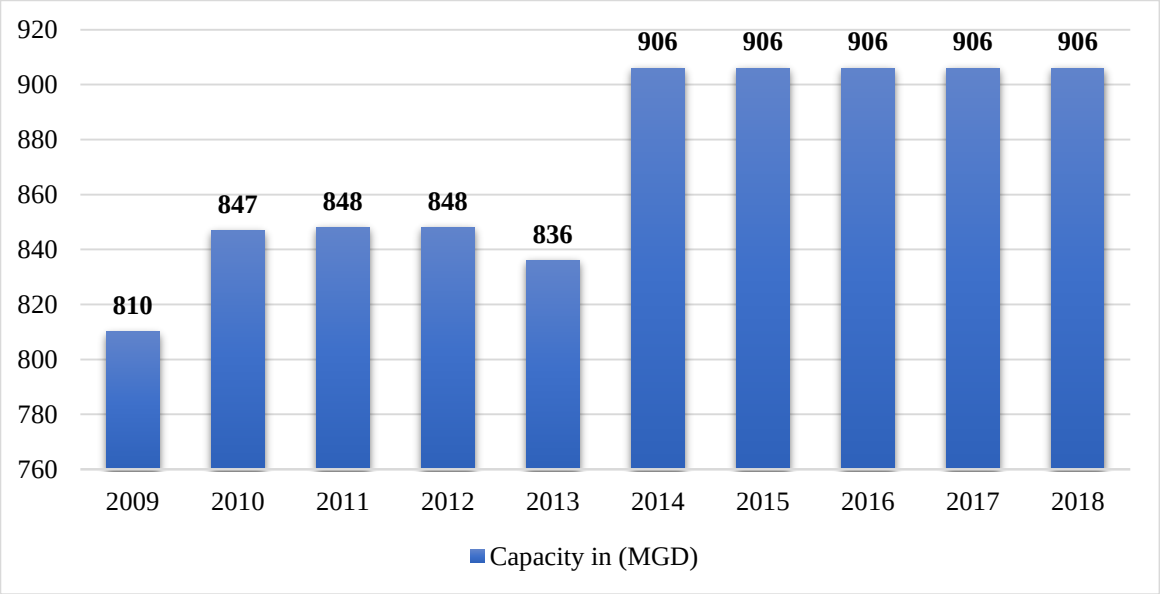
The installed treatment capacity of Water in Delhi during 2006-18 is as below in Table 7.15 and Figure 7.7. The installed capacity of DJB has been augmented by 12 percent during the last 10 years. The capacity, which was 810 MGD in 2009, has been increased to 906 MGD in 2014. But ever since 2014 till 2018, there has been no further augmentation of water treatment plants in NCT Delhi.

Table 7.15: Installed Capacity of Water treatment plants 2009-2018

S. No	Name of Plants	Capacity (MGD)									
		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	Chandrawal Water House No. I & II	90	90	90	90	90	90	90	90	90	90
2	Wazirabad I, II & III	120	120	120	120	120	120	120	120	120	120
3	Haiderpur	200	200	200	200	200	200	200	200	200	200
4	North Shahdara (Bhagirathi)	100	100	100	100	100	100	100	100	100	100
5	Bawana	20	20	20	20	20	20	20	20	20	20
6	Nangloi	40	40	40	40	40	40	40	40	40	40
7	Sonia Vihar	140	140	140	140	140	140	140	140	140	140
8	Ranney Wells & Tube Wells	100	100	100	100	80	80	80	80	80	80
9	Recycling of Water at Bhagirathi, Haiderpur & Wazirabad	--	37	37	37	45	45	45	45	45	45
10	Commonwealth Games Village	--	--	1	1	1	1	1	1	1	1
11	Okhla	--	--	--	--	--	20	20	20	20	20
12	Dwarka	--	--	--	--	--	50	50	50	50	50
	Total	**810**	**847**	**848**	**848**	**836**	**906**	**906**	**906**	**906**	**906**

Source – Delhi Jab Board

Figure 7.7: Installed Treatment capacity of water treatment plants NCT Delhi 2009-1018



Source – Delhi Jal Board

The geographical locations of raw water resources have tempted to plan for construction of all Water Treatment Plants in the North-West and North-East parts of the National Capital. The water treatment plants constructed are Chandrawal near Metcalf House, Wazirabad, Bhagirathi opposite Yamuna Vihar, Haiderpur 1st & 2nd near Rohini Jail on Outer Ring Road, Sonia Vihar opposite Bhajanpura on Wazirabad Road and Nangloi.

Two new Water Treatment Plants constructed at Dwarka (50 MGD) and Okhla (20 MGD). Raw water for these two plants has been made available with the commissioning of the pucca parallel channel from Munak to Haiderpur. Further Bawana Water Treatment Plant (20 MGD) has been constructed but will be commissioned after the availability of raw water. Water from the 12 WTPs is stored in Under Ground Reservoirs (UGRs) before it is put into the distribution system. Delhi has 107 UGRs, each having a list of corresponding command area. Water from the UGRs is then supplied to the households through 572 km of main pipelines and 8,3634 km of distribution pipelines. 75 percent of the pipelines have been installed after the year 2000 suggesting a relatively new network. In areas where there is no piped network, water is supplied through tankers to almost 6,500 fixed locations daily.

7.7.1 Need for treating waste water efficiently

It is critical for treated sewage waste water which is presently being released into drains is harnessed for non-domestic uses like washing operations in factories, service stations, metro and bus transport hubs. It must be made mandatory for watering parks and gardens. Only 20 percent of treated waste water is being used efficiently which needs to change as the water table in Delhi has declined to alarming levels. All the major parks and green belt areas have to make arrangements for decentralized waste water treatment systems near to a feeding point to be provided by Delhi Jal Board.

7.8 Incentives taken by Delhi Jal Board to bridge water demand and supply gaps

Gaps in water provision, particularly for the urban poor that are key for sustainable development of Delhi were recognized by the DJB and following are some key initiatives taken to bridge the same.

- Free water for all metered connections which consume up to 20 kilo litres of water per month.

- Extension of piped water supply to unauthorized colonies over the next three years.

- Reducing development charges for water connections to enable residents of unauthorized colonies to afford connections.

- Using information technology for effective, continuous, and strict monitoring of water tankers and to enable people to track the water tankers, find out estimated time of arrival in their colony and quantity of water.

- DJB awarded a contract to set up pilot Water ATMs for serving the urban poor. DJB invited tenders for treatment kiosks and anytime water machines (ATMs) under the Design-Finance-Build-Operate-Transfer (DFBOT) model in 2012, and selected resettlement colonies for this pilot. These are legal, planned colonies which are entitled to all municipal services. After a delay of about 18 months in accessing land, the chosen operator managed to commission the first kiosk and associated water ATMs in Savda Ghevra, a resettlement colony in northwest Delhi. This was followed by three more such clusters in different parts of the city.

- While 10 percent of the population adopted this mechanism as the primary source for potable water, these ATMs were mentioned as their secondary source for potable water by 27 percent of people, the highest for any secondary source. These kiosks are managing to cover operating costs and generate some additional revenue, though they are very susceptible to the vagaries of municipal water supply, both piped and tanker supply. The above localities were equipped with water ATM facilities provided by Sarvajal. In addition, there were two more localities with water ATMs, namely Mahavir Colony market and Mahavir Colony Mandir area. The water ATM in the former locality was run by Sulabh International at their Delhi Head Office in Mahavir Colony, while the latter was run by the DJB with technical supervision provided by Sarvajal, a Primal Foundation venture.

- The ATMs, as implemented, have not been well received by residents, and in areas without ATMS, there is low willingness to pay. People in resettlement colonies with these water ATMs generally expressed disapproval of the nature of the water delivery mechanism. They reported issues like irregular filling of ATMs, unfavorable distance from home, low portability, and trouble in recharging their RFID cards. While 42 percent reported spending less than 10 minutes in water collection, another 45 percent reported spending 10-20 minutes and the rest spent more than 20 minutes. Most households in this study (82 percent) in areas without Urban Small Water Enterprises (USWE) did not pay any monthly fee for their water sources. Households seemed fairly satisfied with the frequency and adequacy of tanker water supply for potable purposes, and thus only 37 percent were willing to pay for clean potable water while another 35 percent were not sure if they would spend money for the same.

- Usage of water ATMs was found to be low, with higher usage linked to higher per capita income. The majority (80 percent) of respondents in areas with Urban Small Water Enterprises (USWE) was aware of the ATMs in their colonies; however, only 28 percent reported fetching water from them. Out of these users, 51 percent reported purchasing

water every day while another 30 percent reported two to three purchases every week. There was an overall higher level of adoption of water ATMs as the primary source as monthly per capita income of the households increased.

- Designed to be complementary and affordable potable water sources to municipal piped supply, USWEs could be compromised by ambitious piped water plans. Water ATMs were set up to be complementary sources of affordable and clean water, but they are almost perceived as competitors by the target population in these resettlement colonies, who have a fairly good perception of DJB-supplied water and almost-free municipal piped water supply. This raises doubts as to the financial sustainability of water ATMs given the location of sites for commissioning such mechanisms and the current government's plans to provide piped water to all with no charges for up to a monthly household usage of 20,000 litres per month. USWEs can be an important part of the solution to address insufficient potable water supply in Delhi slums. In slums where there is still a gap in water provision, USWEs can play a role, particularly for potable water. To be successful and reach their potential, playing a complementary role to piped water and providing treated, reliable, and affordable water to underserved slum populations, USWEs must be supported by government and other stakeholders through a favourable policy and enabling environment.

7.9 Water Accounting and Auditing

Delhi Jal Board was using an old system for measuring the quantity of raw water available at water treatment plants and the quantity of treated water supplied by treatment plants for distribution. The position at underground water tanks, reservoir and booster pumping stations was similar. Due to this system, the Delhi Jal Board has not able to assess the exact amount of water distribution losses.

7.9.1 Bulk meters for Water assessment

Assessment of water distribution losses through proper water accounting and auditing system has been given top priority by DJB. Delhi Jal Board has started a comprehensive programme for installation of bulk meters at all water treatment plants and about 302 bulk meters have already been installed. Delhi Jal Board has also decided to install bulk meters on all distribution mains, underground reservoirs and booster pumping stations for correct measurement of water supply from these points up to different localities/consumer points.

- As on 1st April 2017, there were 1.79 lakh un-metered connections.
- Around 4.00 lakh meters were defective or non-functional.
- Fixing of the maximum average of 20 KL/30 KL per month (as the case may be) for domestic consumers, if water meters are non-functional and till defective water meter is replaced.

7.9.2 Ease of conversion of water meters

Delhi Jal Board has streamlined its system for obtaining water meters for metering of unmetered supply of water. The existing system of supply of water meter along with sanction of water connection has been amended and now consumers can purchase water meters of approved specifications from the open market. The consumers having Delhi Jal Board's defective meters have been allowed to get the defective meter replaced with private water meter and have been given option either to get the refund of meter security or get the same adjusted towards water charges in future.

7.10 Water Tariff

The tariff is based on the principle of "use more pay more". Present water tariff policy acts as a deterrent for consumers consuming excessive water or having wastage of water. DJB had collected 1,719.81 crore against the estimated revenue collection of 1,841.25 crore with a collection efficiency of 93.4 percent during 2017-18.

- Water consumption rates and service charge are levied slab-wise.
- Water Tariff for Un-metered Connections in JJ Resettlement Colonies and Rural Areas: Water charges are applicable on the assumed average of 10 KL Per month per floor for unmetered water connection in JJ resettlement colonies.
- For unmetered water connections in case of rural areas assumed an average of 25 KL per month per connection is charged.
- Sewerage maintenance charge is also recoverable if sewerage services are being managed by Delhi Jal Board.
- Besides above, water cess is recoverable from all consumers at the rates determined by the Central Government from time to time.
- Existing water tariff has two parts. One is Service Charge and other Volumetric Water Consumption Charge applicable w.e.f. 1.12.2004 and 1.4.2005 respectively.
- 60 percent of water consumption charges are recoverable towards Sewerage Maintenance Charge from such colonies/areas where sewerage services have been provided/ maintained by the Delhi Jal Board.
- In case of bulk connection for a colony/group housing society serving a number of residential premises, water charges will be worked out as per residential unit-wise at the domestic rates applicable from time to time.

As of 01.03.2015, all domestic consumers of Delhi Jal Board consuming water up to 20 KL per month and having functional water meters are being given 100 percent subsidy and fully exempted from payment of water bill including all components namely, water charges, sewerage maintenance charge, service charges, meter rent (wherever applicable) and cess.

7.11 Rain Water harvesting

Adequate focus has been given on requirement of rainwater harvesting (RWH) and water conservation measures in Unified Building Bye Laws (UBBL) of Delhi, 2016, Model Building Bye Laws (MBBL), 2016 and Urban and Regional Development Plan Formulation and Implementation (URDPFI) Guidelines, 2014. Due importance is given to rainwater harvesting in urban Missions like Smart Cities Mission and AMRUT.

NCT Delhi has introduced financial incentives for adopting rainwater harvesting by the Residents Welfare Associations (RWAs) and neighbourhood societies with financial assistance of 50 percent of the total cost of the project or maximum of Rs. 50,000 on satisfactory completion of the rainwater harvesting structures.

Delhi Metro Rail Corporation too has successfully adopted rain water harvesting. Out of 150 elevated stations, 116 stations have been provided with systems with total pit capacity of 6,169

cum and rainwater harvesting under construction at 19 stations. Rainwater harvesting structures have been constructed at 22 ancillary buildings and nine structures at Metro Depots.

Delhi Development Authority has also constructed conventional RWH structures at 30 locations in different zones in residential, commercial and office buildings while modular RWH structures provided at 17 locations in different zones in residential buildings/flyovers and open spaces at five locations in different zones at parks, parking and footpaths.

7.11.1 Role of Delhi Jab Board in rain water harvesting

The Rain Water Harvesting Cell of DJB provides technical assistance to individuals for providing Rain Water Harvesting. DJB also actively provides information regarding Rain Water Harvesting on several platforms like print media, social media etc., for public facilitation. A couple of NGOs have also been engaged by DJB to create public awareness and promote community participation to implement Rain Water Harvesting. DJB has provided Rain Water Harvesting in its 166 no. installations. DJB has provided financial assistance to the tune of 82 lakh for 172 cases in the institutional category for providing Rain Water Harvesting Systems.

As per DJB amended tariff Regulations (March 2016) rebate of 10 percent in the water bills is provided for having functional RWH system and non-provision will make water bills increased by 1.5 times till functional RWH system is installed. These provisions are applicable for plots of 500 sqm and above. The following provisions have been made in the Delhi Water and Sewer Tariff and Metering Regulations, July' 2012 for promoting Rain Water Harvesting:

Regulation 8 (d) of Chapter II provides that for Category D consumers, the following rebate is given in tariff for the provision of Rain Water Harvesting, Waste Water Recycling or both: -

- Such plot/properties which have an area of 2,000 square meter or more and having installed functional rainwater harvesting system or wastewater recycling system, shall be granted rebate of 10 percent in the total bill amount and 15 percent if both the above systems have been set up and functional.

- If the Rain Water Harvesting system is adopted by a society, then the individual member of that society will be entitled to the above-mentioned rebate in the water bill.

- The area Zonal Engineer or such other suitable agency as authorized by the board will provide a functional certificate in respect of the above systems mentioning therein that substantive portion of the plot/ property has been covered as far as Rain Water Harvesting is concerned. Similarly, he will certify that a substantive quantity of the wastewater generated has been recycled by the consumer. A certificate will be issued after every six months.

Regulation 50 of Chapter V provides that rainwater harvesting is mandatory.

- The consumer of the Board having a plot/property of size 500 sq. meter or more shall make provision for rainwater harvesting covering the entire plot area, within one year, in case of commercial/industrial property and within three years for residential property from the date of coming into force of these regulations under intimation to the area zonal officer.

- In case, the consumer fails to comply with the above provisions within the time limit the tariff as applicable for the consumer respective category will be increased by 1.5 times until the provision is installed.

Delhi Jal Board has 771 building installations and rain water harvesting systems are feasible in 594 installations. Delhi Jal Board has implemented rain water harvesting systems at its 563 installations and in 31 installations rain water harvesting systems are under construction and targeted to be completed before monsoon of 2021. Delhi Jal Board has also taken up implementing rain water harvesting systems in 89 building installations of other government departments of NCT of Delhi. Out of these, Rain Water Harvesting systems at 20 buildings installations have been completed and at 59 installations works are in Progress/ under award and targeted to be completed before monsoon 2021. DJB is also monitoring installation of rain water harvesting system in schools and colleges. 4778 Schools and Colleges have been Mapped and Rain Water harvesting systems have been provided in 3687 School/Colleges. At 229 locations, implementation of Rain water harvesting system is not feasible. In 413 school/colleges works are under Progress and in another 449 works for Providing, rain water harvesting system will be taken up by the respective departments/schools /colleges.

Delhi Jal Board is Promoting implementation of rain water harvesting system in Delhi. Rebate in water bills to the extent 10% is given for functional rain water harvesting system and is made applicable for plots size of 100sqm and above. At the same time non-provision of adequate and functional rain water harvesting system invite penalties in water bills, which are Increased by 1.5 times. Further 11 Rain Centers across Delhi and one at the Headquarter have been setup to facilitate the public in implementation of rain water harvesting systems. To encourage installation of Rain Water Harvesting Structure by domestic consumers, having plot area of 200sqm or more, Delhi Jal Board has approved a ‘Scheme for grant of Financial Assistance’ to these consumers (including Group Housing Societies) for construction of Rain Water Harvesting Structures. Financial Assistance of 50% of total cost of rain water Harvesting structures or Rs. 50,000/-, whichever is less would be given to the consumers by DJB.

7.11.2 Incentives for Rain Water Harvesting

- Such Plots/ properties having an area of 500 sq. meters or more having installed functional RWH system or Waste Water Recycling shall be granted rebate of 10 percent in total bill amount for having RWH system and 15 percent if both the systems have been set up and are functional.

- Consumers having a plot area between 100 sq. meters to 499.999 sq. meters and a functional Rain Water Harvesting facility will get a rebate of 10 percent.

- The area Zonal Engineer or such other suitable agency as authorized by the Board will provide a functional certificate in respect of the above systems mentioning therein that substantive portion of the plot /property has been covered as far as Rain Water Harvesting is concerned. Similarly, he will certify that the substantive quantity of the wastewater generated has been recycled by the consumer. A certificate will be issued after every six months.

- Provision for penalty: For all the consumers irrespective of their consumer category Rain Water Harvesting penalty at an enhanced tariff of 1.5 times will be applicable if they have plot area 500 sq. meters or above and do not have a functional rainwater harvesting system.

7.12 Ground Water

It is important to consider groundwater as well, since many people depend on this for meeting their daily water requirements. While government extracts groundwater through tube

wells for piped water supply in areas which are not adequately served by a WTP, households extract groundwater through personal bore wells. Additionally, a lot of groundwater is extracted for agriculture purposes in the outer realms of this region. According to the Central Ground Water Development Board (CGWB, 2011), the average level of exploitation of groundwater in Delhi is 137 percent.

7.12.1 Existing Ground water situation

Groundwater occurs under the following three hydro-geological conditions in the NCT Delhi.

- Alluvial basin of Chhatterpur in the Mehrauli Block, south of Delhi, enclosed within rocky surroundings of the Delhi ridge. The basin acts as a single aquifer under unconfined groundwater conditions.
- Alluvial deposits to the west of the ridge. This aquifer is under semi-confined conditions.
- Alluvial deposits to the east of the ridge:

  a) Between the ridge and the Yamuna river, and
  b) East of the Yamuna river. The aquifers here are under semi-confined conditions.

The water table slopes away from the ridge on both sides. The water table is relatively shallower in northern and north-western parts and deeper levels exist in the southern parts. The south-western part of the NCT has a large groundwater trough at Najafgarh Block. The alignment of the Delhi Branch of the Western Yamuna Canal acts as a groundwater ridge diverting the flow of water to the south-west and east towards the Yamuna. The groundwater consumption in Delhi is detailed below in Table 7.16, which confirms the fact that domestic sector is the major consumer of groundwater resource in NCT Delhi.

Table 7.16: Sector-wise groundwater consumption in Delhi

Sector	Share of NCT Delhi's Groundwater Usage
Irrigation	40
Domestic Sector	50
Industrial Sector	10

Source – Water Policy for Delhi

Further split of this groundwater extraction of NCT Delhi is as below given in Table 7.17.

Table 7.17: District wise Groundwater Extraction of the NCT Delhi 2014 in MCM

S.No	Assessment Unit	GW Extraction [domestic purpose]	GW Extraction [industrial purpose]	GW Extraction for Irrigation	Total Draft
1	Central	165.18	0	0	165.18
2	East	466.17	179.38	141.99	787.54
3	North	254.56	0	0	254.56
4	New Delhi	509.49	0	0	509.49
5	North East	810.54	192.92	150.01	1,153.5
6	North West	821.75	1,607.14	9,799	12,228

7	South	7,428.13	805.72	109	8,342.9
8	South West	1,1766.6	438.97	8,567	20,773
9	West	1,421.2	1,075.44	1,234.99	3,731.6
	TOTAL	23,643.61	4,299.57	20,002	38,945*

Source – Central Groundwater Water Board, 2014

Table 7.18: Stage of groundwater development, Delhi (CGWB, 2011)

Districts	Net Groundwater Availability (hec.mt.)	Annual Groundwater Draft (hec.mt.)	Stage of groundwater development (%)
Darya Ganj	234	139	59
Karol Bagh	40	55	138
Pahar Ganj	72	98	136
Gandhi Nagar	357	284	80
Preet Vihar	604	1,466	243
Vivek Vihar	227	374	165
Chanakay Puri	353	340	96
Connaught Place	189	149	79
Parliament Street	175	160	91
Civil Lines	1,223	764	62
Kotwali	128	151	118
Sadar Bazar	49	53	108
Seelam Pur	873	743	85
Seema Puri	120	269	224
Shahdra	143	287	201
Model Town	476	848	178
Narela	4,859	3,722	77
Saraswati Vihar	2,689	4,446	165
Defence Colony	1,035	1,346	130
Hauz Khas	1,523	3,565	234
Kalkaji	1,565	3,128	200
Delhi Cantonment	803	1,844	230
Najafgarh	6,661	8,388	126
Vasant Vihar	1,663	2,545	153
Patel Nagar	1,014	1,945	192
Panjabi Bagh	1,307	1,214	93
Rajouri Garden	331	892	269
Total	**28,713**	**39,215**	**137**

Source – Central Groundwater Water Board, 2011

As per Table 7.19, and as per CGWB, except for a small area in Central and North Districts the water table is overexploited. The average level of exploitation in Delhi is 170 percent. As per CGWB, 2014 the total annual groundwater draft in Delhi is 389 MCM and the net natural recharge is 281 MCM resulting in an overdraft of 108 MCM. In view of this overdraft the CGWA has notified most parts of NCT Delhi as areas where no new tube wells can be installed except with specific permission of the authorities for drinking water purposes only.

Table 7.19: Groundwater Development of the NCT Delhi, 2014

S. No.	NCT Delhi Districts	Stage of Groundwater in %	Categorization of Groundwater development
1	Central	88.08	Safe
2	East	130.27	Over-exploited
3	North	34.61	Safe
4	New Delhi	170.82	Over-exploited
5	North East	129.15	Over-exploited
6	North West	136.31	Over-exploited
7	South	243	Over-exploited
8	South West	214.41	Over-exploited
9	West	111.56	Over-exploited
	Total	**170.28**	

Source - Study on Ground Water Recharge in NCT Delhi, INTACH

The decreasing groundwater level in Delhi has become a matter of serious concern. At some places in South and South West Delhi, the water level has gone 20-30 meter below the ground level. The quality of underground water is deteriorating in several places. It has been found to be unfit for human consumption. The salinity of groundwater is increasing in South-West and North-West Delhi. In some areas of Shahdara and Kanjhawala, Nitrate content has been found not more than 500 mg/litre. Fluoride and chemical concentrations, more than prescribed limits, have also been found in groundwater at various locations in Delhi. To tackle these problems, the Central Ground Water Board has taken steps to regulate the number of tube wells being commissioned in Delhi.

In 2018, Delhi Jal Board has 4,234 functional Tube Wells and eight Ranney Wells. The flood plains downstream of Wazirabad and the area adjacent to Najafgarh Lake are being explored for extraction of water on a sustainable basis. Pre-feasibility studies for groundwater recharge through the abandoned Bhatti Mines and Canal system in the North Western region of Delhi have also been taken. Deepening of old lakes and other water bodies, preserving and developing the forest area in Delhi, construction of check dams at Asola Wild Life Sanctuary and plantation of trees, are some of the steps being taken to improve groundwater resources by custodian department. Excessive ground water exploration has made recharging of ground water the need of the hour.

Figure 7.8: Decadal fluctuation in Groundwater level NCT, Mean from May 2005 – May 2015

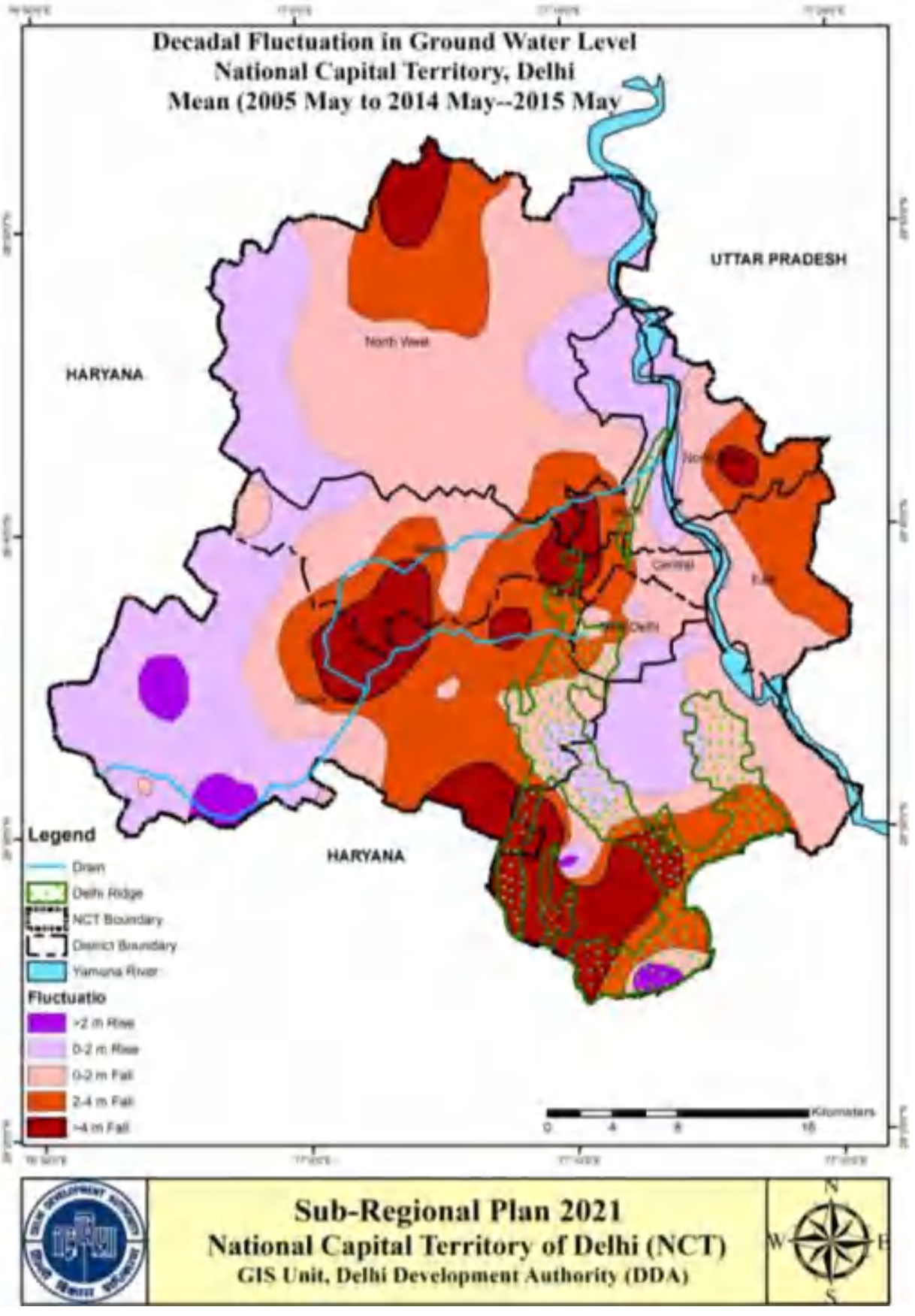


Figure 7.9: Fluctuation in Groundwater May 2014-May 2015 in NCT Delhi

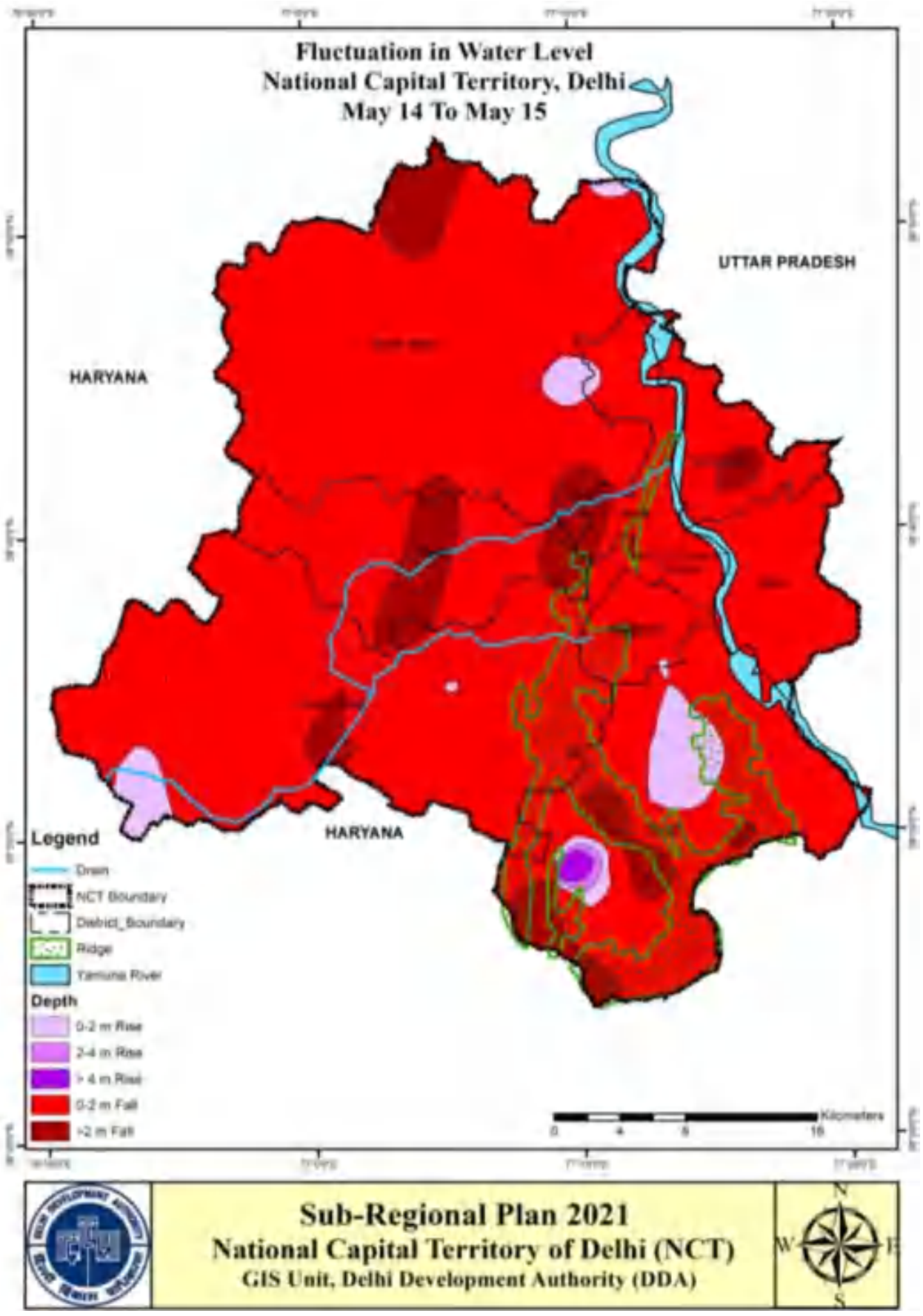


Table 7.20: Area under various Depths to Water (DTW) level in NCT Delhi, 2015

S. No.	DTW (mbgl)	Area (sq. km)	Location	Districts
1	0 to 2	5	Raj Ghat, Jagat Pur-2, Balswa Lake	Central, N, NW.
2	2 to 5	270	Jagat Pur-1, Nangli Rajapur, Burari, Kanjawala, Auchandi, Majra Dabus, Deorala, Hiran Kudna	E, N, NW, SW, W
3	5 to 10	401	Indiagate, Chilla, Bakoli, Palla, Peeragarhi etc.	New Delhi, E, NW, W.
4	10 to 20	383	Birla Mandir, Kichner Road, Shram Shakti Bhavan, Chawla, Daulatpur etc.	SW, New Delhi,
5	20 to 40	195	Mahavir Banasthali, Nehrupark, JamaliKamali etc.	SW, S, New Delhi
6	> 40	229	PushpVihar, Bhatti, Asola Jaunapur, Satbari, Sultanpur etc.	S

Source – Groundwater Year book 2015-16, CGWB

According to CGWB, the depth to water level recorded in NCT Delhi during May 2015 ranges from 1.20 to 62.22 meter below ground level (mbgl), which is elaborated in Table 7.20.

- About 50 percent wells of South district show more than 40 m bgl water level and 19 percent wells have 20 to 40 m below ground level (bgl) water level.
- In New Delhi and Southwest districts, water level in the range of 10 to 20 m bgl is shown by 57 percent and 35 percent wells respectively.
- In North, East and Northwest districts, 29 percent, 40 percent and 46 percent wells show water levels in the range of 5 to10 m bgl respectively.
- In East, North, Northeast, Northwest, and West districts 30 percent, 57 percent, 50 percent, 29 percent and 12 percent of wells show water level in the range of two to five m bgl respectively.
- The entire Yamuna flood plain is also falling in the two to five m bgl category.

Figure 7.10: Depth to Water Level Map May 2015 in NCT Delhi

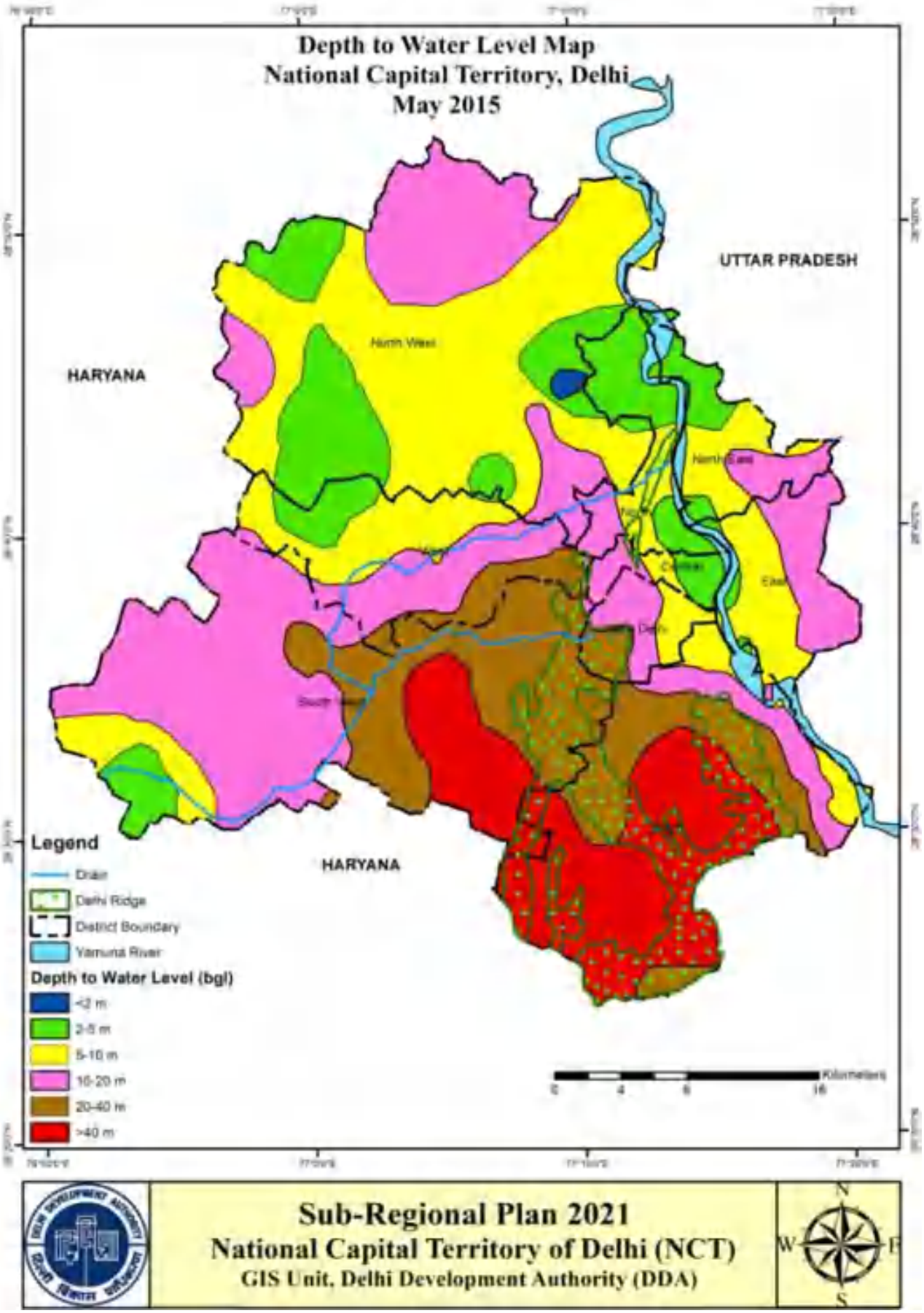
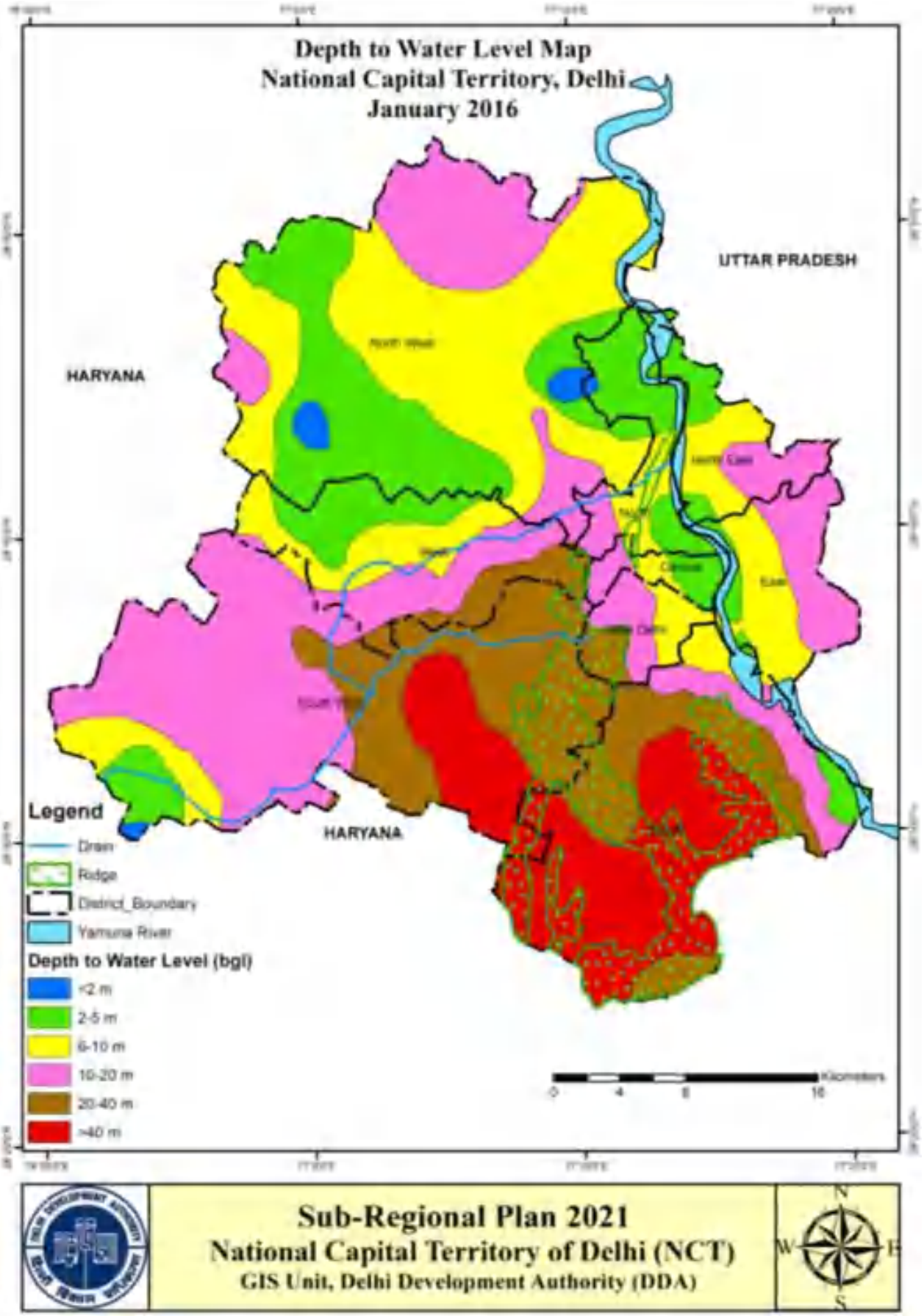


Figure 7.11: Depth to Water Level Map January 2016 in NCT Delhi



Spatially, it is clear that south and southwest Delhi are now relatively more deficient in groundwater compared to other parts of the city. This is due to receiving less water supply being at the tail end of the distribution network with resultant groundwater overdraft. Ironically, it is this relatively higher exploited area which has fewer natural recharge sites and less suitable storage strata available.

NW, N, NE, E and Central Delhi have suffered relatively less water depletion. This is mainly due to a variable combination of better natural recharge owing to proximity to river, high density network of irrigation and drainage channels, suitable soil strata for recharge, better supply from the distribution network. It is these relatively better off areas which have a larger number of natural recharge sites.

The fluctuation of water level between May 2014 and May 2015 of Delhi state shows rise in water level in the range of 0.02 m to 8.82 m in the districts of New Delhi, North, South, Northwest, Southwest and West. Whereas rest of the districts like Central, East, Northeast, West, South and Southwest shows fall in the range of 0.01 to 3.55 m.

According the latest 2015-16 Annual report published by CGWB, the overall data indicates that in South and Southwest districts the water levels are showing maximum fall. A comparison of the water level data of May 2015 with 10 year mean water level of May shows that 63 percent of wells show a fall in the range of 0.24 to 10.10 m. In New Delhi, North, Northwest and Southwest districts 52 percent of wells show a rise in water level varying from 0.70 to 3.76 m. The maximum fall has taken place in Northwest, South and Southwest districts (i.e. 4.90 to 10.10 m). The depth to water level recorded in NCT Delhi during August 2015 ranges from 0.51 to 61.84 m bgl. About 44 percent wells of South district show more than 40 m bgl water level and 19 percent wells have 20 to 40 m bgl water level. In New Delhi and Southwest district 50 percent and 31 percent wells have shown 10 to 20 m bgl water level, respectively. The water level fluctuation between May 2015 (Pre-monsoon) and August 2015 for Delhi indicates that 19 percent wells show a fall in the range of 0 to two m and 23 percent depict a fall ranging from 0.06 m to 9.92 m.

Due to depleting ground water levels and lesser water availability in Delhi, water security of the State has become a very important aspect. Currently, the ground water during the non-monsoon season is not only depleting but also in danger of getting highly saline. Delhi Jal Board (DJB) conducted a detailed study titled “Assessment of Ground Water Resources and Development Potential of Yamuna Flood Plain, NCT Delhi” through National Institute of Hydrology (NIH) in the year 2014. An aquifer mapping and ground water management plan of NCT Delhi has also been studied by Central Ground Water Board (CGWB) in 2016.

7.12.2 Groundwater quality

As we know the groundwater quality varies with depth and space. The following have been the observations in this regard –

1. The ground water availability in the territory is controlled by the hydro-geological conditions characterized by occurrence of different geological formations namely Delhi Quartzite, Older and Younger Alluvium. Central Ground Water Board (CGWB) has established 127 hydrograph monitoring stations till March 2016, out of which 24 are dug wells and 103 are Piezometers. The ground water monitoring stations are spread over both Alluvial and quartzite area. Nearly 11 stations fall in Delhi quartzite and 116 stations fall in alluvial area including Yamuna Flood Plain.

2. In most parts of the Northwest District, chemical quality of shallow ground water is brackish with Electrical Conductivity more than 3,000 ms/cm except north eastern part i.e. all along western Yamuna Canal and its tributaries; shallow ground water is fresh with electrical conductivity in-between 1,000 ms/cm to 3,000 ms/cm. In other parts of NCT Delhi falling Central, New Delhi, East and North-east districts ground water is fresh.
3. In over 30 percent of the area in NCT Delhi, the fluoride contents in ground water is more than permissible limit (1.5mg/1) particularly in the South-western and Western part of the city comprising Southwest, West and Northwest Districts.
4. The nitrate pollution in the ground water is also significantly high which may be attributed due to combined effect of contamination from domestic sewage, livestock rearing, landfills and run off from fertilized fields, unlined drains and cattle sheds.
5. About 45.5 percent of ground water samples in NCT, Delhi have been found unsuitable for drinking based on overall impact of physio-chemical characteristic including heavy metals, total dissolved solids, nitrate, fluoride, trace metals or due to synergic effects of some or all of these.

7.12.3 Potential Resources Available For Groundwater Recharge in NCT Delhi

The potential resources which can be partially used for effecting recharge are as follows -

1. The runoff generated by the rainfall in the NCT Delhi at a 75 percent level of probability and amounting to 177 MCM
2. Delhi's monsoon season allocation of the River Yamuna water amounting to 282 MCM which flows past non-utilised for lack of upstream storages.
3. Floodwaters entering NCT Delhi through seasonal streams and escaping to the River Yamuna. This is as yet an un-quantified resource.

7.13 Service Level Benchmarking Index

These service level benchmarking parameters have been defined primarily from a utility manager/planner's perspective. In other words, the parameters highlight the performance as would be monitored by the leadership/management of ULBs or other civic agencies. These performance measurements will need to be carried out by the service delivery agencies themselves, reported to higher levels of management and also disseminated widely. Table 7.21 shows DJB's performance versus the service level benchmarking indicators.

Table 7.21: Performance of Delhi Jal Board versus Water supply Service Level Benchmarking indicators

S. No	Proposed Indicator	Unit	Value	Benchmark
1	Coverage of water supply connections	%	72	100
2	Per capita availability of water at consumer end	LPCD	144	135
3	Extent of metering of water connections	%	55	100
4	Extent of Non-Revenue Water (NRW)	%	52	20
5	Continuity of water supply	Hrs./Day	3	24
6	Efficiency in redressal of customer complaints	%	73	80
7	Adequacy of treatment and disinfection and quality of water supplied	%	99.5	100
8	Cost recovery in water supply services	%	42	100
9	Efficiency in collection of water supply–related charges	%	86	90

Source – SLB Handbook, Water Policy for Delhi

DJB's performance along with the Ministry of Urban Development, promoted water supply Service Level Benchmarks (SLBs) from 2009.

- DJB claims to now have covered 81 percent of the population through piped connections, as opposed to this 2009 assessment.
- There is no scientific figure available with DJB on how much of their water is non-revenue. They estimate it to be around 40 percent as opposed to 52 percent in the above assessment.
- There are over 20 lakhs connections in NCT of Delhi, with about 20 percent of them being unmetered. Most metered connections also get charged a flat tariff.

7.14 Policies and Proposals

7.14.1 Measures for Management and Rejuvenation of River Yamuna Water bodies/ Lakes/ Wetlands

1. A single unified agency such as 'State Water Resources Board' should be established and tasked with policy related issues for integrated water resources development and management shall be created.
2. Suitable measures must be taken to maintain the water bodies with the minimal flow/ water level. To facilitate ground water recharge, it may also be ensured that minimum required flow in the river during lean season exists. The reservoirs may be created in low-lying areas. It would also help in maintaining ecology and social considerations.
3. Lakes, water bodies including village ponds and other groundwater recharging areas should be preserved to maintain availability of water and ground water recharge.
4. Development of underground reservoir along the Yamuna Flood Plain.
5. Development of water bodies/ reservoirs in Yamuna flood plain area by retaining excess flood water during the monsoon season for recharging the ground water from Palla to Wazirabad.
6. Apart from the above measures, steps would also need to be taken to augment ground recharge from the river and decentralized wastewater treatment system. The creation of 'regulated flood plain reservoirs', for storing the excess monsoon overflow at suitable locations would augment the water retention capacity of the riverbed. The upstream of Wazirabad Barrage and some other areas offer such a potential.
7. Annual reassessment of the groundwater potential on a scientific basis should be undertaken to ensure sustainable extraction. Groundwater recharge projects are to be formulated and implemented.
8. No encroachment or unauthorised construction in wetlands should be permitted.
9. The storage capacities of water bodies and water courses and/or associated wetlands, the flood plains, ecological buffer and areas required for specific aesthetic recreational and/or social needs may be managed to the extent possible in an integrated manner to balance the flooding, environment and social issues as per prevalent laws.
10. The quality of river water will not improve unless the flow in the river is increased. To improve the quality of river water, innovative and holistic approaches including creating wetlands in the floodplains, recycling of waste water (thereby reducing the demand for

fresh water, rain water harvesting, creating off river reservoirs upstream of Wazirabad both in Haryana and Delhi, improving water use efficiency of agriculture and gradual switching over from water intensive agronomic practices need to be introduced.

11. Water bodies / recharge ponds need to be proposed and be created by retaining excess water during monsoon seasons for recharge ground water. The flood season discharge shall be controlled by creating storage of the area. This amount of water shall be recharging the aquifers in the Delhi side which has a huge capacity for storing such water in the aquifers.
12. The quality of ground water improves with increase in recharge. There are certain pockets in this region where Ground Water quality is saline and having high ammonia content. Dilution is the best practice to improve the Ground Water Quality in any region, including in Aquifers, confined as well as unconfined Aquifers.

7.14.2 Relocation of Water consuming industries

1. Quality conservation and improvements are even more important for ground waters, since cleaning up is very difficult. It needs to be ensured that industrial effluents, local cesspools, residues of fertilizers and chemicals, etc., do not reach the ground water.
2. Intensive urban development/induced developments/water consuming industries, should not to be proposed in over exploited of ground water potential as per Central Ground Water Board, Ministry of Water Resources in NCT of Delhi.
3. Recycling of Waste Water for Non-working/non-potable/ horticultural use.
4. The actual quantity of waste water treated is much below the installed capacity on account of missing links in sewer connectivity between the generation points and treatment plants and choking/silting of sewer lines, etc. The missing links in sewer connectivity must be covered for its continuity from the generation point to the treatment plant.
5. To treat the all-available wastewater Soil-Aquifer Treatment plants can be put up near the existing sewage as well as near the major drains carrying the wastewater. A battery of tube wells for using the treated wastewater for domestic purposes can pump this wastewater out. As the water is free of foul smell it can be used for all purposes after proper chlorination.
6. The treated wastewater is being largely put back into the drains and gets polluted again before flowing into the river Yamuna.
7. Major urban structures and complexes to incorporate recycling facilities and at least 50 percent of the water used is to be recycled water.
8. At least 50 percent of the treated waste water should be recycled for these purposes and emphasis should be laid towards waste minimization, which will also help in improving the environment on the whole.
9. Government may also provide liberal tax rebates for institutions/industries adopting recycled waste water to compensate for the cost involved in treating waste water for recycling. Fresh water should not be used for irrigation purpose if treated waste water is available. Enabling provisions in the respective acts of the local bodies may be made by the Delhi Government.

10. Initiatives must be taken by a local MP should be used for utilising MPLADS for rain water harvesting work in schools, hospitals, Group Housing Societies flats.
11. Artificial Recharge Schemes which have been implemented in the past by the CGWB in Urban areas such as the artificial recharge in JNU, IIT, Vasant Vihar, Tughlaq lane area, CGHS in Dwarka, Delhi Cantonment buildings should be encouraged and replicated throughout NCT Delhi.
12. Property tax rebates could be proposed in the year in which the rain water harvesting facility has been completed as an incentive.

7.14.3 Creation of Mass Awareness

1. It is imperative to create mass awareness among public through mass media with regard to saving water, waste minimization and utilization of sprinkler/drip irrigation techniques, waste water re-utilisation to save water for human consumption.
2. Need for disseminating information on rain water harvesting through print media and various other platforms including organizing workshops etc.
3. Creating public awareness by distributing informative booklets and pamphlets on rain water harvesting to be distributed along with the water bills.

7.14.4 Commercial Approach for Water Tariff

1. With the increased requirement of improved quality as well as adequate quantity of water, the Government alone will not have financial capacity to continue with subsidies for improving the water supply systems in times to come.
2. Water Metering coupled with improved recovery of revenue may help reduce the revenue-expenditure gap. The tariff should be fixed to meet at least the operation and maintenance cost of the water supply system, if not the capital cost of the system.
3. The structure of the water tariff should be demand based and increase telescopically depending upon the monthly consumption and should be reviewed periodically as a built-in mechanism to make the service self-sustaining and a deterrent to wastage.
4. Tariff for the recycled treated waste water should be fixed accordingly to encourage its non-potable uses such as gardening, horticulture and other uses referred above.
5. Commercial approach should be adopted by the local bodies for revenue generation. ‘Public-Private Partnership’ needs to be introduced for operation and maintenance of water supply.

7.14.5 Quality of Drinking Water

- The quality of water should conform to the BIS standards and CPHEEO Manual for water supply and its treatment.

7.14.6 Institutional Capacity Building

- Water demand management and institutional capacity building measures, e.g. zoning, setting up a contingent valuation fund, transparent operation-maintenance, regulatory guidelines etc. for efficient operation of the system contribute towards improvement in the finances.

7.14.7 For water supply

1. CPHEEO standards and norms at city level and different usage levels must be revisited and revised
2. All new development areas should have two distribution lines, one for drinking water and other for non-drinking water/recycled treated waste water to reuse the treated waste water.
3. All the waste requirements for non-drinking purpose in big hotels, industrial units, air-conditioning of large buildings/institutions, large installations, irrigation of parks/green areas and other non-potable demands should be met through treated recycled waste water as per norms.
4. Need for preparation of a comprehensive water supply plan from DJB/ Central Ground water Authority, along with the requirement of pumping stations, storage tanks, ground water recharging/ rain water harvesting and drainage plan as per norms.
5. Water supply network must be made more efficient. South and south west must be provided with a trunk distribution line, and should not be at the tail end of the distribution network.
6. There is also a need for a phased augmentation/replacement drive for replacement of existing ageing distribution network, starting with the congested areas.
7. Need for public awareness through print and social media to emphasize on minimizing wastage. A simple hashtag across multiple social media platforms can be used to make this drive go viral among the youth.
8. Involvement of NGOs and private sector in operation and maintenance.
9. Kiosks and ATMs should be set up in areas where there is a clear need for augmentation in water supply, and there should be a provision to shift them if the locality they serve receives access to treated municipal tap water. The contracting authority, in this case DJB, should ensure this and should also arrange for land, raw water, and electricity approvals at the time of award contract.
10. DJB should partner with organizations or advise organizations to take up such projects under their CSR funding. Vending machines could be developed in order to have both RFID and coin-based functions. This would enable greater access to clean, potable water.

7.14.8 Rain water harvesting

1. Rainwater harvesting and water conservation should be encouraged. All urban structures to have compulsory water harvesting facility installed.
2. Rebates could be offered on the first year of construction of this facility on property tax.

CHAPTER 8. SEWERAGE, SOLID WASTE MANAGEMENT AND DRAINAGE

8.1 Introduction

Demographic explosion has led to rapid urbanization and growth of the city imposing enormous pressure to provide the basic infrastructure to its citizens. NCT Delhi with 167.8 lakh of inhabitants is no exception as it generates large volumes of both liquid and solid wastes. All liquid as well as solid wastes are expected to be treated and then disposed or recycled. Delhi treats and also recycles both forms of wastes though in limited capacities, and part of it is disposed off without any treatment. Parastatal agency of Delhi Jal Board (DJB) is responsible for the treatment and disposal of waste water. DJB has tried to increase capacity to match the ever-growing demand by laying water pipes; construction of underground reservoirs and water treatment plants; fixing leakages, etc.

8.2 Sewerage

As per Census 2011, Delhi had a population of 167 lakhs and as per the Delhi Master Plan 2021, the population of Delhi is projected to be 230 lakhs in 2021. Presently, approximately 79 percent of Delhi's population is covered under sewerage network in NCT Delhi. Delhi Jal Board is the service provider for entire NCT Delhi region.

8.2.1 Existing Situation

Coverage of Sewage Network Services

Over the last 30 years, the population of Delhi has rapidly increased from 40 lakhs (in 1971) to around 180 lakh people today. The burgeoning population coupled with slow and unorganized development in sewerage infrastructure has posed a major threat to the city's sanitation issues, subsequently affecting river water quality and public health of the inhabitants. (Sewerage Master Plan for Delhi, 2031). Table 8.1 shows the sewerage network coverage by population for 2001 and 2011.

Table 8.1: Sewerage Network Coverage by Population in Year 2001,2011

Year	Urban Population	Population Covered	Percentage Covered
2001	1,29,05,780	83,88,757	65
2011	1,63,34,000	89,83,700	55

Source: Analysis by NCRPB

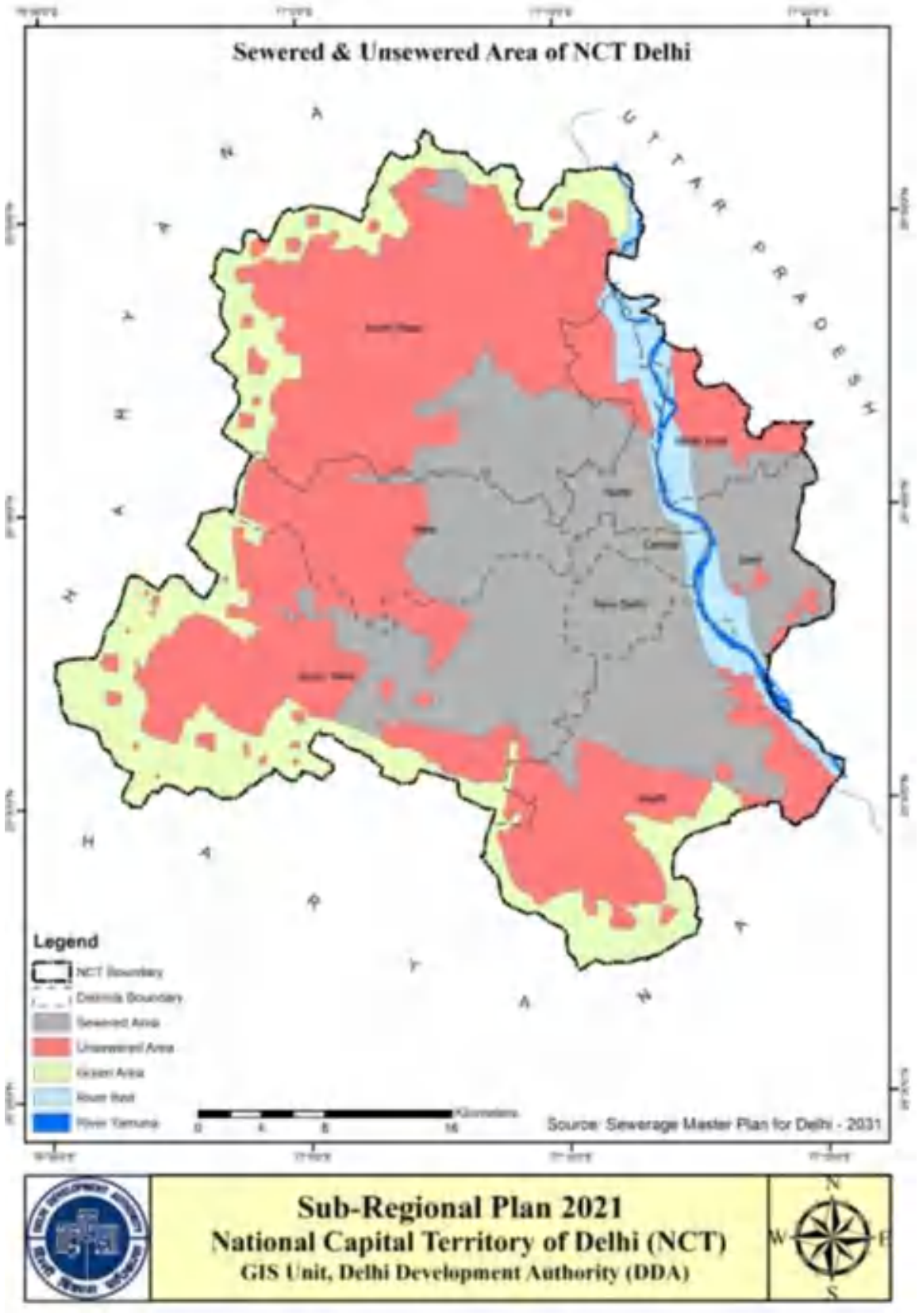
The entire National Capital territory of Delhi (NCT) with an area of 1483 square kilometers can be broadly categorized into: sewered area and un-sewered areas, as shown in the Figure 8.1 below. Presently Delhi is divided into six drainage zone namely Rithala, Keshopur, Okhla, Shahdara, Coronation Pillar and Outer Delhi (Figure 8.12). Out of these zones Keshopur, Okhla, Rithala, South of Shahdara and Coronation Pillar drainage zones are majorly sewered with pockets of unsewered colonies. The whole of NCT of Delhi has been delineated into 12 proposed drainage zones excluding Cantonment and Airport area.

8.2.2 Existing Infrastructure

Present water availability = 930 MGD
Present sewage generated = 744 MGD
Present waste water treatment capacity = 579 MGD
Present sewerage network = about 8400 km
Present area with sewerage network = 79%

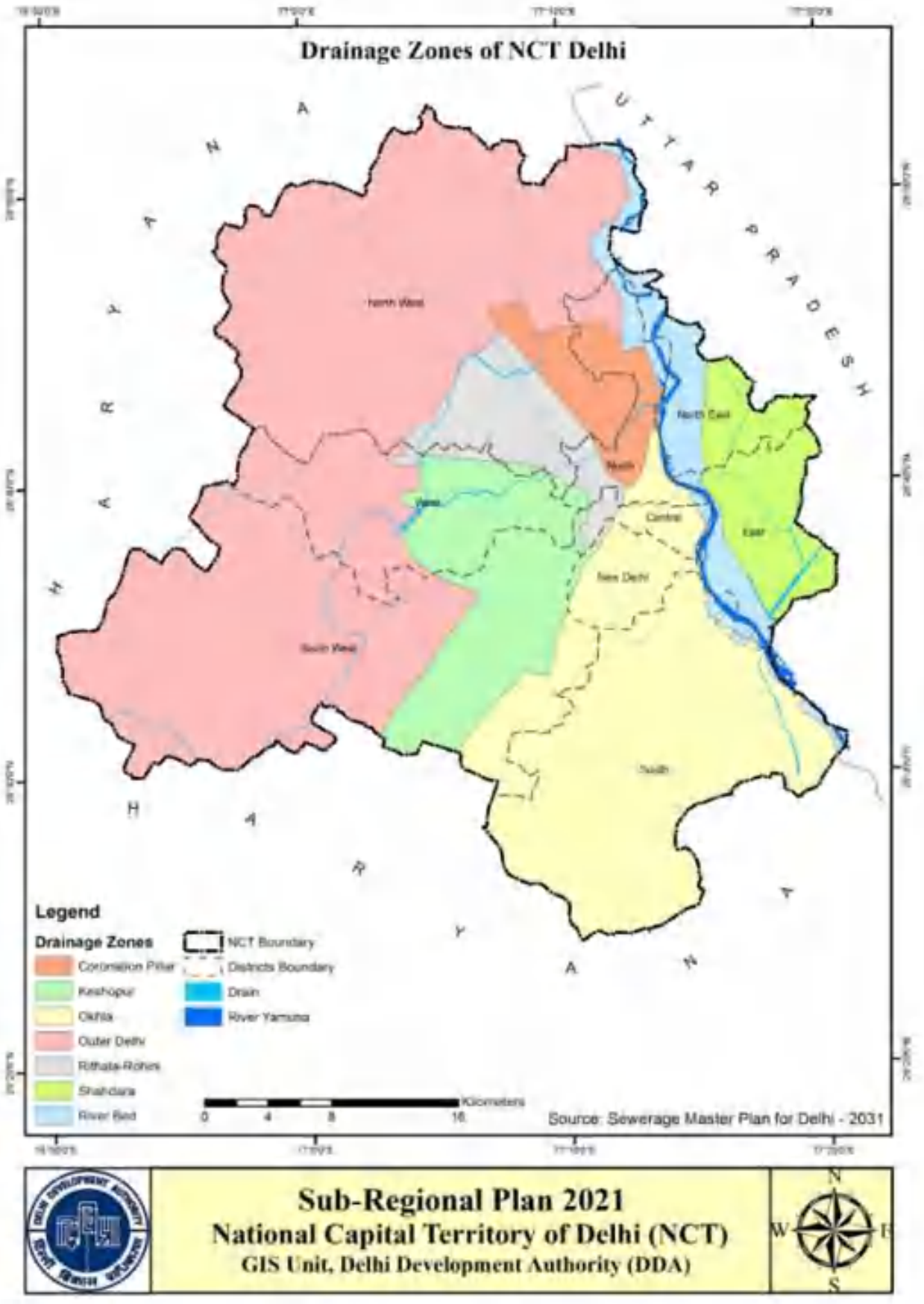
Present average treatment = 520 MGD
Present Capacity utilization = 87%

Figure 8.1: Sewered and Unsewered Area of NCT Delhi



Source: Sewerage Master Plan for NCT Delhi 2031

Figure 8.2: Six Drainage Zones of Delhi



Source: Sewerage Master Plan for Delhi 2031

8.2.3 Sewage Collection System

Sewerage facilities are provided through network of sewers in planned colonies, unauthorized/regularized colonies, Urban villages and JJ Resettlement colonies. It is observed that 76.78 percent urban villages are connected with sewerage system, 13.16 percent of rural villages are connected with sewerage system and 15.18 per cent of unauthorised colonies have sewerage connections. However, all the JJ Clusters are sewered, since they are mostly located within the built-up area. Category wise number of colonies served by sewerage is given in **Table 8.2**.

Table 8.2: Colony wise Existing Sewerage Status

S. No.	Colonies (Category wise)	No. of colonies	No. of Sewered colonies/ villages	Percentage
1	**Urban Villages**	135	103	76.38
2	**Rural Villages**	190	25	13.16
3	**Unauthorized colonies**	1857	282	15.18
4	**JJ Clusters**	46	46	100
	TOTAL	2228	456	-

Source: Sewerage Master Plan for Delhi 2031

8.2.4 Sewage Treatment Capacity

About 79% of population is covered by sewerage network, and sewage generated from the remaining population is going through a number of surface drains into the river. Delhi Jal Board (DJB) is responsible for treatment of domestic sewage in the NCT of Delhi and also the executing agency entrusted with the construction and maintenance of the Wastewater Treatment Plants (WWTPs), Wastewater Sewage Pumping Stations (WWPSs), Sewerage Networks and associated structures. DJB has 35 WWTPs at 20 locations in the NCT of Delhi along with WWPSs.

Adequate sanitation is essential for the protection & promotion of individual's and community health. Various schemes are being implemented by the DJB to improve sanitation conditions. Sewage treatment capacity of Delhi Jal Board increased from 402.40 MGD in 31st March 2001 to 607.26 MGD in 31st March 2018. The information regarding the sewerage treatment capacity and percentage of utilization is presented in the table below:

Table 8.3: Sewage Treatment Plants in NCT Delhi

S. No.	Sewage Treatment Plants	2001	2011
1	**Treatment Capacity (MLD)**	1828	2475
2	**Actual Sewage Treated (MLD)**	1500	1589
3	**Gap in Sewage Treatment (MLD)**	1040	1407

Source: Delhi Jal Board

The table above shows that in Delhi the quantity of sewage treated is 53 percent of sewage generated. Also, six sewage treatment plants of capacity 564 MLD are under construction in NCT Delhi.

8.2.5 Wastewater Treatment Facilities

At present, there are 35 WWTPs at 20 locations equipped to treat 2716.35 MLD of waste water with a utilization of around 84 %. The capacity of WWTP varies from 0.66 MGD to

170MGD. In NCT of Delhi 410 MLD of treated effluent is reported to be used in horticulture/Irrigation/ Power plants against a present sewage generation of 3276 MLD which works out to 38.62% Considering 267 MGD (1210MLD) of mandatory return flow.

As per the notification dated 28.7.2010 issued by Ministry of UD and Poverty Alleviation (Delhi Division) GOI on Building Bye laws 1983, every premises having water consumption more than 12.50 KL has to install recycling plant and use the treated effluent for non-potable use. This coupled with the policy of dual piping being adopted by DDA in all new building can make the utilization of treated effluent for flushing purpose also.

Sr. No	Name and location of STP	Present Capacity (in MGD)	Present Average Treatment (in MGD)
1	Keshopur	72	72
2	Okhla	140	114
3	Kondli	70	70
4	Rithala	60	58
5	Yamuna Vihar	45	43
6	Vasant Kunj	5	3.25
7	Coronation Pillar	30	30
8	Narela	10	4.4
9	Nilothi	60	39
10	Najafgarh	5	4
11	Pappankakan	40	42
12	Dr. Sen Nursing Home Nalla	2.2	2.35
13	Delhi Gate	17.2	17.47
14	Mehrauli	5	4.25
15	Rohini	15	4.8
16	Ghitorni	5	0.33
17	Kapashera	5	1.75
18	Commonwealth Games Village	1	0.16
19	Molar Bandh	0.66	0.54
20	Chilla	9	9.05
	Total	**597**	**520 (approx)**
Sr. No	**Name and location of STP**	**Present Capacity**	**Present Average Treatment**

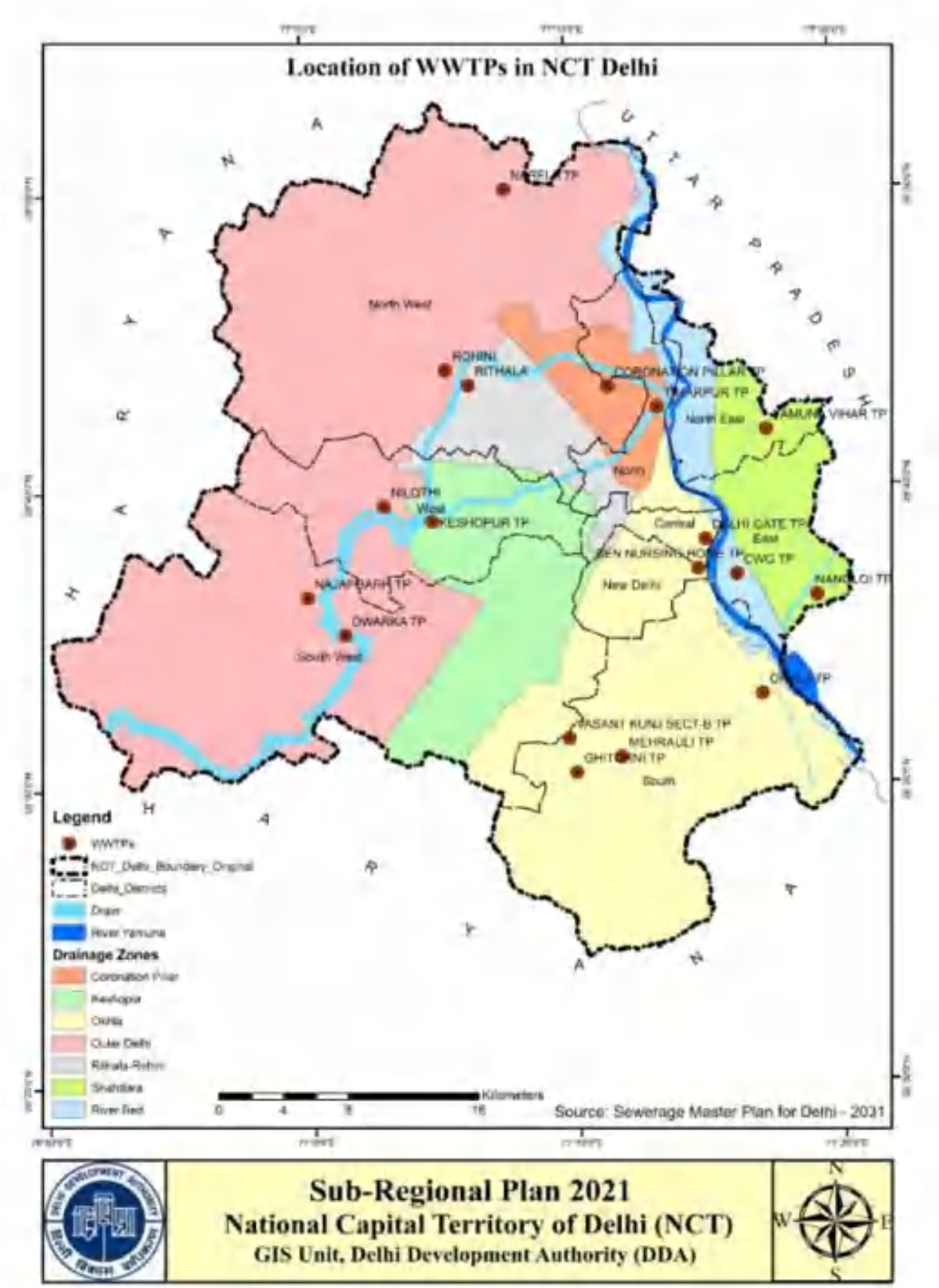
Table 8.4 below represents design capacity of existing WWTPs and their present utilization efficiency based on the quantum of treated sewage by individual WWTP.

		(in MGD)	(in MGD)
1	Keshopur	72	72
2	Okhla	140	114
3	Kondli	70	70
4	Rithala	60	58
5	Yamuna Vihar	45	43
6	Vasant Kunj	5	3.25
7	Coronation Pillar	30	30
8	Narela	10	4.4
9	Nilothi	60	39
10	Najafgarh	5	4
11	Pappankakan	40	42
12	Dr. Sen Nursing Home Nalla	2.2	2.35
13	Delhi Gate	17.2	17.47
14	Mehrauli	5	4.25
15	Rohini	15	4.8
16	Ghitorni	5	0.33
17	Kapashera	5	1.75
18	Commonwealth Games Village	1	0.16
19	Molar Bandh	0.66	0.54
20	Chilla	9	9.05
	Total	**597**	**520 (approx)**

Table 8.4: Present Infrastructure: Details of STP (capacity and utilization)
Source: Delhi Jal Board

The location of various WWTPs in Delhi is shown in Figure below:

Figure 8.3: Location of various WWTPs in NCT Delhi



Source: Sewerage Master Plan for Delhi 2031

The sewerage network of Delhi comprises 7000 km of sewerage lines including trunk sewers and branch sewers (peripheral/ internal sewers). This includes main trunk sewers of total length of 192 km. About 50 percent of population is covered by sewerage network, and sewage generated from the remaining population is going through a number of surface drains into the river. The rehabilitation/desilting has been completed in a trunk sewer and is in progress in the peripheral sewer.

8.2.6 Sewage Generation

As per SMP 2031 waste water generation for NCT Delhi has been estimated for 2021 and 2031.Waste water generation has been estimated at 80 percent of water supply. Accordingly, it was estimated that 863.4 MGD and 1061.6 MGD of waste water would be generated by 2021and 2031 respectively. Table below shows the estimated generation of waste water in the year 2021 and 2031:

Table 8.5: Projected Population and Estimated Wastewater Generation of NCT of Delhi as per SMP 2031:

Projected Population in 2031	**Waste Water Generation (MGD)**		
	2011	2021	2031
2,93,87,379	679.9	863.4	1061.6

As per the study carried out by DJB on 'Delhi Water Supply & Sewerage Project' funded by the World Bank, it has been estimated that water supply requirement for Delhi in 2021 will be 5,259 MLD and wastewater generation from this level of water supply will be about 3,760 MLD. Details of the calculation are shown in the Table 8.6 below:

Table 8.6: Water Supply Requirement and Wastewater Generation Estimated

Sl. No.	**Details**	**Volumes (MLD)**	
		2011	**2021**
1	Total water demand	5181	6272
2	Total net water supply	4144	5259
3	Waste water generated	3573	5017
4	Treated at CETP	346	755
5	Proportion not sewered	10%	5%
6	Outside sewered area	294	210
7	Net generated waste water	2218	3242
8	Infiltration	518	518
9	Gross wastewater for treatment	2736	3760

Source: Delhi Jal Board

8.2.7 Proposed Drainage Zones

As per the Sewerage Master Plan for Delhi-2031 prepared by DJB, the whole of NCT of Delhi has been delineated into 12 proposed drainage zones excluding Cantonment and Airport. Zone wise estimated waste water generated for 2021 and 2031 is given below:

Table 8.7: Zone wise Estimated Wastewater Generation of NCT of Delhi

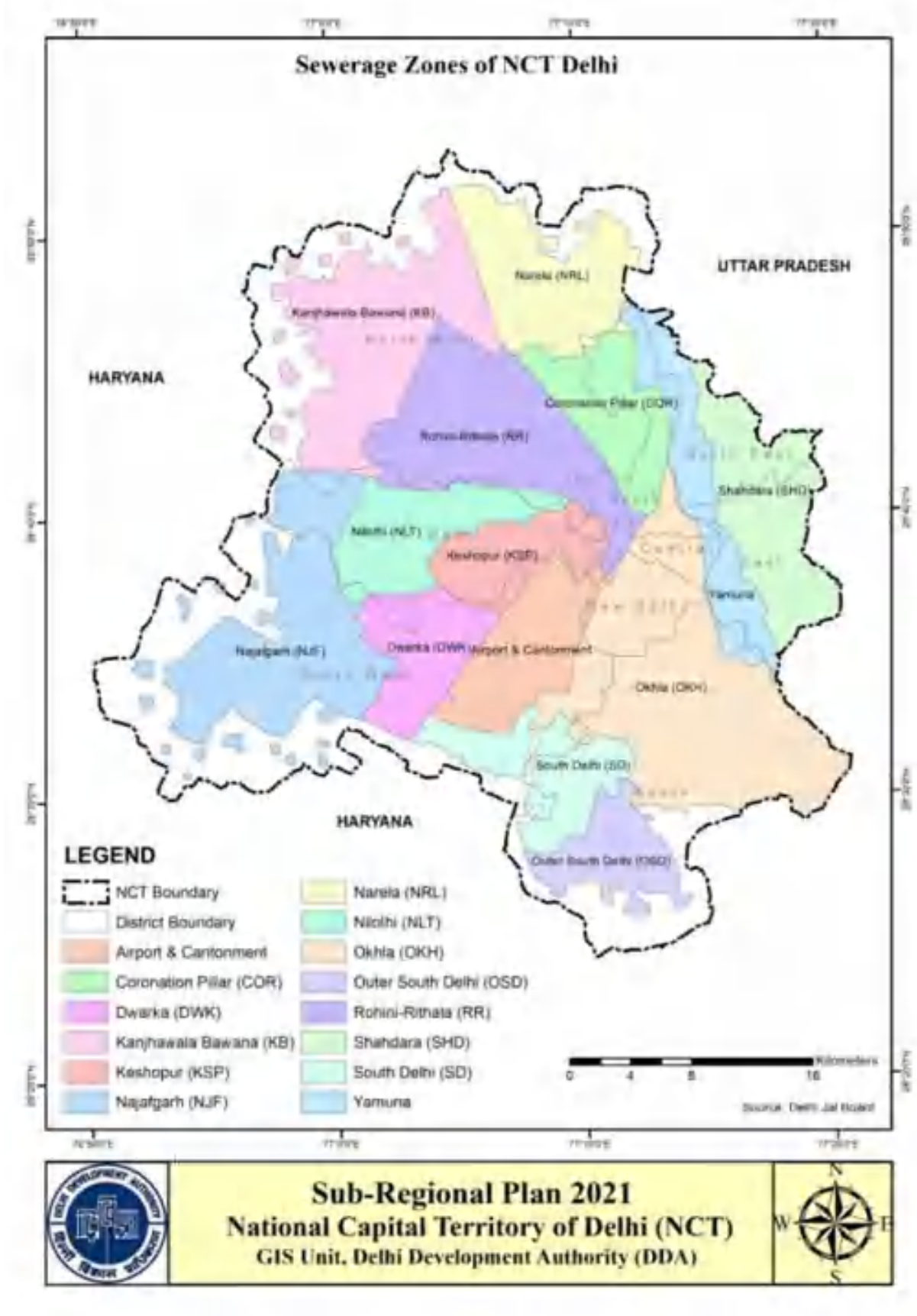
Sr. No	Drainage Zone	Waste Water Generation (MGD)	
		2021	2031
1	Shahdara	126.00	142.00
2	Okhla	162.00	187.00
3	South Delhi	34.00	40.40
4	Outer South Delhi	20.00	49.20
5	Narela	42.70	59.30
6	Coronation	67.50	79.90
7	Najafgarh	65.30	87.50
8	Nilothi	52.80	60.66
9	Kanjhawala- Bawana	69.60	103.60
10	Rohini- Rithala	107.50	120.00
11	Dwarka	49.20	60.00
12	Keshopur	67.00	72.00
Total (MGD)		863.40	1061.60

Source: Sewerage Master Plan for Delhi 2031

Note: The Waste water generation as shown in the table includes estimation of sewage generation for sewered areas based on zonal PPH, existing plant capacities, their utilization and integration with sewage generation from unsewered areas.

As per the Table 8.7, it is observed that Okhla drainage zone generates the highest amount of waste water that is 162 MGD in 2021 and 187 MGD in 2031 followed by Shahdara zone, Rohini-Rithala zone and Kanjhawala-Bawana zone because these zones are having larger catchment areas and higher concentration of population served by sewerage network. Rest of the zones are relatively smaller with lesser population and propose to generate less than 100 MGD by 2021 and 2031. Twelve drainage zones as proposed in the Sewerage Master Plan of Delhi 2031 are shown in Figure 8.4.

Figure 8.4: Proposed Drainage Zones – NCT Delhi



Source: Delhi Jal Board

8.2.8 Proposed increase in Wastewater treatment capacity

Based on anticipated flows from already sewered areas, Delhi Jal Board propose to augment the wastewater treatment capacity to 731.9 MGD by constructing additional capacity of 137 MGD in seven treatment plants namely Coronation Pillar, Yamuna Vihar, Dwarka, Nilothi, Chilla, Delhi Gate (phase II) and Delhi Cantt. The details are presented in the Table 8.8.

Table 8.8: Proposed Waste Water Treatment Plants

Sr. No	Location	Capacity in MGD		
		Present Sewage Treatment Capacity (MGD)	Under Renovation / Proposed (MGD)	Total Sewage Treatment Capacity after augmentation (MGD)
1	Okhla	140	124*	170
2	Keshopur	72	-	72
3	Coronation Pillar	30	70*	80
4	Rithala	80	40	80
5	Kondli	70	20	90
6	Vasant Kunj	5		5
7	Yamuna Vihar	45	-	45
8	Ghitorni	5		5
9	Pappan Kakan	40		40
10	Narela	10		10
11	Najafgarh	5		5
12	Mehrauli	5		5
13	Delhi Gate	17.2		17.2
14	Sen Nursing Home	2.2		2.2
15	Rohini	15		15
16	Nilothi	60		60
17	Kapashera	5		5
18	CWG Village	1		1
19	Molar bandh	0.66		0.66
20	Bakkarwala			0.66
21	Chilla	9		9
22	Delhi Cantt.	-		8
	TOTAL	617.06	254	725.72

Source: Delhi Jal Board

8.2.9 Augmentation/Upgradation of STPs

As far as upgradation is concerned, the plan for capacity addition is as under:

The installed capacity at present is 617 MGD.However the present treatment capacity is 597 MGD since one stream of 20MGD at Rithala has been shut due to rehabilitation work of the 40MGD plant

- Sewage Treatment capacity will increase to 632 MGD by March 2021 as 35 MGD will be added after commissioning of 50% of Coronation Pillar STP

- Capacity will further increase by 5 MGD i.e 637 MGD after commissioning of complete 70 MGD Coronation Pillar STP in June, 2021(existing STPs of 30 MGD capacity pillar will be decommissioned)
- In December,2022 capacity will be increased to 657 MGD after commissioning of Rithala STP Ph-I of 20 MGD, which is presently under rehabilitation
- Capacity will be further enhanced to 677 MGD in Dec, 2022 after rehabilitation of Kondli STP of 20 MGD
- Capacity will be further augmented to 707 MGD in Dec,2022 after construction of new Okhla STP

8.2.10 Interceptor Sewer Project

Interceptor Sewer Project has been conceptualized for abatement of pollution in the River Yamuna because of discharging wastewater from the three major drains namely Najafgarh, Supplementary and Shahdara drains. The scheme consists of construction of deep Interceptor Sewers along the drains to trap and take the sewage into the interceptor sewers so that sewage can be conveyed to Sewage Treatment Plants (STPs) for treatment before disposal into main drains. The project envisages laying of 54 kms of interceptor sewerage along 3 major drains and it has been divided into 6 packages. The ISP is expected to be commissioned by June 2019. By June 2019, all the 242 MGD of sewage is expected to be trapped.

Table 8.9: Package wise Breakup of the Project

Package	**Package Description**	**Sub-Drains being trapped (in Nos)**	**Discharge in (MGD)**	**Flow already Trapped**
1	Dwarka	2	13.80	13.80
2	Nilothi and Keshavpur	37	63.10	52.80
3	Coronation Pillar and Bharat Nagar	19	69.10	-
4	Rohini and Rithala	19	26.0	19.00
5	Shahdara North (Yamuna Vihar)	15	31.80	-
6	Shahdara South	16	37.20	31.5
Total		**108**	**242.00**	MGD

New Initiatives by DJB to control the pollution in River Yamuna

Trapping of Drains

Out of the 18 drains falling directly into River Yamuna, following 13 drains have been trapped and/2 major drain i.e., Najafgarh & Shahdara are included in interceptor Sewer Project by Delhi Jal Board:
* For the balance 03 drains, action plan has been prepared which requires construction of STPs at the mouth of two drains i.e., Mori Gate and Barapullah drains.

*the land for STPs is yet to be provided by DDA DIB is committed to take further action after allocation of land.

Septage Management Regulations-2018

After extensive efforts by Delhi Jal Board, notification of Delhi Water Board Septage Management Regulations-2018 was issued In Nov. 2018 for collection, transportation and disposal of waste of septic tank.

- As per the Regulations, Septic Tank Waste shall be collected and transported only by an agency having a valid licence for this purpose issued by DJB
- Public Notice inviting applications from the Individual/Agencies /Firms /Companies for grant of licence for collection, transportation and disposal of Septic Tank Waste have been issued.
- DJB has already designated 86 SPS locations for the collection of Septage from the licensed vendors/individuals engaged in-the activity of cleaning of Septic Tank waste for licensing.
- The compliance of the Regulations and its enforcement is entrusted upon the respective District Magistrates as under: “The District Magistrate of the area will ensure that only license holders [vendor(s)] registered with Delhi Jal Board carry out the cleaning, transport and disposal of Septage/sludge from the septic tanks, drains etc. in their respective area of jurisdiction. The enforcement of these regulations will be controlled by the Committee headed by the area District Magistrate [Deputy Commissioner (Revenue)]; however, the District Magistrate may co-opt Committee Members from various Government/ Municipalities/ Public Undertakings...”
- These regulations, application Performa, Terms & Conditions of Licence and notified sites for disposal of waste can be downloaded from Delhi Jal Board website www.delhijalboard.nic.in or may be obtained from the designated DJB office.
- It may be noted that undertaking this task without a valid license or/and dumping the septic tank waste at any non-designated location will be punishable as per law.
- DJB has issued 206 nos. of licenses
- The DJB is only responsible to issue the licenses to the Septage collection vendors. It is also emphasized that DJB has no jurisdiction or authority in unsewered areas and cannot enter and inspect any property/premise for any construction including Septic Tanks. Such powers are available only to the Municipal Corporations, NDMC, DDA etc.

1. Decentralized STPs

DJB has framed a policy for setting up of DSTP by individual schools/institutions/complexes/parks/hospitals etc o use the treated effluent for horticulture purpose in their parks. The raw sewage Is to be lifted by them from the nearby sewer network. It would avoid exploitation of ground water, besides ensuring recharging the same.

DJB will allow any of the willing Dept/Societies/Institutions from the Sewer Manholes passing from the areas for its suitable treatment as per latest DPCC/CPCB norms/guide lines for the utilization for the purposes other than the drinking, largely for the Horticulture. The Agency shall install a suitable treatment plant keeping in view the treatment standards for horticulture purposes as per norms of CPCB/DPCC.

To encourage the implementation of the instant proposal, only 10% of the sewerage maintenance charges on the volumetric consumption of water will be levied instead of 60% of the Volumetric Consumption charges, wherever applicable.

2. Use of Treated Effluent

DJB is promoting the use of treated effluent for non-potable purposes, such as irrigation, horticulture, Power Plants, Water Bodies etc. In pursuit of this, DJB has installed filling points for treated effluent at almost all WWTPs. The Biochemical Oxygen Demand (BOD) stands at <20 ppm and the Total Suspended Solids (TSS) of the treated effluent stands at <30 as well, making it usable for non-potable purposes. DJB has also written to and conducted workshops with a number of Government agencies such as DMRC, PWD, NDMC, SDMC, EDMC, NTPC, Indian Railways (for their wagon and carriage washing) and others, encouraging them to use treated effluent. DJB is committed to return 270 MGD of treated effluent in river Yamuna as a return flow as per Yamuna water allocation, which is to be utilized by other riparian states as per allocation of Yamuna water at Okhla headwork's.

3. Current utilisation of Treated Effluent

At present, DJB is operating 35 waste water treatment plants at 20 locations and the total installed capacity of the plants located at 20 locations is 597 MGD whereas the total current production of treated waste water is 520 MGD. After the completion of interceptor sewer project, it is expected that another 107 MGD of waste water shall be intercepted and will be made available for treatment at the sewage treatment plants by December'2019. Thus, the total treated waste water/ effluent will be available to the tune of 617 MGD. The treated waste water is supplied all over Delhi through various stake holders including MCDs, CPWD, I&FC, DDA, PPCL etc. The current usage of treated effluent is about 90 MGD.

4. Rehabilitation of peripheral sewers in Delhi

Delhi Jal Board maintains a huge sewerage network of about 8400 km. spread over entire Delhi. Most of the crucial length of trunk sewers of sizes from 600 to 2700 mm dia has already been rehabilitated. The trunk sewers receive sewage from peripheral sewers and transport it to various STPs for treatment & disposal. A large area of Delhi has been benefited after rehabilitation of Trunk Sewers in West, Central, North and South District. A huge expenditure incurred in maintaining temporary trolleys (more than 50) has been saved. But the complete benefit will be achieved only after rehabilitation of the peripheral sewers (laterals of trunk sewers). Entire sewage is still not reaching STP's due to malfunctioning of peripheral sewer and sewage flowing to drain causing pollution to Yamuna water. Most of the peripheral sewers are also too old and suffering from severe structural deterioration, outlived their economic life span and hence, exhibit operational deficiencies. From the information collected from maintenance division, the peripheral sewers have settled at many places and are also heavily silted up causing over flooding in residential areas. To overcome these problems, it has been proposed to rehabilitate the

peripheral system, so that entire sewage generated in city could be transferred to STPs for optimal utilization of installed capacity of plants and reduction of pollution in river Yamuna. Therefore, DJB intends to take up the peripheral sewers for rehabilitation which are dysfunctional or partially functional due to multitude of problems such as settlement of sewers, sewage gas related structural failures, leaking joints, disjointed sewer pipes, heavy siltation, blockage due to indiscriminate throwing of rubbish and debris into manholes, illegal discharge of trade waste and collapsed sewers. The peripheral sewers recommended under Phase 1 for rehabilitation is comprising of diameter ranging from 450mm to 1400mm and about 162 km of total length.

However, as per CPCB Report about 761 MGD of waste water is being out-falling in river Yamuna through various drains between Wazirabad to Okhla, out of which 105 MGD is from Haryana and 50 MGD from U.P. (as submitted to Monitoring Committee).

8.3 Toilet Facilities

According to Census of India 2011 data 74.3% of the total households in NCR are having toilet facilities within the premises in comparison to all India level of 46.9% whereas in NCT Delhi the total households having toilet facilities within the premises is 89.5%. The percentage of Flush/Pour flush toilets connected to piped sewer system is 66.2 %, septic tank is 28.4%, other systems are 1% and pit toilet is 2 %. The percentage of night soil disposed into open drain is 2.3% and the percentage of service toilets is nil.

8.3.1 Issues and Challenges

There is a substantial gap between demand and availability of sewer network and sewage treatment facility. The issues related to the sewerage system in NCT Delhi are given below:

Less Coverage of Sewage Network Services

It is observed that 45 percent of total area of NCT Delhi has no sewer facility. The expansion of sewerage network that has lagged behind the growth of population resulting in overflow of sewage into drains causing river pollution or creation of cess pools in low lying areas of the towns/settlements.

Sewage Treatment less than Sewage Generation

Sewage treatment at present is 1,589 MLD against generation of 2,996 MLD which leads to a gap of 1,407 MLD. 34 number of treatment plants of capacity 2,475 are present in the city. Total Capacity for Sewage treatment was 2700.03 MLD, out of which only 1546.2 MLD was treated and 1153.70 MLD was left untreated in the STPs. Around 50 percent of total generated sewage is untreated and 43 percent of the treatment capacity has not been utilized. The untreated sewage is let in the drain and ultimately into the river Yamuna. Thus the gap even after the treatment will continue to remain 521 MLD making it necessary to construct more STPs.

Recycle and Reuse

In NCT Delhi, out of treated sewage available for reuse in Delhi, 645 MLD is reported to be used in Horticulture/ Irrigation/Power plant, against the present sewage generation of 2,996 MLD which works out to be 21 percent. However, it is observed that, the trend for recycling/Reuse of treated sewage is insufficient at present as the reuse systems/ network are not yet developed because planning for prospective users is not done at the time of conceiving STPs.

Inefficient Operation and Maintenance

- The lack of proper maintenance of the sewerage system has resulted in blocking and overflowing of sewers, open manholes and back-flows. The inadvertent act of throwing street sweepings and garbage into manholes/open drains results in blocking of sewers and creates cess pools resulting in environmental degradation, foul smell and diseases. Age old system of manual cleaning of sewers is still followed instead of use of modern machines like jetting cum suction machines, which are quick and do not damage the inner surface of the sewers.

- The upper reaches of sewerage system, where flow mostly remains below the self-cleansing velocity, are silted up as they have no system of regular flushing. There is need for comprehensive maintenance plan for de-silting of the entire sewer system of the city.

- The operation and maintenance of STPs has been mostly neglected. Many times, the sewage is by passed. At many places the condition of mechanical and electrical equipment is in bad shape and pumps are old and consume more power. Renewals are not done timely. Preventive maintenance is generally not available.

- Cost recovery and collection efficiencies are poor. Revenue generation through recovery of resources viz. recycled water, manure and waste to energy; should be resorted for recovery of the expenditure in operation & maintenance. Proper and adequate maintenance is not possible in case of less cost recovery. Lack of proper O&M affects the environmental degradation.

8.3.2 Strategies, Policies and Proposals

- The entire area of NCT Delhi should be covered with sewer facilities. Strengthening and up-gradation of old sewer lines should be carried out in view of re-densification and redevelopment.

- Additional capacity of sewage treatment should be created by way of establishment of STPs with latest technology.

- The treatment capacity of the treatment should be fully utilized and all necessary remedial action for bringing the required sewage to the treatment plants should be undertaken by the DJB on priority basis.

- Untreated sewage should not be allowed to flow into the drains and river or other water bodies.

- All projects related to group housing, institutions, industries, townships etc should be mandated to make provisions for primary treatment of sewage within the project area.

- A detailed Sewerage Zonal plan should be prepared with the purpose of zero disposal of sewage in the river Yamuna.

- The Plan should also evolve policy and mechanism to use the treated sewage water and other waste for commercial utilization in different activities.

- All new projects related to group housing, institutions, industries, commercial complex etc. should be mandated to make provisions for primary treatment of sewage within projected area meeting standards prescribed by CPCB.

- Awareness among residents of the city must be created through campaigning in association with RWAs, NGOs and other active groups for improving sanitary conditions and overall circumstances in NCT Delhi.

- As per the notification dated 28.07.2010 issued by Ministry of Urban Development and Poverty Alleviation (Delhi Division) GOI on Building bylaws 1983, every premises having water consumption more than 12.50 KL, to install recycling plant and use the treated effluent for non-portable use.

- It is advisable that a policy of zero discharge should be adopted in all new developments, wherein all the treated water (treated< the effluent standards of 10 BOD/10 SS) is used within the proposed development for various non-potable requirements and whatever marginal discharge remains can be released in storm water drain to recharge the ground water.

8.4 Storm Water Drainage

Drainage is an important element of physical infrastructure and constitutes removal and disposal of surplus rain/irrigation water from the land. It has three aspects namely flood protection, prevention of water logging and disposal of storm water.

Storm Water Drainage of Delhi is a combination of a number of natural and man-made drainage systems – five drainage basins, large natural drains, storm water drains along the roads and combined sewer cum storm water drains (sometimes as a bypass arrangement for blocked sewer lines) which creates a complex situation. Most of the water collected through different drainage systems get discharged into the river Yamuna.

Topography, rainfall intensity, soil characteristics, irrigation methods, crops and vegetative cover are important factors for deciding the type and design of drainage system. Hon'ble National Green Tribunal, under OA No.6 of 2012 and OA No.300 of 2013 in the matter of Manoj Misra Vs UOI & others, vide its Judgment dated 13/01/2015 directed that, there shall be no construction and/or coverage of any of the drains in Delhi by any Authority or Municipal Corporation.

The storm water takes natural course on land, depressions, ponds etc. To ensure recharge and prevent contamination of storm water carrying or water retaining bodies, separate systems of sewage and storm water are recommended throughout the city.

8.4.1 Existing Drainage System

The topography of Delhi created a drainage system that carried rain and storm water from higher elevations of the West to the Yamuna, providing a natural drainage. While the eastern, low-lying side was originally a part of the flood plain of the river and considered un-inhabitable due to frequent floods. The Eastern wing which is also called Trans-Yamuna area houses about 20 percent of the total population of Delhi.

8.4.2 Natural Drainage System

The NCT of Delhi has three major drainage basins, namely, Najafgarh, Barapullah and Trans-Yamuna basins. There are also a couple of very small drainage basins (Aruna Nagar and Old Chanderwal) that have outfall directly into Yamuna. The Najafgarh basin is the largest of all the basins and accounts for close to two third of the area of NCT of Delhi. As per the Delhi Drainage Master Plan-1976 there are a total 201 Natural drains in three major basins of Delhi. As per 1976, Drainage Master Plan NCT of Delhi was divided in five Drainage basins as follows:

1) Alipur Block
2) Khanjhwala Block
3) Najafgarh Block
4) Trans Yamuna Block
5) Mehrauli Block

Now IIT has divided NCT of Delhi in 3 Major Drainage basins as shown in figure 8.5 as given in table 8.9 below. There are also a couple of very small drainage basins (Aruna Nagar and Old Chandrawal) that have outfall directly into River Yamuna. Drainage basin-wise distribution of drains is given in Table 8.10 (Source: Drainage Master Plan for NCT of Delhi

As per the drainage map prepared by the Irrigation and Flood Control Department, GNCTD, NCT of Delhi has been demarcated into six drainage zones namely (i) North Zone, (ii) West Zone, (iii) Central North West and South East Zone, (iv) Central South and South East Zone, (v) East Zone, and (vi) South Zone. Irrigation and Flood Control Department is having 57 drains with total drains length of 381.68 KM. 16 Nos. drains with 202.69 KM length are having discharge carrying capacity of 1000 cusec and above, while 41 nos. of drains with 178.99 Km length have discharge capacity of less than 1000 cusec. Alipur catchment located in the north has the longest length of drain measuring ~~127.7~~ km and has a discharge of 207.26 ~~cumecs~~. The catchment at Mehrauli in the South has the shortest length of main dran which measures 8.09 km. The catchment at Kanjhawala in the west has the lowest number of discharges which is 52 cumecs measuring a length of 120 km. Table 8.11 presents the catchment area of the natural drains in the city

Table 8.11: Drainage Channels and Catchments for Delhi

Sr. No	Catchments	Location	Length of main Drains (Km)	Drainage Channels	Discharge (cumecs)
1	Alipur	North	–127.7	Supplementary Drains Bawana Escape- Drain No. 6 -new drain	–141.57 65.69
2	Kanjhawala	West	~~107.09~~	Mungeshpur	52
3	Najafgarh	Central-North, West, South-West	~~108.14~~	Najafgarh Palam Bhupania-Chudania (from Haryana)	283 86 40
4	Trans-Yamuna	East	~~50.65~~	Shahdara outfall - Ghazipur Trunk drain no. 1	158 86
5	Mehrauli	South	–8.09		

Source: Drainage Master Plan for NCT of Delhi

Figure 8.5 shows the major basins of NCT Delhi namely Trans-Yamuna, Barapullah and Najafgarh basins.

Table 8.10: Basin wise Natural Drains in Delhi as per 1976 Drainage Master Plan

S. No	Basin	Number of Drains
1	Trans – Yamuna	34
2	Barapullah	44
3	Najafgarh	123

S. No	Basin	Number of Drains
Total Number of Drains		**201**

Source: Drainage Master Plan for NCT of Delhi

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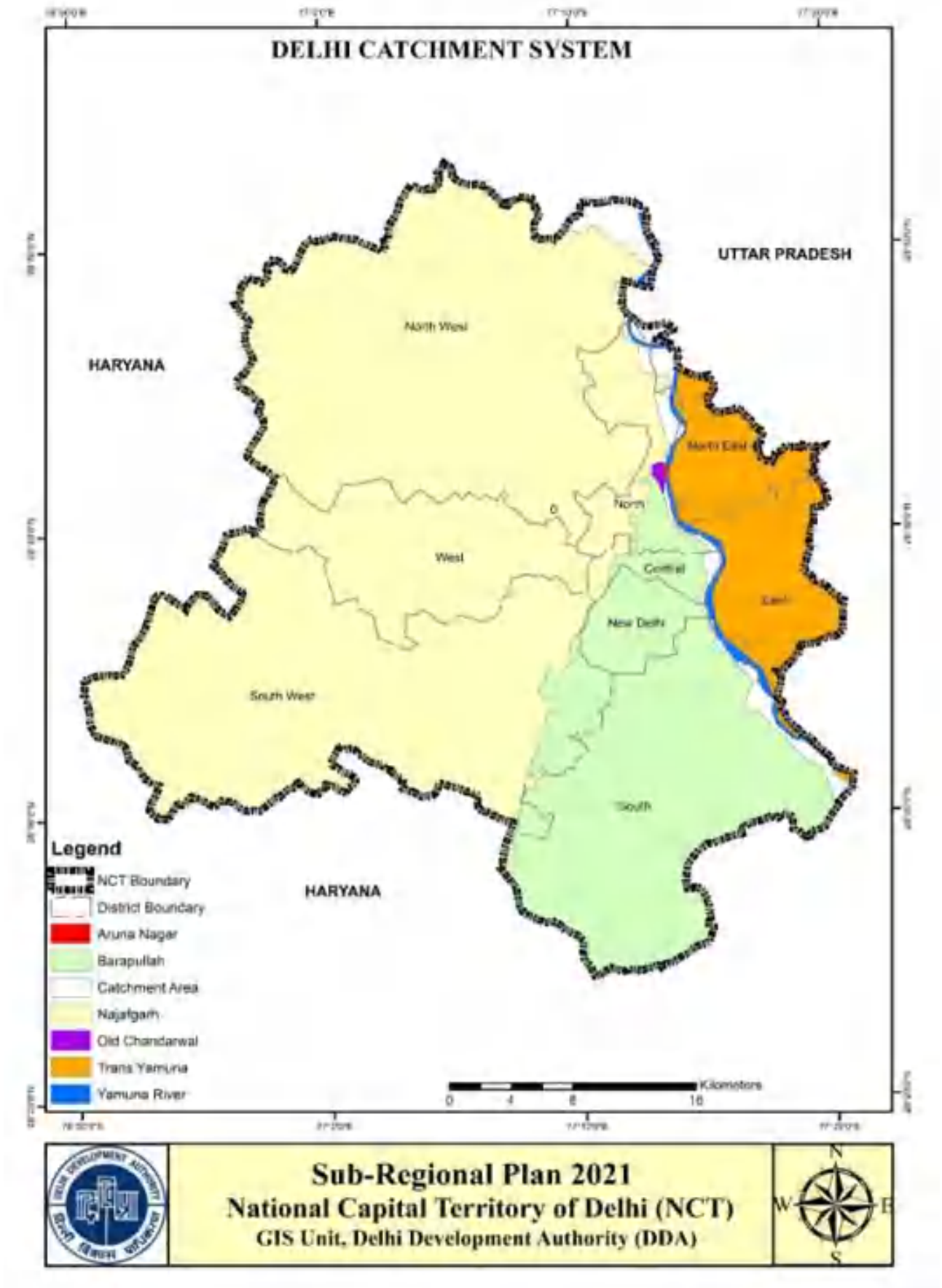
4	Trans-Yamuna	East	50.65	Shahdara outfall - Ghazipur Trunk drain no. 1	158 86
5	Mehrauli	South	8.09		

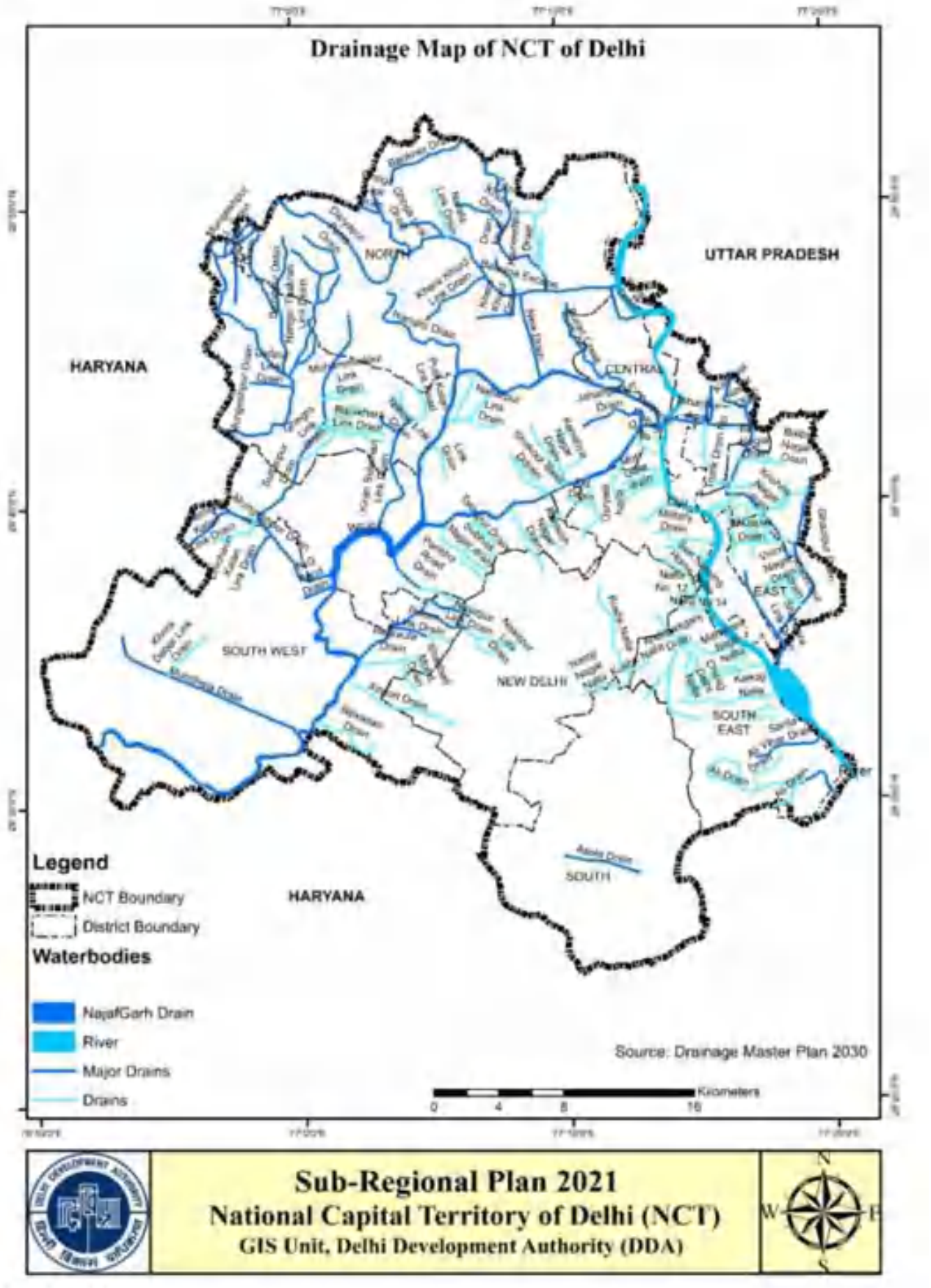
Source: Drainage Master Plan for NCT of Delhi

Figure 8.5: Major Basins of NCT of Delhi



Source: Drainage Master Plan for NCT of Delhi

Figure 8.6: Drainage Map of NCT Delhi



Source: Irrigation and Flood control Department, Govt of NCT of Delhi

The above map shows the drainage Map as defined by Irrigation and Flood Control Department, NCT of Delhi.

1. Najafgarh drain
2. Magazine Road drain
3. Sweeper Colony drain
4. Khyber pass drain
5. Metcalfe drain
6. Kudsia Bagh drain
7. Moat drain
8. Trans Yamuna MCD drain
9. Mori Gate drain
10. Civil Mill Drain
11. Power House drain
12. Sen Nursing Home drain
13. Drain No. 14
14. Barapullah Drain
15. Maharani Bagh drain
16. Kalkaji drain
17. Okhla drain
18. Tughlakabad drain
19. Shahdara drain
20. Sarita Vihar Drain
21. LPG Bottling Plant Drain
22. Tehkhand Drain

There are total of 201 natural drains in the three major basins of Delhi. The final disposal of majority of the storm water generated from Delhi is into river Yamuna through 22 outfall points distributed across the stretch along its course through Delhi.

8.4.3 Man-Made Drainage System

The total length of drains is 1,700 kms spread over 12 municipal zones. There are 1,296 drains with a total length of 1,694.1 km out of which the west zone has the longest length which measures 410 km and Sadar- Paharganj zone with the shortest length measuring 4.5 km. Shahdara North zone has the highest number of drains which is 197 and Sadar-Paharganj and city zone has the lowest number of drains which are 10 each. The details of the number of man-made drains and their lengths are given in Table 8.12.

Table 8.12: Existing Drains in Delhi under MCD

Sr. No	Zone	Number of Drains	Total Length of Drains (km)
1	Central	41	47
2	South	127	102
3	Sadar-Paharganj	10	5
4	Karolbagh	47	23
5	City zone	10	9
6	Civil Lines	77	339
7	Shahdara South	174	134
8	Shahdara North	197	135
9	Narela	84	83
10	Rohini	142	180
11	West	185	410
12	Najafgarh	202	228
	Total	1296	1694

Source: Nav Bharat Times, New Delhi, 31st July 2006 (CDP Delhi)

8.4.4 Departmental Jurisdiction

Table 8.13: Storm Runoff System of NCT Delhi and departmental Jurisdiction

Sr. No	Agency name	Length (km)
1	Irrigation and Flood Control	**381.68**
2	Public Works Department	**2064.08**
3	South Delhi Municipal Corporation	**258.78**
4	North Delhi Municipal Corporation	**122.46**
5	East Delhi Municipal Corporation	**140.63**
6	New Delhi Municipal Council	**335.29**
7	Delhi Development Authority	**251.30**
8	Delhi State Industrial and Infrastructure Development Corporation	**98.12**
9	Delhi Cantonment	**39.68**
10	National Thermal Power Corporation Limited	**3.11**
11	UP Irrigation (Old Agra Canal)	**0.31**

Source: Drainage Master Plan for NCT of Delhi

Table 8.13 lists all the agencies that manage the storm runoff emanating from the entire urban expanse of Delhi carried by a total of 426.55 km of natural drainage lines and a cumulative length of 3,311.54 km. The Najafgarh basin is the largest of all the basins and accounts for close to two third of the area of NCT of Delhi.

8.4.5 Existing Policies and Proposals

Irrigation & Flood Control Department is working on a project to rejuvenate 10 water bodies by diverting the adjacent drain and treating the waste water through a constructed wetland system in phased manner subject to availability of funds and approval.

The Irrigation and Flood Control Department and DJB are working on a project to rejuvenate 201 water bodies through treated wastewater from the STPs. DJB has undertaken pilot projects in Dwarka and Rohini to create artificial water bodies using treated wastewater (through constructed wetlands).

The Delhi Government mandates provision of installation of on-site decentralized wastewater treatment system by industries, hotels, construction Projects. Five/four-star hotels and hospitals having more than 50 beds have also been directed to install decentralized STPs. Drainage Master Plan for NCT of Delhi has been prepared by IIT Delhi. The final report of Delhi Master Plan submitted by IIT Delhi is under consideration for recommendation by Technical Expert Committee headed by member (RM), CWC for its approval by Government.

DJB is executing the project of laying of interceptor sewer along three major drains Najafgarh, Supplementary and Shahdara out of which 93 MGD has already been trapped. The project is expected to be completed in 2019. There is a policy proposed to connect every household in Delhi

to the sewer system, where DJB will bear the cost of entire network and connections. The policy is still is a draft stage and pending approval.

8.4.6 Policies and Proposals

- Encroachments and diversion of water bodies (like rivers, lakes, tanks, ponds, etc.) and drainage channels (irrigated area as well as urban area drainage) must not be allowed, and wherever it has taken place, it should be restored to the extent feasible and maintained properly.

- Storm drain should not ever outfall into sewer system in any condition since they are never designed for such situation and shall therefore result in surcharge of sewerage network and may flood some of the areas with sewage. All such cases should be identified and immediately addressed.

- Practice of opening sewer man-holes to discharge local storm water should be banned. Adequate system to discharge storm water should be developed and public awareness should be created towards ill-effects of diverting storm water into sewer lines.

- All the household sewer should be trapped to sewerage system and no one be allowed to connect storm water drain.

- Households draining storm water into the sewer lines should be penalized. Locality level storm drains should be revived or as an alternative groundwater recharging mechanism should be developed by individual household – at own cost. Awareness campaign should be carried out to sensitize public in this regard.

- The storm water is diverted from drains to nearby parks where depression storages have been created to reduce flooding.

- There is a natural temptation to dispose off wastes into available storm water collection system with impunity. Use of garbage disposal bags should be made mandatory for businesses along road carriageways.

- Storm drains should be treated as key public assets and no encroachment should be allowed. Any encroachment of the drain should be immediately removed and reported back. Department managing the storm drain should be made responsible for keeping drain encroachment-free. Special drives to remove encroachments from the storm drains should be taken up. Also, in the locations such compromise of the section has happened, adequate measures should be taken immediately to restore the original carrying capacity.

- The capacity of present drainage system through densely populated area be analyzed and if there found of in sufficient capacity the remodeling/planning of new drainage system should be carried out.

- Design of new storm water drains should not be done in isolation. Overall impact of any new drain on the existing storm water drainage system should be studied.

- Policy guidelines should be issued to all the concerned department providing services such as water supply, sewerages, power supply, gas supply, oil pipe lines, connectivity/ internet/

entertainment networks etc., so as to ensure no hindrance for free flow of drain/ de-silting operations.

- To improve flood management low cost sensors which can also serve the purpose of issuing appropriate warning should be used

- Regular de-silting should be undertaken to avoid reduction in storage capacity of the water bodies. Effective and timely de-silting would help keep the storm water drains unclogged. Effort should be made to put all the storm water drains under single agency.

- Many of the water bodies have become redundant over the years and are not even properly connected to their catchments. Once rejuvenated, these water bodies can play a pivotal role in reducing the flooding as they act as detention and recharge basins. They should be continuously monitored and maintained in order to reduce runoff into storm drains.

- Dumping of waste into water bodies should be prohibited to maintain ambient water quality. No encroachment or unauthorised construction in wetlands should be permitted.

- The civic agency (DMC's) should ensure 100% home collection of MSW, so as to ensure that it is not dumped in or around the drain by the nearby residents. The DMC's should also be making responsible to remove MSW from the banks of storm water drains.

8.5 Solid Waste Management

Solid Waste Management (SWM) is a major environmental concern and is increasingly becoming an important challenge for urban and sub-urban areas. Over the years the amount of municipal solid waste generated in cities has been increasing due to rapid growth of urban population, improvements in economic conditions, change in lifestyles and consumption pattern. The amount of per capita generation of solid waste in India is estimated to have increased at a rate of one percent - 1.33 percent annually. Municipal solid waste is heterogeneous in nature and consists of a number of materials generated by various activities as indicated in Box 8.1

Box 8.1

On the basis of source and degeneration characteristics solid waste can be classified as follows:

1. Municipal Solid Waste: As per the Municipal Solid Waste (Management &Handling) Rules 2000 garbage is defined as MSW which includes commercial and residential waste generated in a municipal or notified areas in either solid or semi-solid form.

2. E- Waste: As per the CPCB Guidelines (2008), "e-waste is defined as waste generated from used electronic devices and household appliances which are not fit for their originally intended use and are destined for recovery, recycling and disposal."

3. Hazardous Waste: Hazardous waste has been defined in Rule 3 of the Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules, 2008 came into force with effect from Sep. 24, 2008, as any waste, which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances.

4. Plastic Waste: "Plastics are non-biodegradable, synthetic polymers derived primarily from petro-fossil feedstock and made-up of long chain hydrocarbons with additives and can be moulded into finished products CPCB, 2012). In India, approximately eight Million tonnes plastic products are consumed every year (2008).

5. Construction and Demolition Waste: Construction and Demolition waste is generated whenever any construction/demolition activity takes place. It consists mostly of inert and non-biodegradable material such as concrete, plaster, metal, wood, plastics etc.

6. Biomedical Waste: Bio-Medical Waste is generated during the diagnosis, treatment or immunisation of human beings or animals, or in research activities pertaining thereto, or in the production or testing of biological and including categories mentioned in Schedule-I of the Bio Medical Waste (Management and Handling) Rules 1998.

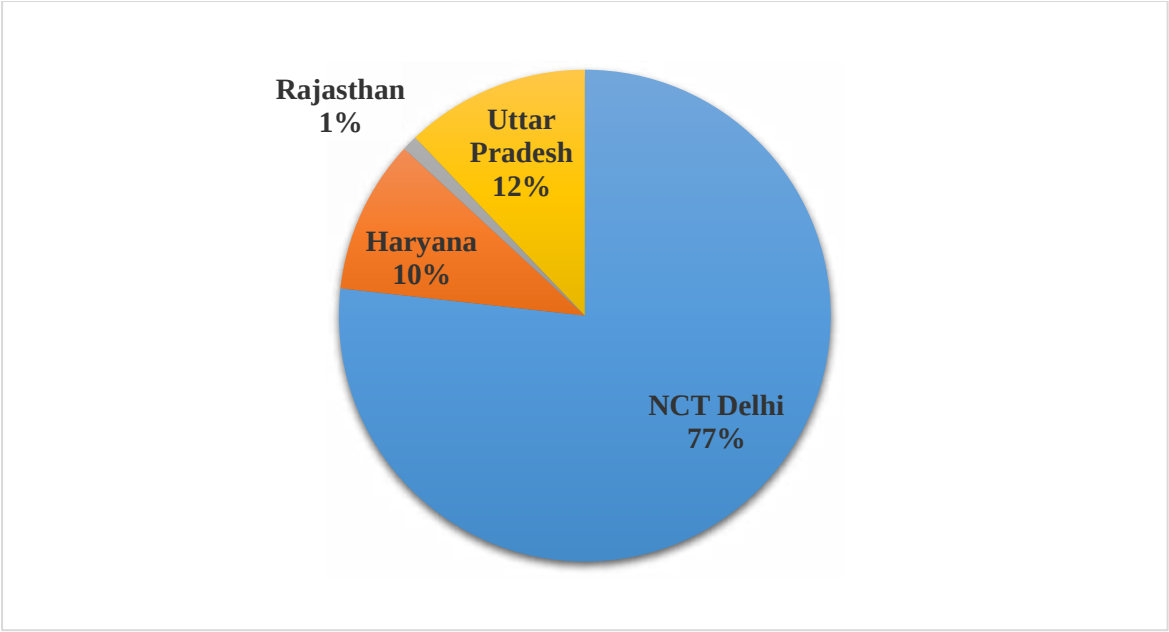
Sources: Regional Plan 2021

8.5.1 Existing Situation

As per the NEERI study, the solid waste generated in Indian cities has increased from six million tonnes in 1947 to 48 million tonnes in 1997 and is expected to increase to 130 million tonnes per annum by 2021. It clearly indicates that in 50 years from 1947 to 1997, generation of solid waste increased by eight times whereas urban population increased by three times.

According to NCRPB estimates based on population as per Census 2011, 13,199 MT solid waste is generated per day in NCR in the year 2011. Highest amount of solid waste was generated in NCT Delhi i.e. 10,051 MT/day (76 percent) followed by UP sub-region 1,638 MT/day (12 percent), Haryana sub-region 1,373 MT/day (10 percent) and Rajasthan sub-region 137 MT/day (1.03 percent).

Figure 8.7: Solid Waste Generation in NCR (MT/Day)



Source: Estimate by NCRPB Planning team based on population as –per Census, 2011

The methodology for estimating the MSW is based on the per capita generation of MSW in accordance with the norms prescribed by CPHEEO. As per MSW Annual Review Report of DPCC, the total Municipal Solid Waste generated is 8930 tonnes/day. The number of municipal authorities responsible for management of municipal solid wastes in the state is given below:

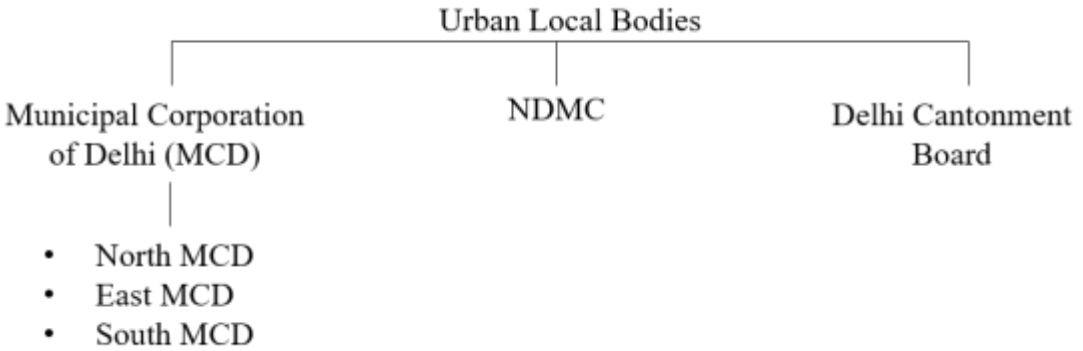
Table 8.14: Waste Generated in NCT Delhi

Sr. No	Municipal Authority	Waste Generated
1	North Delhi Municipal Corporation	3000 MTD
2	South Delhi Municipal Corporation	2500 MTD
3	East Delhi Municipal Corporation	2500 MTD
4	New Delhi Municipal Council	300 MTD
5	Delhi Cantonment Board	90 MTD

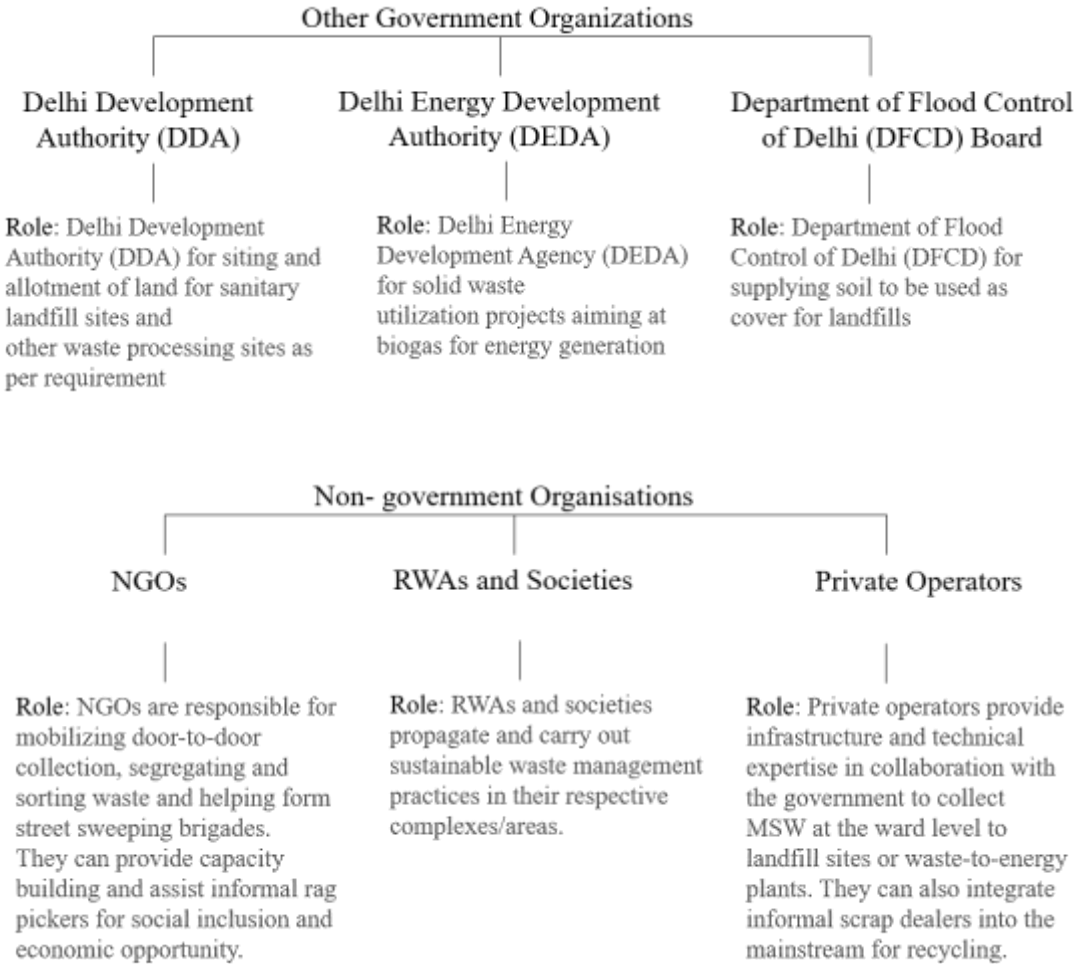
Source: Annual Review Report of DPCC, 2014
Note: May refer to the observations of SDMC in the Annexure J for the amount of solid waste collected daily in all four zones of SDMC

8.5.2 Concerned Local Bodies Responsible for SWM

Various agencies/organizations that are responsible for the management of Municipal Solid Waste in Delhi are as below:



Role: Municipal Corporation of Delhi (MCD), New Delhi Municipal Corporation (NDMC) and Delhi Cantonment Board (DCB) are three local municipal bodies responsible for MSW management in their respective jurisdiction in Delhi.



8.5.3 Existing Processing/Disposal Facilities

At present there are four Composting Plants, one waste to energy plant which is operational and two more are under installation, one C & D waste plant and three operational Sanitary Landfill sites. The details of these facilities are given below.

Compost Plants

NCT Delhi has four Compost Plant with total capacity of 975 TPD located at Okhla, Bhalaswa and Tikrikhurd, Narela. Out of these, the compost pant at Bhalaswa has the highest capacity of 500 TPD spread over an area of 4.9 Ha and operating at 50 percent of its capacity. The compost plants located at Okhla are the oldest out of which the plant managed by MCD (150 TPD), setup in 1981 is presently closed and proposed to be upgraded to 200 TPD. The other plant managed by NDMC at Okhla has a capacity of 200 TPD is operating below its capacity. Similarly, the plant at Tikrikhurd located at Narela has the lowest capacity of 125 TPD. All these plants are using Aerobic Windrow Composting technology. Authorization has been issued to two compost plants i.e. M/s IL & FS Compost Plant at Okhla and M/s Delhi MSW Solutions Ltd, Narela-Bawana. The plant wise details are given in Table 8.15.

Table 8.15: Details of Compost Plants in Delhi

Sr. No	Facility	Capacity	Area (ha)	Year Started	Technology	Remark
1	Okhla (MCD) presently closed	150 TPD	3.2	1981	Aerobic Windrow Composting	Proposed to be upgraded to 200 TPD
2	Okhla NDMC	200 TPD	3.4	1985	Do	Operated below capacity
3	Bhalaswa (private sector – NWMIL)	500 TPD	4.9	1999	Do	Operating at 50 percent capacity
4	TikriKhurd, Narela (APMC and Private)	125 TPD	2.6	2001	Do	Dedicated at 50 percent waste stream

Source: Annual Review Report of DPCC, 2014

SDMC has started decentralized processing of waste facilities by installing Bio-methanation plants having capacity of 5 TPD and 1 TPD of solid waste in each zone. SDMC also has proposed the setting up of 2 nos. of Biogas plants (200 TPD capacity each of cattle dung) at Nangli Dairy Colony, Najafgarh and Goyla Dairy Colony, Najafgarh. These plants are likely to be operational by March 2021. SDMC also started processing of Solid Waste by 109 nos. Commercial Bulk Generators.

8.5.4 Waste to Energy Plants

The Municipal Corporation/ Municipal Councils and other agencies responsible for managing the solid waste have made some efforts to recycle the waste and also to generate power from waste. Consent to establish has been issued to three wastes to Energy plants at Okhla, Ghazipur and Bawana respectively. These three wastes to Energy plants will solve the problem of disposal of Biodegradable Municipal Solid Waste to some extent. Timarpur-Okhla Waste to Energy Plant is operational and other two are under installation. Out of these three plants, the plant at Narela-Bawana managed by Delhi MSW Solutions Ltd is proposed to have the maximum capacity of 3,000 TPD with electricity generation capacity of 24 MW. The plant at Okhla and Ghazipur is having a capacity of 1950 TPD and 1300 TPD respectively with electricity generation capacity of 16 MW and 12 MW respectively. There is proposal to increase the capacities of existing Okhla Waste to Energy plant by 500 TPD and Ghazipur Waste to Energy plant by 1200 TPD. Plant wise details are given in Table 8.16.

Table 8.16: Details of Waste to Energy Plants

Sr. No	Name	Capacity of Waste Processing (TPD)	Area (ha)	Year Started	Technology	Remark
1	Timarpur- Okhla Waste Processing Company Okhla Compost site	1950	6	2007	Refuse-derived fuel technology	16 MW
2	East Delhi Waste Processing Company Pvt Ltd Ghazipur (under installation)	1300	-	Under installation	Do	12 MW

Sr. No	Name	Capacity of Waste Processing (TPD)	Area (ha)	Year Started	Technology	Remark
3	Delhi MSW solutions Ltd Narela-Bawana Road (under installation)	3000	-	Under installation	Do	24 MW

Source: Annual Review Report of DPCC, 2014

DDA had handed over a piece of land approx. 47.347 acres at Tehkhand near SLF Okhla to SDMC for Solid Waste Management Facilities on 1.11.2017. SDMC has already awarded the work of setting up of Waste to Energy plant for processing of 2000 MTD of Solid Waste on 15 acres land to the concessionaire. The work of development of site for setting up of plant has already been started at site. It is expected that New Waste to Energy Plant will be made operational by Dec 2021.

8.5.5 C & D Waste Plants

Delhi has a capacity to process 2,650 MT of debris per day through its three plants located at Burari (2,000 TPD), Shastri Park (500 TPD), and Rani Khera (150 MT).

Processed C & D material is used for tiles/pavement blocks and also ready-mix concrete, aggregates etc. A fourth C&D waste plant has been proposed at Bakkarwala which will have the capacity to process 500 MT of debris coming in from construction sites across Delhi every day.

SDMC has notified 65 locations in various wards for collection of C&D waste at ward level. DDA handed over a piece of land measuring approx. 4.309 acres to SDMC for setting up of Construction & Demolition (C&D) waste processing plant at Maidangarhi and Satbari area on 31.5.2019. Process for change of land use is with DDA.

8.5.6 Sanitary Landfill Sites

NCT Delhi has three Sanitary Landfill Sites located at Bhalaswa, Ghaxipur and Okhla out of which the landfill site at Ghazipur is the oldest, started in 1984 with a capacity of 2000 TPD. The other two landfill sites at Bhalaswa and Okhla were started in the year 1993 and 1994 respectively with a capacity of 2200 TPD and 1200 TPD respectively. These Landfill Sites were proposed to be filled to its full capacity for the period of 20-25 years. However, it is observed that these sites have been utilized for more than 40 years. The total capacity of the landfill site also has been over spilled.

Table 8.17: Details of Sanitary Landfill Sites

Sr. No	Name of Site	Location	Area (ha)	Year Started	Waste Received (TPD)	Zones Covered	End of Landfill Life	Height (Permissible ht 20m)
1	Bhalaswa	North Delhi	21.06	1993	2200	Civil lines, Karol Bagh, Rohini, Narela,	2005	35 – 42 m (variation)

Sr. No	Name of Site	Location	Area (ha)	Year Started	Waste Received (TPD)	Zones Covered	End of Landfill Life	Height (Permissible ht 20m)
						Najafgarh		
2	Ghazipur	East Delhi	29.16	1984	2000	Shahdara (South and North), city Sadar, Paharganj and NDMC	2008	25.5 – 35 m (variation)
3	Okhla	South Delhi	16.20	1994	1200	Central, Najafgarg, South and Cantonment Board	2005	32.5 – 40 m (variation)

Source: Department of Urban Development, Govt. of Delhi, 2007

The Table 8.17 and Figure 8.8, gives the details and shows the location of Sanitary landfill Sites and other waste processing plants present in NCT Delhi.

DDA had handed over a piece of land approx. 47.347 acres at Tehkhand near SLF Okhla to SDMC for Solid Waste Management Facilities on 1.11.2017. SDMC has also initiated the work of Engineered Sanitary landfill site on 32.347-acre land.

Figure 8.8: Location of Sanitary Landfill and other Waste Processing Plants

Source: GSDL

8.5.7 Projected Generation of Solid Waste

It is estimated that total solid waste generation in NCR would be 19,190 MT/day by the year 2021 and handling this quantity of waste need special efforts and funds. Sub-region wise details of solid waste generations are given in Table 8.18.

The methodology for estimating the MSW is based on the per capita generation of MSW in accordance with the norms prescribed by CPHEEO Manual on Municipal Solid Waste Management for cities with different population ranges.

Table 8.18: Projected Solid Waste Generation in NCR, 2021

S. No.	Sub-region	Solid Waste Generation	
		2021 (in MT/Day)	Percentage
1	NCT Delhi	15413	54.52
2	Haryana	4971.34	17.59
3	Rajasthan	1579.71	5.59
4	Uttar Pradesh	6305.82	22.31
	Total	28269.87	100

Source: Regional Plan 2021 of NCR & Addendum to Regional Plan 2021 for NCR

The garbage from unauthorized developments, slums, JJ settlements, etc. is not collected which further adds to the environmental degradation. The projected average garbage generation up to the year 2021 is @ 0.68 kg per capita per day and total quantum of solid waste is 15750 tons/day as given in Table 8.19.

Table 8.19: Projected Solid Waste Generation in NCT Delhi

S. No.	Local Body Area	Existing Capacity (Tons/day) 2014	Projected Generation for 2021
1	MCD	8000	15100
2	NDMC	300	550
3	Cantonment	90	100
	Total	8390	15750

Source: MPD 2021

8.5.8 Provision of Landfill Sites in Master Plans

It is imperative that SWM sites are identified and marked in the Master Plans which are statutory documents. An analysis of Master Plan of Delhi reveals that, presently solid waste is being dumped at three landfill sites, namely Bhalswa, Ghazipur and Okhla and three new sites have been identified at Jaitpur, Narela Bawana Road and Bhatti mines. DDA has yet to handover the land for the new sites to the Municipal Corporation. In view of the recent Delhi High Court order, the proposed site at Bhatti mines is not to be used for sanitary land filling. The High Court of Delhi has set up a committee of DDA and MCD officers to expedite identification of landfill site.

8.5.9 Issues and Challenges

Delhi produces the largest amount of solid waste in the country i.e. 10,500 tonnes per day of municipal solid waste. Total waste generated in 2011 was 8,390 MT per day which is estimated to be 15,750 MT per day in 2021. There is hardly any segregation done in most part of Delhi, the efficiency is less than 70 percent.

Approximately 55 percent of the total generated waste is processed through Waste to Energy and Waste to Compost plants and rest is dumped in three Sanitary Landfill Sites (SLFs). About 70–80 percent of the generated MSW is collected, while the rest remains unattended to on streets or in small open dumps. The Sanitary Landfill site at Narela-Bawana is the only scientific engineered sanitary landfill, while other sites are primarily disposal sites. Technology used in the system is inappropriate which leads to underutilization of existing resources and inefficiency in collection. Timarpur WTE plant which was put up in late 1990s in Delhi, had to close down because of the incorrect waste characterization and inappropriate technology selected for the project.

8.5.10 Policies and Proposals

In order to improve the overall situation of SWM in NCT Delhi it is recommended that:

- A detailed Solid Waste management plan needs to be prepared on the basis of guidelines provided by CPHEEO manual for managing the solid waste in the city. It would be appropriate that the local bodies plan for the entire city indicating landfill sites in a decentralization manner for reducing the transportation cost and also for reducing carbon footprints.

- Due to limited availability of land for the use as landfill site, the authorities should work towards achieving 'Zero Waste' in the city. The practices of four R's i.e. Reduce, Reuse, Recycle and Recover should be adopted as a policy at the regional, sub-regional and the local body levels. The prevalent system of recycling and recovery of plastic, glass, metal, paper, etc. from the domestic waste which is completely informal and unorganized, should be done in more organized, scientific, cost effective and environmental friendly manner. The segregation of biodegradable waste from non-biodegradable waste such as plastics, glass, metal, paper etc. at the source should be made compulsory.

- Land parcels for the treatment and disposal of waste should be identified and reserved at zonal levels. A decentralized method of waste treatment and disposal including vermiculture, composting etc to be adopted to prevent the formation of new landfill sites in the city which is not a sustainable option for solid waste management.

- There is a need to create public awareness among the citizens so as to make them understand the importance of segregation of waste, ill effects of littering to improve the sanitation in the surrounding areas. NGOs and Resident Welfare Associations should be actively involved in public awareness campaigns.

- There is a need to improve the efficiency and effectiveness of solid waste management at each stage including waste segregation at source, waste collection, waste transportation, treatment and disposal of waste which can be achieved by strengthening the institutional capacity building measures. NGOs and private sector to be involved through PPP mode for effective management of waste. At the same time, informal sector which consists of rag pickers, door to door collectors, etc to be included in the SWM planning process.

- It is also suggested to provide training on Solid Waste Management to integrate waste pickers and waste collectors through concessionaires from time to time and training centres to be set up.

- It is also suggested to designate land parcels for the disposal of inert like soil fraction etc generated after Bio-mining/Bio-remediation of legacy waste near the dumping sites.

- Adequate C & D waste collections locations to be identified at ward level which will cater to various zones and which will be further transferred to the C&D waste processing facilities.

- Mechanisms like charging of penalties to the waste generators who throw/ dispose off waste on the streets, open public spaces and drains. Defenders/offenders to be levied challans and amounts to be recovered from them as per bye-laws. Corrective measures to be explored and examined in Master Plans, ZDPs by Local authorities and state governments to undertake penal actions against the illegal dumping of waste.

- Facilities to be established for processing/disposal of plastic waste. It is suggested that the State Government should initiate some policies to reduce / restrict the use of plastic and allied materials in e-commerce sector or in the industries where it is possible.

The authorities should strive to achieve the Service Level Benchmark prescribed by MoUD, for the SWM indicator.

CHAPTER 9. SHELTER

9.1 Background

The population of National Capital Territory of Delhi experienced an annual growth rate of 2.1 percent in the last decade (2001-2011) and was recorded as 167 lakhs in 2011. With the emergence of the CNCR towns, the growth rate of Delhi has decreased over the last two decades, but in absolute numbers the population of the city continues to grow and so does the demand for employment and housing. Housing is a basic necessity and an important component of human settlement planning. Housing the migrants has also remained a concern as Delhi attracts migrants from all parts of the country in addition to the floating population. Any gap in demand and supply of housing can lead to proliferation of slums and unauthorized development.

9.2 Existing housing scenario in NCT Delhi

9.2.1 Household and Household Size

As per Census of India “a 'household' is usually a group of persons who normally live together and take their meals from a common kitchen unless the exigencies of work prevent any of them from doing so. Persons in a household may be related or unrelated or a mix of both...” NCT Delhi had about 33.40 lakhs households against 164 lakhs persons. Thus, average household size works out to 4.9 persons which has marginally dropped from 5.4 in 2001. Table 9.1 gives the details of number of households and household size for the year 2001 and 2011.

Table 9.1: No. of Households and Household Size 2001,2011

S. No.	Year	2001	2011
1	Population	1,38,50,507	1,63,68,899
2	No. of Households	25,54,149	33,40,538
3	Household Size	5.4	4.9

Source: Census of India 2011, Delhi

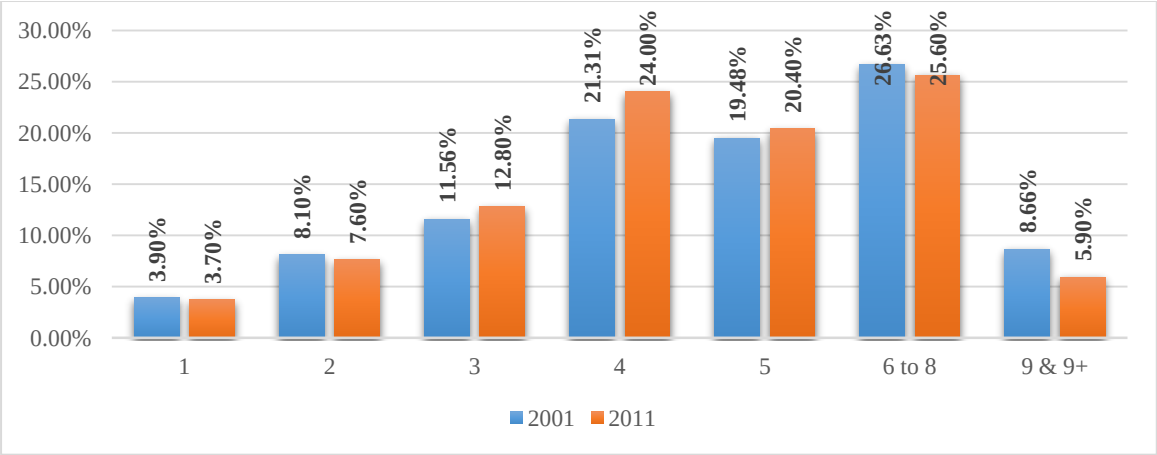
Distribution of households by size shows that the highest percentage of 25.60 percent households has a household size of six to 8; 24 percent households are of household size of four and 20.40 percent are in the size group of 5. Rest 24 percent are below household size below four. However, this trend has decreased from 2001 and sizes three and four households have increased, which suggests a trend of nuclear families and more housing demand. Table 9.2 and Figure 9.1 depicts the distribution of Households by size for the year 2001 and 2011.

Table 9.2: Distribution of Households by Size

S. No.	Family size	2001 (percent)	2011 (percent)
1	1	3.90	3.70
2	2	8.10	7.60
3	3	11.56	12.80
4	4	21.31	24.00
5	5	19.48	20.40
6	6 to 8	26.63	25.60
7	9 & 9+	8.66	5.90

Source: Census of India 2011, Delhi

Figure 9.1: Percentage Household size 2001,2011



Source: Census of India 2011, Delhi

9.2.2 Housing Stock

As per Census 2011, there are 33, 40,538 Households in NCT Delhi, while the number of Census houses is 46, 05,555 indicating that the number of census houses is more than the households but in reality only 31,76,329 (i.e. 77.61 percent) houses are used primarily for residential purpose and the other census houses are being used as shops, offices, schools, colleges, hotels, lodges, guest house, dispensary, workshop, place of worship, etc. Out of the total Census houses 88.90 percent are occupied and the rest 11.10 percent are vacant. As per the Census 2001, Delhi had 24.5 lakh Census houses under the category of residence and residence-cum-other uses, in which 25.5 lakh households are residing which reflected a net housing shortage of about one lakh houses / dwelling units. The households are generally accommodated in a variety of housing types including different categories of planned built housing, squatter settlements, unauthorized colonies, traditional areas and villages. Despite the challenges of population growth, migration and land availability, housing stock has increased in Delhi over a period of time. Table 9.3 below shows the housing stock and occupancy for 2011.

Table 9.3: Housing Stock and Occupancy, 2011

Sr. No	House-list Item	Units	Total	Rural	Urban
1	No. of Census Houses	Total No.	46,05,555	1,24,422	44,81,133
		Percentage	100	100	100
2	Occupied Census Houses	Total No.	40,92,864	1,01,866	39,90,998
		Percentage	88.90	81.90	89.10
3	No. of vacant Census Houses	Total No.	5,12,691	22,556	4,90,135
		Percentage	11.10	18.10	10.90
4	No. of Census Houses used primarily for residential purpose	Total No.	3176329	75,234	31,01,095
		Percentage	77.61	73.86	77.70

Source: Census of India 2011, Delhi

It is observed that the number of census houses was 33,79,956 in 2001 which has increased to 46,05,555 in 2011 by 36.26 percent. Number of Census houses in urban areas have increased by 42.93 percent whereas in rural areas they have decreased by 49.15 percent. The number of vacant census houses have marginally decreased from 11.2 percent in 2001 to 11.1 percent in 2011. Occupied census houses have marginally increased from 88.8 percent in 2001 to 88.9 percent in

2011. Residential and residential cum other uses have increased from 72.6 percent in 2001 to 81.0 percent in 2011. Likewise, Non-Residential census houses have increased from 16.3 percent in 2001 to 18.1 percent in 2011. Table 9.4 shows the trend in housing stock and occupancy for the year 2001 and 2011.

Table 9.4: Trend in Housing Stock and Occupancy, 2001-2011

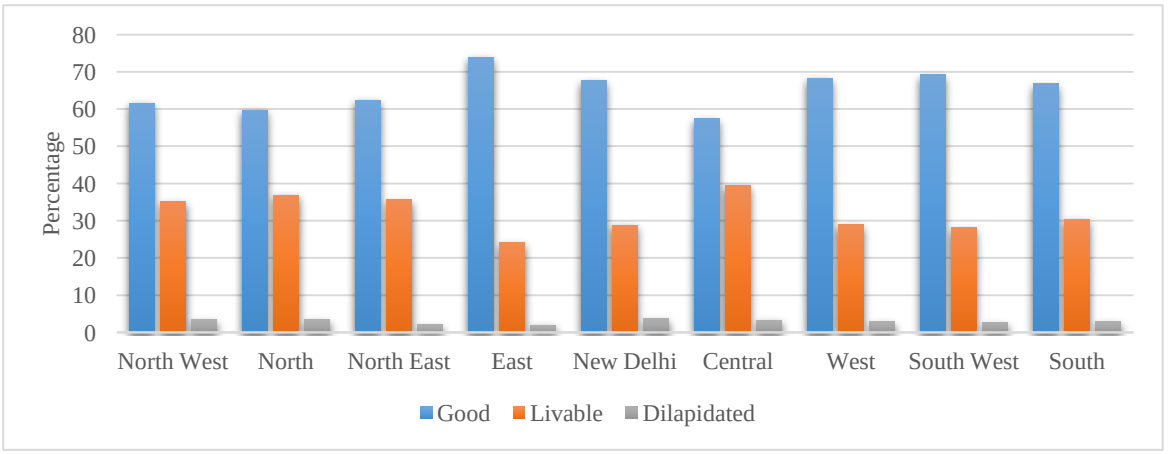
Sr. No	House- list Item	Year	Units	Total	Rural	Urban
1	No. of Census Houses	2001	Total No.	33,79,956	2,44,688	31,35,268
		2011	Total No.	46,05,555	1,24,422	44,81,133
			percent increase	36.26	-49.15	42.93
2	No. of vacant Census Houses	2001	percent	11.2	16.0	10.8
		2011	percent	11.1	18.1	10.9
3	Occupied Census Houses	2001	percent	88.8	84.0	89.2
		2011	percent	88.9	81.9	89.1
4	Residence & Residence cum other uses	2001	percent	72.6	67.1	73.0
		2011	percent	81.0	77.3	81.1
5	Non- Residential Census Houses	2001	percent	16.3	16.9	16.2
		2011	percent	18.1	22.0	18.0

Source: Primary Census Abstract, Census of India 2011

9.2.3 Condition of Houses:

Qualitative analysis of the housing stocks used for residential purposes in NCT Delhi reveals that while 65.2 percent of these houses are in good condition, 31.90 percent are in liveable condition and 2.89 percent are in dilapidated condition. Proportion of good houses is highest (73.96 percent) in East district whereas percentage of liveable houses is highest (39.35 percent) in Central District. This may be attributed to the fact that East Delhi in recent times has witnessed new residential developments, augmentation of transport network and public transport. The highest (3.69 percent) percentage of dilapidated houses is found in New Delhi District of NCT Delhi which has many old bungalows of colonial times with very low occupancy and developments of new residential areas is limited due to strict development controls. Table 9.5 and Figure 9.2 shows the district wise condition of houses for the year 2011.

Figure 9.2: District wise condition of Houses, 2011



Source: Census of India 2011

Table 9.5: District wise Number of households with condition of Census Houses -2011

Sl. No.	District	Total	Good	Percentage to total	Liveable	Percentage to total	Dilapidated	Percentage to total
1	North West	7,30,034	4,49,339	61.55	2,55,851	35.05	24,844	3.4
2	North	1,75,890	1,05,054	59.73	64,825	36.86	6,011	3.42
3	North East	3,95,060	2,46,444	62.38	1,40,641	35.6	7,975	2.02
4	East	3,54,385	2,62,095	73.96	85,473	24.12	6,817	1.92
5	New Delhi	30,385	20,520	67.53	8,744	28.78	1,121	3.69
6	Central	1,14,587	65,804	57.43	45,088	39.35	3,695	3.22
7	West	5,23,703	3,57,650	68.29	1,51,197	28.87	14,856	2.84
8	South West	4,62,772	3,20,360	69.23	1,30,269	28.15	12,143	2.62
9	South	5,53,722	3,69,599	66.75	1,68,128	30.36	15,995	2.89
	Total	33,40,538	21,96,865	65.2	10,50,216	31.9	93,457	2.89

Source: Census of India 2011

9.2.4 Housing Ownership

Ownership of houses is very high in Delhi with about 68 percent of households having their own houses, as per 2011 census. The percentage of self-owned houses is highest (75.3 percent) in North-East district followed by West District (73.1 percent) and North-West district, and the lowest of 13 percent is in New Delhi district.

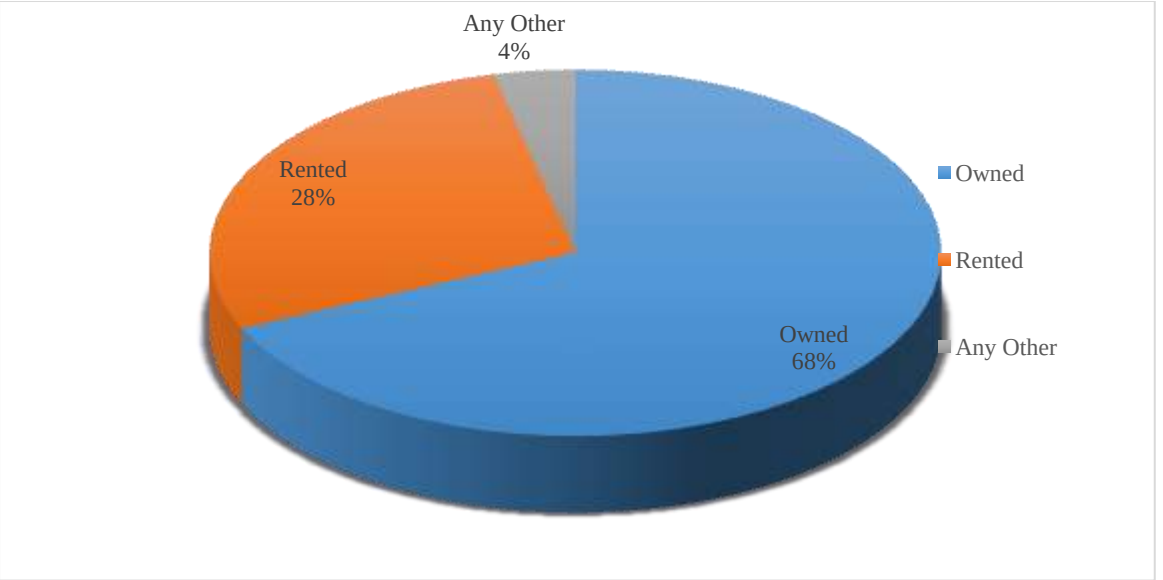
A district-wise distribution shows that the proportion of owned houses is much higher in all districts excepting New Delhi, where a majority of the government quarters and diplomatic enclaves are located. Migrants generally live in rented accommodations, at least initially before they stabilize in the city. The increase in ownership of houses refers to the growing stabilization process in the city. Table 9.5 and Figure 9.3 shows the percentage distribution of households by ownership status for the year 2011.

Table 9.5 : Percentage Distribution of Households by Ownership Status, 2011

S. No.	Districts	Ownership Status (in percentage)		
		Owned Households	Rented Households	Other Households
1	**NCT of Delhi**	**68.2**	**28.2**	**3.6**
2	North-West	72.5	24.1	3.4
3	North	69.2	26.4	4.3
4	North-East	75.3	23.3	1.4
5	East	68.3	28.6	3.1
6	New Delhi	13.0	56.6	30.4
7	Central	70.7	24.7	4.6
8	West	73.1	23.4	3.5
9	South-West	58.1	38.0	3.8
10	South	63.5	32.8	3.7

Source: Census of India 2011, Delhi

Figure 9.3: Ownership status of Census Houses



Source: Census of India 2011

9.2.5 Access to Basic Amenities

As per Census 2011 data, provisioning of basic services in Delhi improved significantly over the last decade. There is a near universal electrification and 99 percent of the households have access to sanitation facilities. The number of households having access to treated water is 81 per cent, as against 75 per cent 10 years ago. Less than one per cent of the households are without both toilet and electricity facilities. Table 9.6 depicts the availability of basic facilities (toilet and electricity) in NCT Delhi for 2001 and 2011.

Table 9.6: Availability of Basic Facilities in NCT Delhi (Toilet and Electricity) 2001, 2011

Sr. No	Items	2001 Census (in lakhs)	Percentage of Total Households	2011 Census (in lakhs)	Percentage of Total Households
1	Electricity	23.72	92.86	33.11	99.1
2	Toilet Facility	19.91	77.96	29.91	89.5
3	Electricity and Toilet Facility	18.74	73.77	29.8	89.2
4	No electricity and Toilet Facility	0.65	2.55	0.19	0.6

Source: Economic Survey of India

As per 2011, the percentage of households having access to electricity has increased from 92.86 percent in 2001 to 99.1 percent in 2011 and the percentage of households having access to toilet facility has increased from 77.96 percent in 2001 to 89.5 percent in 2011. Whereas, the percentage of Households with no electricity and no toilets has reduced from 2.55 percent in 2001 to 0.6 percent in 2011.

Table 9.7: Availability of Basic Facilities in NCT Delhi (Water Supply) 2001, 2011

Sr. No	Items	2001 Census (in lakhs)	Percentage of Total Households	2011 Census (in lakhs)	Percentage of Total Households

Sr. No	Items	2001 Census (in lakhs)	Percentage of Total Households	2011 Census (in lakhs)	Percentage of Total Households
1	Piped Water Supply	19.24	75.33	27.17	81.3
2	Hand Pumps/ Tube wells	5.6	21.91	4.58	13.7
3	Wells	0.01	0.04	0.03	0.1
4	Other Sources (River/canal/ tank)	0.69	2.72	1.63	4.8

Source: Economic Survey of India

Table 9.7 above shows the availability of water supply in NCT Delhi. As per Census 2011, the percentage of households having access to piped water supply, wells and other sources like river, canal and tank have increased from 75.33 percent, 0.04 percent and 2.72 percent respectively in 2001 to 81.3 percent, 0.1 percent and 4.8 percent respectively in 2011. Whereas, the percentage of households having access to hand pumps/tube wells has decreased from 21.91 percent in 2001 to 13.7 percent in 2011.

9.2.6 Housing demand and supply gap

As per the census 2011, the total number of houses required is 33,50,647 and the total number of Census houses available are 46,05,555 out of which 40,92,864 are occupied houses. The number of residential census houses is 33,13,904 whereas number of vacant census houses is 5,12,691 and number of dilapidated Residential Census houses is 93,457. The total number of dwelling units available is 37,33,138 and hence there is a housing surplus of 3,82,491 units.

With reference to the letter no. No: F.4(1/2019/Plg/DES/2732 dated 19.06.2020, Directorate of Economics and Statistics, Government of NCT of Delhi, informed that population of NCT Delhi for the year 2021 estimated to be 205,71,000 as per the report published by Ministry of Health & Family Welfare, Govt. of India, on November 2019. Thus, estimated number of houses will be 45,71,333 where the household size is assumed to be 4.5 by the year 2021. As per the census 2011, the available dwelling units in Delhi are 37,33,138. Therefore, an additional dwelling unit of 8,38,195 will be required by the year 2021. Table 9.8 shows the housing demand and supply gap for the year 2011.

Table 9.8: Housing Demand and Supply Gap, 2011

	No. of Houses Required (5 person/ H.H)	Total no. of Census Houses Available	Total Occupied Houses	No. of Residential Census Houses	No. of Vacant Census Houses	No. of Dilapidated Residential Census Houses	Total DU's Available (5+6 -7)	Housing Shortage/ Surplus (8 - 2)
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Urban	32,66,783	44,81,133	39,90,998	32,35,212	4,90,135	90,477	36,34,870	3,68,087
Rural	83,864	1,24,422	1,01,866	78,692	22,556	2,980	98,268	14,404
Total	33,50,647	46,05,555	40,92,864	33,13,904	5,12,691	93,457	37,33,138	3,82,491

Source: Regional Plan of NCR 2021

9.2.7 Slums

Economic vibrancy of large urban centres offering livelihood opportunities is the chief cause of in-migration to the urban areas and migration has played a significant role in accelerated urban growth. Rural masses migrate to the urban areas for livelihood regardless of the inadequacies in the physical infrastructure.

Planned urbanization has been marred to an extent by the excessive demand for basic amenities resulting in deterioration of physical living environment. Unchecked migration particularly aggravates housing problem resulting in increase in the land prices, which forces the urban poor to settle for informal solutions resulting in mushrooming of slums and squatter settlements. Such unauthorized squatter settlements, bereft of basic amenities, are not only overcrowded and unhygienic but also prone to various environmental hazards.

The first attempt to collect detailed data about slum areas of the country was made during Census-2001 particularly in cities/ towns having a population of 50,000 or more based on census 1991 data. All the habitation/ cluster of poorly built houses, which have been notified as slums by the State Government under any legal provision or recognized by them as such, have been accordingly considered as slum population for this purpose. Besides areas in cities/towns, which satisfy the usual criteria for declaring an area as slum have also been included. In India 42.6 Million people were living in the slums in 640 cities in 2001, out of which 4.8 percent are in NCT Delhi.

In 2011, 14.6 percent (4,87,718) of the total households in Delhi Municipal Corporation have been living in slums, which is comparatively lesser than other Million plus cities like Greater Mumbai, Kolkata and Chennai. Only Bangalore (M.C) has lesser slum population as compared to Delhi. Table 9.9 shows the proportion of Slum HHs in Million plus cities, 2011.

Table 9.9: Proportion of Slum HHs in Million plus cities (2011)

Sr No.	Million Plus Cities	Proportion of Slum HHs to total HHs (percent)
1	Greater Mumbai	40.8
2	Kolkata	29.3
3	Chennai	28.5
4	NCT Delhi	14.4
5	Bengaluru	07.8

Source: Census of India,2011

Delhi continues to face the problem of mushrooming growth of Jhuggi- Jhompri (JJ) Clusters on land pockets belonging to various land-owning agencies i.e., DDA, MCD, NDMC, Delhi Cantonment Board, Railways, Government Departments, CPWD, Land & Development Office, Departments of Delhi Government and other autonomous organizations.

9.2.8 Efforts towards Improvement of Slums

Delhi Urban Shelter Improvement Board (DUSIB) is providing shelter to shelter less people in Delhi through permanent night shelters and temporary shelter. The schemes for providing basic services in JJ clusters being implemented by DUSIB which includes construction of roads, brick pavements, road- side drains, street lights, Sishu Vatika, Basti Vikas Kendra/Community Centers, Community Toilets/Bath. As on date, 44 J.J. Resettlement Colonies have been provided with facilities of piped water supply, sewerage, street lights, parks, community centres etc.

9.2.9 Unplanned Dwelling Units and their Population

Table 9.10 shows the distribution of unplanned dwelling units and their population in NCT Delhi. It is observed that there are 755 JJ Clusters in the city accommodating 17 lakh population. There are 82 resettlement colonies, 1,797 unauthorized colonies which houses 40 lakh population, 2,423 notified slum areas housing 20 lakh population and 135 urban villages. As per Census of India 2011, NCT Delhi has a total population of 1,63,68,899 out of which 17,85,390 persons reside in Slums which is 10.9 percent of the total population of NCT Delhi.

Table 9.10: Distribution of Unplanned Dwelling Units and Population

Sr. No	Category	Number	Comments
1	Jhuggi Basti	JJ Basti 755 (Dwelling units required about 3 lakh) Population 17 lakh	Encroached on public land (State government: 30 percent Central Government 70 percent).
2	Resettlement Colonies	Colonies 82 (45+37) Plots 2,67,859	Incorporated within the expanded city with good shelter consolidation without adequate services
3	Unauthorised Colonies	Colonies 1,797 Population 40 lakh	Illegal colonies in violation of Master Plans, no clear land title
4	Notified Slum Areas (Katras)	Katras 2,423 Population 20 lakh	Notified under Slum Areas (Improvement and Clearance) Act, 1956. The residents are staying on a perpetual license basis.
5	Urban Village	Urban Village 135 (227 rural villages not yet notified as urban)	Notified under Delhi Municipal Corporation Act, 1957
6	Homeless and Pavement Dwellers	16,000 persons	-

Source: Delhi Urban Shelter Improvement Board,2011

9.3 Unauthorized Colonies

Unauthorized colonies in Delhi pose a serious human problem as a huge population is living in these colonies. They are demographically heterogeneous and more than two or three decades old with semi pucca (semi-permanent) two or three storey brick structures, with low levels of basic service delivery, especially water and sewerage.

During 1993, a list of all unauthorized colonies in Delhi was prepared by the Urban Development Department, which indicated that there were 1,071 such unauthorized colonies. Due to litigation

and other policy issues, no decision could be taken about regularization of such colonies. The government of Delhi started a Plan Scheme in 1997-98 for providing minimum civic services i.e. construction of the road, roadside drain and filling up of low-lying area so as to maintain hygienic conditions in these colonies. To meet the expense of the provision of water supply, sewerage, roads, drains, sanitation and street lighting etc, expenditure about Rs 7,745.21 Crore has been incurred till March 2018.

It is estimated that in Delhi there are 1,797 Un-authorised Colonies, which are to be regularized as per government policy. These have about 40 lakh population which needs to be effectively incorporated in the mainstream of urban development. This requires the provision of infrastructure services and facilities for which differential norms and procedure have been devised.

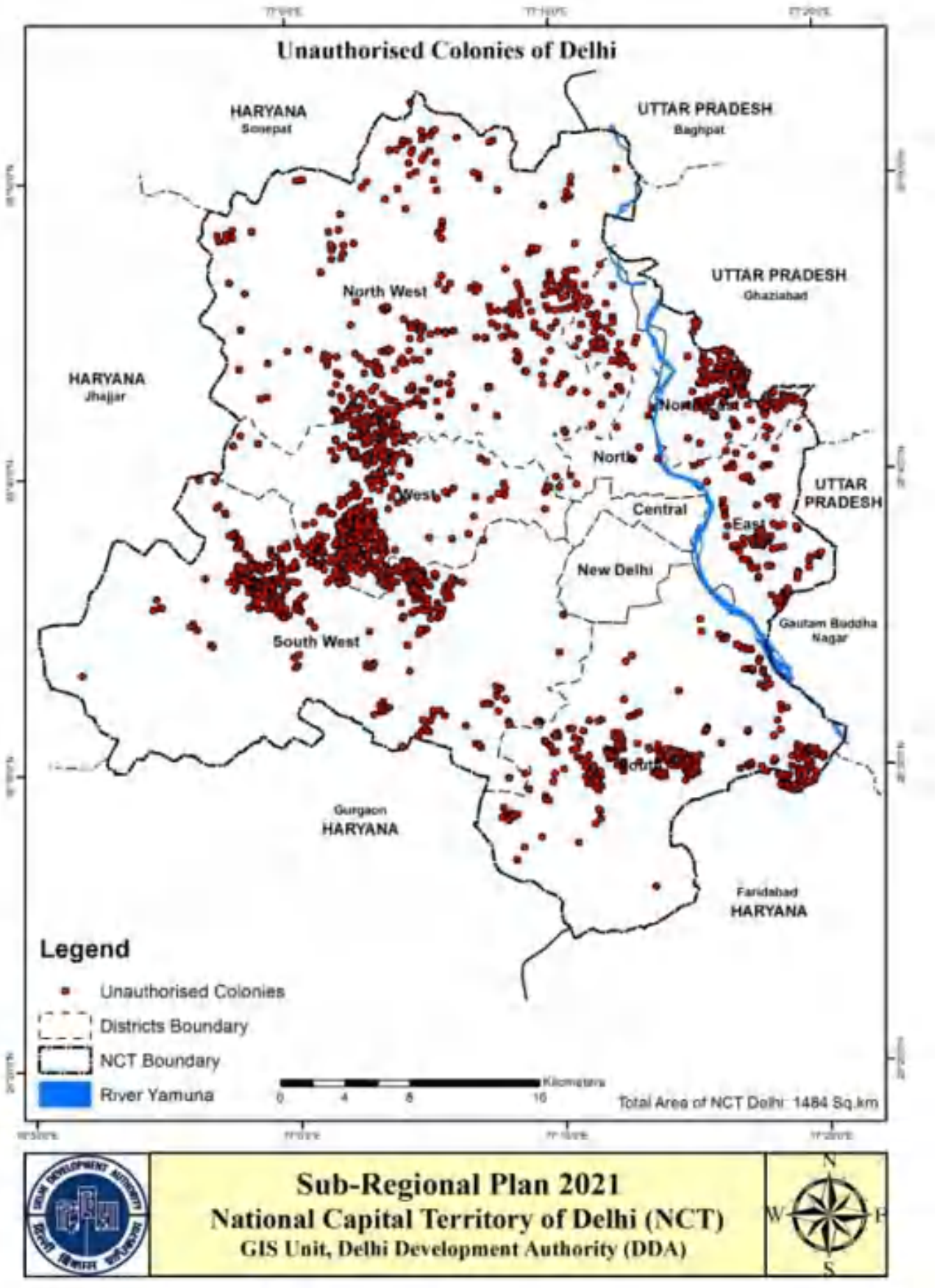
The Delhi Government and its agencies, Delhi State Industrial and Infrastructure Development Corporation (DSIIDC), Department of Irrigation and Flood Control (I&FC), Delhi Jal Board (DJB), Public Works Department (PWD) and Municipal Corporations of Delhi (MCDs) are providing services in the regularized unauthorized colonies. Delhi government had distributed provisional regularization certificates to 895 unauthorized colonies in 2008. However, in only about 70 colonies development work had been carried out. About 580 of these colonies had come up on government land and another 300 came up on private land but have some plots on government land.

DSIIDC has been carrying out the task of developing infrastructure in unauthorized colonies in Delhi for more than a decade. As per new guidelines circulated by Govt. in December 2015, it was decided that for the purpose of carrying out development work, no distinction should be made about the colonies eligible for regularization under the regulation for regularization of unauthorized colonies and other colonies. Development work should be undertaken in all the unauthorized colonies.

GNCTD has mandated DSIIDC to carry out the necessary development activities for the construction of roads and storm water drain in all the 1,797 unauthorized colonies in March 2016, Development work in 760 unauthorized colonies has been completed by DSIIDC and other agencies of GNCTD. It was decided that during the first phase, development works will be taken in all those colonies where no development work has been taken up during the last five years and the colonies which have become eligible as per the guidelines circulated by the GNCTD. Accordingly, 509 numbers of colonies were finalized for taking up the development work in the first phase.

Work amounting to 200 crores in 86 colonies have been completed whereas work amounting to 505 crores is under progress covering 124 colonies and 248 work amounting to 96 crores are under tender covering 20 colonies and estimate amounting to 1,246 crore covering 279 colonies have been prepared for taking up the balance work in remaining colonies by DSIIDC. Figure 9.4 shows the locations of Unauthorised Colonies in NCT Delhi.

Figure 9.4: Location of Unauthorised Colonies in NCT Delhi



Source: Delhi Urban Shelter Improvement Board,2011 & UC DDA

9.4 Night Shelters

The provision of night shelters is envisaged to cater to the shelter less, which should be provided as per requirements, and should be identified keeping in view major work centres. Special provisions should be made for the homeless, women and children including the differently-abled, orphans and old age persons. Further, to the development of night shelters by GNCTD/DUSIB/(concerned municipal body)/ DDA as per MPD-2021, provisions for night shelter should also be made in existing buildings and in new proposed constructions within the Railway Terminals, Bus Terminals, Wholesale/Retail markets, Freight Complexes, Police Stations, etc. by the agencies concerned such as Railways, Health, Industry, DTC, Police, etc., wherever available, with suitable modifications into night shelters as well as by adopting innovative concepts such as integrated complex with commercial space on the ground floor and night shelters on the first floor. In addition, multi-purpose use of the existing facility buildings may be allowed for night shelter purpose. Provision should also be made for converting existing buildings, wherever available, with suitable modifications into night shelters. On the basis of the 2001 Census of houseless population, at least 25 sites should be earmarked in Delhi for night shelters. In order to make the provision of this facility financially sustainable for the local body, innovative concepts such as integrated complex with commercial space on the ground floor and night shelter on the first floor should be explored. The guidelines and incentive package should be designed by the concerned local agency in collaboration with the Govt of NCT-Delhi with a view to develop self-sustaining night shelters. One-night shelter shall be provided for one lakh population.

Night Shelters are important during the winter season for the homeless. In 2001, there were 23 Government run/ Managed shelters for homeless, which increased to 47 in 2005 and 148 in 2010. There is a proposal to increase the numbers of such shelters to 173 by 2013. Many of these night shelters are running above its capacity and such growth in night shelter also indicates large scale migration of poor and homeless to Delhi. Therefore, NCRPB has requested adjoining towns of Delhi in the NCR, namely, Gurgaon, Noida, Greater Noida, Faridabad, Ghaziabad etc to create adequate number of night-shelters for which NCRPB also provides financial assistance for the construction of night shelters as per the guidelines for eight financing of the projects.

Delhi Urban Shelter Improvement Board (DUSIB) is providing shelter to shelter less people in Delhi through permanent night shelters and temporary shelter. The schemes for providing basic services in JJ clusters being implemented by DUSIB includes construction of roads, brick pavements, road- side drains, street lights, Sishu Vatika, Basti Vikas Kendra/Community Centers, Community Toilets/Bath. Existing Policies and Regulations

9.4.1 Land Policy of Delhi, 2018

This policy is applicable in the five land pooling zones of Delhi namely, Zone J, k-1, P-2, N and L. The basic premise of the policy is that the land owners can surrender their landholding into a central pool and become stakeholders in the development process on their land. This Policy is expected to have a huge impact of the housing market of Delhi as or the first-time development of this scale will be spearheaded by involvement of the private sector. DDA will just play the role of a facilitator in the whole process. It is expected that this development will create housing to the tune of 15-17 lakh dwelling units in the land pooling zones.

9.4.2 In-situ Slum Rehabilitation Scheme of DDA, 2018

This scheme is based on the In-situ Slum Rehabilitation vertical of the Pradhan Mantri Awaas Yojana (PMAY). In Delhi, this scheme is being called as the Mukhya Mantri Awaas Yojana. Through this scheme slums are rehabilitated on the land on which they dwell. Land is being used as resource with private participation for providing houses to eligible slum dwellers. This approach aims to leverage the locked potential of land under slums to provide houses to the eligible slum dwellers bringing them into the formal urban settlement. Slums redeveloped under this scheme have to be compulsorily be identified.

9.4.3 Draft Transit Oriented Development (TOD) Policy, 2019

DDA's TOD Policy (2019) envisages high density mixed-use development within the 500 m influence zone of the transit stations. The permissible FAR as per the Policy is 1.5 times the prevalent FAR, with a minimum limit of 300 and maximum limit of 500. The minimum land to be amassed as per this policy is one Ha. The stakeholders who undertake redevelopment through the postulates of this policy will be allowed to utilise the residential FAR for constructing DUs as big as their old DUs, but the additional FAR will have to be utilised for constructing DUs of size not exceeding 100 sq. m. This will facilitate construction of more DUs in areas proximate to the transit nodes and achieving a DU density coherent of TOD development.

9.4.4 Policy for Redevelopment Schemes (MPD 2021: Section 3.3.2)

Although no Redevelopment Policy exists for Delhi, there are provisions in the Master Plan that enable redevelopment on a cumulative planning area of minimum four Ha. However, development will be allowed on a minimum area of 3000 sq. m. provided an approved influence zone plan or an integrated scheme for the area exists. To incentivise the redevelopment, a maximum overall FAR of 50 percent over and above the existing permissible FAR on individual plots, subject to a maximum of 400, shall be permissible. The provisions for redevelopment in the Master Plan also include norms for parks and open spaces, parking, provision PSPs, etc.

9.4.5 Draft National Urban Rental Housing Policy (NURHP) 2015

The National Urban Rental Housing Policy (NURHP), 2015 focuses on a multipronged approach such as enabling legal and regulatory measures, encourage involvement of Private Sector, Cooperative, Non-Governmental Sector, Industrial Sector (for labour housing) and the Services/Institutional Sector (for employee housing), to promote rental housing. The Policy seeks to promote various types of public-private partnerships for promotion of rental housing in the country which will act as a catalytic force to achieve the overall goal of Housing for All by 2022.

9.5 Housing schemes

There have been a number of schemes in the past to provide low cost housing facilities for the Urban Poor, EWS and LIG sections of society. Slum upgradation also has been a major programme of the successive governments in Delhi. However, continuous in-migration from different parts of the country, especially in search of better employment opportunities, makes it difficult to completely overcome the problem of housing for the weaker sections. Government of India has announced a new scheme known as Pradhan Mantri Awas Yojana (PMAY).

9.5.1 Pradhan Mantri Awas Yojana

The Mission will be implemented during 2015-2022 and will provide central assistance to Urban Local Bodies (ULBs) and other implementing agencies through States/UTs for:

a. In-situ Rehabilitation of existing slum dwellers using land as a resource through private participation

b. Credit Linked Subsidy

c. Affordable Housing in Partnership

d. Subsidy for Beneficiary-led individual house construction/enhancement.

9.5.2 Atal Mission for Rejuvenation and Urban Transformation

- Providing basic services (e.g. water supply, sewerage, urban transport) to households and build amenities in cities which will improve the quality of life for all, especially the poor and the disadvantaged is a national priority.

- The purpose of Atal Mission for Rejuvenation and Urban Transformation (AMRUT) is to

- Ensure that every household has access to a tap with the assured supply of water and a sewerage connection.

- Increase the amenity value of cities by developing greenery and well-maintained open spaces (e.g. parks) and

- Reduce pollution by switching to public transport or constructing facilities for non-motorized transport (e.g. walking and cycling). All these outcomes are valued by citizens, particularly women, and indicators and standards have been prescribed by the Ministry of Housing and Urban Affairs (MoHUA) in the form of Service Level Benchmarks (SLBs)

The components of the AMRUT consist of capacity building, reform implementation, water supply, sewerage and septage management, stormwater drainage, urban transport and development of green spaces and parks. During the process of planning, the Urban Local Bodies (ULBs) will strive to include some smart features in the physical infrastructure components.

9.5.3 Policies and proposals of MPD 2021

According to the projections and as proposed in MPD 2021, Delhi needs 24 lakh new housing units by the year 2021 (MPD-2021). Of these, 54 percent are required for the EWS and LIG. About 42 percent housing units, i.e. about 10 lakhs are to be provided by densification and redevelopment of existing residential areas, covering in-situ slum rehabilitation, infill development, regularization and redevelopment of unauthorized colonies and by densification and up-gradation of old residential areas.

Based on the projected population of 230 lakhs by 2021 in MPD 2021, the estimated additional housing stock required will be around 24 lakh dwelling units. This includes an estimated housing requirement of 20 lakh dwelling units for additional population and backlog of about four lakh units comprising of one lakh net shortage and the rest by dilapidated and Kutcha structures requiring replacement.

It has also been assessed that around 40 percent of housing need can potentially be satisfied through redevelopment / up-gradation of existing areas of Delhi. This may be met in the present urban limits of A to H zones and in the sub cities of Dwarka, Rohini and Narela. This implies that the remaining 60 percent of the requirement would have to be met through 14.4 lakh new housing units to be provided in new areas.

Keeping in view the socio-economic composition of the population, it is estimated that around 50-55 percent of the housing requirement would be for the urban poor and the economically weaker sections in the form of houses of two rooms or less. Based on past experience it is necessary to distinguish between the urban poor comprising the inhabitants of squatter settlements / pavement dwellers, etc. and other economically weaker sections of the society, conventionally classified in the form of EWS, LIG, etc. The role of the government would have to be both as a provider and facilitator. The category of the urban poor is to be broadly catered in old and new urban areas through up-gradation of old / traditional areas, employers and industrial housing, group housing and also in unauthorized regularized colony infill.

9.6 Issues and Challenges:

- Average household size has decreased to three and four which suggests a trend of nuclear families and more housing demand.

- Delhi is overwhelmingly urban with 75 percent of its area and 98 percent population falling under urban jurisdiction as in 2017. The decadal growth in population was 21.2 percent during 2001-11 and the population density (urban) is very high at about 14,693 per square kilometre. The rate of in-migration has been stabilising, yet the city continues to be a preferred destination for significant numbers seeking a livelihood. Close to 100,000 persons in-migrate into the city every year.

- Highly urban character of Delhi exerts tremendous pressure on public delivery of services / civic infrastructure systems like water supply, sewerage and drainage, solid waste management, affordable housing, health and educational facilities etc. and poses a great challenge for the city government.

- About one-third of Delhi lives in sub-standard housing, which includes 695 slums and JJ Clusters, 1,797 unauthorized colonies, old dilapidated areas and 112 villages. These areas often lack safe, adequate housing and basic services.

9.6.1 Strategies, Policies and Proposals

1. Additional Housing stock to be created through in-situ augmentation of services in slums instead of going for new housing developments.

2. Attempt should be made to bring vacant housing into the housing stock.

3. Emphasis to be given more on social housing scheme and rental housing for migrants, economically weaker sections, close to their work places.

4. As per the report of the committee out of 1,797 unauthorised colonies, 519 are on DDA land. 179 are on forest land, three are in protected or notified area of ASI (Archaeological Survey of India) and 37 are in regulated/prohibited area of ASI. Unauthorised colonies are in urban areas as well as rural villages. It is observed that many unauthorised colonies have come up outside the notified areas of urban local

bodies and development areas of Delhi Development Authority. Subsequently, with the expansion of area under urban local bodies and DDA these colonies have been incorporated in the notified urban areas. Delhi Development Authority should have notified the entire area outside the urban local bodies as development area and should have controlled that through the process of planning and development.

5. DDA should notify the entire area remaining at present as development area under section 12 of DDA Act, 1957.

6. The committee constituted for unauthorised colonies recommended to revive the development control norms for to be more liberal and different for different colonies/localities. It is observed that revision in development controls to make more liberal may not serve the purpose of regularization of unauthorised colonies. Therefore, it is suggested that the unauthorised colonies may be considered to regularize on 'as and where' basis without going into the details of development controls. Structural safety, fire safety and removal of encroachments on roads and streets and public open spaces may be ensured.

7. The DDA, urban local bodies and state government should ensure that planning and development exercise should not be an exercise of regularization of unauthorised redevelopment and construction in future. Development agencies should create additional low-cost housing stock to prevent such unauthorised development. Preventive and punitive actions must be initiated immediately in case any individual and agency is found to be engaged in unauthorised colonisation.

8. Future housing close to Transit corridors promoting transit-oriented development.

9. Wherever possible: Redevelopment schemes for unauthorized colonies and Slums by plot reconstitution.

CHAPTER 10. SOCIAL INFRASTRUCTURE

10.1 Introduction

While physical infrastructure improves physical connectivity, the sustainability of economic growth and development is dependent on social infrastructure, more importantly education and health infrastructure. It may be emphasized that educational facilities have been recognized as a critical investment for sustaining the socio-economic development. Since NCT-Delhi has traditionally been a city with relatively better availability of educational infrastructure than rest of the NCR, 2.7 percent migration into Delhi (census 2001) has been observed on account of education.

10.2 Education

The literacy in Delhi has continuously been improving and also the literacy gap has been decreasing. There is an upward trend in the Literacy Rate for both male and female. The Literacy Rate of 75.29 percent in 1991 increased to 81.67 percent in 2001 which further increased to 86.20 percent in the 2011 Census against 80.04 percent of whole NCR and 74 percent of the country in the same year.

10.2.1 Existing Situation of Educational Infrastructure in NCT Delhi

Literacy rate: According to the Census 2011, NCT- Delhi has the highest literacy rate i.e. 86.3 percent in the NCR region, which has a literacy rate of 80.4 percent, followed by Haryana (78.2 percent), Uttar Pradesh (77.7 percent) and Rajasthan (71.1 percent) Sub-Regions.

Table 10.1: District wise Literacy Rate in Delhi (in Percentage)

S. No	District	Persons	Males	Females
1	**North West**	84.4	89.7	78.4
2	**North**	86.9	90.9	82.2
3	**North East**	83.1	88.8	76.7
4	**East**	89.3	93.1	85.0
5	**New Delhi**	88.3	92.2	83.6
6	**Central**	85.1	87.5	82.5
7	**West**	87.0	91.0	82.4
8	**South West**	88.3	93.1	82.5
9	**South**	86.6	91.7	80.6
10	**NCT of Delhi**	**86.2**	**90.9**	**80.8**

Source: Census of India 2011

District wise literacy shows that except Northwest and Northeast districts all seven other districts have literacy rate higher than average literacy of the NCT Delhi highest being in East district. Higher literacy in the NCT Delhi is mainly due to availability of education facilities at all levels throughout the state. Table 10.1 is showing district wise males and females literacy rates for districts of NCT Delhi.

10.2.2 Educational Facilities

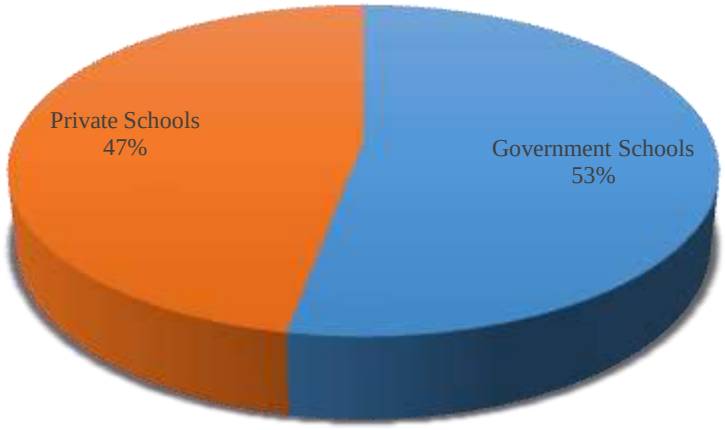
Table 10.2: Population served by one school

Population (2011)	1,67,87,941
No of Schools (Govt& Private)	5,239
Population served by one school	3,204

Source: Census of India 2011

As per the Table 10.2 above, total number of schools both Government and private is 5,239 that is, each school serves approximately 3,204 population. Figure 10.1 indicates that, out of the total 5239 schools in NCT Delhi, 2772 schools (52.9 percent) are government schools and 2467 schools (47.1 percent) are private schools.

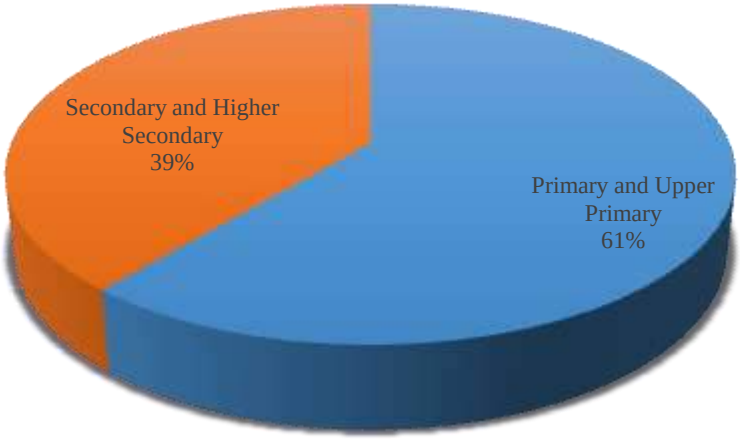
Figure 10.1: Share of Govt. and Private schools in NCT Delhi



Source: District Elementary Report card, 2010-2011

As per the District Elementary Report card, 2010-2011, National Institute of Educational Planning and Administration, out of 5239 schools in NCT Delhi, 3201 (61 percent) schools are Primary & Upper Primary school whereas 2038 (39 percent) schools are Higher secondary schools. (Figure 10.2)

Figure 10.2: Share of Primary to Secondary Schools in NCT Delhi



Source: District Elementary Report card, 2010-2011

The Table 10.3 shows that the number of all types of schools have increased from 5,155 in 2012-13 to 5,760 in 2017-18, an addition of 605 schools during the last six years. Number of all types of schools have increased during the last six years except the secondary schools which may be due to the up gradation of the existing secondary schools to higher secondary schools. The highest increase of 341 schools has been observed in case of middle schools.

Table 10.3: Educational Facilities available in NCT Delhi

Sr No.	Items	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
1	Pre-Primary + Primary	2629	2709	2806	2779	2735	2745
2	Middle	564	728	933	940	933	905
3	Secondary	458	389	385	393	400	374
4	Higher Secondary	1504	1627	1674	1684	1704	1736
	Total	5155	5453	5798	5796	5772	5760

Source: District Elementary Report card, 2010-2011

10.2.3 Number of Government and Private Schools in NCT Delhi

Delhi Govt. has a total of 1,227 government and government-aided schools in Delhi, which is 21.30 percent of the total schools running in Delhi, whereas, the share of enrolment in government and government-aided schools is 37.24 percent of a total enrolment of all schools in Delhi during 2017-18.

Table 10.4: Number of Government/Private Schools and Enrolments (in lakh)

S. No.	Items	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
1	**No. of Delhi Govt. Schools**	969	992	1007	1011	1017	1019
2	**Total Enrolment (in lakh)**	15.75	16.10	15.42	15.09	15.28	14.81
	Boys	7.84	7.87	7.40	7.14	7.18	6.91
	Girls	7.91	8.23	8.02	7.95	8.10	7.90
3	**No. of Govt. Aided Schools**	216	211	211	211	211	208
4	**Total Enrolment (in lakh)**	1.65	1.65	1.63	1.68	1.57	1.55
	Boys	0.90	0.90	0.87	0.85	0.83	0.82
	Girls	0.75	0.75	0.76	0.83	0.74	0.73
5	**No. of Un-Aided Schools**	2076	2277	2277	2113	1715	1719
6	**Total Enrolment (in lakh)**	13.80	13.57	14.71	15.26	15.65	16.21
	Boys	8.33	8.19	8.86	9.16	9.37	9.66
	Girls	5.47	5.38	5.84	6.10	6.28	6.55

Source: Directorate of Education, GNCTD

The above Table 10.4 shows that the number of schools under Delhi Government has increased from 969 in 2012-13 to 1019 in 2017-18, whereas the total enrolment in these schools has shown a marginal decline from 15.75 lakhs in 2012-13 to 14.81 lakhs in 2017-18. At the same time the enrolment of students in unaided schools is increasing. The enrolment of girl students is more than the boys which may be due to various incentives provided for girl students.

50. Gross Enrolment Ratio

Gross Enrolment Ratio, is calculated as the ratio of the number of students in a given class or set of classes to the number of children in the given age group. Net Enrolment Ratio, on the other hand, is the enrolment of the official age group for a given level of education expressed as a percentage of the corresponding population of that age group. The Gross Enrolment ratio in NCT Delhi is 119. During the last five years (2006-2011) the Gross Enrolment ratio has increased from 108 to 119. As per District Information System on Education (DISE) Report-2017, during

2016-17, the Gross Enrolment Ratio in Primary Education in Delhi was 109.19 percent as compared to 95.12 percent at all India level.

51. Pupil Teacher Ratio (PTR) in the Primary and Upper Primary Schools

Right to Education Act (RTE) mandates an optimal student teacher ratio of 30:1 for all Indian Schools. If we consider the 2010-11 survey by the District Information System on Education (DISE) it is observed that, in NCT-Delhi the ratio is within the range of norm except in upper primary and higher secondary level where it is 38:1.

52. Condition of schools

Sarva Shiksha Abhiyan (SSA) focuses on provision of basic minimum facilities including physical infrastructure and availability of adequate number of teachers. There has been significant growth in school infrastructure under the SSA.

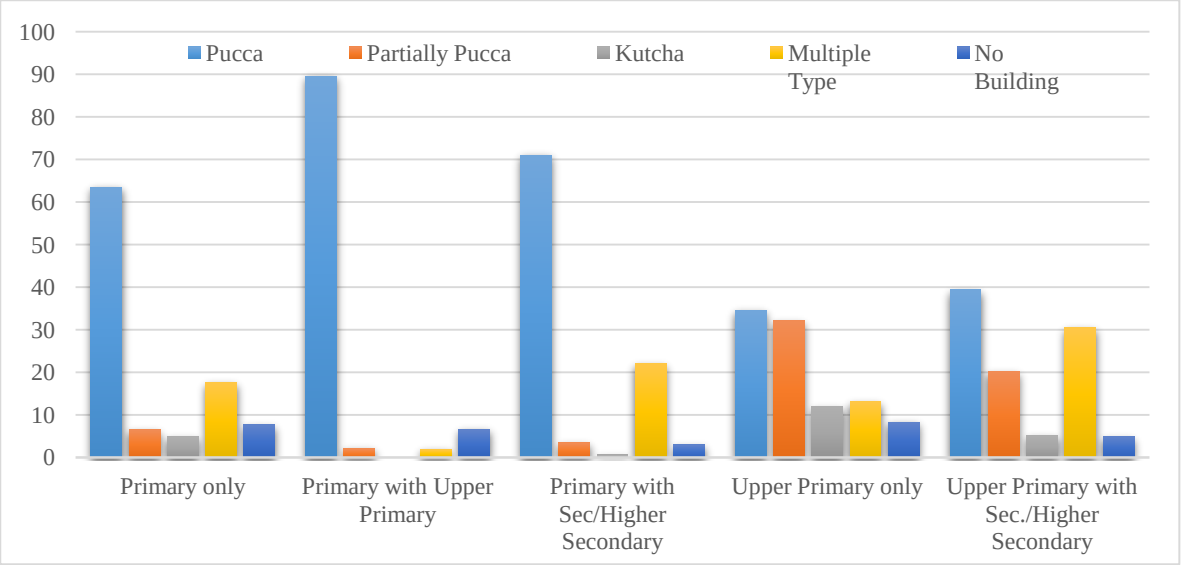
It has been observed that 63 percent of the Primary only, 35 percent of the Upper Primary only and 39 percent of the Upper Primary with Secondary/ Higher Secondary schools have Pucca buildings for running their schools. As a whole in NCT-Delhi 64.6 percent of the schools are Pucca, 7.4 percent partially Pucca, 3.5 percent Kutcha, 18.4 percent multiple type and 6.1 percent schools have no buildings. The Table 10.5 and Figure 10.3 shows the condition of school buildings of different categories of school.

Table 10.5: Condition of Schools in NCT Delhi

S. No.	Type of School	Pucca	Percent	Partially Pucca	Percent	Kutcha	Per cent	Multiple Type	Percent	No Building	Percent
1	Primary only	1,617	63.4	166	6.5	126	4.9	447	17.5	196	7.7
2	Primary with Upper Primary	476	89.5	11	2.1	0	0	10	1.9	35	6.6
3	Primary with Sec/Higher Secondary	822	71	39	3.4	7	0.6	255	22	35	3
4	Upper Primary only	29	34.5	27	32.1	10	11.9	11	13.1	7	8.3
5	Upper Primary with Sec./Higher Secondary	232	39.4	119	20.2	30	5.1	179	30.4	29	4.9

Source: Report on Educational Infrastructure in NCR, 2010

Figure 10.3: Condition of Schools in NCT Delhi



Source: Report on Educational Infrastructure in NCR, 2010

53. Status of Basic Infrastructure in Schools

The Table 10.6 below depicts the trend that has been observed from year 2012-13 to 2017-18 regarding the status of basic infrastructure of schools in NCT Delhi. It has been observed that the percentage of schools having access to basic amenities like playgrounds, boundary walls, electricity connections and computer facility have improved from the year 2012-13 to the year 2017-18. Whereas, the sanitation facilities such as drinking water and toilet facilities have always been in a good condition.

Table 10.6: Status of basic Infrastructure in Schools in NCT Delhi

S. No.	Percentage of Schools having access to	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
1	Playgrounds	73.9	81.7	85.8	87.4	87.37	88.06
2	Boundary Walls	97.8	98.7	99.4	99.5	99.9	99.88
3	Girls Toilet	100	100	100	100	100	100
4	Boys Toilet	100	100	100	100	100	100
5	Drinking water facility	100	100	100	100	100	100
6	Electricity Connection	99.7	100	99.9	99.9	99.9	100
7	Computer facility	77.9	81.6	81	83.9	87.18	88.82

Source: Elementary Education in India, DISE Publications, NUPEA

10.2.4 Higher Education

In case of higher education, NCT Delhi has 101 number of General colleges, 90 number of technical colleges, 93 number of Vocational Colleges and 42 number of Medical colleges. Table 10.7 gives the details of higher educational institutes.

Table 10.7: Number of Higher Educational Institutions

Sr. No	Type of Colleges	Number	Percentage

Sr. No	Type of Colleges	Number	Percentage
1	General Colleges	101	31
2	Technical Colleges	90	27.5
3	Vocational Colleges	93	28.5
4	Medical Colleges	42	13
	Total	326	100

Source: Report on Educational Infrastructure in NCR, 2010

There are five Central Universities, seven State Universities and thirteen Deemed Universities in NCT Delhi.

10.3 Policies and Proposals

- National Education policy 2019, addresses the challenges related to access, equity, quality, affordability and accountability faced by the current education system.
- As the extent of coverage of RTE Act for free and compulsory education is proposed to be extended from 14 yrs. to 18 yrs., the number of students in secondary school education is going to increase and that would require an additional number of secondary level schools and trained teachers. Therefore, the space requirement for additional schools have to be considered in the new Master Plan of Delhi.
- The Master Plan should make available land at appropriate locations for the development of school complexes which may house different level of schools in an area where each school complex will be a semi-autonomous unit providing integrated education across all stages from elementary to secondary education.
- Right to Education Act (RTE) mandates an optimal student teacher ratio of 30:1 for all Indian Schools. In NCT-Delhi the ratio is within the range of prescribed norms except in upper primary and higher secondary level where it is 38:1. Thus, there is a need to improve pupil teacher ratio to bring it at 30:1 as stipulated in the 12th plan so as to correct the imbalance in teacher deployment.
- As a whole in NCT-Delhi 64.6 percent of the schools are Pucca, 7.4 percent partially Pucca, 3.5 percent Kutcha, 18.4 percent multiple type and 6.1 percent schools have no buildings. It is recommended that all schools should have well planned school building, playgrounds, laboratories, library and equipped with all necessary educational apparatuses to provide modern skill-based education.
- The higher education infrastructure in Delhi comprises of 23 Universities (incl. Central/ State universities, Deemed universities), five Institutes of National Importance and 188 Colleges (incl. General/ Professional colleges). In addition, there are 112 Standalone Institutions imparting diploma course in various fields; and there are Vocational Training Institutions and *Pradhan Mantri Kaushal Vikas Yojana (PMKVY) institutions.*
- More investment is needed in Higher Education, Research and Training Institutions for providing State of Art facilities. Higher Education Institutions may also be involved in collaborations with Foreign Educational Institutions, Research laboratories, etc.
- Additional hostel facilities in higher educational institutions all over NCT Delhi should be created to accommodate students coming from different parts of the country.

- All the higher educational institutes to be equipped with latest technologies, equipment, improving access to education for the disadvantaged groups and improving the overall planning, administration and management of the entire education system.
- The State Government should provide adult education institutions in different areas specially areas inhabited by low income group, factory workers and people involved in informal sector activities. These adult education institutions may also have facilities to provide different skill based short term training programs. Proposed school complexes in new areas and existing community centres in old areas may be utilized for this purpose.
- There is a need to provide additional special institutions for mentally challenged, deaf and dumb, transgender and such other children.

10.4 Security

Safety and security of the citizens is an essential component of quality of life. Crime free areas and lower incidence of crime provide higher sense of security and play an important role in the quality of life of the citizen and liveabilty index. Better policing and surveillance system to some extent can reduce the crime rate and also provide a sense of security among the citizens. More than that high footfall on public spaces and presence of pedestrians, vendors and kiosks make an area less vulnerable to crime and instill higher sense of security. On the other hand, segregated land use, inappropriate urban design and streetscape and presence of high compound wall around gated residential neighborhood and bungalows make an area prone to petty crimes.

Delhi inspite of being the capital and presence of huge police force witness high incidence of crime and dubbed as crime capital of India. From the table below, it appears that the crime rate in Delhi is increasing and there is a drastic increase in the cases of robbery, burglary and theft. This is mainly due to the rapid increase of unemployment and mushrooming of unauthorized settlements throughout the city of Delhi leading to high delinquency among the migrant population which is adversely affecting the safety and security of the citizens having implication on the quality of life. This is attributed to disparity in income and living conditions, segregated land use, poor urban design, etc. Increasing rate of crime also impacts the image of city and create a sense of insecurity among the citizens. It directly impacts the investment sentiments and overall development of the capital. Trend of crime in the city as per the information provided by the Delhi Police is given below in Table 10.8.

Table 10.8: Crimes in NCT Delhi, 2011-2019 (in '000)

Crime Head	2011	2012	2013	2014	2015	2016	2017	2018	Up to 16th Nov	
									2018	2019
Dacoity	0.03	0.03	0.03	0.08	0.08	0.05	0.04	0.03	0.02	0.01
Murder	0.54	0.52	0.52	0.59	0.57	0.53	0.49	0.51	0.44	0.46
Att. To Murder	0.39	0.44	0.59	0.77	0.77	0.65	0.65	0.53	0.47	0.44
Robbery	0.56	0.61	1.25	6.46	7.41	4.76	3.15	2.44	2.12	1.75
Riot	0.05	0.08	0.11	0.16	0.13	0.08	0.05	0.02	0.02	0.01
Kid. For Ransom	0.03	0.02	0.03	0.04	0.04	0.02	0.02	0.02	0.02	0.01
Rape	0.57	0.71	1.64	2.17	2.20	2.16	2.15	2.14	1.92	1.95
Total Heinous	2.17	2.40	4.16	10.27	11.19	8.24	6.53	5.69	5.01	4.63

Crime Head	2011	2012	2013	2014	2015	2016	2017	2018	Up to 16th Nov	
									2018	2019
Snatching	1.48	1.44	3.64	7.35	9.90	9.57	8.23	6.93	6.02	5.51
Hurt	1.95	1.75	1.77	2.08	1.90	1.49	1.35	1.51	1.35	1.20
Burglary	1.42	1.72	2.84	10.31	12.85	14.31	9.82	4.12	3.57	2.70
M.V.Theft	14.67	14.39	14.92	23.38	32.73	38.64	40.97	46.43	40.07	40.74
House Theft	1.92	1.75	3.22	12.74	15.32	14.72	10.74	3.73	3.38	2.38
Other Theft	6.31	5.90	11.99	42.63	56.39	77.56	114.05	138.60	116.50	165.52
M. O. Women	0.66	0.73	3.52	4.32	5.37	4.17	3.42	3.31	2.96	2.62
Other Kid./Abd	3.77	3.95	6.29	7.11	7.69	6.60	6.08	6.03	5.37	5.26
Fatal Accident	2.05	1.82	1.78	1.63	1.58	1.55	1.57	1.66	1.40	1.22
Simple Accident	5.23	5.12	5.79	6.99	6.50	5.83	5.11	4.86	4.33	3.71
Other Ipc	11.74	13.34	20.29	26.85	29.97	26.85	25.71	27.86	24.25	27.53
Total Non-Heinous	51.18	51.89	76.03	145.39	180.19	201.28	227.05	245.03	209.20	258.40
Total Ipc	**53.35**	**54.29**	**80.18**	**155.65**	**191.38**	**209.52**	**233.58**	**250.72**	**214.21**	**263.03**

Source: Crime Statistics from 2011 to 2019, Delhi Police

As per the Crime Statistics Report of Delhi Police, the crime is divided into two categories depending on the nature of crime that is heinous and non-heinous. It is observed that rape is the most dominant heinous crime in NCT Delhi followed by robbery and murder. The number of rape cases registered with Delhi police has increased from 572 in 2011 to 1,947 in 2019 (up to 15th Nov 2019). Number of cases of robbery has gone up from 562 in 2011 to 1,751 in 2019. The number of total heinous crimes has gone up from 2,171 in 2011 to 4,628 in 2019, whereas the total number of crimes in NCT Delhi has increased manifold from 53,353 in 2011 to 2,63,027 in 2019 which is more than five times. It is observed that despite of various legal measures taken by the Central Government with regards to crime, there is no substantial impact on the reduction in crimes.

NCT Delhi has acquired a very negative image of crimes against women, which is reflected in the increase of crimes that is 6,052 in 2012 to 11,573 in 2019. It is observed that cruelty in the family, kidnapping and rape are major crimes against women. All these are life threatening crimes and there is a need of a special legal regime to minimize or eliminate the situations in which these crimes are committed. A detailed information regarding the crime against women is given in Table 10.9 below.

Table 10.9: Crime Against Women, 2012-2019

Crime Head	2012	2013	2014	2015	2016	2017	2018	2018 Up to 15th Nov	2019 Up to 15th Nov
Rape (376 Ipc)	706	1636	2166	2199	2155	2146	2135	1921	1947
Assault on Women with Intent to Outrage her Modesty (354 Ipc)	727	3515	4322	5367	4165	3422	3314	2956	2616
Insult to The Modesty of Women (509 Ipc)	214	916	1361	1492	918	640	599	544	427
Kidnapping of Women	2048	3286	3604	3738	3445	3439	3482	3067	3104
Abduction of Women	162	323	423	556	444	322	262	240	170
498-A/406 Ipc (Cruelty by Husband and in laws)	2046	3045	3194	3536	3877	2745	3416	2716	3187
Dowry Death (304b)	134	144	153	122	162	120	153	133	106
Dowry Prohibition Act	15	15	13	20	18	11	15	14	16
Total	6052	12880	15236	17030	15184	12845	13376	11591	11573

Source: Crime Statistics from 2012 to 2019, Delhi Police

The infrastructure for policing in the National Capital has not been improved and strengthened as per the requirement of fast increasing population and spread of unauthorized urban activities in NCT Delhi. As of January 2019, Delhi Police has 15 Police Districts with 178 'territorial' Police Stations and five specialized crime units declared as Police Stations namely, Economic Offenses Wing, Crime Branch, Special Cell, Special Police Unit for Women and Children (SPUWAC) and Vigilance. It is also observed that about 25 percent of the total police force is engaged in the security of important dignitaries.

There is a need to strengthen the policing by increasing the number of police stations, police post and improving the surveillance system. The areas which are prone to crime should be identified for strengthening the policing system. The mixed land use, compact development and better urban design should be encouraged to make the city safe and crime free.

The law enforcement agencies have to take preventive measures for the prevention of crimes especially during nights. Active participation of NGOs, RWAs and other social organizations in the vigilance may be ensured by the police. It will help in identification of potential criminals, reduction in local petty crimes and information gathering.

10.5 Health

10.5.1 Introduction

Health Infrastructure is an important indicator to understand the healthcare delivery provisions and mechanisms in the region. Health facilities in India is structured at three levels namely primary (Sub Centre and Primary Health Centre), secondary (District Hospital and Community Health Centre) and tertiary (Nursing homes, speciality and super-speciality hospitals) based on population norms. Health infrastructure in the urban areas is different from the rural areas. In urban areas mostly two types of health infrastructure are provided i.e. Hospitals and Dispensaries, while rural areas have the Community Health Centres at the Secondary level and Primary Health Centres, Sub Centres and Village Health Guides & trained Dais at Primary level.

10.5.2 Existing Health Facilities in NCT Delhi

54. Existing Health Facilities

As per report on Health Infrastructure in NCR (2015), regarding level of facilities, NCT Delhi accounts for only two percent of the primary level facilities to the total number of primary level facilities (151) present in NCR. On the other hand, in terms of tertiary level medical care i.e. district hospitals and multi-specialty hospitals, Delhi has a maximum number of 134 accounting to 85 percent of that of NCR.

NCT Delhi has eight public health centres (PHCs), no community health centres (CHCs) and 134 tertiary care hospitals, which includes both general as well as speciality, super and multi-speciality hospitals. Apart from that there are 260 dispensaries which do not have any inpatient facility but only observation beds.

Table 10.10: Number of Government Health Facilities in NCT-Delhi

Sr. No	Health Facility	Number
1	District/ SD Hospitals	134
2	Community Health Centres (CHC)	0
3	Primary Health Centres (PHC)	8
4	ESI Hospital & Dispensaries	15
5	Others	260
	Total	**417**

Source: Report of Health Infrastructure in NCR, 2015

As per the Table 10.11, the private health facilities include a total of 14 super and multi-specialty hospitals, 448 general care private hospitals, 362 limited bedded private nursing homes and 17 charitable hospitals and private clinics.

Table 10.11: Number of Private health Facilities in NCT - Delhi

Sr. No	Health Facility	Number
1	Multi Sp/ Specialty Hospital	14
2	General Hospital	448
3	Nursing Home	362
4	Others	17
	Total	841

Source: Report of Health Infrastructure in NCR, 2015

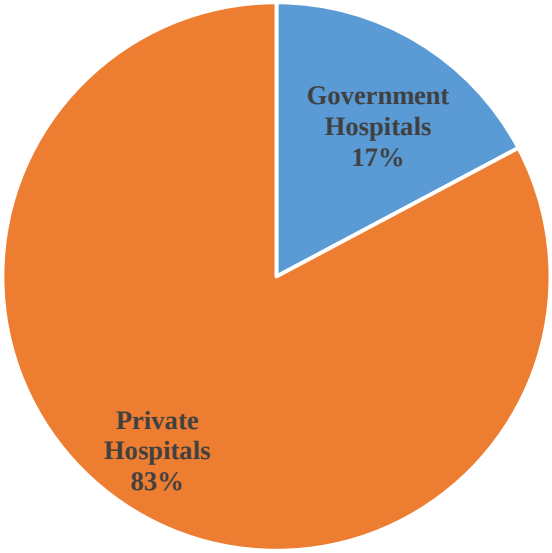
More than half of the private health facilities accounting for 56.5 percent of NCR are concentrated in the NCT-Delhi. The ratio of Government Hospitals to Private Hospitals in NCT Delhi is the highest in NCR region i.e. 1: 4.8. The details are given in Table 10.12 and Figure 10.4.

Table 10.12: Percentages of Government and Private Health Facilities

S. No.	Health Facility	Number	Percentage
1	Government Hospitals	175	17
2	Private Hospitals	841	83
3	Total	1016	100

Source: Report of Health Infrastructure in NCR, 2015

Figure 10.4: Percentages of Government and Private Health Facilities



55. Number of beds available in NCT Delhi

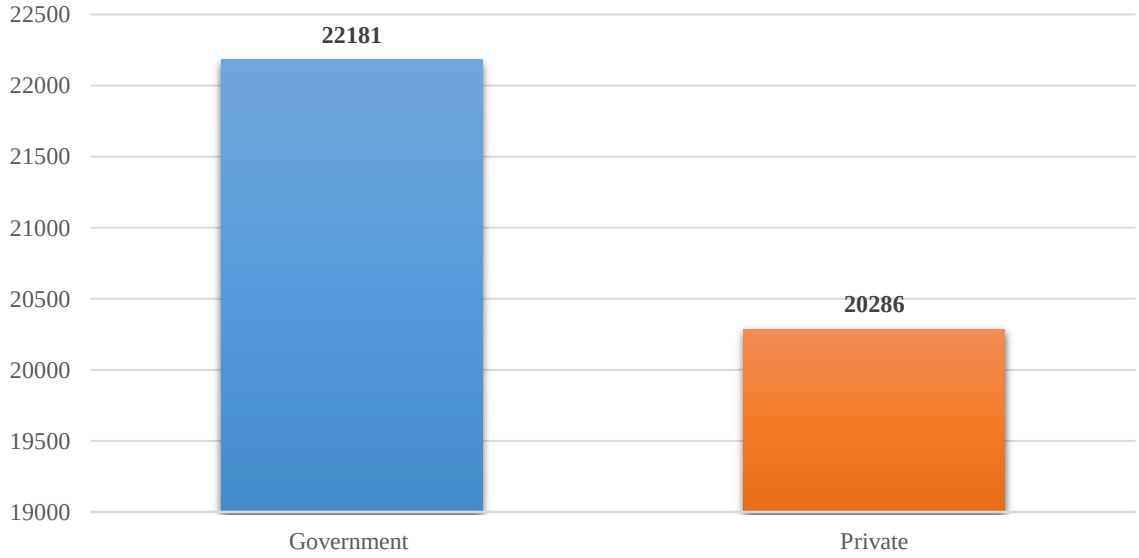
The total number of inpatient beds available in NCT Delhi is 42467, out of which 22181 number of beds (52 percent) are available in Government Hospitals and 20286 number of beds (48 percent) are available in Private Hospitals. In NCT Delhi, the proportion of beds is more in Government Hospitals than that of Private Hospitals. In government hospitals, occupancy rate in NCT-Delhi is the highest 72 percent in whole of NCR. The details of percentage distribution of available beds are shown in Table 10.13 and Figure 10.5

Table 10.13: Percentages Distribution of Available Beds

S. No.	Type	Number of beds available	Percentage	Average bed utilisation (percent)
1	**Government**	22181	52	72
2	**Private**	20286	48	45
	Total	42467	100	-

Source: Report of Health Infrastructure in NCR, 2015

Figure 10.5: Number of Beds in Government and Private Hospitals



Source: Report of Health Infrastructure in NCR, 2015

As per the analysis of bed population ratio which has been done using IPHS norms for District Hospital i.e. 3.33 beds per 1,000, the available bed population ratio in NCT Delhi is 2.53.

10.5.3 Ambulance Facility

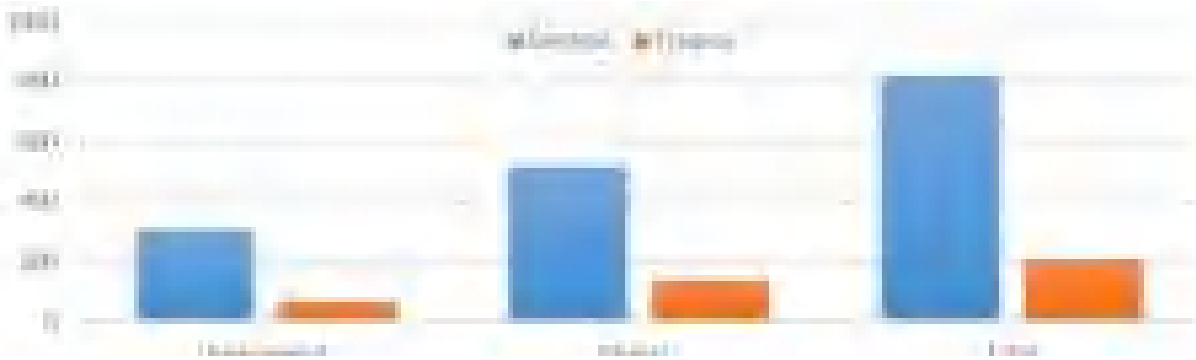
The average number of ambulance available per health facility (like Hospitals, Health Care Centers, and Nursing Homes etc) is highest (2.1 per health facility) in the government sector in NCT Delhi among the ones in NCR region. The details of ambulance available are given in Table 10.14 and Figure 10.6.

Table 10.14: Number of Ambulance Available

S. No.	Type	General	Trauma
1	Government	304	67
2	Private	513	139
	Total	817	206

Source: Report of Health Infrastructure in NCR, 2015

Figure 10.6: Number of Ambulance Available



Source: Report of Health Infrastructure in NCR, 2015

10.5.4 Medical Testing Facilities

Table 10.15: Availability of Haemo / Patho / Radiological Tests in NCR Hospitals

Sr. No	Testing Facility	Government	Private	Total
1	Blood test	132	725	857
2	Urine Test	132	660	792
3	Histopathology test	106	180	286
4	Radiological test	119	465	584
	Total	**489**	**2030**	**2519**

Source: Report of Health Infrastructure in NCR, 2015

Testing Facilities of Haemo, Patho and Radiological tests are found to be maximum in Private medical facilities as compared to government medical facilities in terms of Blood test, urine test, Histopathology and Radiological test. The details are given in Table 10.16.

10.5.5 Medical Facilities Available

Table 10.16: Availability of Medical Facilities in Visited Health Units

Sr. No	Medical Facility	Government	Private	Total
1	Operation Facility	123	648	771
2	Emergency Care Facility	118	421	539
3	Blood Storage Facility	27	121	148
4	Blood Bank (without component)	36	30	66
5	Blood Bank (with component)	29	23	52

Source: Report of Health Infrastructure in NCR, 2015

Medical Facilities in Visited Health Units are found to be maximum in Private medical facilities as compared to government medical facilities in terms of Operation Facility, Emergency Care Facility, Blood Storage Facility and Blood Bank (without component) facility. Blood Bank (with component) facility is found to me more in government medical facilities than in private medical facilities.

10.5.6 AYUSH

Among different categories of AYUSH medical facilities Ayurveda is most common. A total of 226 Ayurveda specialists are providing consultations to the patients in various NCR sub-regions. Out of them, 200 are available in Government facilities. Majority of them are available in health facilities of Delhi and NCR Uttar Pradesh.

The next popular AYUSH category is Homeopathy. There are total of 123 homeopaths in NCR out of which 68 percent are in Delhi. Also, in Delhi private and government health facilities have equal number of homeopaths. There are 11 Yoga, one Siddha and 85 Unani specialists in NCR, of which majority are available in Delhi.

Table 10.17: Availability of AYUSH facility in NCR

Sr. No	Name of Facility	Government	Private	Total
1	Yoga	4	6	10
2	Siddha	0	0	0

Sr. No	Name of Facility	Government	Private	Total
3	Ayurveda	78	13	91
4	Unani	68	7	75
5	Homeopathy	42	42	84

Source: Report of Health Infrastructure in NCR, 2015

10.5.7 Referral Hospitals

Any hospital, including a district hospital/CHC/PHC, receiving referrals from lower levels of care is categorised as Referral Hospital. NCT Delhi has approximately 35 numbers of Referral Hospitals spread throughout the city. Few of the referral hospitals such as Indraprastha Apollo, AIIMS, Rajiv Gandhi Cancer Institute and Research Centre are of international repute which also cater to many developing countries of Asia and Africa. The Table 10.18 shows the district wise list of Referral Hospital, both Government and Private.

Table 10.18: Referral Hospitals in NCT Delhi

Sr. No	Name of the District	Referral Hospital (Government/Private)
1	North Delhi	Aruna Asaf Ali Hospital, Delhi.
		Hinu Rao, Delhi
2	North - East Delhi	St.Stephens Hospital
		Jeewan Nursing Home & Hospital
		Delhi Heart & Lung Institute Super Speciality Hospital
3	North-West Delhi	Dr. Ambedkar Hospital, Rohini, Sector-6
		Sant Parmanand Hospital
		Jaipur Golden Hospital
		Rajiv Gandhi Cancer Institute and Research Centre
		Sanjay Gandhi Hospital, Mangolpuri
		Max Superspeciality Hospital
		Fortis Hospital, Shalimar Bagh
		Santom Hospital
4	East Delhi	G.B.Pant Hospital, Delhi
		Guru Teg Bahadur Hospital, Dilshad Garden, Delhi
		Dharamshila Hospital, Vashundhara, Delhi
		Garg Hospital, opp. karkardooma court
5	Central & New Delhi	Lok Nayak Hospital, Delhi
		G.B.Pant Hospital, Delhi
		Sir Ganga Ram Hospital
		Dr.Shroff's Charity Eye Hospital
		Guru Nanak Eye Centre, Delhi
		Sanjeevan Medical Research Centre (P) Ltd.
		Primus Super Speciality Hospital
6	South Delhi	Vardhaman Mahavir Safdarjung Hospital, Delhi
		G. M. Modi Hospital & Research Centre
		All India Institute of Medical Science, Delhi
		Indraprastha Apollo Hospital
		Moolchand K R Hospital

Sr. No	Name of the District	Referral Hospital (Government/Private)
7	South-West Delhi	V. P.S Rockland Hospital, Dwarka
		Indian Spinal Injuries Centre
8	West Delhi	Gandhi Hospital
		MGS Superspeciality Hospital
		Bhatia Global Hospital & Endosurgery Institute
		Action Medical Institute

Source: Report of Health Infrastructure in NCR, 2015

10.5.8 Issues and Challenges

- The NCT Delhi accounts for only two percent of the primary level facilities to the total number of primary level facilities (151) present in NCR. On the other hand in terms of tertiary level medical care i.e. district hospitals and multi-speciality hospitals, Delhi has a maximum number of 134 accounting to 85 percent of that of NCR.

- There are 260 dispensaries which do not have any inpatient facility but only observation beds.

- More than half of the private health facilities accounting for 56.5 percent of NCR are concentrated in the NCT-Delhi. The ratio of Government Hospitals to Private Hospitals in NCT Delhi is the highest in NCR region i.e. 1:4.8.

- As per the analysis of bed population ratio which has been done using IPHS norms for District Hospital i.e. 3.33 beds per 1000, the available bed population ratio in NCT Delhi is 2.53.

- In NCT Delhi, the proportion of beds is more in Government Hospitals than that of Private Hospitals. In government hospitals, occupancy rate in NCT-Delhi is the highest 72 percent in whole of NCR. Though the number of beds in private hospital and nursing home is comparatively lower than the government hospitals, yet the occupancy of beds in private hospitals is only 45 percent. It indicates that the facilities in private hospitals is highly underutilized.

- The number of health-care facilities under almost all categories (Hospitals, nursing home, maternity home, dispensary) fall short of the MPD-2021 provisions.

10.6 Policies and Proposals

- It is observed that contamination of drinking water, air pollution, congestion, adulteration of edible items, passive lifestyle and lack of cleanliness are some major reasons for health problems in NCT Delhi. Therefore, it is imperative to have a special emphasis on the preventive measures for creating a better healthy environment. It will also ease out the pressure on the health infrastructure and medical facilities to be provided in NCT Delhi. It is recommended that:

- The State Government should have a plan to take preventive measures immediately for the entire area of NCT Delhi. This plan should include the availability of clean drinking water, well laid drainage and sewer, complete removal of municipal waste and other

garbage from the roads and colonies, removal and treatment of biomedical and other waste, regular cleaning of roads, drains and other water bodies, regular vaccination of children and pet animals, removal of dairies and animal rearing from the urban areas, treatment of industrial waste, punitive actions against adulteration of edible items, complete closure and removal of air/water polluting industrial units, ban on garbage burning etc. to clean the environment.

- Food retails on roads and public places should be regularly checked by the concerned authorities and punitive action should be taken immediately as and when required.
- Air pollution control measures at the local and regional level should be implemented and enforced in every season to contain the air pollution leading to serious health in NCT Delhi.
- All water bodies in NCT Delhi have to be disinfected regularly to prevent the breeding and spread of insects which cause disease. Contamination of water should be prevented to contain the water-borne disease.
- Public health facilities such as dispensaries, local health centres, maternity homes, child welfare centres, etc to be provided in all areas. These facilities should act as health awareness centres for the local population especially in slums, unauthorised colonies, night shelters and other congested market areas.
- Number of beds required as per IPHS norms for District Hospitals 55,844, available number of beds is 42,467- thus the gap in number of beds is 13,377 (24 percent). Number of beds and their optimum utilization to be increased and ensured as per norms, both in public and private hospitals. Better utilization of beds in hospitals maybe ensured by way of rationalisation of bed and room tariff.
- The support facilities of accommodation to be provided for patient-caring persons near to the referral hospitals.
- The Government should ensure the availability of drugs, testing facilities, medical equipment for patients etc. at reasonable rates in the hospitals and nursing homes.
- Admission of patients in the hospitals should be through online procedure.
- Specialised hospitals and nursing homes should also be developed in other NCR towns to reduce the pressure of patients in the hospitals of Delhi.

CHAPTER 11. HERITAGE AND TOURISM

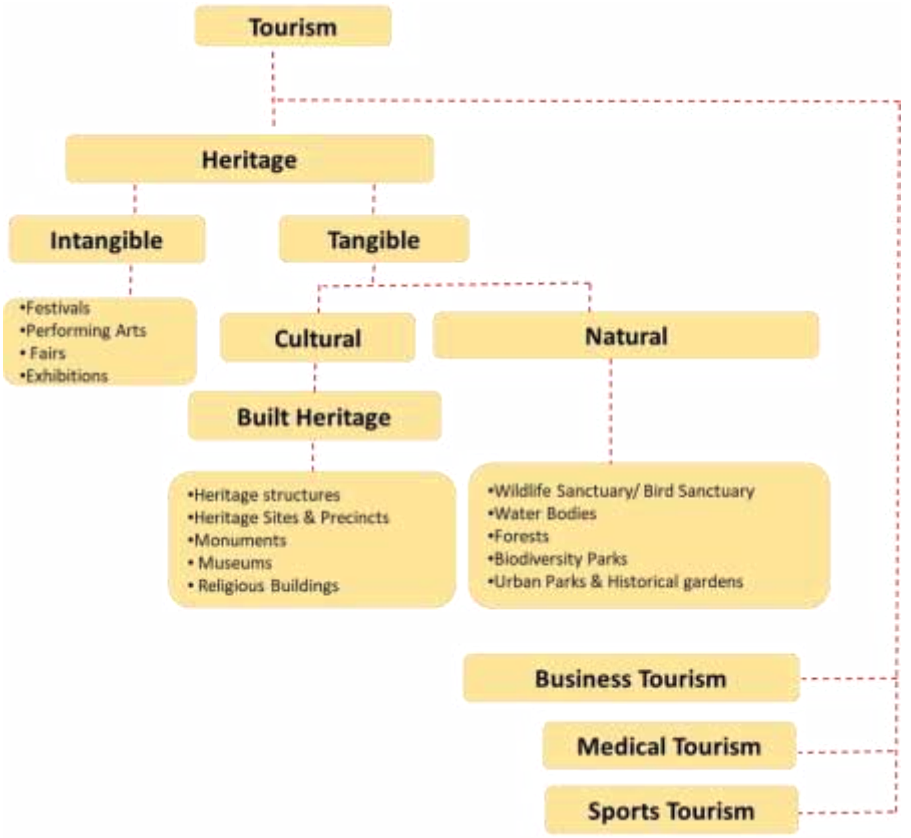
11.1 Introduction

Delhi is a metropolitan city with a large number of heritage structures of diverse ranges with unique tangible and intangible cultural, natural and man-made tourism sites of various historical periods. Central Government through Heritage Conservation Committee (HCC) and Archaeological Survey of India (ASI) and the State Governments through their respective State Department of Archaeology (SDA), Urban Local Bodies- MCD (EDMC, SDMC, NDMC), Cantonment Board, Tourism Department, Delhi Tourism and Transportation Development Corporation (DTTDC) and Non- Government organisations like INTACH and Aga Khan Trust are working to conserve, protect and create awareness about heritage assets of Delhi and boost tourism. citizen's organisations such as Pani Morcha, the Church of North India, Delhi University, and Residential Associations are also contributing in the endeavour of conservation and protection of heritage sites in their respective areas.

As per Master Plan of Delhi 2021, there are 1208 monuments which include protected heritage structures. Besides physical structures, there are historical gardens, water engineering structures and their catchments, the remains of fortified citadels, places for worship/tombs, historic cities/villages, unearthed heritage and their components and intangible assets. However, the ASI and other concerned agencies presently protect heritage sites of period up to 1947. Considering the city’s vast cultural heritage, there are innumerable historic buildings and precincts of architectural, historical and aesthetic importance that remain outside the status of recognition.

Delhi Tourism has the essential expertise for all meeting activities ranging from a small conference to a massive international convocation, with an array of aesthetically created meeting centres like our own Dilli Haats in Janakpuri, Pitampura and INA to the natural beauty of the idyllic Garden of Five Senses; from the massive Vigyan Bhawan to the Hotel Ashok; from the welcoming intimacy of the India International Centre and the Habitat Centre to huge interiors of the IG Indoor Stadium, the Talkatora Stadium and the opera hall sized Siri Fort Auditorium.

Tourism in Delhi is based on Heritage values which includes both tangible and intangible assets. Apart from this Business and Medical facilities also attracts tourists. The flow diagram below shows the relationship of tourism with heritage and others.



11.2 Historical Background

Historically, developments in Delhi took place in a triangular patch of land with River Yamuna on one side and the northern range of Aravalli hills on the other ~~two~~ sides. The wider regional importance of Delhi strategically stems from its location on an important trade route, the Uttarapatha that ran along the Gangetic plain and linked up to the Silk Route.

Archaeological findings have revealed continuous cultural layers from 3rd-4th BC to the Mughal Period. Lal Kot, the 1st city of Medieval Delhi was founded by the Tomar dynasty in 1060 AD. The Chauhans replaced the Tomars in the mid-12th centuary and extended Lal Kot to Qila Rai Pithora. Delhi grew to be the capital of an empire in the time of the Delhi Sultanate, with the establishment of Siri city, the 2nd city of Delhi. Ghiyasuddin Tughlaq (r. 1320-24), the first of the Tughlaq kings who followed the Khaljis built Tughlaqabad the 3rd city of Delhi. In AD 1326-27, Muhammad-bin-Tughlaq linked the older cities of Lal Kot and Siri with two walls to build the 4th city of Delhi, Jahanpanah. Firoz Shah Tughlaq (1351-1388) built Firozabad, the 5th city of Delhi, on the banks of River Yamuna. Unlike other dynasties that ruled from Delhi, the Sayyid (15th C) and Lodi Dynasties (mid 15th C) did not leave behind any particular city. Delhi was then intermittently the capital of the Mughal Empire (with a hiatus from the mid-16th to mid-17th centuries), Emperor Humayun, in AD 1533, built Dinpanah, the 6th city of Delhi. In AD 1639, Shahjahan shifted the Mughal Empire back to Delhi and the walled city of Shahjahanabad, the 7th city of Delhi was built. The British defeated the Marathas in AD 1803 and took over Delhi. In AD 1911, they moved their capital from Calcutta to Delhi and New Delhi was built to the south-west of the walled city, Shahjahanabad.

The British reign in Delhi also contributed to the Heritage canvas through typologies like the Central Vista, Colonial Bungalows, Rashtrapati Bhavan and the various colonial secretariats. After Independence New Delhi was officially declared the seat of Govt. of India and since then Delhi has witnessed tremendous expansion and growth around these seven cities.

1. Lal Kot (1060 AD)
2. Siri (1304 AD)
3. Tughlakabad (1321-23 AD)
4. Jahanpanah (Mid- 14Th century)
5. Firozabad (1354 AD)
6. Shergarh (1534 AD)
7. Shahjahanabad
8. New Delhi (1920)

11.3 Heritage & Tourism in Delhi

Tourism is an acknowledged driving force of economic growth. It has a strong potential for regional development and can become an efficient means for attracting resources to the region. Delhi's heritage houses the diverse range of natural and man-made built assets form Indraprastha (rule of Pandavas of Mahabharata fame) rein to contemporary British rule. The National Capital has numerous edifices of cultural, archaeological, historical, architectural, educational, economic, social and natural significances in forms of forts, monuments, tombs, historical precincts, cultural landscapes, religious structures, historical settlements, colonial architecture, natural parks, recreational facilities, urban cultural centers, etc. that is why it attracts a large number of tourists and visitors to the city.

Delhi is the potential hub of connectivity and destination to most of the tourist circuit and destinations in the Northern Plains as it strategically connects to rest of the pan northern areas and popular and remote destinations by virtue of its logistical facilities and compatible visitor infrastructure. Delhi is already an established destination of the golden tourism triangle of Delhi-Agra-Jaipur. Delhi also acts as international and national tourism transit destination for the tourists bound to Jammu & Kashmir, Rajasthan, Uttarakhand and Himachal Pradesh, thus establishing it as the tourism gateway to northern India with immense potential and opportunities which can be exploited for the benefit of the NCR.

In the NCT Delhi, the following two circuits have been identified for integrated development:

- *Circuit 1:* Heritage circuit covering the heritage monuments and structure in the NCR
- *Circuit 2:* Religious circuit, covering the important places of worship such as Akshardham, Bahai Temple, Jama Masjid, Nizamuddin Dargah, Gurudwara Bangla Sahib, etc.

Qutub Minar, Red Fort and Humanyun's Tomb are the rich cultural Heritage in the city and are listed as World Heritage Monuments by UNESCO. Tourist destinations like Purana Qila, Jantar Mantar, Safdarjung tomb, Bahai temple, Raj Ghat, Lodhi Garden etc. are also frequently visited by the domestic and foreign tourists as these sites have good supporting infrastructure.

11.3.1 Top Tourist Destination in Delhi

The number of visits to each destination under study was either obtained from the tickets sold (for ticketed destinations) or determined through an enumeration. The study for the annual report was conducted by the Department of Delhi Tourism in 2010. The top destinations have been mentioned in Table 11.1.

Table 11.1:Top 10 destination in Delhi by number of Visits in 2010

S. No	Top 10 Tourist Destination	Domestic	Foreign
1	Qutub Minar	23,94,097	2,70,519
2	Red Fort	24,17,688	1,40,717
3	Delhi Zoo	15,17,689	15,826
4	Pragati Maidan	12,82,058	67,604
5	Dilli Haat- INA	10,70,757	69,372
6	Jama Masjid	8,71,332	1,26,172
7	Akshardam Mandir	6,16,666	81,987
8	Lotus Temple (Bahai Temple)	6,27,096	89,635
9	Hazrat Nizam-ud-din shrine	5,74,817	1,41,390
10	Raj Ghat	3,91,745	67,892
	Total	**1,17,63,945**	**10,71,114**

Source: Tourism survey of Delhi, Annual Final Report, Ministry of Tourism, New Delhi, 2010
Note: May refer to the observations of DTTDC in the Annexure N for the smaller tourist circuits with one to four days' trip within the sub-region to promote tourism by DTTDC

11.3.2 Tourism Trend and Arrivals

Following are the domestic and foreign tourist visits to Delhi as reported by the Ministry of Tourism on the basis of data provided by the State Government.

Table 11.2: Domestic and Foreign Tourist visits to Delhi

S. No.	Nationality	2004	2005	2006	2007	2008
1	Indian	18,66,552	20,61,782	22,37,130	23,88,330	21,32,970
2	Foreign	8,39,574	15,11,893	19,74,836	20,18,848	23,39,287
3	Total	**27,06,126**	**35,73,675**	**42,11,966**	**44,07,178**	**44,72,257**

Source: Tourist Statistics, Ministry of Tourism, New Delhi, 2010

11.3.3 Existing Situation- Tourism

Delhi is among the top tourist destinations in the country. The number of domestic tourists visiting the state had been rising continuously. It grew from 18.49 million in 2012-13 to 22.62 million in 2014-15. The latest survey conducted by NSSO (72nd round, 2014-15) on tourism illustrated that the majority of tourists (95 per cent) visited Delhi. This clearly reveals that tourism has a huge potential for employment generation. There are an increasing number of medical tourists also to take advantage of its world-class hospitals in Delhi.

The schemes of Tourism Department, Government of NCT of Delhi have been implemented by the Delhi Tourism and Transportation Development Corporation (DTTDC), an undertaking of the GNCTD incorporated in 1975 to promote tourism in Delhi. DTTDC organize the smaller tourist circuits with one to four days trip within the sub-region to promote tourism by DTTDC. Smaller tourist circuits with one to four days trip enhanced the local heritage and boost more tourism in Delhi & NCR region with an enriching cultural experience. Heritage has become the mainstay of Indian tourism and will only gain strength in future. Heritage typologies can be broadened up as Archaeological Parks/ sites, Religious complexes, Dargarhs of Delhi, Villages of Delhi, Historic Gardens, Unprotected Heritage, Shahjahanabad, Lutyens Delhi and Water Harvesting Structures. The survey conducted by the DDA and INTACH identified 1208 historical monuments. The numbers of monuments under the jurisdiction of each body are as follows: -

ASI	174
MCD	767
Central Public Works Department	20
NDMC	141
State Archaeological Department	6

Source: Compilation on Heritage of Delhi, HCC

Table 11.3 : The listing of monuments and sites according in ASI

As per Delhi Circle, ASI Total – 174 (Monuments + Sites)	
As per National Monument Authority Categorization: -	
Category I	13
Category II	24
Category III	15
Category IV	03 (total 10 in which 3 are listed in Category I and 4 listed in Category II and III)
Category V	1
Category VI	3
Category VII A	18
Category VII B	24
Category VII C	1
Category VIII	
Heritage Zones	53
Arch. Parks	7
Total Monuments Classified in Eight Categories	**162**
Missing/Untraceable	11
De-notified	1
Total Notified Monuments	**174 (Monuments + Sites)**

Source: National Monuments Authority, Government of India Ministry of Culture

11.3.4 Man-Made Heritage

The NCT- Delhi comprises various man-made heritage sites and protected monuments/ ancient remains. These protected monuments and sites are visited by tourists from all over India and abroad. The centrally protected monuments are maintained by Archaeological Survey of India (ASI) in the sub-region under the Act as "The Ancient Monuments and Archaeological Sites and Remains (Declaration of National Importance) (AMASR) Act, 1958. ASI protects 171 monuments of national importance in Delhi.

National Monument Authority (NMA) rested with the responsibility of protection and preservation of monuments and sites through management of the prohibited and regulated area around the centrally protected monuments.

The various cities within Delhi were built as capitals of the ruling dynasty at different times in response to very specific social, political and cultural catalysts. Two of these, the walled city of Shajahanabad and New Delhi remain intact as traditional human settlements of outstanding universal significance Moreover, the organic growth of the city in the centuries following its establishment has reflected the assimilative tendencies in Indian society— with various religious

sects, occupational and ethnic groups finding space within the city without any one being privileged over the others. New Delhi, built between 1913 and 1931, exhibits an interaction of a different sort. Two traditional Western trends —The American 'City Beautiful' and the British 'Garden City' movements, were blended with the peculiar needs of British colonialism in India. It is Delhi's surviving historic urbancape comprising four precincts of Mehrauli, Nizamuddin, Shahjahanabad and New Delhi that still have an outstanding universal significance, that are being proposed for nomination as a World Heritage City.

56. Heritage Zones

Heritage Zone is an area, which has significant concentration, linkage or continuity of buildings, structures, groups or complexes united historically or aesthetically by plan or physical development.

As per the MPD-2021-the following areas have been identified as Heritage Zones:

x. Heritage complex within Walled City of Delhi, Shahjahanabad.
xi. Heritage complex within Lutyens Bungalow Zone.
xii. Heritage complex within Nizamuddin and Humayun's Tomb Complex.
xiii. Heritage complex within Mehrauli area.
xiv. Heritage complex within Vijay Mandal - Begumpur - Sarai Shahji - Lal Gumbad.
xv. Heritage complex within Chirag Delhi. However more areas can be added to this list based on studies by concerned agencies.
xvi. 'Imperial Cities of Delhi' in UNESCO's list of World Heritage Cities.
xvii. *Lodi Garden – Safdarjung Tomb
xviii. *Deer park-Green park

* Additional categories suggested by NMA

57. Archaeological Park

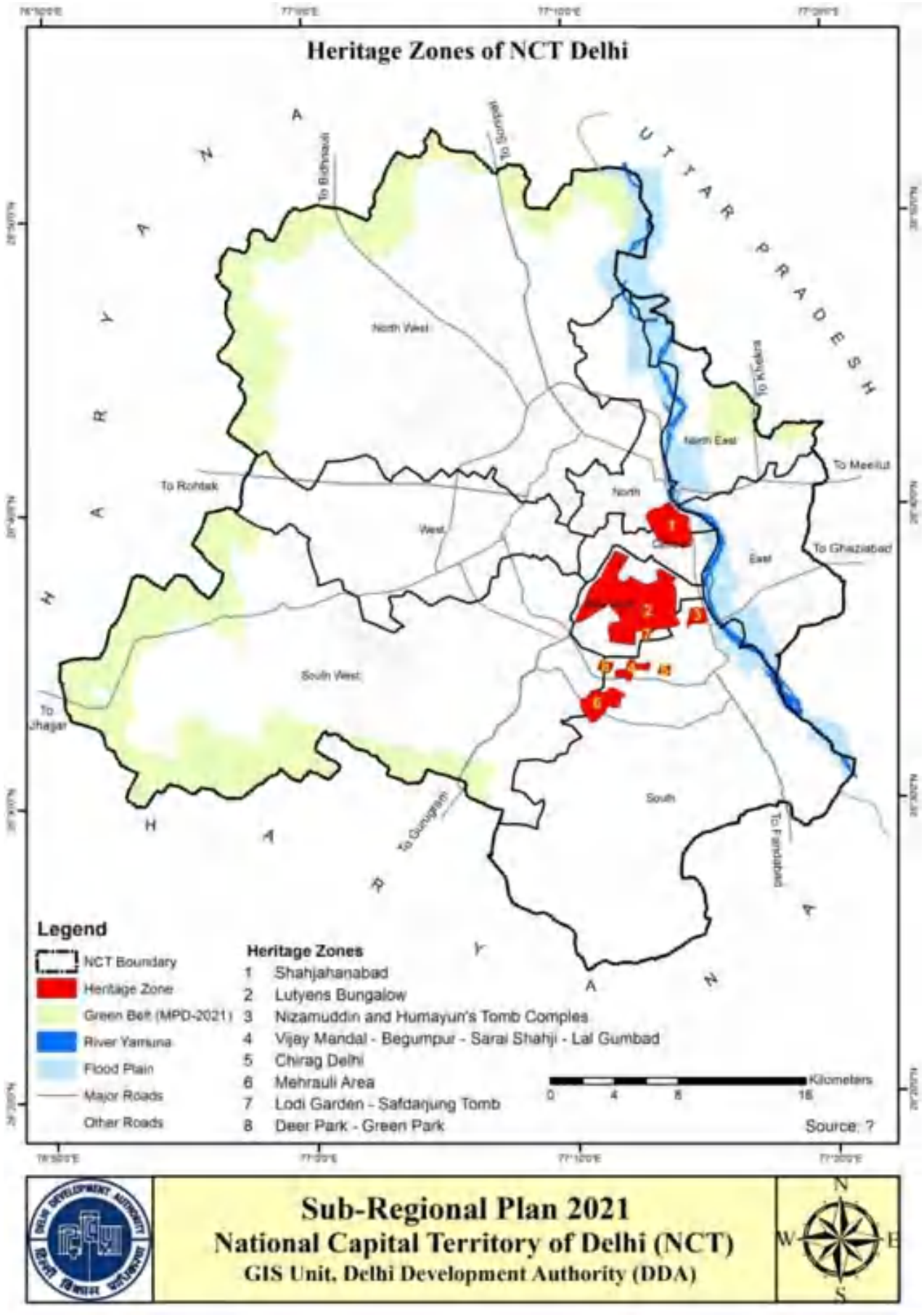
Archaeological Park is an area distinguishable by heritage resource and land related to such resources, which has potential to become an interpretive and educational resource for the public in addition to the value as a tourist attraction. All decisions regarding Built Heritage in general and Archeological Parks in particular should be based on evaluation of the pertinent aspects like form and design, materials and substance, use and function, traditions and techniques, location and setting, spirit and feeling and other internal and external factors.

As per the MPD-2021-the following areas have been designated as Archaeological Parks:

vi. Mehrauli Archaeological Park.
vii. Tughlaqabad Archaeological Park.
viii. Sultan Garhi Archaeological Park.
ix. *Purana Qila (Indraprastha) Archaeological Park
x. *Northern Ridge Archaeological Park

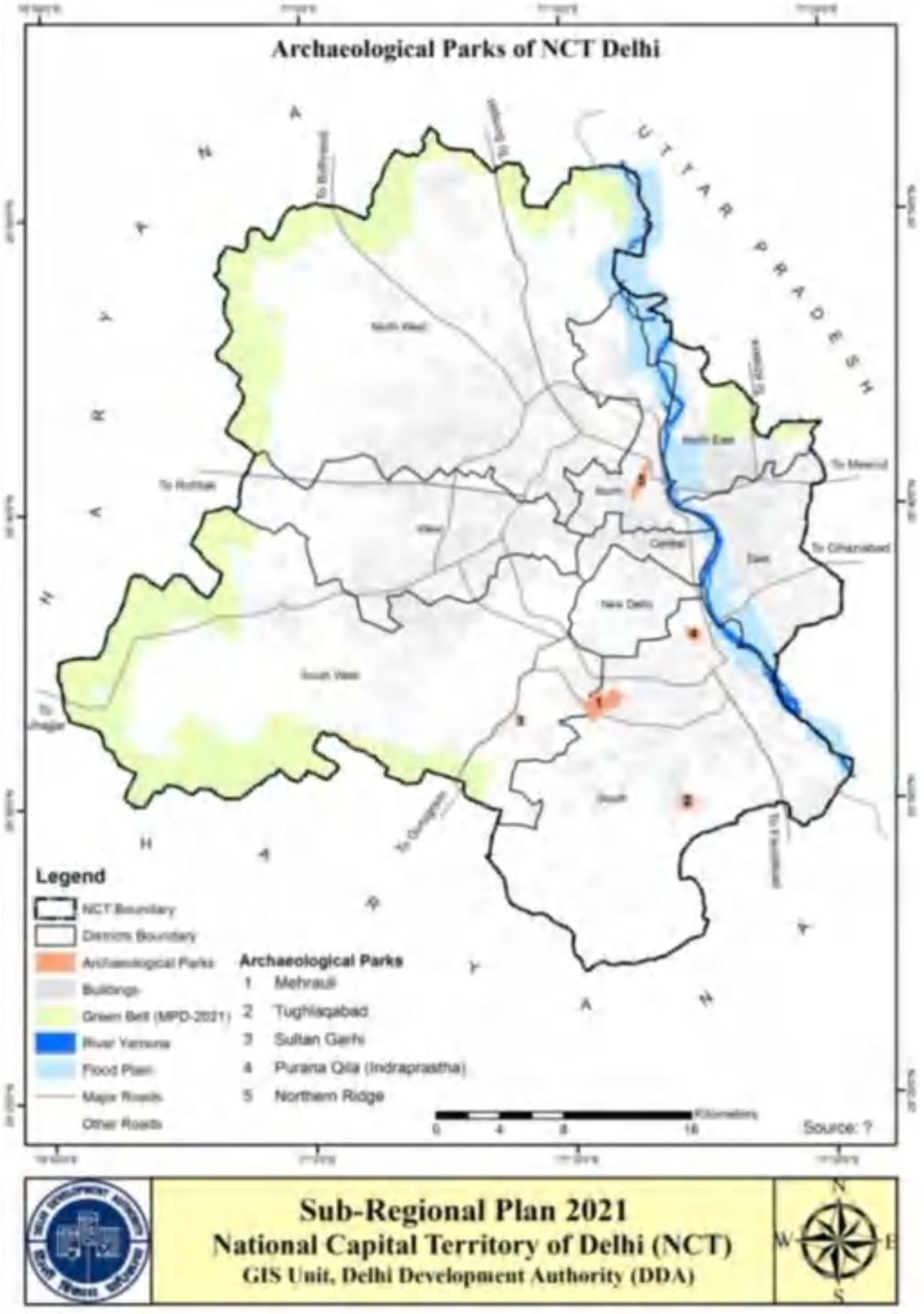
*Additional Archaeological Parks suggested by NMA

Figure 11.1: Location of Heritage Zones



Source: National Monument Authority

Figure 11.2: Location of Archaeological Parks



Source: National Monument Authority

58. Natural Heritage (Eco-Tourism Sites)

To be include in the list of Natural Heritage the site must have values such as superlative natural phenomena; demonstrate significant ecological and biological processes and contain important natural habitats. Accordingly following areas with natural features have been identified as Natural Heritage sites:

- River Yamuna
- Delhi Ridge
- Naturally or constructed Baolies/ Water Bodies/ wetlands/ Lakes
- Forests/ Urban Parks/ Biodiversity Parks/ Heritage Gardens
- Eco- Sensitive Zone - Asola Bhatti wildlife sanctuary (Indira Priyadarshani Sanctuary), okhla Bird Sanctuary

11.3.5 Business Tourism

Delhi has an attractive real estate market and is a preferred tourist destination owing to its location, connectivity. The Government of Delhi has been committed towards creating a progressive business environment. The new Industrial Policy 2010-21 aims to provide a conducive environment for knowledge-based and hi-tech IT/ITeS industries in Delhi. The real estate market in Delhi is lucrative and attracts investors from India and abroad. Owing to the advanced infrastructural base, the city meets the requirements of a profitable investment. Real estate sector contributed around 28.49 per cent to Delhi's Gross State Value Added (GSVA) in 2018-19. (India Brand equity Foundation)

11.3.6 Medical Tourism

Medical tourism can be broadly defined as provision of 'cost effective' private medical care in collaboration with the tourism industry for patients needing surgical and other forms of specialized treatment. The world class medical facility is being facilitated by the corporate sector involved in medical care as well as the tourism industry - both private and public. The popular medical tourism destinations include India, Brunei, Cuba, Columbia, Hong Kong, Hungry, Jordan, Malaysia, Singapore, South Africa, Thailand and USA etc.

Delhi as the Medical tourism hub refers to traveling to other countries to obtain medical and surgical treatment. Medical tourism is relevant and a reality today because of exorbitant costs of healthcare in industrialized nations, ease and affordability of international travel, favorable currency exchange rates in the global economy, rapidly improving technology and standards of care with modern medical treatments in many countries of the world, and most importantly proven safety of healthcare in select foreign nations

Medical Tourism – The industry catering to patients seeking care outside of their home region. Includes health care, but also collateral consumer activities (travel, accommodations, recreation).

Medical Travel – "Patients traveling outside of their home region in pursuit of care that is more accessible, of higher quality, and/or lower cost." Focus is primarily on the health care.

Popular Medical Treatments- Delhi multi-specialty hospitals under study provide medical treatment for a wide range of simple and complex medical problems. Cardiac, Orthopedics, Neurology, Oncology, Organ Transplant, Eye Surgery and Tumour treatment are some of the popular medical treatments undertaken by the patients visiting Delhi-NCR hospitals. Patients are

also found to be coming to Delhi for Spine treatment, Hip Surgery, Bone Marrow Transplant, ENT, Hernia, Gastroenterology, Diabetes and Hypertension.

The key competitive strengths reported are economy in costs, big brand hospitals, qualified doctors, availability of all kinds of medical treatments, high tech procedures, online consultancy, less waiting time for treatment, good infrastructure and hygiene and cleanliness. However, patients faced challenges in finding good interpreters /translators, obtaining visas, getting insurance covers, problems are also faced by them in respect of follow ups and monitoring care, behavior of tour operators, corruption, differential pricing policies and inadequate lodging arrangements.

The Govt. of India, tour and travel operators, hotels, private sector hospitals are channelizing their efforts and resources to capitalize on this opportunity by making India emerge as a preferred destination for medical services. On the one hand, medical tourists come to India for rejuvenation and relaxation therapies offered by Yoga and Ayurveda. On the other, it is becoming popular for its low cost, hi-tech world class medical facilities in multi-specialty hospitals by teams of dedicated and highly qualified professionals. Delhi appears among the first five most popular destinations for medical tourism in India.

11.3.7 Sports Tourism

Sports tourism is based on the theme of sports. It refers to a specific travel outside the usual environment for either passive or active involvement in competitive sport. Sport is the primary reason for travel whereas the leisure element may reinforce the overall experience. Another school of thought explains it as a combination of sports activities and travel wherein it consists of two broad categories.

- **Active Sports Tourism-** Travel for the purpose of participating in a sport, leisure or recreational activity.
- **Passive Sports Tourism-** Travel for the purpose of visiting a sport, leisure or recreational activity or an event.

General benefits of sports tourism create economic growth through filled hotels, restaurants and retail, creates new product, a new tourism destination, maximizes facility use in community, builds community relationships and strengthens corporate support, creates youth opportunity/ entertainment, attract high-yield visitors, develop new infrastructure, generate increased rate of tourism growth or a higher demand.

Table 11.4: Delhi has hosted the following major international sports championships and multi-sports events

Sports Name	Year
1st -Asian Games	1951
9th -Asian Games	1982
Asian Athletics	1989
AFC Challenge Cup	2008
Commonwealth Games	2010
Field Hockey World Cup	2010
Formula One – Motorsports – Greater Noida	2011

Source: Sports Authority of India

Owing to New Delhi's developed infrastructure and transportation, the Indian government has always given it a top priority while hosting sporting events like the two Asian Games (1951 and 1982) and Commonwealth Games 2010.

With booming interest among sports enthusiasts to explore their interests in different sport fields encouraging tie-ups with Delhi tour operators, Delhi has emerged as a Sport Tourism destination and which boost overall tourism in the country.

Major Sports events such as Asian games, Commonwealth Games have helped in the development of stadiums, sport complexes, Sport colleges and academies and other infrastructure like roads, flyovers, under passes, bridges, hotels etc. in the different parts of NCT- Delhi. This enhances the levels of facilities and infrastructure of the city which ultimately help in growth of tourist activities in the region.

11.4 Legal Framework

Recent amendments in the Ancient Monuments and Archeological Sites and Remains (Amendment and Validation) Act,2010 has made it mandatory to identify the prohibited and regulated areas around centrally protected monuments that will help in regulating the surrounding areas of protected monuments.

11.4.1 Prohibited and Regulated Areas

As per Section 20 A and 20 B of the Act of 2010, every area, beginning at the limit of the protected area or the protected monument, as the case may be, and extending to a distance of one hundred meters in all directions shall be the prohibited area in respect of such protected area or protected monument. Provided that the central Government may, on the recommendation of the Authority, by notification in the Official Gazette, specify an area more than one hundred meters to be the prohibited area having regard to the classification of any protected area.

11.4.2 Regulated Area

Every area, beginning at the limit of prohibited area in respect of every ancient monument and archaeological sites and remains, declared as of national importance and extending to a distance of 200 meters in all directions shall be regulated area in respect of every ancient monuments and archaeological sites and remains.

11.4.3 Heritage Bye-Laws

As per Section 20 A and 20 B of the Act of 2010, The competent authority, in consultation with the Indian National Trust for Arts and Cultural Heritage (INTACH), being a trust registered under the Indian Trusts Acts, 1882, or such other expert heritage bodies as may be notified by the Central Government, shall prepare heritage bye-laws in respect of each protected monument and protected area. The Heritage bye-laws include matters relating to heritage controls such as elevations, facades, drainage systems, roads and service infrastructure (including electric poles, water and sewer pipelines. The Central Government shall, by rules specify the manner of preparation of detailed site plans in respect of each protected area or protected monument or prohibited area or regulated area, the time within which such heritage bye-laws shall be prepared and to be included in each such Heritage bye-laws.

11.5 Issues and Challenges

- Systematic identification and delineation of Heritage Assets have never been collated on a single database and as a result overview of heritage status never emerged.
- Overlapping of data between the three-line agencies in Delhi (namely ASI, Dept. of Archaeology, GNCTD and ULB lists). Often results in ambiguity in the applicability of the buffer zones and clarity on Acts applicable on the monument.
- Encroachments and unplanned development along the heritage precincts like Shahjahanabad, Mehrauli and Tughlaqabad are many due to their close proximity to unauthorized colonies, slum areas, urban villages.

11.6 Policies and Proposals

Delhi represents the aura and splendor of different historical periods, with its entire landscape dotted with magnificent forts, mosques and tombs. Huge potentials of Delhi are remarkable not only for its antiquity but also their diversity. Estimation of number of visitors coming to Delhi- NCR and to analyse the trend of tourism is the basis for framing policies and proposals in Delhi. Following are the several prospects in the region which should be utilized for tourism enhancement:

11.6.1 General Policies and Proposals for Heritage and Tourism

1. Preparations of detailed heritage and tourism plan for:
    - Built heritage structures
    - Natural Heritage areas
2. Analyse tourism impact and incorporate appropriate policies and regulations in the plan.
3. Plan should provide smart heritage improvements and environmental up-gradations.
4. Eco-tourism should be encouraged and promoted
5. Social and cultural activities, exhibitions and fairs should be organized in and around the heritage areas for local, national and international audiences.
6. Education, health and medical, business and recreational facilities of international standards should be promoted and developed in the NCT-Delhi.
7. The Government and Authorities should take appropriate actions to enhance the image of the capital city as a secure, safe, clean and attractive city.

11.6.2 Heritage Zone

- Delineation and demarcation of Heritage Zones should be carried out as a part of Master Plan/ Zonal Plan.
- Conservation of each Heritage Zone should be an integral part of the Master Plan/ Zonal Plan.

11.6.3 Heritage Villages

Delhi has some villages which have played an important role in evolution of Delhi as a capital city and have heritage buildings & structures. These villages represent the traditional life styles and values of the region. The process of urbanisation some of these villages have also experienced the transformation from agriculture-based economy to urban activities. These

villages can be identified as “Heritage Village” for the purpose of conservation development & maintenance for heritage buildings and structures and village tradition.

11.6.4 Heritage Sites and Circuits

- Heritage sites and heritage circuits for tourism should be identified for different heritage zones, Heritage Villages with different historical eras.
- Marketing and promotion of the heritage sites and heritage circuits should be identified.
- Development of tourism infrastructure facilities and utilities all along the identified heritage circuits must be ensured.
- Security and safety of tourists must be ensured.
- Cultural activities must be promoted and utilized for tourism purposes.
- Vulnerable heritage structures should be identified and restored in a scientific manner.
- Development of urban design features: Urban arts, Landscaping of roads, park/ playgrounds and other open spaces, Signage and street furniture.

CHAPTER 12. ENVIRONMENT

12.1 Environmental Setting

Unprecedented scale and speed of urbanization in Delhi and consequent pressure on physical and social infrastructure has created damaging stress on the living environment and resulted in environmental degradation in Delhi. Delhi has become one of the most polluted cities in India in terms of air pollution, carrying one of the country's highest volumes of particulate matter pollution in its funnel. Increase in the number of vehicles in Delhi is far faster than construction of roads. Besides large-scale construction activity, the problem of air pollution gets aggravated due to Agriculture burning in the NCR and neighbouring states which do not favour dispersion of air pollutants. It is also evident that Delhi's Environment is highly influenced by different meteorological phenomena. In summer, the particulate is influenced by dust storms from Rajasthan and in winter by calm conditions and inversion as well as biomass burning in NCR.

12.1.1 Forest

The term 'Forest Area' (or recorded forest area) refers to all the geographic areas recorded as 'Forests' in government records recorded forest areas largely consist of reserved Forests (RF) and Protected Forests (PF), which have been constituted under the provisions of the Indian Forest Act, 1927.

The Indian Forest Act, 1927, defines three categories of forests:

- *Reserved forests:* Those are under the direct supervision of the government and no public entry is allowed for collection of timber or grazing of cattle.
- *Protected forests:* that are looked after by the government, but the local people are allowed to collect fuel-wood/timber and graze their cattle without causing serious damage to the forests.
- *Unclassified forests:* are those in which there is no restriction on the cutting of trees and grazing of cattle.

The total reserved and protected forest in NCT of Delhi is 102 sq km which is 6.88% of geographical area according to the Indian State of forest report, 2019.

Reserved Forest

Delhi Ridge which is the rocky outcrop of Aravalli hills in Delhi has been notified as Reserved Forests under Section 4 of the Indian Forest Act, 1927. The Delhi ridge is categorized as the Regional Park in the MPD-2021. Spread over an area of 7777 Ha. It forms the "green lung" of urban Delhi. It provides the increasingly polluted capital with oxygen as well as absorption of pollutants, it blocks the dust and hot winds ('loo' that sweep across the city in summer), and it acts as a massive sound insulator of the city.

The Ridge in Delhi is an extension of the Aravalli hills that enter Gurgaon from south and sprawl towards north of Delhi in the form of a tableland. Besides the ridge, pockets of protected and unclassified forests also house as bird sanctuaries act as city forests. The total recorded forest area in Delhi and the ridge constitutes 76.5 percent.

Table 12.1 : Distribution of Ridge (Reserved Forest) in Delhi

S. No	Ridge Forest	Approximate Area in Ha.	Proportion of different parts of Ridge (in %)
1	Northern Ridge Forest	87	1.13
2	Central Ridge Forest	864	11.1

3	South- Central Ridge Forest	626	8.05
4	Southern Ridge Forest	6200	79.72
	Total	**7777**	**100**

Source: MPD- 2021

Southern Ridge is least urban as compared to the other portions of the forests and consists of the eco-sensitive zone of Asola Bhatti wildlife sanctuary and also Tilpath valley Biodiversity Park.

The recorded forest area in the state is 102. Sq.km of which 78 sq km(7800 Ha) is Reserved Forest as per the Indian state forest report 2019.

Protected Forests

Delhi has been notified as Protected Forests under Section 29 of the Indian Forest Act, 1927 vide Notifications as mentioned against each. There are 26 protected forests within NCT-Delhi, spread over a total area of 1658 Ha (Department of Forest) and constituting about 0.1 percent of NCT's area. (Annexure D) provides details of the areas in Delhi that have been notified as Protected Forests.

The recorded forest area in the state is 102. Sq.km of which 24 sq.km is protected Forest as per the Indian state forest report, 2019

Unclassified Forest

The Department of Forests, GNCTD has raised plantations on the gram sabha and other government lands and maintained them as City Forests. (Annexure E) provides details of old and new city forests in Delhi. Many of these are likely to be notified as Protected Forests in order to ensure their preservation. NCT- Delhi has considerably increased tree cover. Forest Department in its state report of 2019 has included the information related to the increase in the area under Forest and tree cover from 1993 to 2019 as shown in the following table.

Table 12.2 :Forest and Tree Cover Area of Delhi 1993- 2019

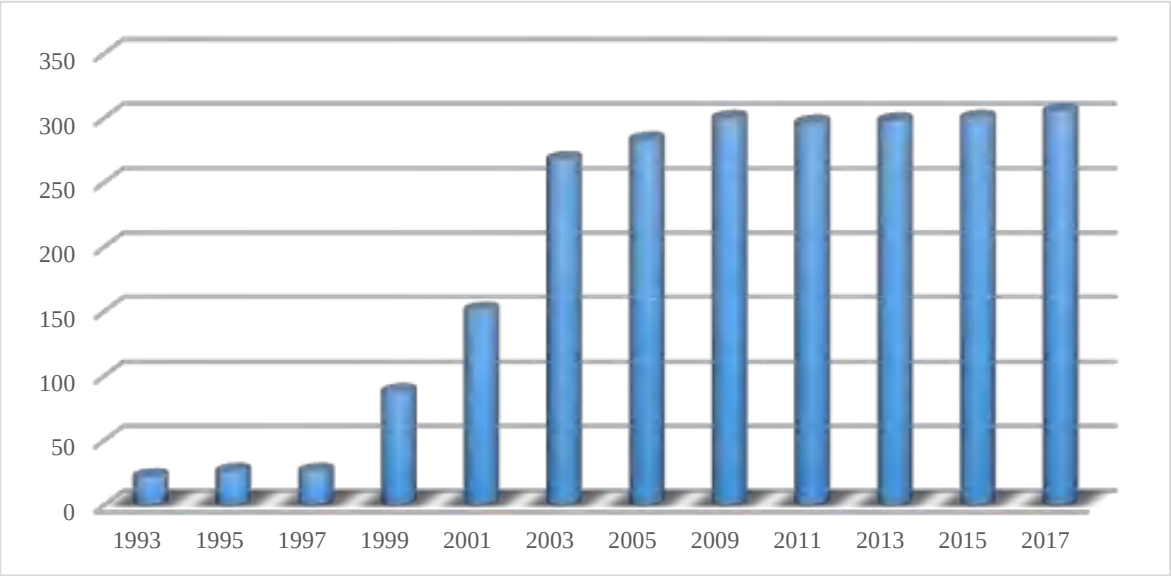
Year	Forest and Tree Cover (Sq. Km)	Absolute Increase In Area	% of Total Area Sq. Km
1993	22		1.48
1995	26	4	1.75
1997	26		1.75
1999	88	62	5.93
2001	151	63	10.2
2003	268	117	18.07
2005	283	15	19.09
2009	299.58	16.58	20.2
2011	296.2	-3.38	19.97
2013	297.81	1.61	20.08
2015	299.77	1.96	20.22
2017	305.41	5.64	20.59
2019	**324.44**	**19.03**	**21.88**

Source: State Forest Report, 2019

As a result of the initiatives taken by the Government of NCT-Delhi, forest and tree cover area has been increasing steadily since 1993.The forest and tree cover area increased to 305.41 sq. km

in 2017 from 22 sq.km in 1993. Resulted in increase of forest area from 1.48 sq.km in 1993 to 20.59 sq.km in 2017 increasing thereby the share of forests in the total area to 20.59 per cent.

Figure 12.1 Change in Forest and Tree Cover Area of Delhi 2015- 2019



Source: State Forest Report, 2019

It also may be mentioned that trees had to be felled because of construction projects such as the metro and road widening. But at the same time, afforestation drives were also undertaken. The new plants have not been accounted for as they are too small. They would only come under the medium dense forest or very dense forest after a period of five to 10 years at least. Forest land has been diverted for construction of various projects in the period 2016-17 to 2019-20. Details of diversion of land is attached as Annexure - O

Table 12.3 District- Wise Forest Cover in Delhi 2019

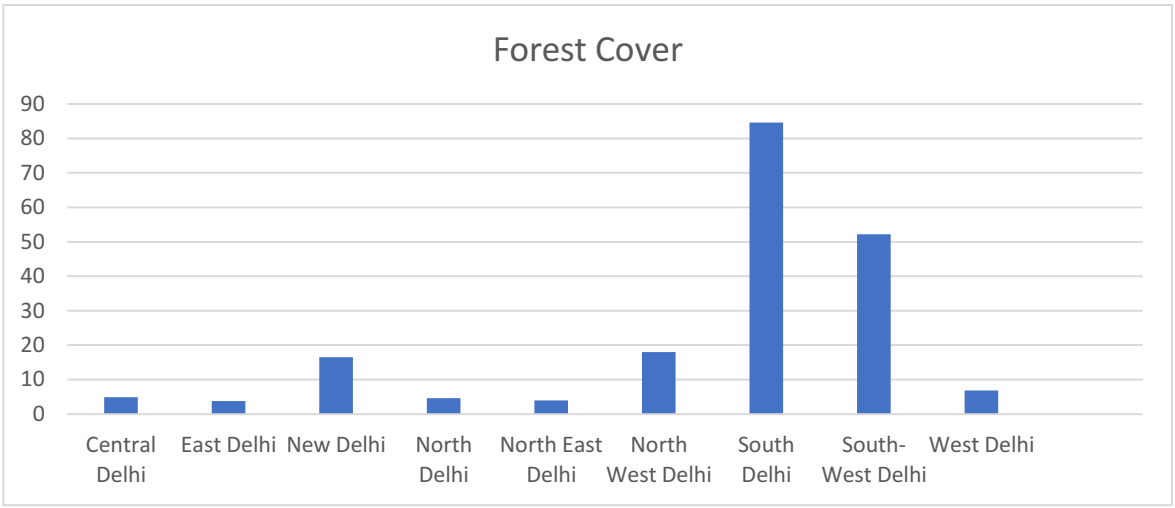
S. No	Districts	Geographical Area	Forest Cover Area	% of Geographical Area
1	Central Delhi	21	4.94	23.52
2	East Delhi	63	3.75	5.95
3	New Delhi	35	16.47	47.06
4	North Delhi	61	4.58	7.51
5	North East Delhi	62	3.99	6.44
6	North West Delhi	443	18.04	4.07
7	South Delhi	247	84.63	34.26
8	South- West Delhi	421	52.19	12.40
9	West Delhi	130	6.85	5.27
	Total	1483	195.44	13.18

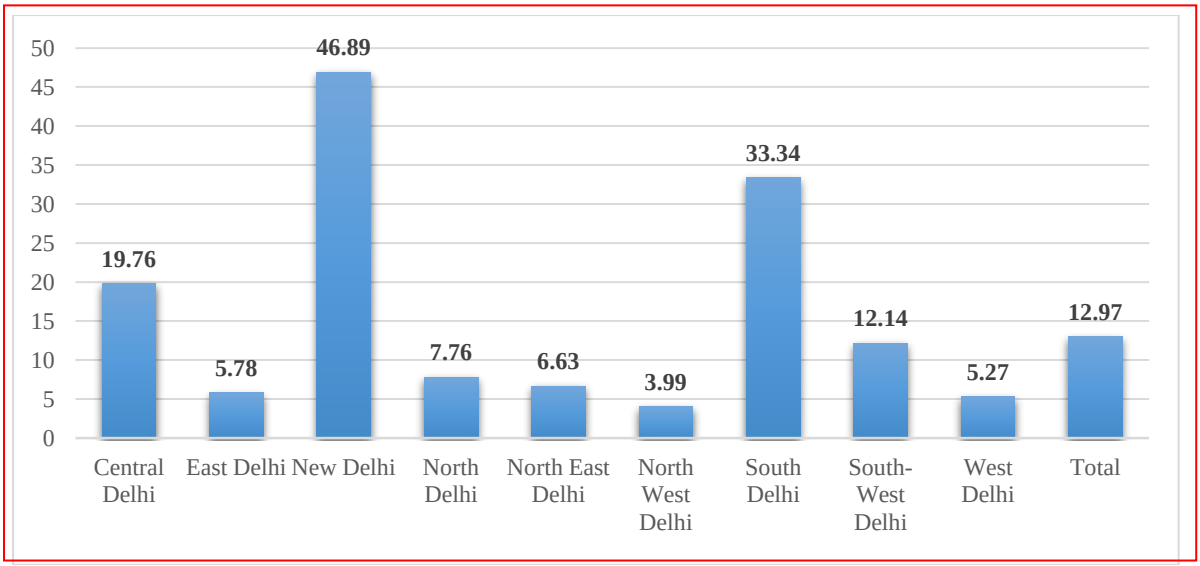
S. No	Districts	Geographical Area	Forest Cover Area	% of Geographical Area
1	Central Delhi	25	4.94	19.76
2	East Delhi	64	3.7	5.78
3	New Delhi	35	16.41	46.89
4	North Delhi	59	4.58	7.76
5	North East Delhi	60	3.98	6.63
6	North West Delhi	440	17.55	3.99
7	South Delhi	250	83.35	33.34
8	South- West Delhi	421	51.1	12.14
9	West Delhi	129	6.8	5.27
	Total	1483	192.41	12.97

Source: State Forest Report, 2019

It is inferred from the above table that South Delhi constitutes the highest forest cover area of (84.63sq. km), South West Delhi (52.19sq. km), North West Delhi (18.04sq. km), and New Delhi (16.47 sq. km) (16.41 sq. km) respectively. The lowest forest covers observed in East Delhi (3.75 sq. Km.) (3.70 sq. Km.) district-wise percentage forest cover in Delhi is also depicted in Table 12.3 and Figure 12.2.

Figure 12.2: District- Wise percentage Forest Cover of Geographical Area in Delhi 2019





Source: State Forest Report, 2019

As per record of Department Plantation achievement by Forest Department during the period from 2011-12 to 2019-20 is attached as Annexure P

12.1.2 Nature Conservation Zone

As per the Regional Plan 2021, "*The major natural features, identified as environmentally sensitive areas, are the extension of Aravalli ridge in Rajasthan, Haryana and NCT-Delhi, forest areas, the rivers and tributaries of Yamuna, Ganga, Kali, Hindon and Sahibi, sanctuaries, major lakes and water bodies such as Badkal lake, Suraj Kund and Damdama in Haryana Sub-region and Siliserh lake in Rajasthan etc. These areas have been demarcated as Natural Area Conservation Zone in the Regional Plan-2021".* Similarly, ground water recharging areas such as water bodies, lakes and paleo-channels have also been demarcated. These areas will further be detailed out in Sub-regional Plans and Master Plan/ Development Plans. Policies for these zones be further elaborated and implemented to preserve and develop the natural conservation zones. It is proposed that:

i. The extension of the Aravalli Ridge, sanctuaries and other ecologically sensitive areas be conserved with utmost care and afforested with suitable species. The development in this

area is in accordance with the notifications issued for such areas by the Ministry of Environment and Forests under the Environment (Protection) Act, 1986 from time to time.

ii. In view of the very low existing forest cover (4.02 percent), it is imperative to bring more areas under forest to maintain the ecological balance in this region. Accordingly, all wastelands identified in the existing Land use 1999 and proposed Land use Plan 2021, ROW of irrigation canals, drains, roads, railway lines and village common lands are proposed to be brought under forest cover. The total forest cover proposed to be 10 percent of the total area of the region.

iii. The areas under water bodies, lakes and paleo- channels and their surrounding areas as shown in the Ground Water Rechargeable Areas to be kept free from encroachment/ development to allow free flow of water. Construction activities for human habitation or for any other ancillary purpose thereto should not be permitted. Suitable measures should be taken to maintain the water bodies with the minimal flow/ water level.

iv. In the flood prone areas/river beds/banks, construction or habitation activities should not be permitted. Flood Protection Plan is prepared by the concerned state Government/ Agencies. Policies proposed in the Disaster Management plan should be further elaborated in the Master plan and flood protection Plans.

v. Detailed conservation plans should be prepared for the areas shown as Natural Area Conversation Zone in the Land use plan 2021.

vi. The monument/ man-made heritage sites and heritage areas should be identified in the Master/ Zonal Plans and detailed conservation plans be prepared for their protection and conservation.

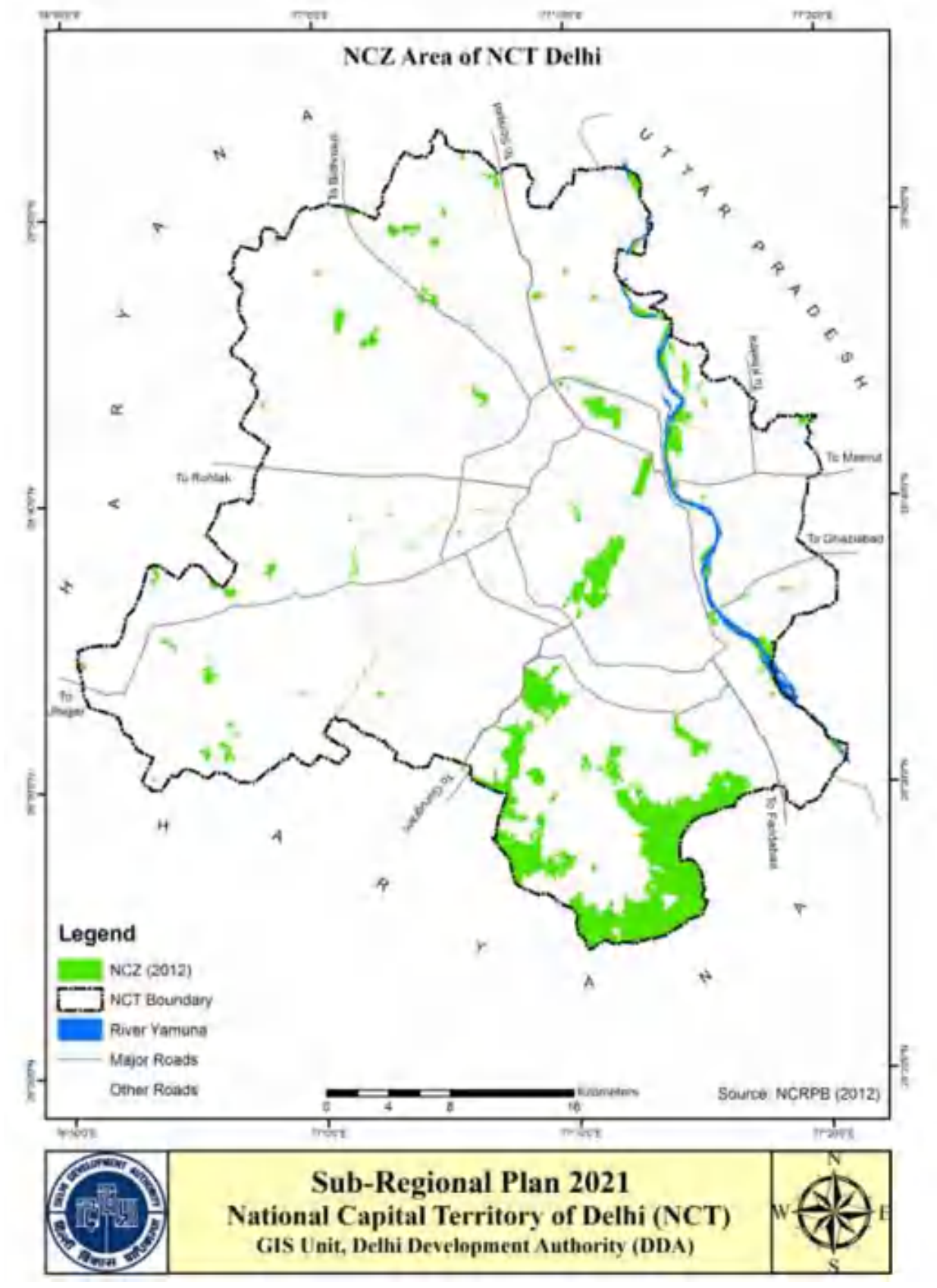
GNCTD obtained a satellite imaginary through NCRPB indicating the NCZ area and superimposed these areas on the approved Land use Plan of MPD-2021. It shows the variation of Nature Conservation Zone in the year 2005, 2012 and 2019. The Natural conservation Zone area in NCT- Delhi in year 2005 was 15437 Ha, whereas it reduced to 13054.63 Ha in year 2012. After the tabletop exercise conducted by DDA the area in 2012 was 10,668.3 Ha and in 2019 it comes out to be 10,213.5 Ha. The list of NCZ pockets are placed in (Annexure-F)

However, there are more potential areas available in NCT-Delhi that can be designated under the Nature Conservation Zone. Following are the Natural features that can be designated under Nature Conservation Zones are:

1. Foothills of Aravalli (Delhi Ridge)
2. Watercourse Corridors- Drains & Canals (Man-Made and Natural), Wetlands (Najafgarh Wetland), Bhalaswa (OX- Bow Lake), Water Bodies
3. Woodlands, Forests (Reserved, protected, other forests), National Parks and Sanctuaries
4. Environmentally sensitive/ significant areas
5. Areas of Natural and Scientific Interest (Biodiversity Parks, Areas with endangered species- Flora & Fauna
6. Biosphere Reserves
7. City Green Belt

8. Planned Greens (Parks, Gardens, Heritage/ Cultural Sites)

Figure 12.3: Nature Conservation Zone NCT- Delhi



Source: NCRPB

12.1.3 Eco- Sensitive Zone

Eco-Sensitive Zones are the special areas identified by the Ministry of Environment, Forests and Climate Change (MoEFCC) under Environment Protection Act, 1986. The Notification provides for prohibition of mining, stone quarrying and crushing units located within one km of Protected Areas. Also, in absence of ESZ Notification, an area of 10 Km around the Protected Areas is considered as default ESZ as per the directions of Hon'ble Supreme Court. These areas ECZ require special protection because of natural landscape, wildlife, natural historical values etc and the new activities in any category may not be encouraged in areas which falls in the ESZ identified and notified by MoEFCC as to maintain the carrying capacity of that zone.

The aim is to regulate certain activities around National Parks and Wildlife Sanctuaries to minimise the man-animal conflict and avoid negative impacts of harmful activities on the fragile ecosystem encompassing the protected areas.

59. Activities Allowed in ESZs:

- ***Prohibited activities:*** Commercial mining, saw mills, industries causing pollution (air, water, soil, noise etc), establishment of major hydroelectric projects (HEP), commercial use of wood, Tourism activities like hot-air balloons over the National Park, discharge of effluents or any solid waste or production of hazardous substances.
- ***Regulated activities*****:** Felling of trees, establishment of hotels and resorts, commercial use of natural water, erection of electrical cables, drastic change of agriculture system, e.g. adoption of heavy technology, pesticides etc, widening of roads.
- ***Permitted activities:*** Ongoing agricultural or horticultural practices, rainwater harvesting, organic farming, use of renewable energy sources, and adoption of green technology for all activities.

As on 25.06.2019, final ESZ Notifications covering 316 Protected Areas and Draft ESZ Notifications covering 199 Protected Areas have been published by the Ministry of Environment, Forest and Climate Change (MEF&CC). According to the State-wise details of ESZ listing, Asola Bhatti Wildlife Sanctuary categorized under ESZ.

60. Asola Bhatti Wildlife Sanctuary

The sanctuary was established in 1992 to protect the wildlife between Delhi and Haryana Border. It stretches across 13.2 sq. kms consisting of a tract of degraded land opposite the infamous Bhatti mines close to Haryana border. It encompasses the wastelands of Asola, Maidan Garhi and Shaurpur.

The main function of the sanctuary is to create a natural buffer and arrest environmental deterioration. The major problems of the area are inadequate groundwater reserves, extraction of fuel wood by villagers, illegal quarrying and mafia elements safeguarding the interests of quarry owners. The Department of Forests and Wildlife, Government of National Capital Territory of Delhi (GNCTD) and Bombay Natural History Society (BNHS) have set up conservation education centres within Sanctuary to create environment education & awareness among its visitors. Apart from the areas designated as Wildlife Sanctuary (ECZ), there are some sensitive ecosystems, which need to be protected for environmental improvement of NCT-Delhi like Okhla Bird Sanctuary.

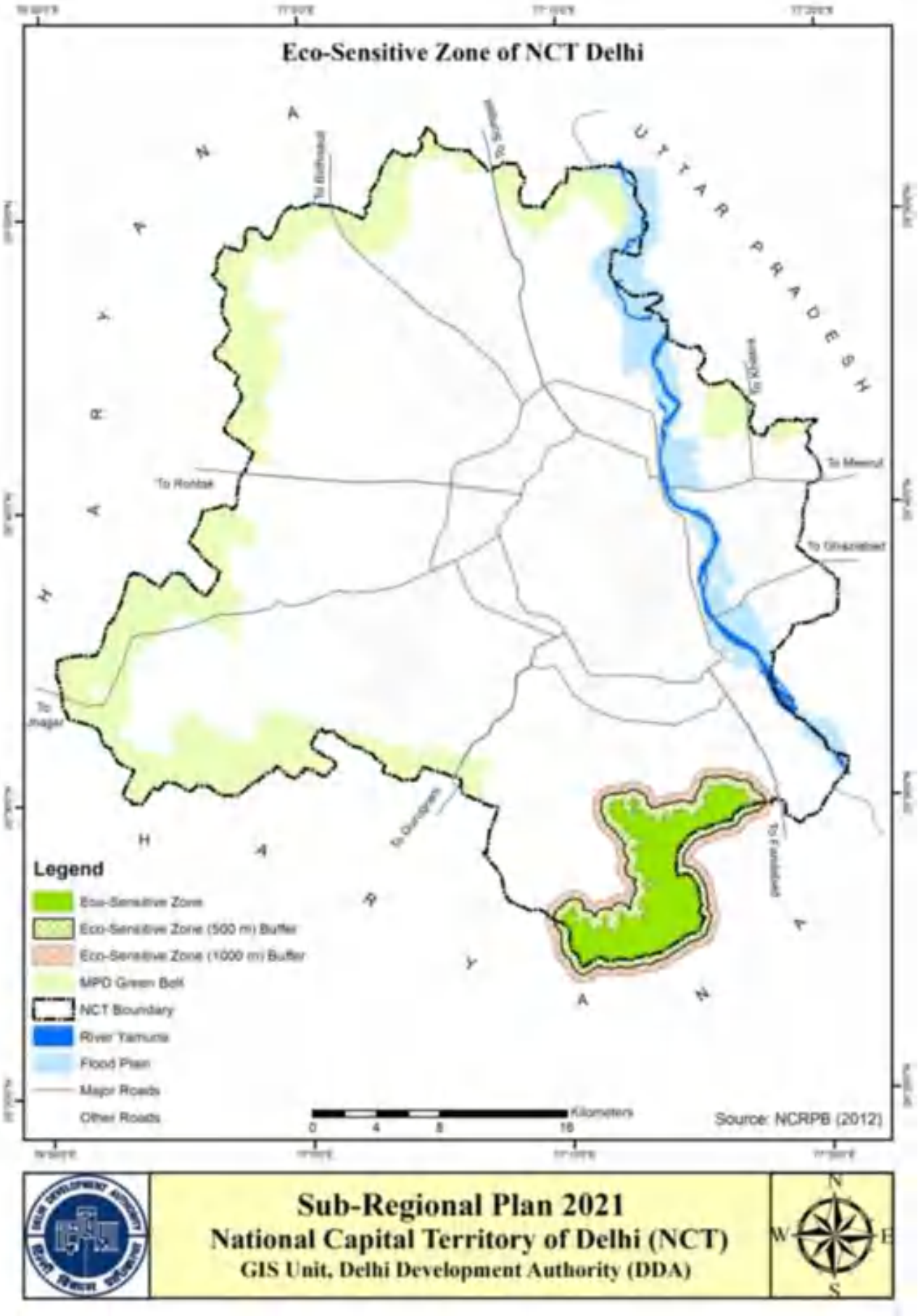
61. Okhla Bird Sanctuary

The Okhla Bird Sanctuary is known for its aquatic habitat of large number and variety of migratory and resident birds (about 324 species of about 6000 birds) have been listed during winters and the important birds that visit the sanctuary includes different species of Cormorants, Herons, Egrets, Darter, Koot, Ducks, etc. The Central Government considers that the Okhla Bird Sanctuary is located in the National Capital Region (NCR) at the point where the river Yamuna leaves the territory of the National Capital Territory of Delhi and enters the State of Uttar Pradesh and whereas, the boundaries of Okhla Bird Sanctuary are as follows:

- North: The Okhla Weir and Okhla Weir Bund forms the Northern boundary of the Sanctuary; River Yamuna and Hindon Cut enter the sanctuary from the section close to Delhi Noida Direct flyover but there is no entry to the flyover from this side;
- South: The Okhla barrage Tie Bund, Amrapali Marg (a road that connects Delhi and Noida) and Shahdara drains forms the Southern boundary, and most of this boundary is fenced
- East: Left afflux bund forms the Eastern boundary. The left afflux Bund is the dyke that prevents water from entering the nearby areas, and it is 2.5 kilometres long and is used as a road;
- West: The right Marginal Bund forms the western boundary of the sanctuary and this bund is protected partly by a fence and partly by a wall

It is necessary to conserve and protect the area around the sanctuary and to propagate improvement. It has become necessary to conserve and protect the area up to one hundred meter from the eastern, western and southern boundary and up to 1.27 kilometres from the northern boundary of the Okhla Bird Sanctuary as an Eco-sensitive Zone from ecological and environmental point of view and to prohibit any commercial mining activities within one kilometre area from the eastern, western and southern boundary.

Figure 12.4: Eco- Sensitive Zone NCT- Delhi



Source: ESZ Notification, 2017

12.1.4 Biodiversity Parks

Delhi is hub of migratory birds and the urban greens like Biodiversity potential rich areas acts as a stepping stones for conservation of Biodiversity, that seeks to preserve the biodiversity of any habitat that is likely to be converted into urban infrastructure, to conserve keystone species and other threatened plant and animal species, establish field gene banks for threatened land races and wild genetic resources, promote education on environmental awareness and nature conservation, establish native communities of the Aravalli hills and the River Yamuna basin particularly of the Delhi region, develop mosaic of treatment and catchment wetlands that not only improve the water quality of untreated sewage but also sustain the rich aquatic flora and fauna of the Yamuna and monitor short term and long term changes in the ecology of the Delhi region.

The Biodiversity Parks are unique landscapes that serve as nature reserves of Delhi and harbor hundreds of native plants, animals and microbial species living in ecologically sustainable biological communities and rendering ecological services to metropolis. These Biodiversity Parks are first of their kind in the world and serve as innovative models for conserving the natural heritage under the matrix of urban development.

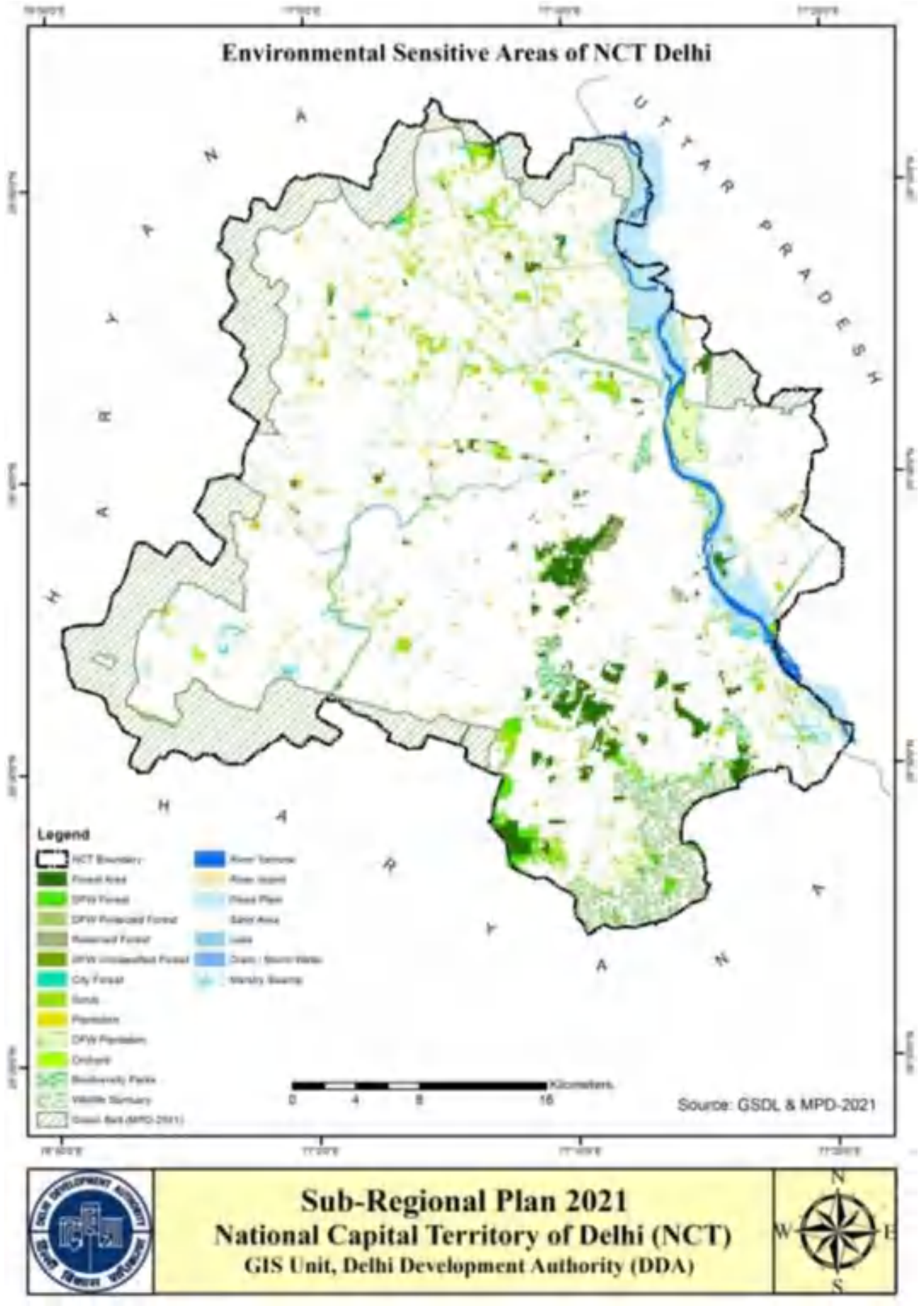
Total six numbers of Biodiversity Parks have been notified by Delhi Development Authority, of which two are fully functional and others are being developed.

- Yamuna Biodiversity Park
- Aravalli Biodiversity Park
- Kamla Nehru Ridge Biodiversity Park
- Tilpath Valley Biodiversity Park
- Neela Hauz Biodiversity Park
- Tughlaqabad Biodiversity Park

Biodiversity Parks act as heritage sites and repositories of the approximately 50, threatened communities of the Yamuna river basin and Aravalli hills, provide ideal alternative habitats for migratory and resident bird species, enhance groundwater recharge, impound floodwaters and augment fresh water availability, act as sinks for CO2 and other pollutants, ameliorate local weather conditions and buffer ambient temperatures, promote eco-tourism and social connectivity across the urban community, serve as gene pools, and represent unique ecological models possessing not only wildlife and natural values but also aesthetic, environmental and educational values.

Under the DDA Act 1957 with a view to safeguard, conserve, preserve and manage the ecological, aesthetical and cultural values of Biodiversity sites in the National Capital Territory of Delhi, the Delhi Biodiversity Foundation is set up by Delhi Development Authority in exercise of its powers under section 5-A of the ACT and sets Delhi Biodiversity Foundation Regulations (Amendments 2015)

Figure 12.5: Environmental Sensitive areas of NCT-Delhi



Source: Author

12.2 Yamuna Flood Plain

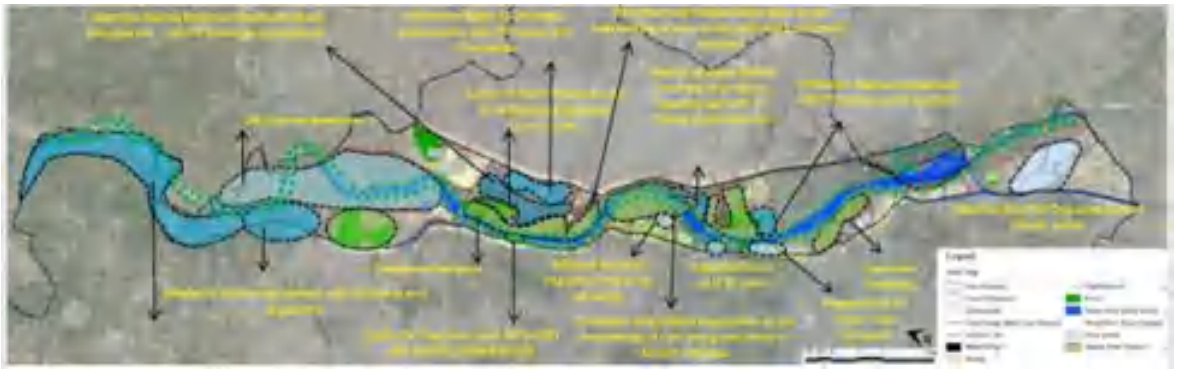
River Yamuna in Delhi is about 50 kms in length with floodplains having a width of 1.5 to three kms. The total area of active floodplain including river bed is about 97 sq. km. of which about 16.5 sq. km. is under water and the remaining 80.5 sq. km is water logged or has very shallow water tables. In addition, the river floodplain, now jacketed between left and right main embankments, consists of deposits of new alluvium with depth to bedrock of over 100 m and contains mainly fresh water up to a depth of 50 mbgl. The older alluvium lies below this and consists of clayey silt containing mainly saline water.

Figure 12.6: River Yamuna O Zone

Source: Zonal Development Plan Zone-O

The Planning Zone 'O' comprises the Yamuna and most of its flood plains. As per the Zonal Development Plan, Zone 'O' has been divided into eight sub-zones while all nine categories of land use are permitted in the Zone, the actual development has deviated significantly from the planning norms. Figure 12.7 shows the proposed comprehensive plan of eight zones and Table 12.4 summarizes the status of current development in each sub-zone.

Figure 12.7: Proposed comprehensive plan of eight zones



Source: Landscape department, DDA

Table 12.4: Land use in the 'O' Zone (text marked in blue indicates non-conformant to planning norms)

Sub-Zone	Description of Area	Existing characteristics/ Developments in Zone 'O'	
		Western Bank	**Eastern Bank**
1	NCTD Boundary to Wazirabad Barrage	Agriculture, Biodiversity Park, Jagatpur Village, Wazirabad Village, Monuments, **Unauthorized colonies**, Wazirabad Waterworks, Ghats.	Agriculture, water works Facility centre, CRPF Camp, Delhi Police Firing range, **Unauthorized colony.**
2	Wazirabad Barrage to ISBT Bridge	**Unauthorized Colonies, Unauthorized Religious Structures,** CNG station, Bathing Ghat.	220 KV Electric Sub -station, water Ponds, Grass Farms, Marshes, Gurudwara & Agriculture.
3	ISBT Bridge to Old Yamuna Rail cum Road Bridge	Nigambodh Ghat, **Unauthorized Growth of Yamuna Bazaar**, Salimgarh Fort, Ghats, ESS.	**Unauthorized colony,** Agriculture, DMRC Depot, IT Park, PSP Site.
4	Old Yamuna Bridge to ITO Barrage	Electric Crematorium, Vijay Ghat, Shanti Van, Shakti Sthal, Raghat, Gandhi Darshan, I.G. Stadium Complex, Power House, Delhi Secretariat, Fly Ash Brick Plant.	Agriculture, Cremation Ground.
5	ITO Barrage to Nizamuddin Rly Bridge	IP Power House, Gas Turbine Power House, **STP**.	Agriculture, Forest, Site for DMRC Depot & Station.
6	Nizamuddin Rly Bridge to NH 24	**Fly Ash Pond,** Fly Ash Brick Plant.	Agriculture, PSP (Public and Semi Public) Site, Akshardham Temple Parking, CWG Village Complex.

Sub-Zone	Description of Area	Existing characteristics/ Developments in Zone 'O'	
		Western Bank	**Eastern Bank**
7	NH24 to Okhla Barrage	Electric Crematorium, Rajiv Gandhi Smriti Van, **Unauthorized Petrol Pump, Unauthorized Encroachment,** ESS, UGR, **Unauthorized Colonies.**	Agriculture
8	Okhla barrage to NCTD Boundary	Unauthorized Colonies, Water Body, Agriculture, **Madanpur Khadar Resettlement Scheme, LPG** bottling plant.	Agriculture & water Body

Source: Landscape department, DDA

Almost 25 percent of the flood plain has been built-up as indicated in the Zonal Development Plan (Zone O). Out of the remaining 75 percent of the floodplain area, some are developed/ to be developed by DDA as planned greens such as the Yamuna Biodiversity Park, Golden Jubilee Park. There are areas demarcated for compensatory afforestation and wetlands. The flood plains have massive infrastructural structures running across such as the several Bridges, Metros and Railway lines. There has been a significant increase in the road construction over the years acting as embankments. However, it is uncertain whether these would survive a 100- year flood event.

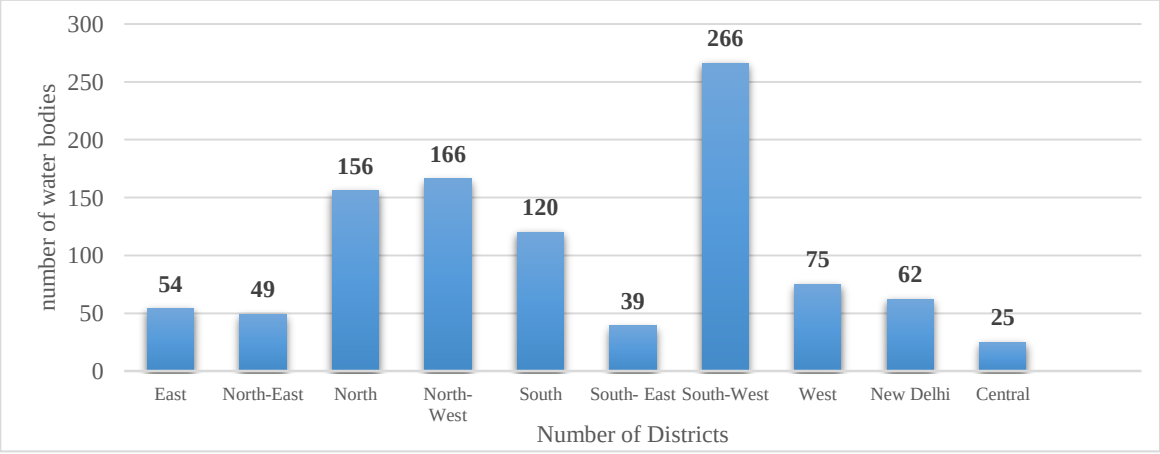
Major drains are draining into the River Yamuna and acts as a disposal ground for sewer and other municipal waste. River Yamuna is highly stressed by the pollution loads it receives 84 percent of the total BOD load through major drains and rest through canals. Due to poor river quality there is an urgent need to rejuvenation of the River Yamuna.

12.3 Water Bodies

12.3.1 Existing status of water bodies

The water bodies are one of the most productive ecosystems and play a crucial role in the hydrological cycle. They provide services such as storm and flood control, clean water supply, food, scenic beauty, educational and recreational benefits and are natural groundwater recharge area.

Figure 12.8 : District wise distribution of water bodies in NCT Delhi



Source: Delhi Parks and Garden Society,2012

Table 12.5 District wise status of water bodies in NCT Delhi

S. No.	Districts	Total Water Bodies	Traced	Non-Traced	Dry	Wet	Encroachment	Built Up
1	East	54	52	2	25	3	3	16
2	North-East	49	47	2	13	2	2	9
3	North	156	149	7	82	52	49	8
4	North-West	166	157	9	46	81	23	11
5	South	120	108	12	34	31	29	28
6	South-East	39	11	28	3	2	2	5
7	South-West	266	245	21	110	91	36	16
8	West	75	70	5	18	36	21	10
9	New Delhi	62	45	17	15	0	0	0
10	Central	25	21	4	3	11	0	0
	Total	1012	905	107	349	309	165	103

Source: Delhi Parks and Garden Society, 2012

There are total 1012 number of water bodies in NCT- Delhi, out of which 905 numbers are traced and 107 are non-traced, 349 are dried, 309 are wet and 165 are encroached and 103 water bodies have been constructed upon.

12.4 Air Pollution

The Hon'ble Supreme Court on 25.11.2019 expressed its anguish on the situation of pollution in Delhi. The Hon'ble Supreme Court said that *"Delhi has become worse than narak (hell). Life is not so cheap in India and you will have to pay. How much do you value a person's life?" The court asked the Delhi government, saying that it has "no right to be in the chair".*

The court's comments on air pollution in the national capital region were just as scathing. "Why are people being forced to live in gas chambers? It is better to kill them all in one go, get explosives in 15 bags at one go. Why should people suffer all this? Instead, a blame game is going on in Delhi.

This observation of the Hon'ble Supreme Court clearly indicates the grave situation of increasing air and water pollution in the NCT- Delhi.

Delhi's geography with high rate of transportation and stubble burning in neighboring states- all play a role in making the region a gas chamber, equally the weather conditions like wind speed and direction play a role which has no control, Smog is the final condition coming up. Smog is formed during periods of high pressure in winter, caused by the cooler air that tends to descend; solar radiation hits the ground and warms it. This warm air rises and ends up acting as a lid when, in the absence of cloud cover on clear winter nights, the ground loses heat rapidly and the air in contact with the ground becomes cooler. This cold air is trapped close to the ground by the warm air that had risen above. The pollution from different sources like vehicles, industries, stubble burning etc. is trapped close to the ground and becomes more and more polluted. This accumulation and trapping of pollutants affects not only Delhi, but the entire belt from Punjab to West Bengal in the east, which turns into an inverted "bowl" that collects pollutants.

Acknowledging the Trans boundary impact of air pollution, actions are also proposed for evolving effective regional and global coordination mechanisms.

A study by IIT Kanpur states that the two most consistent sources for PM10 and PM2.5 are secondary particles and vehicles. Secondary particles themselves are generated by industry and vehicles. Road dust contributes significantly in the summer. The EPCA report indicates that particles from coal and diesel are more harmful than windblown dust.

12.4.1 Ambient Air Quality

The ambient air quality in NCT- Delhi is monitored by Central pollution control Board (CPCB), State Pollution Control Board/ Pollution control committees and Environment Pollution (Prevention & Control) Authority under the National Air Quality Monitoring Program (NAMP). Under NAMP, CPCB has selected four pollutants for regular monitoring at all designated monitoring stations that are: Sulphur Dioxide (So2), Oxides of Nitrogen (NOx), PM10, PM2.5

Table 12.6 National Ambient Air Quality standards (NAAQS), 2009

S. No	Pollutant	Time Weighted average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically sensitive area (notified by Central Govt.)	Methods of Measurement
1	Sulphur Dioxide (SO2), µg/m3	Annual*	50	20	• Improved West and Geake • Ultraviolet fluorescence
		24 hours**	80	80	
2	Nitrogen Dioxide (NO2), µg/m	Annual*	40	30	• Modified Jacob & Hochheiser (NaArsenite) • Chemiluminescence
		24 hours**	80	80	
3	Particulate Matter (size less than 10 µm) or PM10µg/m3	Annual*	60	60	• Gravimetric • TOEM • Beta attenuation
		24 hours**	100	100	
4	Particulate Matter (size less than 2.5 microns) or PM2.5 µg/m3	Annual*	40	40	• Gravimetric • TOEM • Beta attenuation
		24 hours**	60	60	
5	Ozone (O3) µg/m3	8 hours **	100	100	• UV photometric • Chemiluminescence • Chemical method
		1 hour **	180	180	
6	Lead (Pb) µg/m3	Annual*	0.5	0.5	• ASS / ICP method after sampling on EPM 2000 or equivalent filter paper • ED – XRF using Teflon filter
		24 hours**	1	1	
7	Carbon	8 hours **	2	2	Non Dispersive Infra-

S. No	Pollutant	Time Weighted average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically sensitive area (notified by Central Govt.)	Methods of Measurement
	Monoxide (CO) mg/m3	1 hour **	4	4	RED (NDIR) Spectroscopy
8	Ammonia (NH3) µg/m3	Annual*	100	100	• Chemiluminescence • Indophenol blue method
		24 hours**	400	400	
9	Benzene (C6H6) µg/m3	Annual*	5	5	• Gas chromatography based continuous analyzer • Adsorption and desorption followed by GC analysis
10	Benzo (a) Pyrene (BaP) – particulate phase only ng/m3	Annual*	1	1	Solvent extraction followed by HPLC / GC analysis
11	Arsenic (As) ng/m3	Annual*	6	6	AAS / ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni) ng/m3	Annual*	20	20	AAS / ICP method after sampling on EPM 2000 or equivalent filter paper

Source: Central Pollution Control Board

National Air Quality Index notified by the government which classifies air quality of a day considering criteria pollutants through color codes, air quality descriptor along with health advisory which is as follows.

Table 12.7 :National Quality Index

S. No	AQI Category (Range)	PM 10 24- hr.	PM 2.5 24- hr.	NO2 24- hr.	O3 8- hr.	CO 8- hr. (mg/m3)	SO2 24- hr.	NH3 24- hr.	Pb 24- hr.
1	Good (0-50)	0-50	0-30	0-40	0-50	0-1	0-40	0-200	0-0.5
2	Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.5- 1.0
3	Moderately polluted (51-100)	101-250	61-90	81-180	101-168	2.1-10	81-380	401-800	1.1-2.0
4	Poor (51-100)	251-350	91-120	181-280	169-208	17-Oct	381-800	801-1200	2.1-3.0
5	Very Poor (51-100)	351-430	121-250	281-400	209-748*	17-34	801-1600	1200-1800	3.1-3.5

S. No	AQI Category (Range)	PM 10 24- hr.	PM 2.5 24- hr.	NO2 24- hr.	O3 8- hr.	CO 8- hr. (mg/m3)	SO2 24- hr.	NH3 24- hr.	Pb 24- hr.
6	Severe (51-100)	430+	250+	400+	748+	34+	1600+	1800+	3.5+

Table 12.8 :Likely Health Impacts

S.No	AQI	Associated Health Impacts
1	Good (0-50)	Minimal impact
2	Satisfactory (51-100)	Minor breathing discomfort to sensitive people
3	Moderately polluted (51-100)	May cause breathing discomfort to the people with lung disease such as asthma and discomfort to people with heart disease, children and older adults
4	Poor (51-100)	May cause breathing discomfort to the people on prolonged exposure and discomfort to people with heart disease.
5	Very Poor (51-100)	May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases.
6	Severe (51-100)	May cause respiratory effects even on healthy people and serious health impacts on people with lung/ heat diseases. The health impacts may be experienced even during light physical activity.

Source: Central Pollution Control Board

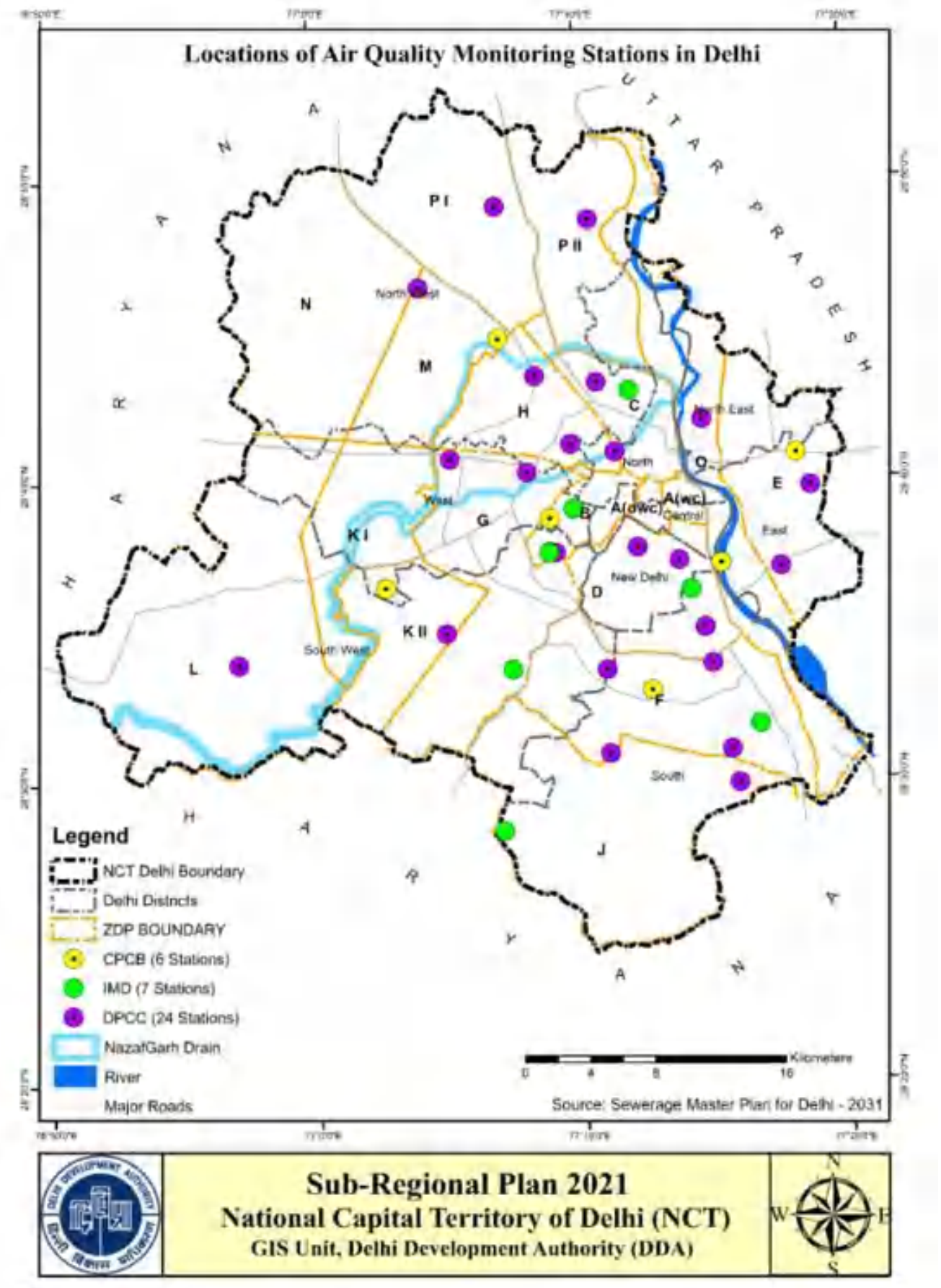
The number of stations monitoring air quality in the city increased to 37 from the existing 17that will enhance the understanding of the issue of air pollution and help with exploring more data to understand the air quality in Delhi. The list of 37 monitoring stations is shown in Table 12.9 and locations of all the monitoring stations are shown in Figure 12.9.

Table 12.9 : List of Air Quality monitoring stations in Delhi

1. Alipur, Delhi - DPCC	2. NSIT Dwarka, Delhi - CPCB
3. Anand Vihar, Delhi - DPCC	4. Najafgarh, Delhi - DPCC
5. Ashok Vihar, Delhi - DPCC	6. Narela, Delhi - DPCC
7. Aya Nagar, Delhi - IMD	8. Nehru Nagar, Delhi - DPCC
9. Bawana, Delhi - DPCC	10. North Campus, DU, Delhi - IMD
11. Burari Crossing, Delhi - IMD	12. Okhla Phase-2, Delhi - DPCC
13. CRRI Mathura Road, Delhi - IMD	14. Patparganj, Delhi - DPCC
15. DTU, Delhi - CPCB	16. Punjabi Bagh, Delhi - DPCC
17. Dr. Karni Singh Shooting Range, Delhi DPCC	18. Pusa, Delhi - DPCC
19. Dwarka-Sector 8, Delhi - DPCC	20. Pusa, Delhi - IMD
21. IGI Airport (T3), Delhi - IMD	22. R K Puram, Delhi - DPCC
23. IHBAS, Dilshad Garden, Delhi - CPCB	24. Rohini, Delhi - DPCC
25. ITO, Delhi - CPCB	26. Shadipur, Delhi - CPCB
27. Jahangirpuri, Delhi - DPCC	28. Sirifort, Delhi - CPCB
29. Jawaharlal Nehru Stadium, Delhi - DPCC	30. Sonia Vihar, Delhi - DPCC
31. Lodhi Road, Delhi - IMD	32. Sri Aurobindo Marg, Delhi - DPCC
33. Major Dhyan Chand National Stadium, Delhi - DPCC	34. Vivek Vihar, Delhi - DPCC
35. Mandir Marg, Delhi - DPCC	36. Wazirpur, Delhi - DPCC
37. Mundka, Delhi - DPCC	

Source: CPCB, 2019

Figure 12.9: Location of Air Quality monitoring stations in Delhi



Source: Ongoing Phd, Environmental Planning Department, SPA, Delhi (Meenakshi Pawar)

12.4.2 Ambient Air Quality Levels

The real time Ambient Air Quality monitoring data in Delhi from 2001 to 2018 are given in the following table:

Table 12.10: Ambient Air Quality Levels in Delhi: 2001-2018 (Till November)

S. No	Years	Ambient Air Quality (µg/m3)			
		SO2	NO2	CO	RSPM (PM10)
1	2001	14.1	41.8	4183	150
2	2002	11.3	50.8	3258	192
3	2003	9.5	55.8	2831	170
4	2004	9.3	57.4	2581	160
5	2005	8.8	55.9	2541	168
6	2006	8.8	55.9	2541	168
7	2007	4	38	2460	161
8	2008	5	43.1	2461	201
9	2009	5	47.3	1768	248
10	2010	5	46	1937	249
11	2011	15	66	2020	281
12	2012	18.2	82.4	2020	293
13	2013	20.1	77.5	2100	282
14	2014	16.9	79	1700	318
15	2015	17.6	73	1618	268
16	2016	19.9	70.2	2090	290
17	2017	23.36	73.55	2130	263
18	2018 (Till Nov)	17.66	64.06	1880	314
	Permissible Limits	50	40	2000	60

Source: Department of Environment, GNCTD/CPCB & DPCC

a. **Sulphur Dioxide (SO2):** No significant variation was observed in the annual city average value between 2011 to 2018 (till Nov.). The values monitored were always within the prescribed limits of 50µg/m3 at all stations.

b. **Nitrogen Dioxide (NO2):** Annual city average of NO2 concentration has shown the marginal decrease as compared to the year 2011. The highest annual average was observed in 2012 (82.4 µg/m3). In 2018 (till Nov.), the average value was 64.06 µg/m3. At all the monitoring locations annual city average exceeded the prescribed standard of 40 µg/m3.

c. **Carbon Monoxide (CO):** Annual city average of CO concentration has shown the decrease as compared to the year 2011. In 2018 (till Nov.), the city average value was 1.88 mg/m3. At all the monitoring locations annual city average is within the prescribed standard of two mg/m3 except Anand Vihar.

d. **Particulate Matter for measuring Pollution:** One way of measuring pollution is by the measure of particulate matter. Particulate matter is basically a mixture of extremely small

particles and liquid droplets like acids, chemicals, gas, water, metals, soil dust particles, etc, the measurement of which gives an idea of the pollution of a city.

e. **Particulate Matter (PM10):** Annual city average of PM10 varied from 2011 to 2018 (till Nov.) by 281 µg/m3 to 314 µg/m3. At all the monitoring locations annual city average exceeded the prescribed standard of 60 µg/m3.

f. **Particulate Matter (PM2.5):** Annual city average of PM2.5 varied from 2011 to 2018 (till Nov) by 130 µg/m3 to 140 µg/m3. At all the monitoring locations annual city average exceeded the prescribed standard of 40 µg/m3.

g. **Ozone (O3):** Annual city average of O3 varied from 2011 to 2018 (till Nov.) by 57 µg/m3 to 35 µg/m3.

12.4.3 Sources of Air Pollution in NCT- Delhi

The air pollution sources are being categorized into area source, point source and line source. Following are the source categories and types of sources of air pollution.

- ***Area Sources:*** Domestic cooking, Bakeries, Crematoria, Hotel & Restaurants, Open eat outs, open burning (refuse/biomass), Paved and unpaved roads, construction/ demolition/ alteration activities for buildings, Waste Incinerators, DG Sets.
- ***Point Sources:*** Large scale industries and power plants, medium scale industries, small scale industries
- ***Line Sources:*** Traffic and Transportation

Most of the pollution in Delhi comes from outside its geographic boundaries. A study commissioned by the Ministry of Heavy Industries and Public Enterprises revealed that only 26 percent of the pollution in Delhi is indigenous during the summer. The figure is slightly higher at 36 percent in the winters. While much of the non-indigenous pollution emanates from the neighboring states, the study points out that a good fraction also comes from outside India especially from western sides in summers).

Table 12.11 : Sources of PM 2.5 Pollution in Delhi, 2016-17

S. No	Areas of sources of Pollution	Winters	Summers
1	Delhi Itself	36%	26%
2	NCR Except Delhi	34%	24%
3	Upwind Region Outside NCR	17%	17%
4	Upwind Region Outside India	13%	33%

Source: The Energy and Resource Institute

12.4.4 Impact of Air Pollution

Delhi is not complying with WHO and National Ambient Air Quality (NAAQ) standards, and the city is critically polluted. The entire state is experiencing a public health crisis due to high air pollution levels. Due to the range of different sectors responsible for pollutant emissions, urgent and determined action is needed by a number of ministries in the states and central governments, industry and general public.

12.4.5 Air Pollution Control Initiatives

62. National Clean Air Program (NCAP)

It is one of the initiative efforts towards control of air pollution at pan India level with the aim to improve the air quality in India.

63. Implementation of Graded Response Action Plan (GRAP) In Delhi:

To reduce air pollution, Graded Response Action Plan (GRAP) along with Comprehensive Action Plan (CAP) and 41 directions issued by CPCB under Air Act-1981 are being implemented by the Civic Agencies, Transport Department., Urban Development Department, Traffic Police and Pollution Control Committee of Delhi. Under the notification and directions for the Hon'ble Supreme Court the following system has been set up to implement GRAP:

a) Expansion of the air pollution monitoring network so that NCR is covered and there is information about the level of pollution and the impact on human health.

b) The Air Quality Index (AQI) has been established with links to the health advisory. The Index automatically takes the readings of the connected stations and puts out a daily index on the state of pollution.

c) A task force, headed by CPCB has been set up to meet regularly (daily during the high pollution period) to assess the pollution levels and to deliberate with the officials of the Indian Meteorological Department (IMD) on forecasts. This task force, in turn informs, EPCA on recommendations for action.

d) It has been agreed that between March to October, every year when pollution levels are low, the measures listed under the Moderate to Poor category would be in effect.

On October 17, 2017 EPCA imposed the "Very Poor and Severe" Category under GRAP in Delhi NCR. The levels of pollution were in the poor and very poor category, but this was done as a precautionary step in view of impending winter and inversion. GRAP under Very poor category was invoked from 15.10.2018 till 15.03.2019 with following directions:

- Increasing bus and metro services by augmenting contract buses and increasing frequency of service.
- Increase the frequency of mechanized cleaning of roads and sprinkling of water on roads. Identify road stretches with high dust generation.
- Residential Welfare Associations and individual house owners to provide electric heaters during winter to security staff to avoid open burning by them.
- Alert in newspaper/TV//Radio to advise people with respiratory and cardiac patients to avoid polluted areas and restrict outdoor movement
- Stop use of diesel generators sets.
- Shut down Badarpur Power Plant as of October 15, 2018.
- Take steps to maximize the generation of power from existing natural gas based plants to reduce the operation of coal-based power plants in the NCR.

Recommendations of Graded Response Action Plan (GRAP) are:

1. Air Quality Monitoring Committee (AQMC)

The Hon'ble NGT in ordered directed constitution of Air Quality Monitoring Committee (AQMC) in respect of Delhi to prepare action plan to control air pollution.

2. Promotion of Battery Operated Vehicle
3. Prohibition on bursting of Firecracker
4. Imposition of Change on lights and heavy duty commercial vehicles entering Delhi
5. Greening of City
6. Environmental Marshalls

   Delhi Govt. has deployed Home Guard (HG) volunteers as Environmental Marshals.

7. Green Budget

   The Government of Delhi has passed a Green Budget wherein provisions have been made for providing a subsidy to Conversion of industries to PNG and Conversion of coal-based Tandoors to Gas base.

12.5 Water Pollution

Water pollution contribution is due to the discharge of untreated industrial and municipal wastes in the drains and River Yamuna. The river is so contaminated that it is classified in the category E which makes its water non-suitable for utilization.

12.5.1 Sources of Water Pollution

There are two types of water pollution sources: point and nonpoint. River Yamuna is highly polluted with both point and nonpoint sources of water pollution due to the flow of untreated sewage and also the discharge of inadequately treated industrial effluents.

64. Point Source of Pollution

Urban centers located along or near the bank of Yamuna River are the major pollution sources of River Yamuna. The point source of pollution covers two major categories.

A. Domestic Pollution

The Domestic Pollution is the major source of pollution in the Yamuna River. The intensity of impact of domestic pollution on rivers depends on the efficiency of the wastewater collection system, type and length of the waste transportation system. If wastewater gets more retention time within urban premises before reaching to receiving water bodies, in such case the pollution load will reduce due to biodegradation and settling. The organic matter and micro-organisms are the main constituents of the domestic waste. Besides these, total salts, chlorides, nutrients, detergents, oil & grease etc. are also contributed by the domestic sources. There are numerous unauthorized colonies in exist in various urban centres. Due to non-availability of sewerage system in these colonies, the night soil is collected, transported and dumped either in drains, tributaries or directly into rivers without any treatment.

B. Industrial Pollution

The categories of industries discharging wastewater into Yamuna river includes Pulp & paper, Sugar, Distilleries, Textiles, Leather, Chemical, Pharmaceuticals, Oil Refineries, Thermal Power Plants, food etc. In order to compliance to the environment laws, it is compulsory for these industries to treat the effluent to achieve prescribed standards before discharging effluent into the

environment. However, it is observed that all the industrial units do not treat waste water and discharge that into the river through drains.

65. Non Point Sources of Pollution

The non-point sources of pollution originate in the catchment area of the river and transported to the river regularly or occasionally by leaching, drainage and surface water off during monsoon. The pollutants originated from diffuse sources are topsoil, organic matter, plant residues, nutrients, organic chemicals, toxicants, microorganisms etc.

The important diffuse pollution sources contributing to river Yamuna are:

A. Agricultural pollution sources
B. Dumping of garbage and dead bodies
C. Immersion of idols
D. Pollution due to in-stream uses of water

12.5.2 Water quality of River Yamuna

The major issues related to the quality of water in River Yamuna are as follows:

1. High Organic Contents
2. High Nutrients
3. Excessive presence of pathogens
4. Accumulation of pollutants in the catchment area
5. Deforestation in the catchment area
6. Reduction in the quantity of water
7. Use of river stream for transportation of water
8. Discharges from sewage treatment plants into the river

Table 12.12 :Annual water quality Yamuna River, 2016

Water Quality of River Yamuna- 2016								
Station Name	**Dissolved oxygen (mg/l)**		**pH**		**B.O.D (mg/l)**		**Total Coliform (MPN/100 ml)**	
	min	max	min	max	min	max	min	max
	> 4mg/l		6.5 - 8.5		< 3 mg/l		<5000 MPN/ 100ml	
Yamuna at Wazirabad	5.1	13.5	7.2	8	1	9	490	54000
Yamuna at Nizamuddin	0.4	2.6	7.1	7.9	4	45	240000	9200000
Okhla Bridge (Inlet of Agra Canal)	0.4	1.8	7.1	7.8	3	49	240000	9200000
Yamuna at Okhla (Shahdara Drain)	0.1	1.6	7	7.9	4	67	230000	16000000

Source: Water Quality Data 2016, CPCB Envis centre

From the above table it is observed that in the year 2016, BOD values range from 1-9 mg/1 at Wazirabad, 4-45 mg/1 at Nizamuddin, 3-49 mg/1 at Okhla Bridge (Inlet of Agra Canal) and 4-67

mg/l at Okhla (Shahdara Drain). Similarly, at all locations, except Wazirabad, the total coliform levels are many times higher than the minimum tolerable standards for drinking and bathing purposes. The dissolved oxygen decreases and BOD level increases from North to south direction in River Yamuna. It indicates that the quality of water becomes highly polluted as it moves downwards in NCT- Delhi.

The major source of pollution in the river to the extent of about 80 percent is the discharge of treated and untreated waste water through the 24 major drains (table-12.14), which flow into the river. Control of river coliform is essential as the Yamuna is used by thousands of people for fishing and bathing. Coliforms are diseases like hepatitis- A, cholera, typhoid, ring/hook worm etc.

As the sewerage system is not provided in unplanned habitats, the wastewater generated in the unplanned area is discharged into drains. No utilization of installed capacity of Sewage Treatment Plants is another important issue. Delhi Jal Board has prepared a plan to provide sewerage facilities in unauthorized colonies.

Yamuna River receives about 84 percent of the total BOD load through major drains and rest through canals. From the table- 12.14 it is observed that Najafgarh, Sahibabad and Shahdara drains continue to remain the highest contributors to BOD load. Whereas COD levels are also high in Sahibabad and Shahdara drains.

Table 12.13 :Annual average water quality of Drains Location in Delhi, 2018

S. No	Measure/Drains	pH	TSS	COD	BOD
	Water Quality Criteria	**5.5-9.0**	**100 (mg/l)**	**250 (mg/l)**	**30 (mg/l)**
1	Najafgarh Drain	7.4	118.36	133.45	144.54
2	Metcalf House Drain	7.33	79.27	79.27	25.27
3	Khyber Pass Drain	7.33	70.9	84.18	26.36
4	Sweeper Colony Drain	7.39	70.72	78	24.9
5	Magazine Road Drain	7.3	127	114.8	37.4
6	ISBT Drain	7.46	96.9	112.36	36.09
7	Tonga Stand Drain	7.43	146	130.18	41.72
8	Moat Drain	No flow	No flow	No flow	No flow
9	Civil Mill Drain	7.33	105.09	125.27	43.09
10	Power House Drain	7.3	110.36	134.9	44.63
11	Sen Nursing Home Drain	7.28	196.72	261.81	89.81
12	Drain No. 12A	No flow	No flow	No flow	No flow
13	Drain No. 14	7.41	76.18	83.81	26.36
14	Barapullah Drain	7.4	129.63	140.72	45.36
15	Maharani Bagh Drain	7.39	224.9	330.18	107.36
16	Kalkaji Drain	No flow	No flow	No flow	No flow

S. No	Measure/Drains	pH	TSS	COD	BOD
	Water Quality Criteria	**5.5-9.0**	**100 (mg/l)**	**250 (mg/l)**	**30 (mg/l)**
17	SaritaVihar Drain (Mathura Road)	7.5	145.81	129.45	42.18
18	Tehkhand Drain	7.34	169.81	287.09	93.63
19	Tuglakabad Drain	7.49	238.54	261.81	97.54
20	Drain Near LPG Bottling Plant	No flow	No flow	No flow	No flow
21	Drain Near SaritaVihar Bridge	7.32	127.63	155.09	51.09
22	Shahdara Drain	7.36	316.18	389.81	128.68
23	Sahibabad Drain	7.43	326.54	495.27	164.54
24	Indrapuri Drain	7.35	229.45	348.72	113.63

Source: Delhi pollution control board

12.6 Noise Pollution

For regulating ambient noise quality in the environment, the Central Government has notified the Noise Pollution (Regulation and Control) Rules, 2000 amended in 2002 and 2006 under the EPA. The noise standards for different categories of areas are based on the weighted equivalent noise level (Leq). Ambient Noise level standards have been notified by the MoEF vide Gazette Notification dated 26th December 1989 and also in the Schedule III of the Environmental (Protection) Rules 1986.

Delhi witnesses' excessive noise on account of large numbers of the vehicle, construction activities, diesel generating sets, etc. Use of high sound loudspeakers during festivals and many social gatherings in public places directly increases the noise pollution in the affected areas. GNCTD has notified an area of 100 metres around the hospitals with 100 beds or more, educational institutions with 1000 students or more, all court complexes, all government complexes as Silence Areas/Zones. The Central Pollution Control Board published the information regarding permitted ambient noise levels in different areas. The prescribed ambient noise levels are presented in table below:

Table 12.14 :Ambient Noise level standards

Area Code	Category of Area/ Zone	Limits in db (A) Leq*	
		Day Time	**Night Time**
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Source: Noise Pollution (Regulation and Control) Rules, 2000, Ministry of Environment, Forests and climate change Government of India.

Notes:- 1. Day Time from 6 AM to 10 PM and Night Time from 10 PM to 6 AM. 2. Silence zone is an area comprising not less than 100 meters around hospitals, educational institutions, courts, religious places or any other areas which is declared as such by the competent authority

The day and night ambient noise levels due to road traffic in residential areas along the major roads in Delhi are shown in table 12.16 and 12.17, where all the levels are exceeding the ambient noise standards limits during day time as well as at the night time.

Table 12.15: Ambient noise levels in residential areas along major roads in Delhi due to road traffic for Day Time

Yearly Average of Real Time ambient Noise levels (Day Time)					
Year	**Anand Vihar db (A)**	**Civil Lines db (A)**	**Mandir Marg db (A)**	**Punjabi Bagh db (A)**	**R.K. Puram db (A)**
2015	67.8	62.9	57.1	63.4	60.3
2016	67.6	62.7	58.4	59	61
2017	67.8	62.4	56.8	59	60.6
2018 (till Oct)	66.3	61.1	57.9	59.5	60.7

Source: CPCB

Table 12.16: Ambient Noise levels in Residential areas along major roads in Delhi due to road traffic for Night Time

Yearly Average of Real Time ambient Noise levels (Day Time)					
Year	**Anand Vihar db (A)**	**Civil Lines db (A)**	**Mandir Marg db (A)**	**Punjabi Bagh db (A)**	**R.K.Puram db (A)**
2015	64.9	61.9	50.8	58.9	53.7
2016	65.8	61.3	51.5	54.8	56.1
2017	65	60.3	48.5	53.3	54.4
2018 (till Oct)	63.5	58.8	51.6	52.6	54.8

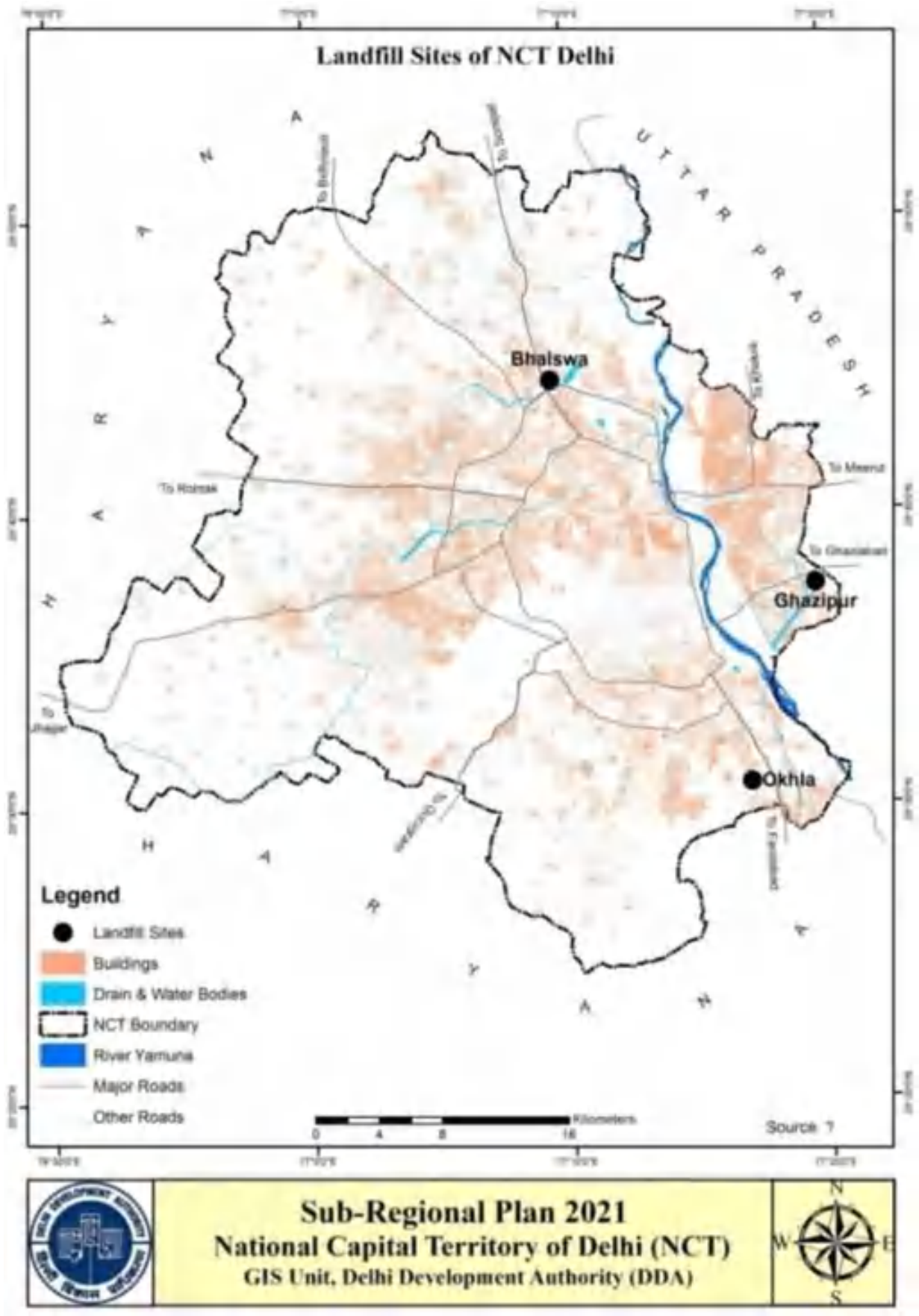
Source: CPCB

12.7 Land Pollution

12.7.1 Solid waste

Solid waste includes commercial and residential waste generated in municipal or notified areas. As per the data available with DPCC records, solid waste generation in Delhi was around 8930 tons per day. Delhi's three oversaturated landfill sites namely Bhalswa at GT karnal road in the north, Ghazipur in the east and Okhla in the south, which ages around 20 to 30 years old and produces many toxic gases in the air. Bawana in the northwest is an "engineered solid waste dumping and processing site". The areas in the vicinity of these landfills are highly polluted. Figure 12.1 shows the location of three landfill sites, all the three sites are in close proximity to River Yamuna and the pollution coming from the three sites is directly going into the River and groundwater, which contaminates the soil, water and air.

Figure 12.1: Landfill sites in NCT-Delhi



Source: NCRPB

12.7.2 Hazardous waste

Hazardous waste means any waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment. The most critical hazardous waste generated in Delhi is from small-scale enterprises such as pickling units, electroplating units, anodizing units, and sludge from CETPs.

66. Bio-Medical Waste (BMW)

Bio-Medical Waste (BMW) means any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities. With the increase in the number of hospitals and nursing homes in Delhi, hospital waste has become another area of concern.

The collected bio-medical waste is sent to common biomedical waste facilities in the city. Delhi has three Common Biomedical Waste Treatment Facility (CBWTF) operators who collect the waste from Healthcare Establishments (HCE) of Delhi and dispose the BMW after its treatment. These CBWTFs have a total capacity of 63 Tons/ Day and have Incinerators, Autoclaves and Shredders for the treatment and disposal of the Bio-Medical Waste and have installed an Online Monitoring System. Delhi Pollution Control Committee (DPCC) has issued closure directions to 12 hospitals and identified 56 others in violation of biomedical waste norms.

12.7.3 Electronic Waste

Electronic Waste, means any waste, which is generated due to product obsolescence and discarded electronic items, and may include data processing, telecommunications or entertainment in private households and businesses. The quantity of e-waste generated in the city is going to be much higher than hazardous waste and healthcare waste and thus requires proper management.

The environmental damage from electronic waste can come from the hazardous elements contained in EEE (electrical and electronic equipment), or the auxiliary substances Open and manual dismantling, shredding, burning, leaching and uncontrolled dumping of WEEE not only directly harm the exposed workers but also reach environment through contaminating soil, ground water, surface water and polluting air.

According to the Informal E-waste Recycling in Delhi report by think tank Toxic Link, the processing units are primarily located in 15 regions in northeastern and eastern parts of Delhi, which includes the localities of Daryaganj, Mandoli, Mata Sundari Road, Mayapuri Junk Market and Mustafabad, among other places. These 15 areas are estimated to have about 3400 processing units employing over 12,300 workers.

These processing units carry out e-waste collection, trading, dismantling, segregation of components, repairing, refurbishing, metal recovery and recycling of electronic wastes, exposing the workers and the environment to hazardous conditions.

12.8 Acts and Policy

The Ministry of Environment and Forest, GOI enacted Environmental Protection Act in 1986. Over the years, the Government of India has framed several policies and promulgated a number of Acts, Rules and Notifications for the management and protection of the environment. During the last three decades an extensive network of environmental legislation has grown and presently it

has a fairly complex body of environmental legislation aimed at ensuring that the development process meets the overall objective of promoting sustainability in the long run. The available legal Acts and Legislation referred during the study are:

- The Water (Prevention and Control of Pollution) Act, 1974 (Amendment 1988)
- The Water (Prevention and Control of Pollution) Cess Act 1977, (Amendment 2003)
- The Water (Prevention and Control of Pollution) Cess Rules, 1978, 1991
- The Air (Prevention and Control of Pollution) Act 1981 (Amended 1987)
- The Environment (Protection) Act, 1986, amended 1991
- Noise Pollution (Regulation and Control) Rules, 2000 (Amendment 2002, 2006)
- Municipal Solid Waste Rules, 2000
- The Indian Forest Act, 1927
- Forest (Conservation) Act, 1980, amended 1988
- Forest (Conservation) Rules, 2003
- The Wild Life (Protection) Act 1972, Amendment, 2002
- The Ancient Monuments and Archaeological sites and Remains (Amendment and Validation Act),2010
- E-waste (Management & Handling) Rules, 2011

12.9 Policies and Proposals

12.9.1 Forest and Green areas

1. The land identified in Regional Plan 2021 under "Forests" and "Waste Land" categories of existing land use has been proposed for the Natural Conservation Zone. The Sub-Regional Plan for NCT- Delhi also proposes the same area to be developed and maintained as a Natural conservation Zone.
2. Delhi Master Plan 2041 should also propose the Natural Conservation Zone and other green areas in view of protection of the environment.
3. Delhi Master Plan 2041 should make proposals for development, re-development and re-densification to promote vertical and compact development and to enhance the green cover in the NCT- Delhi.
4. Afforestation/ Plantation in the Aravallis (Delhi Ridge) having scarce vegetation and the River Flood areas/ River banks should be carried out and maintained.
5. Canopy cover in Reserve and Protected Forests needs to be improved through determined afforestation and conservation programmes.
6. Development of Green belts/Plantation of evergreen trees should be carried out along the natural drainage channels, wetlands, irrigation canals and water bodies, wastelands, village common lands and the road side & railways lines. Resident welfare associations (RWAs) and other NGO's should be involved in the development and maintenance of these green belts.
7. Encroachment and unauthorized urban activities in the designated Natural Conservation Zone and other green areas should be strictly prohibited. Regularization of any such activity which contains the green cover should not be allowed in any condition.
8. The Delhi Ridge, River Yamuna and other environmentally sensitive areas should be conserved with utmost care and afforested with native species.
9. Detailed Zonal plans for the Natural conservation Zone, Eco- Sensitive Zone and other Green areas should be prepared for effective restoration, conservation and maintenance.
10. Zonal plans should provide for restoration of degraded areas, conservation of existing water bodies, management of catchment areas, watershed management, groundwater

management, soil and moisture conservation, needs of the local community and such other aspects of ecology and environment that need attention.

11. The Master Plan/ Zonal Master Plan should be co-terminus with the Regional Plan/ Sub-regional Plan.
12. The NCT- Delhi should have a detailed "***Environmental Plan***" that may define a sustainable environmental framework within its spheres of responsibility in areas of health and safety, education, corporate, programs and services, transportation, community (land use) planning, waste management, water use, the natural heritage system and urban green space.
13. A Functional plan for "Environmental Issues" may also be prepared as a statuary document as per the provision of Section 16 of the National Capital Region Planning Board Act, 1985.

12.9.2 Policies and Proposals for NCZ:

1. The recreational and natural conservation zone such as Biodiversity parks, wildlife Sanctuaries and major water Bodies, greens along the natural drains etc. having ecological significance should be categorized separately in the Delhi Master Plan- 2041 and other than recreational areas which mainly includes the urban open spaces and parks, gardens, playgrounds should be demarcated separately for better monitoring of ecologically sensitive areas.
2. The Delhi Ridge, River Yamuna and other environmentally sensitive areas should be conserved with utmost care and afforested with native species. Any development or conservation in these areas to be in accordance with the Environmental Protection Act, 1986, Indian Forest Act, 1927, Forest Conservation Act, 1980 and wildlife Protection Act, 1972and further notifications/ rules/ guidelines issued for such areas by the State Government and Ministry of Environment, Forest and Climate Change (MoEF& CC) from time to time.
3. The Aravalli (Delhi Ridge) delineation and ground truthing by expert bodies/ institutions up to appropriate extent is not completed, it is needed for ground water recharge and to maintain overall environmental balance.

12.9.3 Policies and Proposals for ECZ:

1. Construction and degraded landscapes pose adverse impact on okhla bird sanctuary particularly impacting the nesting home of many avian species therefore it is suggested that part of okhla bird sanctuary falling within boundary of NCT-Delhi along the west bank of Yamuna may also be designated as eco-sensitive zone and accordingly necessary notification may be issued under Environment Protection Act, 1986 and Environmental Management Plan may be prepared.
2. The high level of pollution in Yamuna River is having adverse environmental implications on okhla bird sanctuary and avian habitats.

12.9.4 Policies and Proposals for Yamuna River

1. The use of floodplain should be regulated by assigning zones of permissible activities. Wherever possible, the old river channels and water bodies within the floodplain should be revived and their extent be deepened. Such water bodies may be used for raising fish nurseries without using fish feeds.

2. A green belt all along both side embankment of River Yamuna should be developed and maintained and it should act as a barrier between River Floodplain and areas of urban activities.
3. As in case of River Ganga specific zoning regulations for 200 metre wide area along the River Yamuna also should be prepared in the Master Plan- 2041.
4. Major Drains draining into River Yamuna and the Floodplains of River Yamuna in Delhi should not be made disposal grounds for sewer and other municipal waste. Untreated sewer or industrial waste water and water from other anxious activities should not be allowed in the River Yamuna in any condition. The concerned authorities should evolve a mechanism to separate the sewer and municipal waste from River Yamuna. Many cities all over the world have adopted this mechanism and stopped flow of sewer and municipal waste into the rivers flowing in the urban areas.
5. All the permanent and temporary structures (both within NCTD and UP) that have come up in the Floodplain in this zone should be removed at the earliest.
6. Regular removal of sludge/garbage from River Yamuna and all the drains falling in Yamuna should be carried out to protect the carrying capacity of the River Yamuna and drains.
7. A chain of ponds/ wetlands/ water reservoirs should be created along the River Floodplain to increase the quantity of water flow and also to enhance the water recharge and water quality.
8. Riverfront development projects should aim at the protection and conservation of River Yamuna and maintain ecological flow of the River.
9. Water pollution in Delhi is caused mainly by the disposal of untreated industrial waste water, untreated sewer and municipal waste into the water bodies. The authorities should ensure implementation of waste water treatment in all the industrial units and in no condition industrial wastewater should not be allowed to drain into the drains and River.
10. Industrial units, slaughter houses and other individuals should be punished if found putting waste water into the aquifer through unauthorized boring/ pipes. A strict regime of monitoring such activities should be enforced regularly by CPCB and local authorities.
11. The central Government and the State Government of Haryana should evolve the mechanism of diverting the Najafgarh drain and Panipat drain towards the areas of Haryana and Rajasthan instead of Yamuna River. This will ease out the pressure of pollutants into River Yamuna. The water of the diverted drains may be used for agriculture purposes.

12.9.5 Policies and Proposals for Pollution

67. Air Pollution

1. Urban local authorities should implement and regularly the National clean air program and Graded Response action plan which is an effort towards control of air pollution and improvement of air quality.
2. Augment existing ambient air quality monitoring network- use data analysis to evolve science based decisions and air quality prediction system.
3. Continuous monitoring emission coming from sources of pollution.
4. The state Government and local authorities should coordinate with the other states to reduce and regulate pollution creating activities in their respective areas.
5. The state Governments of NCR should not allow any polluting industry in the CNCR. Existing units should be asked to either change the technologies to eliminate pollution or to shift the polluting units out of Delhi.

6. The non- metalled portions of roads /open spaces and public parks should be covered with vegetation. Public parks and open spaces should be provided with evergreen trees. Green belts should have a maximum number of such species which help in reducing the air pollution.
7. Use of public transport (non- diesel base) and Non-Motorized Transport should be encouraged and promoted in all areas of Delhi to reduce carbon emissions.

68. Noise Pollution

1. The state Government and Local authorities do not have an effective control and monitoring system for noise pollution as per the provisions of notification for Noise Pollution (Regulation and Control) Rules, 2000 amended in 2002 and 2006 under the EPA. The major Noise pollution is caused by vehicles and Loud speakers used in socio-cultural programmes. Traffic Police may be involved in controlling the noise pollution by way of penalization and other punitive actions against the creator of noise pollution beyond permissible limits.

69. Solid Waste, Hazardous waste, E-waste and Medical waste Pollution

1. Implementation of 100 percent door to door collection of segregated waste in the entire NCT-Delhi.
2. New and advanced technologies for waste processing that offers systems for processing of both solid organic wastes and waste water treatment such as Soil Biotechnology (SBT) based STP's can be explored and Establish adequate Infrastructure like establish waste deposition centres, Bio-methanation units & composting units, refuse-derived fuel plant etc.
3. Creation of additional landfill sites for waste disposal is not an appropriate and permanent solution. The requirement for additional land for disposal of waste should be minimized by way of mechanical compaction and industrial utilization of waste material for different usable products.
4. Strive to achieve zero landfill sites and waste
5. All individuals or companies or other agencies engaged in development and construction activities should be made responsible to remove C & D waste material from the sites immediately.
6. Landfill sites along the river Yamuna, eco-sensitive and nature conservation zones should not be allowed.
7. The Government of NCT- Delhi should develop composite plants for disposal and recycling of Hazardous waste, E-waste and Medical waste separately for the entire area of NCT-Delhi.
8. Track waste through the National Hazardous waste Tracking system and authorize Hazardous waste collection centres with linkages.
9. Phase out single use plastics by 2020 and divert the plastic waste to resource/ energy recovery.
10. Networking of waste recyclers and linkage with producers under extended producer responsibility (EPR) to facilitate the system of collecting & recycling to add all of the environmental costs associated with a product throughout the product life cycle to the market price of that product.

CHAPTER 13. DISASTER MANAGEMENT

13.1 Background

Disaster Management Act 2005 defines "disaster" as

> *"Disaster means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or manmade causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of property, or damage to, or degradation of environment and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area."*

Delhi is vulnerable to natural disaster like earthquakes and floods as well as human induced disasters such as bomb-blasts, acts of terrorism, fires, industrial and chemical hazards, floods, building collapses, road accidents, water logging, etc. The entire region of Delhi is in Seismic Zone IV, at high risk to earthquakes as gathered from the earthquake hazard map given in the Vulnerability Atlas of India 2001, and can face an earthquake of 5.5 to 6.7 on Richter scale (MSK intensity VIII).

The terrain of Delhi is flat in general except for a low NNE-SSW trending ridge which is considered an extension of the Aravalli hills. Seismicity around Delhi appears to be associated with a major geological structure, which is known as the Delhi-Hardwar Ridge. It coincides with the extension of the Aravali Mountain belt beneath the alluvial plains of the Ganga Basin to the northeast of Delhi towards the Himalayan Mountain.

Parts of district North-East, East, Central, and South East are most affected by flood. The city has been experiencing floods of various magnitudes in the past due to floods in the Yamuna and the Najafgarh Drain. The Yamuna crossed its danger level (fixed at 204.83m) twenty-six times during the last 35 years. Since 1900, Delhi has experienced nine major floods in the years 1924, 1947, 1976, 1978, 1988, 1995, 1998, 2010 and 2013.

Road accidents include all forms of motor vehicle accidents involving two/three/four-wheeler passenger vehicles, vehicles carrying goods including hazardous substances. These accidents may lead to injuries and fatalities to pedestrians, bystanders and/or passengers. Industrial hazards are likely due to accidents occurring during chemical processing, manufacturing, storage, transport and from the disposal of toxic waste. It also happens due to uncontrolled release of hazardous substances fire/explosion and by mechanical failure, operational deficiency, design, construction, installation deficiency etc.

To facilitate the adequacy, efficacy and preparedness of the departments and district administration and identify gaps in resources and systems, the State Disaster Management Authority and District Disaster Management Authorities in coordination with the ESFs of Delhi embark on conducting mock exercises on various types of natural and manmade disasters. This helps in inculcating a culture of preparedness.

13.2 State Disaster Management Plan

As per the provisions of the Disaster Management Act-2005, every office of the Government of India and of the State Government at the district level and the local authorities shall, subject to the supervision of the District Authority.

a) Prepare a disaster management plan setting out the following, namely: -

- Provisions for prevention and mitigation measures as provided for in the District Plan and as is assigned to the department or agency concerned

- Provisions for taking measures relating to capacity-building and preparedness as laid down in the District Plan

- The response plans and procedures, in the event of, any threatening disaster situation or disaster

b) Coordinate the preparation and the implementation of its plan with those of the other organizations at the district level including local authority, communities and other stakeholders

c) Regularly (annually) review and update the plan

d) Submit a copy of its disaster management plan and of any amendment thereto, to the District Authority

Some of important terms to be discussed in the Disaster Management plan are as following:

A disaster is an event triggered by natural or man-made causes that lead to a sudden distribution of normal cycle of life within society, causing widespread damage to life and property. Distribution can be caused due to occurrence of frequent hazards like earthquakes, fires, cyclones, terrorism, biological wars and chemical explosions. When hazards connect with risk and vulnerabilities lead to the massive destruction. Level of risk (high/medium/low) depends upon the various hazards for which any specific area is prone to and/or also on the various physical, social-economic and institutional parameters. The chapter has been covered into two parts. First part is covering hazard assessment and second part is covering vulnerability and risk assessment on the basis of hazard assessment.

Hazard

"Hazard is an event or occurrence that has the potential for causing injury to life or damage to property or the environment. The magnitude of the phenomenon, the probability of its occurrence and the extent and severity of the impact can vary. Hazard "Hazard is an event or occurrence that has the potential for causing injury to life or damage to property or the environment. The magnitude of the phenomenon, the probability of its occurrence and the extent and severity of the impact can vary. In many cases, these effects can be anticipated and estimated." (Terry Jeggle and Rob Stephenson, Concepts of Hazard and Vulnerability Analysis). It is any phenomenon that has the potential to cause disruption or damage to humans and their environment. Hazards are the potential for an event, not the event itself. Extreme events are natural or man-made processes operating at the extremes of their range of energy, productivity, etc.

Vulnerability

Vulnerability is the degree to which a population, individual or organization is unable to anticipate, cope with, resist and recover from the impacts of disasters (Blaikie et al.1994). Vulnerability is a function of susceptibility (the factors that allow a hazard to cause a disaster) and resilience (the ability to withstand the damage caused by emergencies and disasters and then to recover)

Risk

"Risk" is defined as the expectation value of losses (deaths, injuries, property, etc.) that would be caused by a hazard. Disaster risk can be seen as a function of the hazard, exposure and vulnerability as follows;

Disaster Risk = function (Hazard, Exposure, Vulnerability) To reduce disaster risk, it is important to reduce the level of vulnerability and to keep exposure as far away from hazards as possible by relocating populations and property. Growing exposure and delays in reducing vulnerabilities result in an increased number of natural disasters and greater levels of loss. (Asian Disaster Reduction Centre)

13.3 Types of Disasters in Delhi

Mainly following disaster events have been experienced in Delhi:

- Earthquake
- Floods and Urban flooding
- Drought
- Wind (Andhi, Heat wave (Loo), Tornado)
- Fire
- Construction of unsafe buildings loading to collapsing of buildings

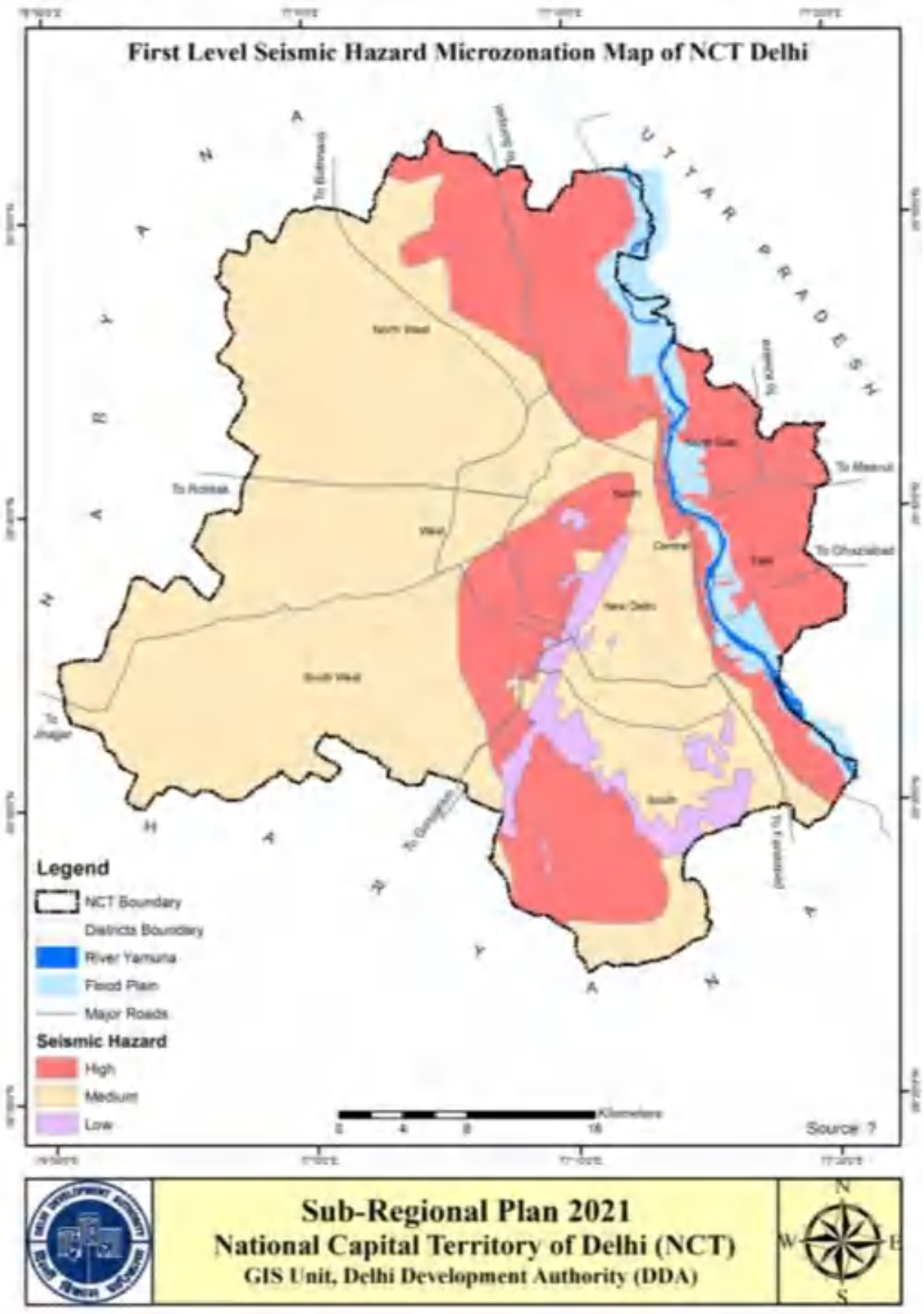
13.3.1 Earthquake

Delhi is located in zone IV which has fairly high seismicity where the general occurrence of earthquakes is of 5-6 magnitude, a few of magnitude 6-7 and occasionally of 7-8 magnitude. Delhi thus lies among the high-risk areas.

Five earthquakes of Richter Magnitude 5.5 to 6.7 are known to have occurred in the NCT-Delhi or close to it since 1720 AD. Major lineaments namely this region is characterized by several dominant features such as the Delhi - Haridwar ridge, the Aravalli - Delhi fold, the Sohna fault, the Mathura fault and the Moradabad fault, having potential of generating earthquakes of magnitude up to MSK VIII will be quite probable in the Delhi territory. Normal depth of 30 km may be assumed for these earthquakes. It will be prudent to consider the effects of such a potential earthquake for developing a prevention-cum-preparedness plan. *Source: DDMA, Delhi.*

As per Vulnerability Atlas of India (1997), for shaking intensity VIII, 6.5 percent houses in Delhi have high damage risk, and 85.5 percent houses have moderate damage risk. These estimates are based on very simplistic assumptions. Systematic studies are needed on vulnerability of different types of constructions in the area. Huge number of multistory reinforced concrete buildings in Delhi, particularly those with open ground story to accommodate vehicle parking, could also pose a major challenge in the event of a strong earthquake.

Figure 13.1: First Seismic Hazard Microzonation Map



Source: Indian Meterological Department

70. Trends of Earthquake in Delhi

Delhi is currently passing through a major infrastructure development phase with a large number of bridges, flyovers and the metro project under construction. Indian seismic code (IS: 1893-1984) is not applicable for major projects which require special studies on seismic design criteria. The list of past earthquakes in Delhi in provided below in table:

Table 13.1 :Earthquakes in Delhi

Date	Latitude (N)	Longitude (E)	Magnitude
June 6, 1992	28.65	76.69	2.8
Feb 16, 1993	28.63	76.35	2.6
Mar 27, 1993	28.63	77.2	3.6
Aug 6, 1993	28.63	77.14	2.5
Dec 3, 1993	28.64	77.14	3.5
July 28, 1994	28.6	77.4	2.8
Oct 15, 1994	28.51	77.25	2.8
Nov 16, 1994	28.59	79.92	2.9
Mar 18, 2004	28.5	76.95	2.7
Mar 28, 2004	28.62	77.25	1.6
April 4, 2004	28.6	77.1	1.5
April 5, 2004	28.6	77.2	1.9
April 21, 2004	28.7	77.3	1.5
June 6, 2004	28.6	77.3	2
Oct 08, 2004	28.6	77	5.6

Source: Amateursesmiccentre.com

13.3.2 Floods

Floods in Delhi are not nature's wrongdoing; it is invariably the irresponsibility of the authorities and those who are totally insensitive to human life. This is very clear from the recurring phenomenon of floods in the River Yamuna and flash floods caused by rains due to choked drains of Delhi.

River Yamuna enters Delhi from the northeast near Palla at an altitude of 210.3 meters and after traverses of about 40 km. it leaves Delhi at an altitude of 198.12 m near Jaitpur in the South. The width of the riverbed varied from 1.5 to 2.0 km. In its flow from Wazirabad barrage, a network of seventeen drains joins the river on the West bank during its traverse in the northern parts of the city. Najafgarh and Alipur drains, due to heavy discharge from Sahibi River, inundate a number of villages in Najafgarh block causing heavy damage to life and property.

Flood zoning

The flood situation is projected in the flood atlas map prepared by Central Water Commission, as per the map of the flood prone areas of Delhi has been classified into thirteen zones based on the flooding risk in relation to incremental rise in the water level of the Yamuna (DDA, 1993). These cover a range from 199m to 212 m level of water in the Yamuna. This zoning map covers part of North Delhi on the West bank of the Yamuna and almost the entire Trans Yamuna Area on the East bank. Besides this, the Delhi Flood Control Order also divided

the NCTD into four Flood Sectors, Shahdara, Wazirabad - Babrapur, Alipur and Nangloi – Najafgarh.

Although the unprotected flood prone area is 1.7 percent or 25km only towards the south east and about five percent or 74 sq. km in the north eastern parts which is protected by earthen embankments, every year water level rises in Yamuna above danger level and large population has to be evacuated to the top of the bunds and Delhi highways. The main reasons for this rise of water level is not natural but release of excess water from Tajewala headworks upstream to the two canals one on left and other on the right bank of the river. Rise in water levels also cause back flows in the connecting drains and have an effect on the city drain network causing overflow.

Local Flooding (Flash floods)

Urban areas are characterized by a high area under impervious surfaces (Roads, pavements, houses etc.). High rates of development along with the resultant loss of soft landscape have led to high surface water run-off rates. This results in flash floods in the low-lying areas. Thus, the water gets logged in the city areas and it takes several days to mechanically pump it out and bring the situation under control. Similarly, during the past few years, flooding due to the city's major drains has also become a common phenomenon. Already under the pressure of the city's effluent discharge, these drains experience reverse flow from the Yamuna.

Past Trends of Floods

Since 1900, Delhi has experienced nine major floods in the years 1924, 1947, 1976, 1978, 1988, 1995, 1998, 2010 and 2013 when the Yamuna River crossed its danger level of 204.83 m. The Table two shows that year 1978 witnessed the worst ever flood in Delhi when water level in Yamuna River in Delhi reached at 207.49 m with discharge 2.53 lac cusec at old railway bridge (7.0 lac cusec discharge was released from Tajewala) when 130 villages and 25 urban colonies in Delhi were submerged in water.

Table 13.2: Major flood events in Yamuna River in Delhi

S. No	Year	Gauge (mm)
1	1976	206.70
2	1978	207.49
3	1988	206.92
4	1995	206.93
5	1998	206.36
6	2010	207.2
7	2013	207.32

Source: Irrigation and Flood Control Department

Major Floods in Delhi

1976: Najafgarh drain experienced heavy floods due to discharge from the Sahibi River. The drain breached at six places between Dhansa and Karkraula, marooning a number of villages in Najafgarh block. Six human lives were lost due to house collapse. 14 persons died in a boat mishap. Crop damage was estimated at Rs 10 million.

1978: (September) River Yamuna experienced a devastating flood. Widespread breaches occurred in rural embankments, submerging 43 sq. km of agricultural land under two meters of water,

causing total loss of the kharif crop. In addition to this, colonies of north Delhi, namely, Model town, Mukherjee Nagar, Nirankari Colony etc. suffered heavy flood inundation, causing extensive damage to property. The total damage to crops, houses and public utilities was estimated at Rs 176.1 million.

1988: (September) River Yamuna experienced floods of very high magnitude, flooding many villages and localities like Mukherjee Nagar, Geeta Colony, Shastry Park, Yamuna Bazzar and Red Fort area, affecting approximately 8,000 families.

1995: (September) The Yamuna experienced high magnitude floods following heavy rains in the upper catchment area and resultant release of water from Tajewala water works. Slow release of water from Okhla barrage due to lack of coordination between cross state agencies further accentuated the problem. Fortunately, the flood did not coincide with heavy rains in Delhi, and could be contained within the embankments. Nonetheless, it badly affected the villages and unplanned settlements situated within the river-bed, rendering approximately 15,000 families homeless. These persons had to be evacuated and temporarily housed on roadsides for about two months, before they went back to living in the river-bed (Source: Sharma, 1996).

13.3.3 Urban Drought

Delhi is having acute water shortage every year and needs a long-term strategy for mitigating urban drought. Mostly in summers water scarcity leading to “urban drought” in most of the areas in Delhi. The land is valued more than water, neglecting local water bodies, which have either gone dry or encroached. According to a NITI Aayog report, Delhi is among 21 major cities that will run out of groundwater by 2020. Another study by the National Geophysical Research Institute (NGRI) found that groundwater levels in the city are depleting at an astonishing rate of 10 cm per year.

13.3.4 High Winds

The storms typically occur in the summer months, when the weather has been dried to allow dust to be picked up by passing winds. Dust storms are an annual weather pattern seen in the region. The scale and intensity of this most recent storm, however, surprised officials on the ground. It stretched from the western state of Rajasthan to the eastern state of Uttar Pradesh and hit Delhi, which lies between them. The dust can take the population by surprise, and can create zero visibility in the area for a short period.

13.3.5 Fire Hazards

Fire hazards, for the purpose of this study, include fires due to chemicals, LPG, explosives as well as short circuit of electrical systems. The fire occurs in buildings every year, especially in the congested areas and unauthorized markets and unauthorized colonies. These fires are generally caused by short circuits in faulty electric fixtures/wiring. In some cases, firefighting by the Fire authorities becomes impossible due to very narrow approach roads leading to non-accessibility of Fire tenders and it generates a hazardous situation for loss of property and human life.

71. Past Trends of Fire Hazards in Delhi

- According to Delhi Fire Service statistics, Delhi had more than 75,000 fire incidents during the last five years (1995-96 to 1999-2000), resulting in more than 1825 deaths, injuries to more than 7,600 persons and loss of property valuing more than Rupees 176

crores. These incidents included two major, twenty-five serious and ninety-nine medium fires. Delhi has witnessed an increasing trend in fires in jhuggies (up by 49 percent from 5277 jhuggis in 1995 to 7840 in 1999, residential areas (up by 21 percent to 2701 in 1999 from 2240 in 1995), and other fires (up by 33 percent from 6640 in 1995 to 8858 in 1999). Persons vulnerable to such fires constitute a majority of the populace of Delhi.

- The numbers of calls have marginally increased and the number of deaths have also increased. The basic reason is that deaths are not as much due to burning but more because of inhalation of toxic fumes, which get concentrated in high density in less open space. It is the lack of circulation/ventilation within houses. In industrial areas, there is a lack of safety measures required and hence large numbers of deaths or injury occur dur to fires.
- Number of fire incidents in jhuggi clusters and high-rise buildings has reduced while fire incidents in industrial and residential areas have increased. One of the reasons for such increase is that industrial areas have started having non-confirming industrial activities and residential areas have become haven for illegal storage's and dangerous commercial activities in pursuit of mixed permitting land and occupancy in these areas without making the required provisions for firefighting.

Table 13.3 shows the fire calls registered since 2003 to 2016 and the injured cases increased from 14595 to 27089, whereas death cases also increased from 235 in 2003-04 to 339 in 2015-16.

Table 13.3 Detail of fire calls and loss in Delhi

S.No	Year	No. of Calls	Injured	Deaths	Medium	Serious
1	2003-04	14595	1334	235	17	5
2	2004-05	14208	1687	272	27	5
3	2005-06	16340	2191	470	16	1
4	2006-07	14291	1743	303	16	3
5	2007-08	15718	2057	351	9	2
6	2008-09	16452	2225	380	6	2
7	2009-10	21314	2598	423	10	2
8	2010-11	22187	243	447	10	3
9	2011-12	18143	2132	357	13	1
10	2012-13	22581	1979	285	9	2
11	2013-14	22726	2299	372	16	1
12	2014-15	23242	2068	291	7	2
13	2015-16	27089	2099	339	11	0

Source: Department of Delhi fire services, GOI

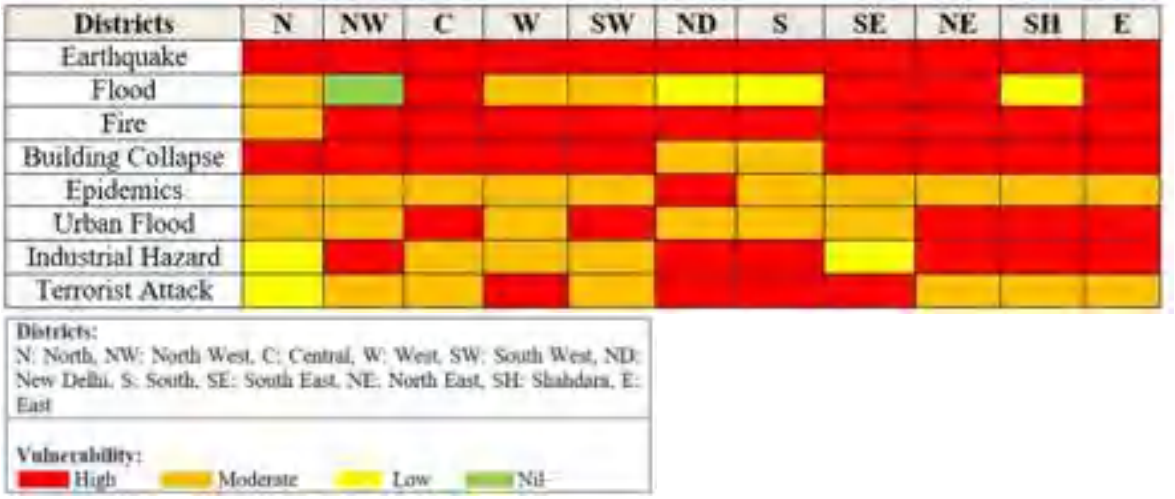
13.3.6 Risk and vulnerability Analysis based on Hazards

Delhi is vulnerable to various disasters. Below table explains (on the basis of hazard analysis) district-wise degree of risk and vulnerability involved in Delhi.

Physical, socio-economic, housing, community and institutional preparedness related parameters had been identified for risk and vulnerability assessment. To assess their importance, checklists

were prepared under each parameter and information was gathered from various primary and secondary sources. Based on the information collected under the checklists, few indicators were formulated and status of strength, weakness, opportunity and threat has been assigned which was further utilized for risk and vulnerability analysis. Below given table explains the risk and vulnerability assessment based on the certain parameters.

Table 13.4: District-wise vulnerability matrix of Delhi



Source: State Disaster Plan Delhi, 2014-15

13.4 Mitigation Measures

Disasters	Effect	Mitigation Measures
Earthquake	Large scale loss of human life and property	• Construction of Earthquake Resistant Building as per the Bureau of Indian Standards IS Code 4326.High rise buildings and unauthorized buildings built without following building norms & guidelines are the high-risk areas exist without specific consideration of earthquake resistance • The major Central building districts like Connaught Place, District Centers and group housings are high risk areas due to vertical as well as configurations. The walled city area, the Trans Yamuna area and scattered pockets of unplanned settlements also figure as high-risk zones due to their substandard structures and high densities. • Housing is concerned, vulnerability analysis has never been carried out and preliminary estimate of damages is not available for strengthening of structures under normal improvement

Disasters	Effect	Mitigation Measures
		development schemes. • Heritage structures need retrofitting attention to cope up earthquakes. Wherever required may be undertaken.
Wind & Heat Waves	• Frequent climatic cycles of dry and wet periods, resulting in loose soil due to weathering • Large scale sediment movement due to heavy flow of water and wind movement and subsequent deposition in reservoirs and river beds • Degrades water quality • Depletion of the water storage capacity, because of soil loss and sedimentation of streams and reservoirs, which results in reduced natural stream flow regulation. • Loss of support and nutrients necessary for plant growth	**Water management:** • Water harvesting through building micro structures through rain water harvesting pits. • Maintenance and conservation of water Bodies • Maintenance and conservation of vegetation & Shelter Belts that includes conservation of Delhi Ridge.
Flooding and Low lying Areas	• Evaporation from depressions having no outlets • Rise of groundwater close to soil surfaces • Decline in soil fertility or even a total loss of land for agricultural use • In certain instances, farmland abandoned because of salinity problems may be subjected to water and wind erosion and become decertified.	• Development of early warning and expert systems by improvement of the monitoring, modelling and prediction capacities and improved communication equipment. • Watershed management through extensive soil conservation, catchment area treatment, preservation of forests and increasing the forest area and construction of check dams shall be promoted to reduce the intensity of floods. Adequate flood cushion shall be provided in water storage projects whenever feasible to facilitate better flood management. An extensive network for flood forecasting shall be established for timely warning to the settlements in the flood plains, along with the introduction of regulation for settlements and economic activity in the flood-prone zones to minimize

Disasters	Effect	Mitigation Measures
		loss of life and property caused by floods. Master plan for flood control and management for each flood prone basin / area shall be prepared. Due consideration to provide proper drainage shall also be given to build up capabilities to tackle water logging and salinity problems.
Drought	• Pushing back against modern energy- and water-intensive industrial usage. • Illegal groundwater extractions	• There is a need to include urban drought as one of natural disasters and have its separate guidelines and preparedness plan as in California (USA) and other developed countries. • Water in the summer season particularly in the urban slums needs urban drought regulation with legal support, guidelines and regulation on water usage. • Mainstreaming disaster risk reduction (DRR) is an imperative pledge of India thus various ministries, viz Ministry of Urban Development, Ministry of Water Resources, and Ministry of Agriculture the nodal Ministry can conjointly develop an approach for urban drought mitigation.
Fire	• Large scale loss of human life and property	• Maintenance of electrical wires • Strict compliance of fire safety norms prescribed by the concerned agencies.

13.5 Policies and Proposals

- GIS, GPS, remote sensing, computer modelling and expert systems, electronic information and management systems etc. for collection, storage, retrieval and dissemination of information. The control rooms need to be modernized and made more effective and community friendly. Detailed database should be compiled on the occurrence of hazards and damage caused in the area. Telecommunications in terms of disaster warning systems need to be set up in all the levels. Disaster warning sets may be located in the States and District headquarters.
- An Emergency Operation Centre (EOC) for coordination and optimization of efforts of the State. Networking of communication between EOC, NCR and State EOC, their

interoperability and compatibility of radio sets is recommended. ERC/s of NCR will function under the EOC, NCR. The Emergency Operation Center at 5 Sham Nath Marg, Delhi-110054 operates a 24X7 Helpline no. '1070' and all the districts also maintain a similar Control room for a response to any emergency or disaster calls received in Delhi. All calls received on this Helpline are logged and information is immediately sent to Police, Fire, district Control Room and concerned officers such as SDMs/ Tehsildars. The EOC's Headquarters is networked with V-SAT connections in all the 11 Revenue Districts for a failsafe communication in the event of any disaster. 53 Satellites phone for the important functionaries of the Govt. of NCT of Delhi have also been procured for having an uninterrupted communication network. A major revamping of Emergency control room (EOC) has also been initiated which will enable all facilities such as GIS, GPS, remote Sensing and Computer modelling. While an EOC operates in NCT of Delhi for coordination among all the 11 revenue districts, if any, EOCs is setup by the NCR for coordination among the States EOCs of the NCR region the same can also be networked for inter-operability. It will only depend when a EOC of the NCR Region is first established.

- A techno-legal regime has to be proposed for amending the present building by-laws and Acts to include safety aspects from natural hazard's point of view. A techno legal regime already exists for amendment in the Building Bye Laws in the concerned Municipal Corporations/ Local Bodies in Delhi, which amend Building Bye Laws from time to time.
- Undertake the vulnerability and risk assessment due to natural hazards and prepare Prevention cum Preparedness Plan. National Disaster Management Authority (NDMA) Govt. of India has proposed a scheme on Hazard Vulnerability Risk assessment (HVRA) for Delhi in the current Financial Year and work on the scheme will be taken up in association with NDMA, GoI.
- Seismic micro-zonation on a scale of 1: 50,000 to 1: 10,000 for areas, having high growth have to be undertaken basis. A report on Seismic Hazard Microzonation of NCT Delhi on 1:10000 scale has already been prepared by the National Centre for Seimology, Ministry of Earth Sciences, Govt. of India in the year 2016 and the same report has been shared with all Local Bopdies and important stakeholders.
- Extensive studies are needed for seismic hazard evaluation for different parts of Delhi and vulnerability assessment for different kinds of constructions; using these, seismic risk evaluation for Delhi must be carried out. The report prepared by the National Centre for Seismology is based on extensive study on seismic hazard evaluation for the whole of Delhi.
- Manuals need to be developed outlining methodologies for new constructions and retrofitting of old structures & Heritage buildings.IEC campaigns have been launched on buildings of earthquake safe buildings describing various easy methods by which the earthquake safe buildings can be constructed in a cost effective manner in the Govt. of NCT of Delhi. A scheme for retrofitting of few public buildings is also being undertaken in the NDMC area in association with the NDMA, GoI.
- Unauthorized colonies are prone to structural problems in the buildings and may cause large scale damage. Hence, a special programme for structural safety audit of these buildings must be undertaken and retrofitting as required may be done. Large number of unauthorized colonies has been regularized by the Government in the year 2019 which will enable proper development activities in these colonies. Regularization will also

enable financing by the banks which will help in re-buildings of the houses in a planned manner.

- Construction of buildings in the River bed area must be prohibited and habitation should not be allowed in any condition. Construction of buildings in River bed area is not allowed and even in the regularization plans of unauthorized colonies, the habitations constructed in the river bed area have not been regularized.

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CHAPTER 14. SUB-REGIONAL LAND USE

14.1 Introduction

Land is a vital non-renewable resource and its supply is finite contrary to ever-increasing demand for growth and development of urban areas. Rapid growth of population poses tremendous pressure on land. Particularly, there is an increasing concern over loss of valuable agricultural land and the consequent natural environmental degradation. This calls for an urgent need for optimizing the use of land resources in any region through rational use of urban land, conservation of areas ecologically sensitive to development activities and evolving appropriate policies for effective control land uses.

The National Capital Territory of Delhi occupies 1,483 sq.km of area which accounts for only 4.4 percent of the total area of NCR, spread over 55,083 sq.km. of area. As per Census 2011, 75 percent land area of NCT Delhi is urban and 25 percent area is still designated as rural against 54 percent in 1991 having 300 villages which reduced to 112 in 2011. North West district is the largest in terms of area having 443 sq.km. and the smallest is the Central district with only 21 sq.km. Table 14.1 that the entire districts of New Delhi, East Delhi and Central are fully urban with no rural area whereas in West and South districts more than 90 percent of land area is under urban. North West and South west districts still have 38 percent of rural areas. Of the total 1114.06 sq.km. of urban area 603.84 sq.km. (54.20 percent) is falling under three Municipal Corporations, New Delhi Municipal Corporation and Cantonment Board and rest of the 510.22 sq.km. (45.79 percent) area under various non statutory census towns spread outside the statutory towns across NCT Delhi.

Table 14.1: District wise distribution of land in urban and rural areas in sq. km

S. No.	Districts	Total	Urban		Rural	
			Area in Sq. km.	Percentage share	Area in Sq. km.	Percentage share
1	North West	443	272	61.40	171	38.60
2	North	61	51	83.61	10	16.39
3	North East	62	47	75.81	15	24.19
4	East	63	63	100.00	0	0.00
5	New Delhi	35	35	100.00	0	0.00
6	Central	21	21	100.00	0	0.00
7	West	130	123	94.62	7	5.38
8	South West	421	267	63.42	154	36.58
9	South	247	234	94.74	13	5.26
	NCT Delhi	**1,483**	**1,114**	**75.12**	**369**	**24.88**

Source: Census of India, 2011

14.2 Statutory Provisions for Regional Land Use Plan

Section 10 (2) of the National Capital Region Planning Board Act, 1985 states "The Regional Plan shall indicate the manner in which the land in the National Capital Region shall be used, whether by carrying out development thereon or by conservation or otherwise, and such other matters as are likely to have any important influence on the development of the National Capital Region". Further, Section 10(2) (a) of the National Capital Region Planning Board Act, 1985 emphasizes that the Regional Plan shall indicate "the policy in relation to land use and the allocation of land for different uses". Therefore, the Regional Land Use Plan translates broad planning policies and proposals into physical (spatial) form to illustrate the manner in which the land in NCR is to be used for various purposes. The reservation of areas for specific land uses

which are of the regional or sub-regional importance will be detailed out in the Sub Regional Plans and Master Plans/Development Plans which are to be prepared by the respective participating States, within the overall framework of the Regional Plan.

As per the Section 17 (3) (a) of the NCRPB Act, 1985, the Sub-Regional Plan shall indicate "reservation of areas of specific land uses which are of the regional or sub-regional importance", therefore, the Sub-Regional Land Use Plan translates the broad planning policies and proposals into physical (spatial) form, to illustrate the manner in which the land in NCT Delhi is to be used for various purposes.

14.3 Review of Land Use proposal of Regional Plan-2001, NCR

i. The review of Regional Plan-2001 policies has brought out certain critical issues of large scale conversion of rich agricultural land into non-agricultural use, and conversion of land along the transport corridors in Delhi urban area, DMA (now CNCR) and close to the designated urban centres.

ii. In States, proper land use control is exercised only within the controlled/ development/ regulated areas around towns through their existing Acts and regulations but in very few cases the planning/ development control have been exercised outside the controlled/development/regulated areas.

14.4 Existing Land Use Analysis - 1999

Analysis of existing land use is based on the IRS IC LISS III Satellite data of March 1999 of NCRPB as part of the study by NRSC on '*Urban Sprawl and Land use/Land cover Mapping in 1999'* as carried out for the preparation of Regional Plan 2021. Land use analysis based on Satellite data of 5.8 meters resolution for March, 1999only depicts the level-I features of regional land use of entire NCR. Apart from this no data or study on existing land use using high resolution satellite data or area calculation for various categories of land uses was done either by DDA or GNCTD. While GNCTD through GSDL has prepared land cover map of Delhi using high resolution satellite data on GIS platform, no analysis of existing land uses is made available for the preparation of SRP 2021 of NCT Delhi.

Table 14.2: Land use area in NCT Delhi and NCR (in Ha.) (Based on 1999 Satellite Data)

S. No.	Category	NCT Delhi	Percentage Area	NCR	Percentage Area
1	Built-up	70,162.00	47.31	371825.00	7.26
2	Agriculture	62,279.00	42.00	4252758.00	83.09
3	Forest	7,015.00	4.73	207806.00	4.06
4	Waste Lands	6,079.00	4.10	230511.00	4.50
5	Water Bodies	2,435.00	1.64	39391.00	0.77
6	Others	330.00	0.22	15788.00	0.31
	Total	**1,48,300.00**	**100.00**	**5118079**	**100.00**

Source: Based on the Study Report on Urban Sprawl and Land Use/Land Cover Mapping for NCR, NRSA, 1999. Figure 14.1: Land Use in NCT Delhi 2012

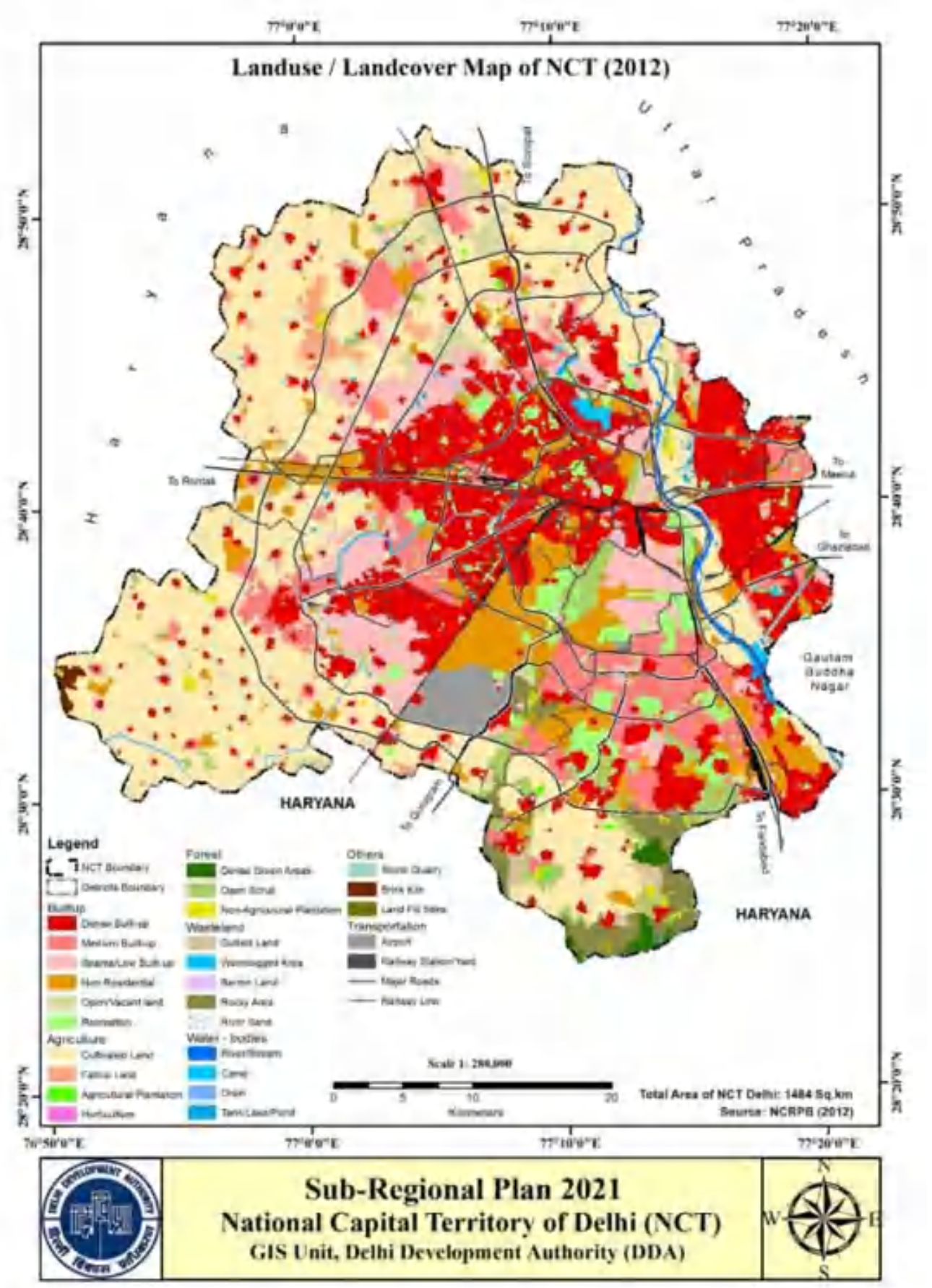
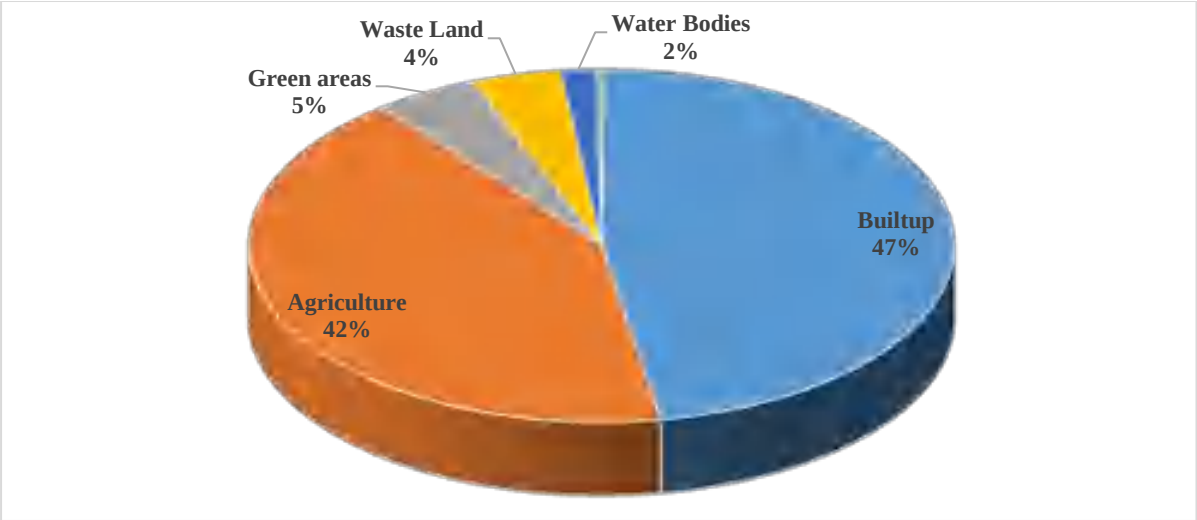


Figure 14.2: Land use/Land cover in NCT Delhi



Source - Sprawl and Land use/Land cover mapping in 1999, NCRPB

14.4.1 Built-up area

The analysis of the above land use data indicates that the "Built up area" of 70,162.00 ha. which includes residential, transport, industries, commercial, public semi-public, landfill sites etc.is the most predominant use of land which constitutes 47.31 percent of the total area of NCT Delhi against only 8.71 percent for the National Capital Region. Although the data on built up area falling within the MCDs, NDMC and Cantonment Board boundaries are not available, it is estimated that 86 percent i.e. more than 60,000 ha. built up area is concentrated within the jurisdiction of these urban local bodies and the rest 14 percent is scattered among the census towns and rural belt outside the Urban Local Bodies' boundaries.

The above analysis also indicates that the balance 52.69 percent i.e.78,138.00 ha. of land area within NCT Delhi is still not built up yet which includes vast agricultural rural areas, forest areas, waste land, water bodies etc. Therefore, there is lot of scope for conserving areas having ecological values and restricting expansion of built up areas further by re-densifying the areas having relatively low density to make Delhi a more energy efficient compact city with better infrastructure and mobility. Any further horizontal expansion will also result in adding more built up areas which imply increased trip length, more automobiles and higher energy consumption having adverse ecological consequences.

14.4.2 Agriculture area

Cultivated land, fallow land, plantation, farmhouses and horticulture shown under "Agriculture use" is the second most predominant use of land, constitutes 42 percent of the total area whereas it is the most predominant land use of entire NCR (79. 52 percent). These agricultural lands are spread around the rural areas and all along Yamuna flood plain of NCT Delhi outside the Municipal areas except the southeast part. As these areas provide ecological services and food security, it is worthwhile to consider conserving these areas for environmental sustainability of the sub-region.

As per Master Plan of Delhi 2021, draft chapter nine on Environment 'Delhi has a much larger green cover than any of the other metropolitan city in the country, and could well be called a "Green City". The green / recreational use constitutes 8,722 ha of land as per MPD 2001, which is around 19 percent of the total urban land area of 44,777 ha. This includes 1577 ha. under the

Northern, Central and South-Central Ridge (the remaining area of the Ridge is in the rural area). The balance area under recreational/ green use i.e. 7145 ha. is in the form of District Parks, City Parks, Community Parks etc. comprising around 15 percent of the total urban land area. In addition to this, a large chunk of green area is provided in the form of Neighborhood Parks / Tot lots in the gross residential use zones, plantations /greens in large campuses like President's Estate, JNU, IARI, Delhi University, Plantations along drains and roadside plantations. In addition to above, two Biodiversity parks are under development by the DDA. Further, Sports Complexes, which were included in the green / recreational use category under the MPD-2001 will be seen under a separate category of sports. In the Urban Extension the green cover is to be provided at the rate of 15 percent of the total land, excluding the Ridge/ Regional Park. Out of this, some area shall be developed in the form of formal parks for the community and the rest shall be developed as woodlands and incidental greens for balancing the environment. This will be in addition to the development of specialized parks like Bio-Diversity Parks, plantation along the roads, drains, riverbank, etc.

14.4.3 Waste land

The Waste land which includes barren, rocky, gullied land and river sand constitute 4.10 percent against 6.63 percent in NCR. These areas can be regenerated through large scale plantation in scientific manner and converted into green areas.'[2]

14.4.4 Water bodies

It plays crucial role for ground water recharge, flood sink, micro climate and aquatic habitat which calls for preservation and revival of existing water bodies to avoid any further loss of precious ecosystem. As per Regional Plan 2021, "*the 'water bodies' include rivers, canals, drains, lakes, tanks and ponds covering 0.80% (24,217 hectares) of NCR's total land area*." As per MPD 2021 'Environment chapter', the length of the river in the NCT of Delhi is 48 kms from Palla in the North to Okhla in the South, with a total river bed/flood plain area of around 97 sq. kms. which is about seven percent of the total area of Delhi. A little over 50 percent of the river lies North of Wazirabad and the rest, around 22kms., to its South, in the Urban area of Delhi. Apart from being the main sources of water supply for Delhi, it is one of the major sources of groundwater recharge. There are 22 drains are flowing into the river Yamuna which are listed below:

List of drains out falling into river Yamuna

1. Najafgarh drain
2. Magazine Road drain
3. Sweeper Colony drain
4. Khyber pass drain
5. Metcalfe drain
6. Kudsia Bagh drain

[2]*Environment Chapter MPD-2021 modified up to 31/12/2018*

7. Moat drain
8. Trans Yamuna MCD drain
9. Mori Gate drain
10. Civil Mill Drain
11. Power House drain
12. Sen Nursing Home drain
13. Drain No. 14
14. Barapullah Drain
15. Maharani Bagh drain
16. Kalkaji drain

72. Okhla drain

17. Tughlakabad drain
18. Shahdara drain
19. Sarita Vihar Drain
20. LPG Bottling Plant Drain
21. Tehkhand Drain

73. Other water bodies

Apart from river Yamuna and 22 drains flowing into the river, there are 1012 other water bodies in Delhi. Water bodies are defined as "*Bodies of still waters in the urbanscape or ruralscape which are either naturally present or intentionally created. However, areas of unintentional water logging along railway tracks, highways are excluded".* The existing status of water bodies is given in Environment chapter. However, the type and nature of water bodies located in NCT Delhi are given below:

74. Village pond/Johar

The village ponds are mostly created water bodies having very small localized catchments for gathering rainwater. Most ponds present a state of neglect. Some of the ponds have become absorbed in the urban area or village abadi area where they have been used to discharge the local waste waters and thus become cess pools.

75. Lakes

Most prominent are Bhalaswa Lake (a fresh water oxbow lake on the river floodplain), Sanjay Lake [apparently a meander scour on the floodplain in East Delhi, Najafgarh Jheel which used to be the largest lake in this area now lies mainly on the Haryana side of the inter-state border, Hauz Shamshi, Hauz Khas, Old fort Lake.

76. Marshes

Jahangirpuri Marshes is presently the largest water body in Delhi, is now outside the floodplain embankments. Stepwell or *Baolis* are different categories of water bodies. They are created for drinking water purposes and get recharged from ground water source. In Delhi they are mostly with ASI.

14.5 Analysis of temporal change of Land use

14.5.1 Change of Built up area (1958-2012)

As per land use inventory carried out by Town & Country Planning Organisation (erstwhile TPO) in 1958 for the purpose of existing land use of urban Delhi for the Master Plan of 1962, the total urbanised area was 17,287.45 ha. in 1958-59 which constituted 11.7 percent of the total area of Union Territory of Delhi having approximately 20 lakh population. Subsequently, NCRPB obtained satellite of IRS 1B in 1993 and analysis of the data indicated a built-up area of 60,340 ha. Analysis of existing land use is based on the IRS IC LISS III Satellite data of March 1999 of NCRPB as part of the study by NRSC on '*Urban Sprawl and Land use/Land cover Mapping in 1999'* as carried out for the preparation of Regional Plan 2021 depicts a built-up area of 70,162 ha. Again in 2012 Regional Planning Board commissioned a study on "Creation and Updation of Land use / cover for review of Regional Plan – 2021 through NRSC and the existing land use analysis based on Resourcesat-2 LISS-IV data pertaining to 2012 indicated that the built-up area of NCT Delhi has further increased to 83536.08 ha. From the above studies and land use analysis it is observed that the built up or urbanised area has increased from 17,287.45 ha which constituted 11.7 percent of NCT area in 1958-59 to 83,536 ha. in 2012 which now constitutes 56.33 percent of NCT area, a net increase of 44.7 percent.

14.5.2 Change of land use (1999-2012)

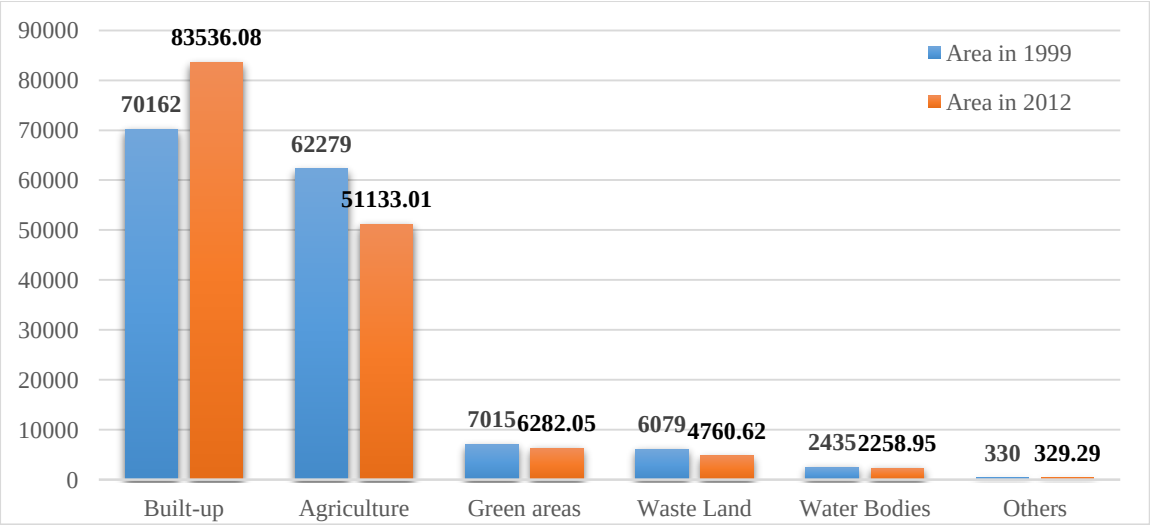
The land use change analysis during the period 1999-2012 indicates that the "built-up" area has increased from 47.3 percent to 56.3 percent, registering an increase of nine percent during the last 13years. Whereas area under "agriculture use" has reduced by nine percent from 42 percent in 1999 to 34.3 percent in 2012. "Forest area" which includes dense forest, plantation and open scrub has been marginally reduced from 4.7 percent in 1999 to 4.24 percent in 2012. In the case of wastelands, the area has been reduced from 4.1 percent to 3.21 percent and area under "waterbodies" had reduced marginally from 1.64 percent to 1.52 percent in 2012. Area under "Others" category remained unchanged during the period 1999-2012.The "Others" comprise uses not included in the above categories such as mining areas, quarrying, brick kiln constitutes 0.22 percent of NCT Delhi and entire NCR has 0.32 percent. Abandoned brick kilns, mining and quarrying areas which have become derelict can be reclaimed and converted into green areas or water bodies. As per the latest additional data provided by GNCTD on the 30.07.2020, the Agriculture Census Data 2016 indicates 29,000-hectare area is available for Agriculture & Horticulture activities out of 1483 sq. kms. The table and the figure below show the category wise change of land use from 1999to 2012.

Table 14.3: Change in areas in land use in NCT Delhi from 1999-2012

S. No.	Category	Area in 1999		Area in 2012		Change in area	
		Area in ha.	Percentage share	Area in ha.	Percentage share	Area in ha.	Percentage change
1	**Built-up**	70162	47.31	83536.08	56.33	13,374.08	9.02
2	**Agriculture**	62279	42.00	51133.01	34.48	-11,145.99	-7.52
3	**Green areas**	7015	4.73	6282.05	4.24	-732.95	-0.49
4	**Waste Land**	6079	4.10	4760.62	3.21	-1,318.38	-0.89
5	**Water Bodies**	2435	1.64	2258.95	1.52	-176.05	-0.12
6	**Others**	330	0.22	329.29	0.22	-0.71	-0.00
	Total	**148300**	**100.00**	**148300**	**100.00**		**-**

Source – Study Report on Creation and updation of Landuse for Review of RP-2021

Figure 14.3: Change of Land use in NCT Delhi (1999-2012)



Source –Study Report on Creation and updation of Landuse for Review of RP-2021

14.6 Issues and Challenges

14.6.1 Conversion of Agricultural Land to Non-Agricultural Built up Use

- During the period 1999-2012 built-up area has increased by 9.02 percent (13,374.08 ha.) from 47.31 percent to 56.33 percent of the total land area of NCT Delhi. This increase has been done through conversion of agricultural land, waste lands, forest cover and water bodies.

- Agricultural area has declined by 7.52 percent from 62279 ha. in 1999 to 51133 ha. in 2012.

- Further horizontal expansion will also result in adding more built up areas which imply increased trip length, more automobiles and higher energy consumption having adverse ecological consequences.

14.6.2 Unplanned/haphazard Growth in Environmentally Sensitive Areas

The satellite imageries have shown that environmentally fragile and sensitive areas such as Yamuna riverbed/ wetland, ridge areas, forest areas are being subjected to both authorised and unauthorised developments. Many unauthorized constructions along rivers, conversion of ponds/paleo channels for residential/ educational purposes are adversely affecting the land use and eco-system of the area.

14.6.3 Large-scale change of landuse for redensification

Large-scale change of land use in existing residential areas without carrying out the environmental and traffic impact assessments as done in the case of East Kidwai Nagar, Sarojini Nagar, R.K. Puram and Srinivaspuri, is causing adverse environmental impacts as well as on traffic and transportation around such developments.

14.7 Policies and Proposals

As envisaged in Regional Plan, land use may be guided and regulated in selected areas and the other areas will be dealt in the Master/Development Plans. Such areas are the pockets where

the development pressure is quite high or various kinds of natural areas which have to be conserved (e.g. ridge, river beds and banks, lakes, wild life and bird sanctuaries, forests, etc.) and pockets of planned green areas including green wedges, buffers, opens paces and parks which need to be regulated for environmental sustainability. Accordingly, following four major land use zones have been identified (as shown in Map 17.2 Sub-regional proposed land use plan for NCT Delhi-2021) and policies and proposals for each of the zones are as follows:

a) Controlled/Development/Regulated Zone
b) Agriculture (Rural) Zone within controlled/development/regulated areas
c) Green buffer
d) Natural Conservation Zone

14.7.1 Controlled/Development/Regulated Zone

As per the existing land use analysis based on Resourcesat-2 LISS-IV data pertaining to 2012 the built-up / urbanised area of NCT Delhi has increased to 83,536.08 ha. The activities within this zone will have to be effectively controlled and monitored by the Delhi Development Authority within the preview of Master Plan of Delhi/Zonal Plan. No development in the controlled/development/regulated zones can be undertaken except in accordance with the Master Plan or as notified as per the provisions of the Delhi Development Act.

77. Urbanisable Areas (including existing Built-up/urban areas)

- Delhi Development Authority would elaborate the details of land uses, its phasing for development and zoning regulations in the Master Plan as per the provision of Delhi Development Act 1957.

- It is to be ensured that development should not be permitted in the natural conservation zones, planned green areas, agriculture areas, ground water recharging areas and water bodies. Land also be reserved for the activities such as disposal of solid waste generated, city level utility services (such as power plant, grid station, water and sewage treatment plants etc.) dairy farming, horticulture, inter and intra urban transport system, etc. Attempt be made to rationalize the quantum of land required for each urban activity while preparing the Master Plan.

- There is a large proportion of underused land with a number of vacant sites as well as dilapidated built-up areas lying vacant in the city. Many of such areas are owned by Government of India. Such areas are recommended to be planned for redevelopment with higher density in order to make optimum use of land resource as per the prescribed norms.

- There is lot of scope for conserving areas having ecological values and restricting expansion of built up areas further by re-densifying the areas having relatively low density to make Delhi a more energy efficient compact city with better infrastructure and mobility.

- There is a strong need to improve the forest cover in the region and preserve the agriculture land. Bio-diversity of the region should also be considered while formulating the strategies along with the green/ forest cover.

- A dynamic city-level integrated transport-land use model for NCT Delhi needs to be prepared to assess land use and transportation planning needs of the city. It is proposed that integrated redevelopment schemes of the influence area of MRTS stations be prepared based on TOD principles.

78. Future urbanisable area

MPD 2021 has worked out the future urbanisable land which would be available up to the year 2021. Apart from the land which has already been built up or used for urbanization, it estimated that an area of 19,509.10 ha. (13.16 percent) having some natural features such as Forest, Wild Life Sanctuary, Ridge, River Yamuna, and Other Water Bodies/Drains cannot be used for future urbanization purpose as they be required for conservation purpose. In other words, an area of 89,671.10 ha. (60.47 percent) has already been used or is out of bound for future urbanization leaving a balance of 58,628.90 ha. (39.53 percent). Out of the balance land of 58,628.90 ha, 31,000 ha. (20.90 percent) needs to be reserved for sanitary land fill sites and mandatory green belt, metro services and utilities along with agriculture zone including dairy farming, horticulture, green belt etc. Therefore, effective land available for future urbanization is only 27,628.90 ha. (18.63 percent). That is, total urbanisable area for 2021 which includes the built up area up to 1999 which is 97,790.90 ha. This accounts for 65.94 percent of the total area of NCT Delhi. The table and map below show the availability of urbanisable land in NCT - Delhi for 2021:

Table 14.4: Availability of Urbanisable Land in NCT - Delhi for 2021

S.No.	Land use	Area (Ha.)	Percentage to total area
1	Built-up area (As per IRS IC LISS III Satellite data 1999)	70,162.00	47.31
2	Natural features (Forest, Wild Life Sanctuary, Ridge, River Yamuna, and Other Water Bodies/Drains	19,509.10	13.16
3	Sub Total (Built up + Natural features)	89,671.10	60.47
4	Balance land available in NCT Delhi (1-4)	58,628.90	39.53
5	Land to be kept for:		-
	a) Disposal of Solid Waste generated up to 2051 (Sanitary land fill & Statutory Green Belt)	10,000.00	6.74
	b) Metro Services / Utilities (power plant, grid station, water and sewerage treatment plant etc.)	10,000.00	6.74
	c) Agriculture zone including dairy farming, horticulture, green belt etc.	11,000.00	7.42
6	Sub Total (Sl.no. 5)	31,000.00	20.90
7*	Effective land available for urbanisation (4-6)	27,628.90	18.63
8	Total urbanisable area for 2021 (including built up area up to 1999) (1+7)	97,790.90	65.94
	Total Area of NCT Delhi	1,48,300.00	100.00

**This included unplanned and existing built up area.Source: MPD 2021*

While planning the future urbanisable area following points may be considered:

- While preparing the Master Plan / Zonal Development Plan for these areas, it is to be ensured that proposed development should not be permitted in the natural conservation zones, planned green areas, ground water recharging areas and water bodies.

- Land also be reserved for the activities such as inter and intra urban transport system, disposal of solid waste generated, utility services (such as power plant, grid station, water and sewage treatment plants etc.).

- To compensate the loss of agriculture land at least 15 – 20 percent of area should be designated for organic vegetable farming, horticulture (*using drip irrigation or treated waste water and local compost and manure*), dairy farming, poultry farm, pisciculture etc. over and above the 15 percent of planned green area. This will also ensure self-sufficiency within NCT Delhi in terms of supply of farm produce and ensure food security.

79. Zoning regulations of Urbanisable Areas (including existing built-up/urban areas) area

Within the urbanisable area proposed in the Master Plan/Zonal Development Plan the functions and uses designated as under be continued:

a) Residential
b) Commercial
c) Industrial
d) Government offices, public and semi-public
e) Recreational
f) Utility services
g) Sports Facilities
h) Transport and communications
i) Open spaces, parks and playgrounds
j) Graveyards/cemeteries and burning ghats
k) Man-made heritage areas
l) Natural heritage areas/eco-sensitive areas/conservation areas
m) Vegetable farming, horticulture and allied activity areas,

14.7.2 Agriculture (Rural) Zone within controlled/development/regulated areas

In order to compensate the loss of agriculture due to increasing urbanization and to make Delhi self-sufficient in terms of supply vegetable supply it is proposed that 15 – 20 percentage of the land available for future urbanization should be reserved for vegetable farming, orchards and allied activities. These areas should be over and above the mandatory recreational / green areas. Agriculture (Rural) zone within the controlled/development/regulated areas of urban centres should be provided in the Master Plan / ZDPs of the respective controlled/development areas and to be strictly adhered to. No activities other than those defined in the zoning regulations to the Sub-Regional Plan-2021 will be permitted.

80. Zoning regulation for Agriculture (Rural) Zone within Controlled/Development/ Regulated Areas

The following activities may be allowed:

1. Organic Vegetable farming, horticulture (*using drip irrigation or treated waste water and local compost and manure*) and allied activity areas,
2. Dairy and poultry farming including milk chilling station and pasteurization plants
3. Compost processing plant
4. Pisciculture
5. Telephone and electric transmission lines and poles
6. Weather station
7. Village houses within *abadi-deh*.

14.7.3 Green buffers

Green buffers be maintained and regulated as per the provisions of the MPD - 2021. These green buffers will be outside urbanisable limits of towns and the zoning regulations for the green buffers will be applicable as given below:

i. Approach/service roads
ii. Vegetable farming and horticulture
iii. Social forestry/plantations including afforestation

14.7.4 Natural Conservation Zone

As per the Section 10 (2) of the National Capital region Planning Board Act, 1985, the Regional Plan 2021 has broadly identified and demarcated major envoronmentally sensitive natural features in NCR such as Aravalli Range, Forests, Sanctuaries, Rivers and tributories, lakes and water bodies, water recharging areas, ox-bow lakes and paleo-channels etc. All such environmentally sensitive natural features shall be delineated in the sub-regional plan of the respective constituent states. Accordingly, NCRPB through NRSC identified 156 sites of Natural Conservation Zone (NCZ) in NCT Delhi in 2005 with the help of satellite data indicating a total area of 15437.06 ha which was again revised 2012 to 13054.63 ha showing a variation of about of 15.43 percent . A recent inhouse preliminary verification of sites carried out by DDA to identify the actual area under NCZ based on the actual ground conditions indicates that the identified 156 sites in NCT Delhi cover an area of 10,214 ha which is free from any encroachments which constitutes 6.89 percent of the total NCT area. Rest of the area is either encroached or built-up leading to drastic reduction of area. List of 156 NCZ sites is given in Annexure …. DDA Planning zone wise distribution of NCZ areas is shown in table .

Table 14.5: Planning zone wise distribution of NCZ areas

S. No.	Zone	Name of Zone	Area (Ha.)	No. of sites	NCZ area in ha.	Percentage share of total area
1	A	Old City	1,159	-	-	-
2	B	City Extn. (Karol Bagh)	2,304	4	17.03	0.74
3	C	Civil Line	3,959	7	362.55	9.16
4	D	New Delhi	6,855	2	745.21	10.87

S. No.	Zone	Name of Zone	Area (Ha.)	No. of sites	NCZ area in ha.	Percentage share of total area
5	E	Trans Yamuna	8,797	10	56.13	0.64
6	F	South Delhi-I	11,958	5	686.10	5.74
7	G	West Delhi-I	11,865	4	32.56	0.27
8	H	North West Delhi-I	5,677	1	58.76	1.03
9	J	South Delhi-II	15,178	24	6,340.04	41.77
10	K	K-I West Delhi-II	5,782	13	77.47	1.34
		K-II Dwarka	6,408	2	15.44	0.24
11	L	West Delhi-III	22,840	15	372.73	1.63
12	M	North West Delhi-II	5,073	-	-	-
13	N	North West Delhi-III	13,975	6	182.42	1.31
14	*O	River Yamuna / River Front	8,070	45	923.63	11.45
15	P	P-I Narela	9,866	10	274.91	2.79
		P-II North Delhi	8,534	8	68.54	0.80
Total			**1,48,300**	**156**	**10,214**	**6.89**

** Sites falling under two or more zones have been shown under the zone having maximum area falling under it*

Zone wise distribution of NCZ sites and their areas indicate that out of total 156 sites 24 sites having an area of 6340.04 ha. (41.77 percent) are in South Delhi -II zone and 45 sites of 923.63 ha. are falling in River zone / river front of Zone O. All other planning zones except Old Delhi (Zone A) and Zone M of North West Delhi -II have NCZ sites. It is also observed that Natural Conservation Zones (NCZ) as marked by NRSC in the year 2012 have missed out many large and small environmentally sensitive areas spread across Delhi are well incorporated in the Master Plan for Delhi 2021 under "Recreational" Landuse. Some of these missed out NCZ areas by NRSC which also need conservation and preservations have to be verified by Forest Department, GNCTD and by other agencies looking after the ground water recharge areas and waterbodies, lakes etc. This calls for an urgent need to have a comprehensive list of NCZ in Delhi after thorough verification by all concerned agencies within their jurisdictions and consensus. This should also consider the present status of the 156 sites and also the areas having environmental values but not included in the list of NCRPB. After the NCZ areas are finalised and vetted by all concerned agencies, these areas should be indicated in MPD 2041 as a separate land use category other than recreational areas.

The broad policies for management of NCZ are as follows:

i. The issues of **delineation of the NCZ** and mismatching on the ground should be based on operational definitions with well-defined cartilage etc., based on satellite images and necessary ground-truthing and verification by the respective agencies within their jurisdiction.

ii. **Extension of Aravalli** -The extension of the Aravalli ridge, sanctuaries and other ecologically sensitive areas be conserved with utmost care and afforested with suitable

species. The development in this area be in accordance with the notifications issued for such areas by the Ministry of Environment and Forests under the Environment (Protection) Act, 1986 from time to time.

iii. **Forest areas, National Parks and Sanctuaries** should be conserved as per the provisions of the prevailing laws/policies. Canopy cover in Reserve and protected Forests need to be improved. Afforestation / plantation should be done to increase the forest cover. Afforestation drives in recorded / Government Forests should be done by the Forest Department.

iv. **Plantation / Afforestation** should be carried out and maintained along Yamuna river, natural drainage channels, water bodies, waste land, village common land, along road and railway lines involving all concerned agencies, community, NGOs, RWAs etc. After plantation / afforestation these areas should be conserved as Green Areas for better maintenance and to avoid conversion to other development activities.

v. **Rivers and tributaries of Yamuna** - The areas under water bodies i.e. rivers, ox-bow lakes, paleo-channels, lakes and ponds and their surrounding areas be kept free from any encroachment/development to allow free flow of water. Construction activities for human habitation or for any other ancillary purpose thereto not be permitted. Suitable measures be taken to maintain the water bodies with the minimal flow/water level.

vi. No construction or habitation should be permitted in the Yamuna flood plain and other drainage channels.

vii. **Lakes, water bodies** including village pond and other groundwater recharging areas should be preserved to maintain availability of water and ground water recharge. Also, a green buffer should be created and maintained around lakes, water bodies and ponds to protect from encroachments and to increase tree cover.

viii. **Ground water recharging areas such as water bodies, ox-bow lakes and paleo-channels** - The areas under water bodies i.e. rivers, ox-bow lakes, paleo-channels, lakes and ponds and their surrounding areas be kept free from any encroachment/development to allow free flow of water. Construction activities for human habitation or for any other ancillary purpose thereto not be permitted. Suitable measures be taken to maintain the water bodies with the minimal flow/water level.

ix. **The monuments/man-made heritage sites and natural heritage areas** be identified and earmarked in the Master/Zonal Plans of each town and detailed Conservation Plans be prepared for their protection and conservation.

x. **Environmental Management Plan** be prepared for the NCZ areas under the provision of the Environmental Protection Act, 1986 which should be treated as Conservation Plan. Similarly, Working Plans/Management plan should be prepared for forests under the provisions of the Indian Forest Act, 1927 and Management Plan for protected areas to be prepared under the provision of Wild Life (Protection) Act, 1972 are to be treated as Conservation Plan for forests and protected areas respectively.

14.7.5 Zoning regulation for Natural Conservation Zone

In this zone the following uses activities may be permitted:

i. Arboriculture and horticulture
ii. Pisciculture,
iii. Social forestry/plantations including afforestation.

iv. Regional recreational activities with no construction exceeding 0.5 percent of the area with the permission of the competent authority.

Figure 14.4: Natural Conservation Zone (NCZ) for NCTD

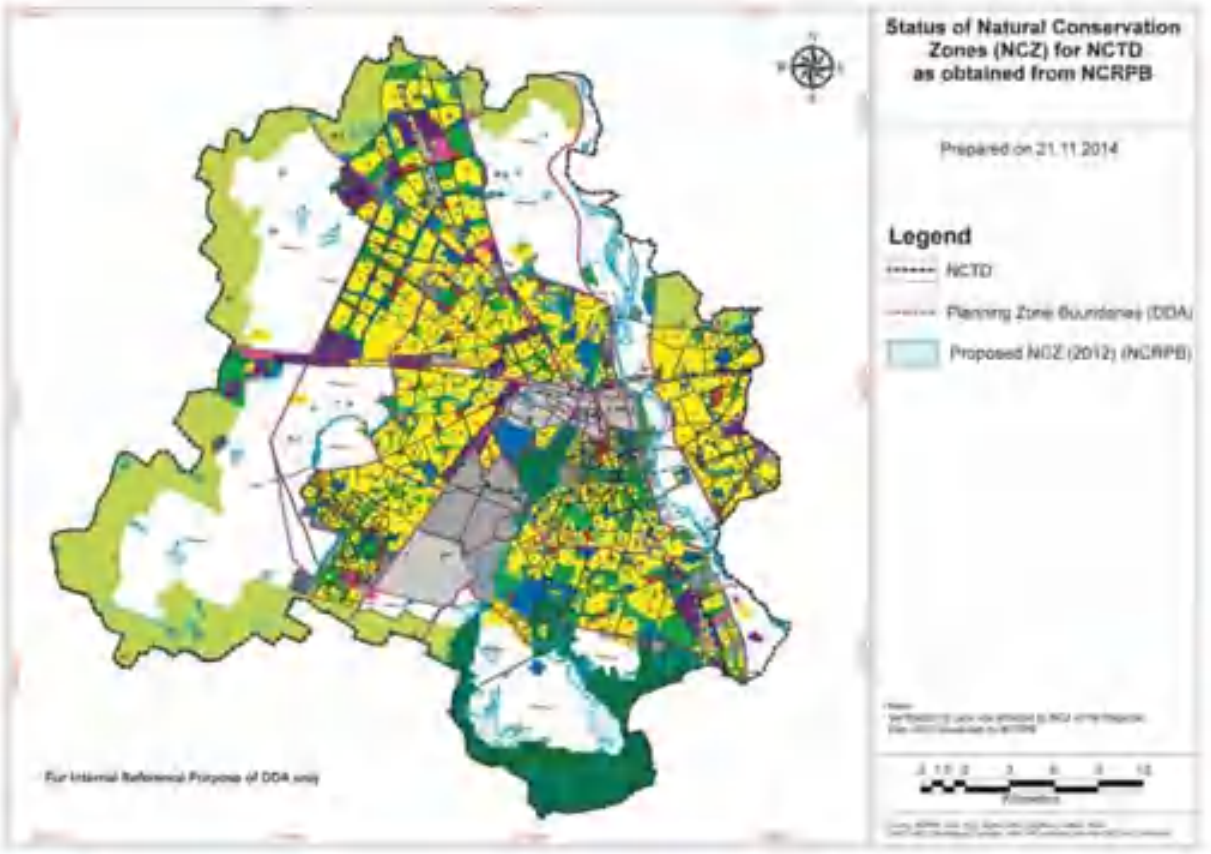
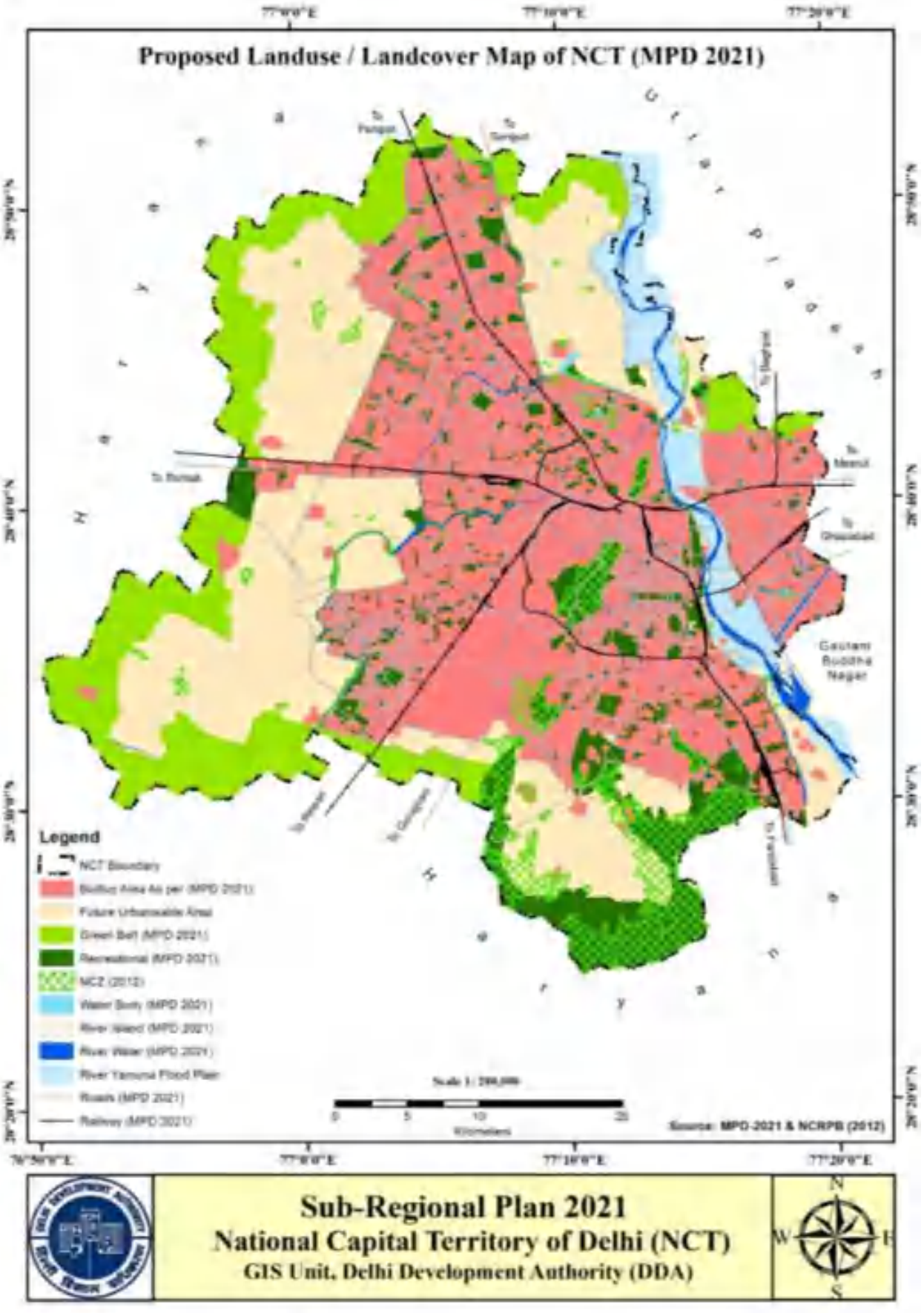


Figure 14.5: Proposed Landuse/Land cover Map of NCT



CHAPTER 15. IMPLEMENTATION STRATEGIES, MANAGEMENT STRUCTURE AND RESOURCE MOBILISATION

15.1 Introduction

Under Section 17 of the Chapter V of The NCRPB Act 1985 National Capital Region Planning Board Act, 1985; each participating state shall prepare a Sub-Regional Plan for the sub-region within that State and the Union territory. Accordingly, NCRPB is empowered under Section-7 to prepare the Regional Plan and the Functional Plans; in additions to arrange for the preparation of Sub-Regional Plans and Project Plans by each of the participating States and the Union Territory; besides to co-ordinate the enforcement and implementation of the Regional Plan, Functional Plans, Sub-Regional Plans and Project Plans, through the participating States and the Union Territory. NCRPB is to ensure proper and systematic programming by the participating States and the Union Territory in regard to project formulation, determination of priorities in the Region or Sub-Regions and phasing of development in accordance with stages indicated in the Regional Plan.

15.2 Nodal Agencies

NCRPB, an apex body has been constituted at the central level with the requisite statutory power to prepare a Regional Plan for the balanced and coordinated development of NCR and to enforce, oversee and monitor the implementation of the plan.

Multiple agencies are involved in order to sustain a coordinated plan over a long-time frame. Main nodal agencies for the planning and coordination are the following:

i. Central Government Departments
    - Ministry of Housing and Urban Affairs
    - Ministry of Finance
    - NITI Aayog
    - Ministry of Road Transport and Highways (MoRTH)
    - Other Ministries / Departments of Central Govt.

ii. Apart from the above-mentioned departments, there are various line departments responsible for planning and implementing the sectoral developments in NCT Delhi.

15.3 Existing Legal Statutes

Legal backing for any policy, plan and program is important for their effective implementation. The law provides the authority for a policy/plan/program finalized by due process and other legal provisions and notifications. It provides for continuity of thought over the long period irrespective of any change in political parties or personnel. The law designates the appropriate departments for implementation and vests with them necessary responsibilities. Law has a three-dimensional role – as the instrument of power, as the regulator of reciprocal interest and as the coordinator of common efforts. Presently, a number of statutes govern the urban and regional planning and development. Important Central Government Acts and notification among them are as follows:

- NCRPB Act, 1985
- Environment Protection Act, 1986
- Forest (Conservation) Act, 1980
- National Forest Policy 1988
- The Forest Conservation Rules 2003
- The Wild Life (Protection) Act, 1972, as amended in 2002 called The Wildlife (Protection) Amendment Act, 2002

- The Mines and Minerals (Regulation and Development) Act, 1957 (No. 67 of 1957) (As amended up to 10th May, 2012).
- The Air (Prevention and Control of Pollution) Act, 1981
- The Water (Prevention and Control of Pollution) Cess Act, 1977
- The Biological Diversity Act 2002 and Rules 2004
- Aravali Notification dated 7th May, 1992
- National Highways Act, 1956
- Land Acquisition, Rehabilitation and Resettlement Act, 2013

Legal support is very necessary to:

- Formulate and translate policies and plans to action programmes and implementation; to identify, empower and enable the relevant agencies
- Establish the rule of law and transparency
- Secure continuity of thought and action
- Distribute responsibilities and fix accountability
- Resolve disputes; etc.

15.4 Implementation Strategy

The strategies for the sub regional Plan-2021 are formulated to suit the implementation of different policies proposed in the Plan.

i. Identifying the line agencies/departments responsible to implementation through the provisions in their own Acts and Rules in NCT Delhi as well as in other sub regions falling under the influence of identified sector wise policies and strategies.

ii. Empowering NCRPB to coordinate and direct various agencies/departments for development, enforcement and implementation.

iii. Preparation of a plan of action in addition to its costing and phasing for its implementation along with dovetailing these costs with annual financing plans for proposed infrastructure up-gradation in NCT Delhi as well as areas of surrounding sub-regions for smooth integration and balanced development in NCR.

iv. Delhi being mother city become engine for economy of NCR. Therefore, to promote sustainable and balanced development in NCR, NCT Delhi and surrounding sub region must work together to decentralization of economic activities to shift development pressure of NCT Delhi. The development plans of surrounding sub regions must embrace supplementing infrastructure, housing, utilities & services for economic activities and floating population of NCR in NCT Delhi.

v. Priority has to be given to improve the connectivity and overall infrastructure between NCT Delhi and other sub regions, which will in the long run help in decentralizing the economic activities, which is at present concentrated in NCT-Delhi.

vi. Need to rationalize the tax structure, extend uniform financial and banking services, remove restriction of interstate movement of taxis and auto rickshaws, to provide uniform telecom facilities and uniform power supply, to have an integrated education policy and finally also to have an integrated law and order machinery in NCT Delhi and other sub regions.

vii. An active role of the private sector with government as Public Private partnership (PPP) for economic development, business efficiency, investment and competitiveness, employment, skills and sustainable development.

viii. The strategy proposed in the plan for developing wholesale markets in Delhi was to meet its own requirements, beside to decentralize the economic activities, alternative wholesale markets were also proposed to be developed in the NCR region outside Delhi by the concerned agencies of the respective State Governments as joint venture projects. The state of U.P. and Haryana have developed wholesale market in Sub-region which should be utilised to decongest the wholesale market in NCT Delhi.

ix. With regards to the policy on decentralization of industries from NCT-Delhi, the plan emphasized that only hi-tech industries be allowed within NCT-Delhi and in the existing industrial areas. Low-tech industries be transformed into hi-tech and those which are unable to do so, be phased out and to be relocated outside NCT-Delhi

15.5 Management Structure

It is important to have an efficient management system for speedy implementation of the Plan proposals and for proper monitoring of the projects. Accordingly, the role of each body has been defined at NCRPB level, State/NCR Cell level, besides at State Departments and Agencies level, and also at Central Ministries level.

The components which need to be undertaken by the private sector, exclusively and jointly with the Central and State agencies, which includes acquisition and development of land, Industries and wholesale trade, social infrastructure, local and trunk services, construction of block housing, construction of expressways, mass transport system, power generation, power transmission and distribution, and telecom services

The Immediate steps to be taken for evolving stable and transparent policies for entry and functioning of private enterprises in a competitive environment, establishing single window system for processing official clearances for development projects, adopting independent regulatory mechanisms, creating modalities for expeditious settlement of disputes between private and official agencies involved in the development projects, and setting up machinery for quick redressal of grievances of targeted beneficiaries (consumers) of various project components.

NCR Planning & Monitoring Cells were proposed to work under the administrative control of the respective State Govts. and are multi-disciplinary in nature and act as coordinating agencies for various sectoral programmes. They also strive to ensure coordination of these programmes with policies as contained in Regional/ Sub-regional/ Functional Plans of NCRPB. In NCR, NCT Delhi, Uttar Pradesh, Haryana and Rajasthan have already setup NCR Cell for effective implementation and monitoring for their respective sub regional plans. NCT Delhi needs to strengthen and capacity building of NCR Cell of NCT Delhi sub-region, to plan and monitor the projects related to the development of NCT Delhi as per approved Regional Plan/Sub-regional Plan and Other Functional Plans.

NCR Cell is to coordinate with the several state government departments and parastatal bodies for effective implementation of the plan. The functions of the NCR Planning and Monitoring Cell are:

- To formulate policies for the Integrated Planning and Development;

- To facilitate Master Plan;
- Mobilize resources for development;
- To ensure planning, development, operation and management of the component sectors of development like transport, physical infrastructure and social infrastructure;
- To coordinate the implementation of the plan policies and programmes by various sector functional agencies;
- To assist the Central Government and state government with regards to Sub-Regional Development.

For discharging its enhanced role in securing balanced growth of the sub-region, NCR Planning and Monitoring Cell, would require substantial up gradation of the existing manpower and their skill sets. More than increasing the manpower strength of the NCR Cells, there is a need to undertake capacity building program for the staff on a large scale to deal with the issues that need to be tackled at both macro and micro levels for balanced regional development.

15.6 Resource Mobilization

It is observed that financing of various projects is critical to the success of the Plan. It is noted that the funds for development activities in the NCR are available mainly for: NCRPB assisted projects, for which the Board provides loan up to 75 percent of the cost of the project; State Government projects which are implemented by various development authorities, local bodies, housing boards, industrial development corporations, etc.; and projects funded by Central Ministries such as Railways, Communications and Information Technology, Shipping, Road Transport and Highways, etc.; and Private sector investment in infrastructure.

The funds available with the Board are from the sources namely grant from the Ministry of Housing & Urbana Affairs (MoUHA), Contribution from Delhi Government, Market borrowing (Taxable and Tax-free bonds) and internal accruals (Interest income). The RP-2021 also underlines that there have been resource constraints with NCRPB in financing large-scale projects in the region due to which the regional infrastructure envisaged in the Regional Plan2001 could not be implemented.

The strategies proposed in RP-2021 may also be adopted for funding of projects under this plan which includes: the mechanism of ‘Special Component Plan’ for the NCR to be established. The requisite funds should be allocated by the NITI Ayog as a Subcomponent of the Plan in respect of Central Ministries of Shipping, Road Transport and Highways, Railways, Communications and Information Technology and Power as well as the participating States of the NCR. However, in order to achieve these objectives, all Central Ministries and the participating States have to go beyond their token approval to the Plan. They have to recognise the Regional Plan-2021 as their own Plan and accept the responsibility of implementing its policies, projects and proposals through their physical and financial effort, reflecting it in their plans, work programmes and annual budgets.

There exists enough scope to enhance revenue generation from the existing local taxes. Tax administration in almost all the states in the country is constrained by not-so-effective tax administration and difficulties encountered in administration of the major tax - the Property Tax. The maladies in tax administration relate to lack of proper assessment of demand, billing and collection. Tax collection and generation of additional revenue could be ensured through a scheme of incentives and penalties for municipal staff and the taxpayers.

Land as Resource. Urban land is a highly valuable asset that should be very judiciously used to raise resources by the implementing agencies to fund the repayment of loans taken for initial development and for funding future development programmes. It is therefore, desirable that a part of this net value addition should be recovered in the form of development / betterment charges and use the same for funding further development programmes in the region by loading it on to the land cost. Some of the methods through which land could be used as a viable resource for financing various urban development programme in the region are: creation of land banks by the public agencies for utilization for future requirements; permitting the private sector to develop the land and recovering a part of the value added on account of such permitted development; granting of transferable development rights (TDR), funding of infrastructure projects on innovative methods like BOT, BOLT, BOOT, etc.; by providing land as initial input; permitting commercial use of precious land by the private sector and deriving returns in the form of social housing/development for the occupants of that land, and recycling of land for facilitating the shifting/relocation of industries units located thereon, etc.

Amongst the non-tax sources, the User Charges happen to be the most important mechanism of cost recovery. Water supply, sewerage, urban transport, solid waste collection and parks qualify for imposition of user charge. The economic rationale of cost recovery entails that the user charges have to be based on the unit cost of providing a service. In actual practice, however, the municipal governments are not recovering even the maintenance cost. Urban Local Bodies do not levy user charges that recover at least the operations and maintenance costs due to political as well as consumer pressures.

Public – Private Partnerships (PPPs) is the first step towards privatization pending legal reforms and institution of a regulatory framework. There is a need for improving commercial viability of the projects through:

- proper project formulation and implementation;
- strengthening capabilities in project formulation of infrastructure agencies;
- supplying services in response to demand rather than in anticipation of demand for urban poor and inclusive approach;
- assessment of demand and supply under the concept of willingness to pay under different pricing policies, cost optimization, and pricing; and
- cost recovery.

Institutional environment with multiplicity of agencies, lack of coordination, inadequate and ill-equipped manpower etc; financial and fiscal environment with limited availability of funds, inappropriate lending policies, improper pricing policies etc; and legal environment with obsolete codes, laws, bye-laws and regulations all tend to limit the potential of PPP.

The other alternative sources of funds include property development; employment tax; tolls; cess on property tax, etc.

15.7 Policies and Proposals

i. Needs to focus on achievable targets, to ensure its policies are effective and driven by all its stakeholders, because the success of plan depend on its implementation

ii. Priority must be given to improve the connectivity and overall infrastructure in the region. Among the infrastructure, transportation networks are the most important aspect which in

the long run will help in decentralizing the economic activities, which is at present concentrated in NCT-Delhi

iii. The components to be undertaken by the Private Sector, exclusively and jointly with the Central and State agencies, includes acquisition and development of land, Industries and wholesale trade, social infrastructure, local and trunk services, construction of block housing, construction of expressways, mass transport system, power generation, power transmission and distribution, and telecom services, accordingly, Private Sector be encouraged and invited to participate in the implementation of Regional Plan.

iv. The Private Sector be allowed to develop the land and recover a part of the value added on account of such permitted development; granting of transferable development rights (TDR), funding of infrastructure projects on innovative methods like BOT, BOLT, BOOT, etc.; by providing land as initial input.

v. Urban land is a highly valuable asset that should be very judiciously used to raise resources by the implementing agencies to fund the repayment of loans taken for initial development and for funding future development programmes, therefore, net value addition should be recovered in the form of development / betterment charges and use the same for funding further development programmes, in the region by loading it on to the land cost.

vi. Under current planning practices, land is 'notified/ reserved' for development as per plan prepared by the Delhi Development Authority whereas the land use planning, development and change is carried out at state department and other agencies. Therefore, there is a need to bridge this gap between planning and implementation by way of active participation of the implementing departments and agencies in the preparation of Plan.

vii. A new strategy is required to be worked out that could enable the implementation of the Plan, creating NCR cell at the state level a main custodian of agglomeration strategy for the region, focusing on improving the level of urban infrastructure/services while responsibility of the respective state governments, their municipal and other para-state bodies should be to work out the detailed strategies for achieving the plan objectives for each sector.

viii. The performance indicators with respect to the urban services and other infrastructure should be institutionalized so that the monitoring of the projects is benchmarked against these indicators. NCRPB to enhance the participatory processes, such that there is buy-in from all stakeholders. Greater efforts are required to increase awareness about the Sub regional plan amongst the elected representatives of the urban local bodies and citizens of these communities

ix. It is imperative that more innovative mechanism of resource generation is explored in addition to normal budgetary support and IEBR (Internal & Extra Badgerys Resources), so that the envisaged development programmes could be implemented within a reasonable time-frame.

x. There exists enough scope to enhance revenue generation from the existing local taxes. Tax administration in almost all the states in the country is constrained by not-so-effective tax administration and difficulties encountered in administration of the major tax - the Property Tax. The disorders in tax administration relate to lack of proper assessment

of demand, billing and collection. Tax collection and generation of additional revenue could be ensured through a scheme of incentives and penalties for municipal staff and the taxpayers.

xi. Implementation agency may consider leveraging the funds from the various schemes / missions launched by the Ministry of Housing and Urban Affairs like Smart Cities, AMRUT, Swachh Bharat Mission, HRIDAY, Urban Transport, Prandhan Mantri Awas Yojana, and Deendayal Antyodaya Yojana National Urban Livelihoods Mission, etc. And also leveraging of funds for rural development from schemes / missions of Rural Development Ministry like Gram Swaraj Abhiyan, PMAY-G, RURBAN (NRuM) and Swachh Gram, etc.

xii. Need to strengthen Project Monitoring Cell for formulation of inter-state projects and their monitoring. It would be advisable to promote E-governance in the designing, implementation and monitoring of RP/ SRP/ FP/ projects of the Region.

xiii. NCRPB should strengthen their own Monitoring Wing and NCR Cells, instead of opting for creation of another separate agency or SPV, as establishment of such agencies may result in overlapping the jurisdiction and duplication of authorities.

xiv. Resources may be shared equally by local bodies, Local authorities & State Govt. as and when required for the city.

xv. Detailed project report of infrastructure projects of NCR should clearly mention the proportional share of costs of states/UTs based on the projected benefits to be shared among participating states like Haryana, Rajasthan and U.P.

xvi. As regards the fixation of user charges on availing services of sewerage, water supply, urban transport etc. finance department may review the structure of existing rates and take a final view revision.

The following steps may enable effective implementation of the Plan:

i. Setting up an MIS to track and monitor/evaluate the implementation and report the progress periodically to the Board.

ii. Conducting Impact Assessments of projects/development works and undertaking corrective measures, where necessary.

ANNEXURES

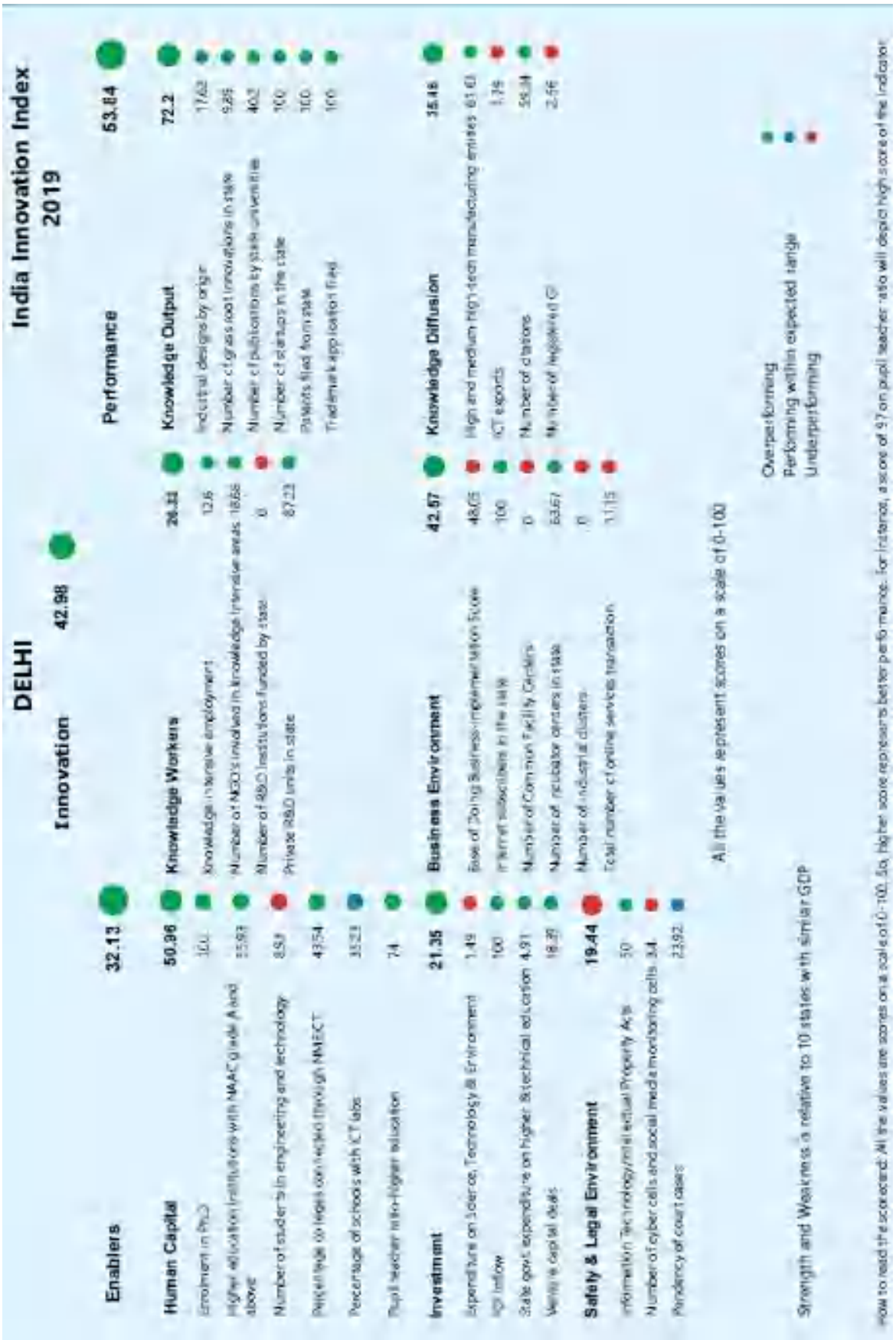
Annexure A

Scores – India Innovation Index 2019

	Dimension	Pillar					Dimension	Pillar	
States	Enablers	Human Capital	Investment	Knowledge Workers	Business Environment	Safety & Legal Environment	Performance	Knowledge Output	Knowledge Diffusion
ANDHRA PRADESH	19.80	32.99	4.00	19.95	19.36	17.75	10.21	6.11	14.31
ARUNACHAL PRADESH	13.00	24.86	1.38	4.64	4.56	19.76	4.00	7.39	0.61
ASSAM	7.99	19.91	0.80	4.74	4.81	9.10	7.48	5.90	9.07
BIHAR	10.34	8.98	0.09	3.04	11.09	29.54	5.44	3.62	7.26
CHHATTISGARH	12.30	25.50	1.9	3.81	11.88	18.20	3.82	3.86	3.78
DELHI	32.13	50.96	21.35	26.32	42.57	19.44	53.84	77.20	35.48
GOA	34.07	43.79	15.82	32.79	52.81	24.85	10.98	18.04	3.92
GUJARAT	22.90	36.99	7.54	21.39	18.05	30.52	10.83	11.01	10.65
HARYANA	25.10	35.39	12.81	15.40	21.94	39.96	16.01	15.95	16.07
HIMACHAL PRADESH	22.68	33.18	1.67	34.24	21.44	21.68	4.84	5.72	3.97
JAMMU & KASHMIR	16.45	25.89	2.20	15.48	11.81	27.68	5.68	5.80	5.56
JHARKHAND	9.75	11.24	0.51	2.93	7.60	18.69	4.65	6.25	3.06
KARNATAKA	24.96	38.00	21.31	20.17	23.10	10.99	46.35	25.63	67.06
KERALA	23.88	46.17	9.10	14.45	27.45	22.21	15.29	9.83	20.75
MADHYA PRADESH	12.61	23.24	3.07	7.77	13.79	15.79	6.79	6.43	7.15
MAHARASHTRA	25.64	34.45	23.00	21.60	27.20	22.97	54.22	28.26	43.17
MANIPUR	18.50	24.38	14.54	24.82	4.38	24.42	4.87	7.33	2.42
MEGHALAYA	11.09	27.79	0.21	9.76	5.23	12.46	1.66	1.73	1.60
MIZORAM	13.31	33.36	5.25	1.11	4.80	17.01	1.46	2.31	0.61
NAGALAND	11.76	24.20	3.63	5.81	4.55	20.59	3.21	4.61	1.82
ODISHA	15.25	28.42	1.68	5.16	12.63	28.36	10.08	4.99	15.16
PUNJAB	19.80	40.88	0.91	8.81	14.50	33.87	7.55	9.19	5.91
RAJASTHAN	13.06	25.90	5.12	7.23	12.83	14.24	8.93	6.26	11.59
SIKKIM	29.86	39.34	4.79	33.62	3.47	68.74	1.01	3.94	1.09
TAMIL NADU	23.56	49.20	9.03	15.42	37.07	7.06	42.40	30.22	54.59
TELANGANA	17.29	31.04	6.55	15.82	23.43	9.63	26.82	18.76	34.89
TRIPURA	16.51	30.02	7.90	5.14	9.42	29.05	1.56	3.13	0.00
UTTARAKHAND	17.01	28.37	2.40	21.77	7.65	27.47	8.73	10.44	7.01
UTTAR PRADESH	11.85	14.97	4.15	5.83	13.83	20.47	26.32	15.44	37.20
WEST BENGAL	14.45	23.91	1.15	7.19	16.87	23.14	21.97	11.52	32.43
ANDAMAN & NICOBAR ISLANDS	22.35	39.89	6.86	11.82	5.94	58.26	3.14	6.28	0.00
CHANDIGARH	32.79	74.96	2.60	29.56	6.31	50.74	23.14	38.42	9.87
DADRA & NAGAR HAVELI	12.37	19.19	1.90	13.41	7.63	28.72	1.11	1.49	10.73
DAMAN & DIU	12.63	23.28	0.11	9.95	5.23	23.60	11.56	17.05	6.06
LAKSHADWEEP	16.67	25.48	24.03	3.00	16.75	17.06	0.04	0.16	0.00
PUDUCHERRY	19.90	36.32	4.28	18.28	9.54	15.09	7.97	10.21	5.73

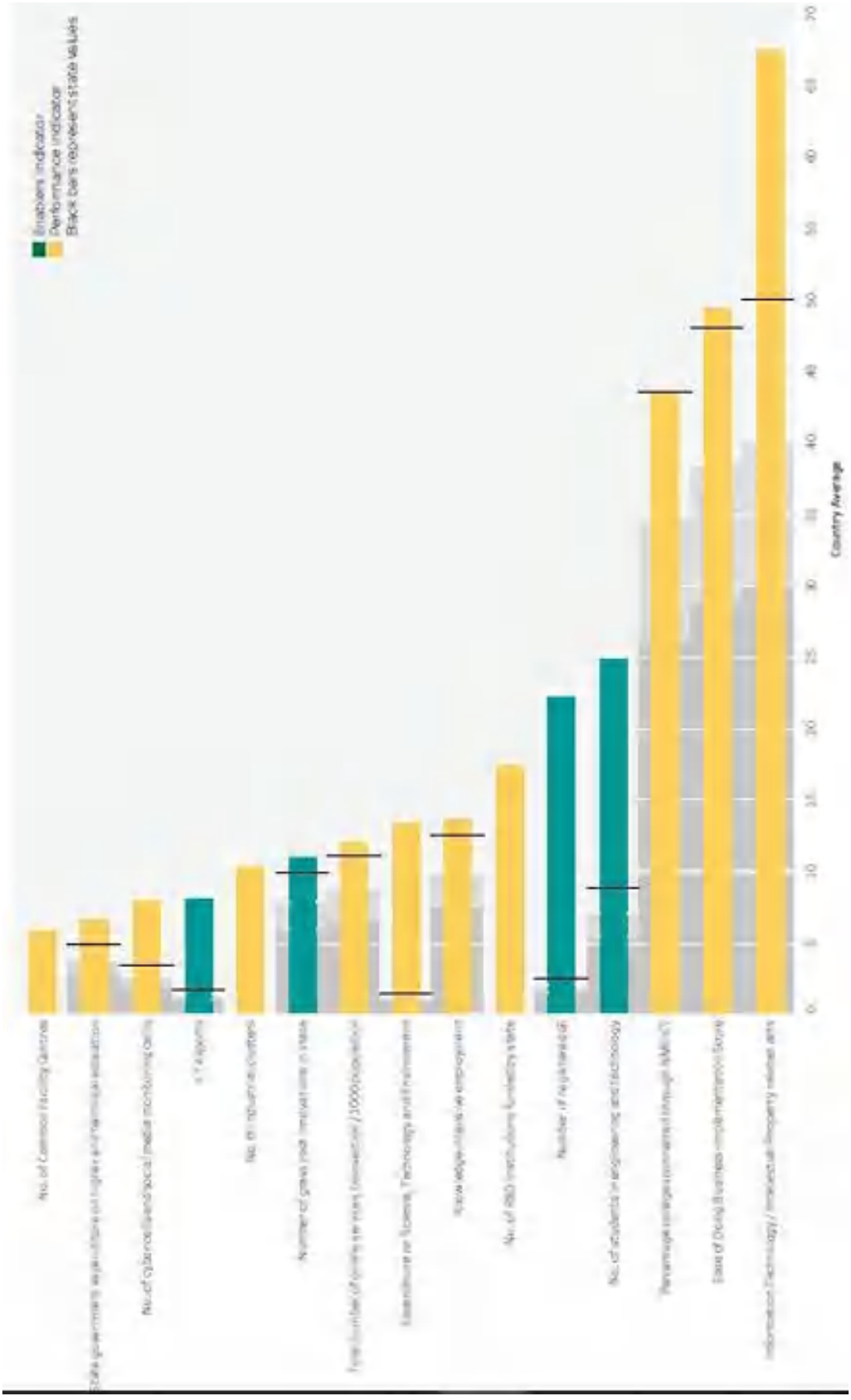
Annexure B

Scorecard of NCT of Delhi according to the India Innovation Index 2019



Annexure C

Focus areas/ Performance indicator plotted with country average



Annexure D

Notified protected forests in Delhi

No.	Name of the Protected Forests and Agency	Area in Acre	Notification No. Date.
1	Mitraon (Forest)	105	F.8(2)/48 (IX) P&D, Dtd. 6.05.1948
2	Sultanpur (Forest)	120	F.8(2)/48-II(P&D, Dtd. 6.05.1948
3	Mukhmelpur (Forest)	133	F 11 (38)/54-P&D-I Dtd 2.3 1955
4	Rajokhari (Forest)	600	EV-7/97/55(I) Dtd. 21.06.1959
5	Tughlakabad (Forest)		F.8(2)/48(V) P&D dated 6.5.1948
6	Distt. Park I/c Hauzkhas picnic Hut Jeke, Garden etc (DDA)	400.00	SO 32(C);Notl-80-61/6974–81 Dt 10.04.80
7	City Forest (DDA)	800.00	-do-
8	Basant Nagar, Moradabad Pahari Area (DDA)	200.00	-do-
9	Vasant Vihar Distt. Park (DDA)	20.00	-do-
10	Dhaula Kuan Complex ((DDA)	200.00	-do-
11	Nehru University Afforestation (DDA)	200.00	-do-
12	Distt. Park Gokulpuri (DDA)	7.50	-do-
13	Distt. Park Jhilmil Tahirpur (DDA)	20.00	-do-
14	Zonal Green Area Kalyanpuri, Trilokpuri, Khichripur, Ghazipur etc. (DDA)	375.00	-do-
15	Orchard between Sirdhara Kalan, Nimri, Gulabi Bagh & Darbar Khan Nursery and Other Areas (DDA)	100.00	-do-
16	Area Between Hill Road & Ludlow Castle Road (DDA/L&DO)	17.00	-do-
17	Orchard in Wazirpur Near Bharat Nagar and Nimri Colony (DDA)	120.00	-do-
18	Mayapuri Green belt (DDA)	5.00	-do-

Source: Forest Department

Annexure E

City forests in Delhi

Old city forests (ha)		New city forests (2007 08) In Ha		New city forests (2008 09) in Acre		New city forests (2008-09)
Nasirpur	28	Issapur	66.25	Rewla Khanpur	20	Rewla Khanpur
Alipur	15.5	Rewla Khanpur	22.85	Shikarpur	109	Pendwala Khurd
Hauzrani	26.8	Kharkhari Jatmal	50	Rajokhari	15.5	Mallikpur
Mitraon	40	Sultanpur Dabhas	24.75	Najafgarh Drain	29.5	Daurala,
Sultanpur	48	Mungeshpur	13.5	Qutubgarh	20	Goyla khurd,.
Ghamenneta	30	Qutabgarh	22.77	Mukhmelpur	13	Kharkhari Jatmal
Ghoga	10.4	Flindon Cut Ghazipur	5.35	Raj Vidya Kendra	37	Garhi Mandu,
Shahapur Garhi	8	Harewal	24.80	Aya Nagar	25	Issapur
Mamurpur	56	Mukhmelpur	19.48	Burari Bund	8	Neb Sarai/ Dera Mandi
Imlipur	47.5					
Mukhmelpur	52					
Bawana	32					
Garhi Mandu	300					

Source: Forest Department

Annexure F

Delineation of Natural Conservation Zone in Delhi was discussed in 33rd meeting of NCRPB held on 01.07.2013 under the Chairmanship of Hon'ble Minister for Urban Development. To delineate Natural Conservation Zone in Delhi as identified by NCRPB, Satellite imagery (1: 10,000 scale) of NCZ which was obtained through NCRPB/UD Dept, GNCTD in the year 2015 and superimposed on approved Land use Plans of MPD-2021/ ZDPs by GIS unit, DDA. List of 156 NCZ pockets falling in Delhi is as below:

NATURAL CONSERVATION ZONES						
S.NO	**FID_ NCZ**	**Zone Name**	**MPD 2021 -LAND USE**	**ZDP LAND USE**	**Area (Ha)**	**REMARKS**
1	58	**B**	SPECIAL AREA TRANSPORTATION	RECREATIONAL TRANSPORTATION RESIDENTIAL	**14.49**	ROAD DISTRICT PARK /MULTIPURPOSE
2	59	**B**	SPECIAL AREA	PUBLIC & SEMI PUBLIC	**1.68**	FACILITY CENTER
3	60	**B**	SPECIAL AREA	RESIDENTIAL	**0.12**	
4	61	**B**	SPECIAL AREA TRANSPORTATION	COMMERCIAL TRANSPORTATION RECREATIONAL RESIDENTIAL	**17.5**	ROAD, DISTRICT PARK/MULTIPURPOSE
5	55	**B & D**	RECREATIONAL TRANSPORTATION PUBLIC & SEMI PUBLIC RESIDENTIAL	RESIDENTIAL, RECREATIONAL	**736.84**	ROAD REGIONAL PARK HOSPITAL SOCIO CULTUAL (SC) RELIGIOUS
6	8	**C**	RECREATIONAL	RECREATIONAL RESIDENTIAL	**2.02**	DISTRICT PARK
7	9	**C**	RESIDENTIAL	RESIDENTIAL, TRANSPORTATION	**9.75**	ROAD
8	10	**C**	RESIDENTIAL	RESIDENTIAL TRANSPORTATION	**3.1**	ROAD
9	11	**C**	PUBLIC & SEMI PUBLIC RECREATIONAL COMMERCIAL TRANSPORTATION	RESIDENTIAL COMMERCIAL TRANSPORTATION	**7.65**	DISTRIC CENTER
10	12	**C**	PUBLIC & SEMI PUBLIC RESIDENTIAL RECREATIONAL WATER BODY UTILITIES TRANSPORTATION COMMERCIAL	RESIDENTIAL PUBLIC & SEMI PUBLIC RECREATIONAL WATER BODY UTILITIES COMMERCIAL	**255.2**	TRANSPORTATION TRANSMISSION CENTER, CITY PARK DISTRICT PARK COMMUNITY PARK
11	62	**C**	RECREATIONAL PUBLIC & SEMI-PUBLIC TRANSPORTATION	RECREATIONAL PUBLIC & SEMI PUBLIC TRANSPORTATION	**155.17**	REGIONAL PARK HOSPITAL
12	63	**C**	RESIDENTIAL TRANSPORTATION	RESIDENTIAL TRANSPORTATION	**1.31**	MRTS
13	57	**D**	RECREATIONAL	RECREATIONAL	**8.38**	REGIONAL PARK
14	97	**E**	COMMERCIAL	COMMERCIAL RECREATIONAL	**1.3**	WHOLE SALE

NATURAL CONSERVATION ZONES						
S.NO	**FID_NCZ**	**Zone Name**	**MPD 2021 -LAND USE**	**ZDP LAND USE**	**Area (Ha)**	**REMARKS**
15	98	**E**	COMMERCIAL INDUSTRIAL	INDUSTRIALCOMMERCIALRECREATIONALTRANSPORTATION UTILITIES	**3**	WHOLE SALEELECTRIC SUB STATION
16	99	**E**	TRANSPORTATION	TRANSPORTATION	**0.17**	
17	100	**E**	RECREATIONAL COMMERCIAL TRANSPORTATION RESIDENTIAL	RECREATIONAL WATER BODY RESIDENTIAL TRANSPORTATION COMMERCIAL	**20.56**	
18	126	**E**	RECREATIONAL	RECREATIONAL	**0.36**	CITY PARK DISTRICT PARK
19	133	**E**	AGRICULTURE/GREEN BELT	RECREATIONAL AGRICULTURE/GREEN BELT	**1.52**	
20	134	**E**	AGRICULTURE/GREEN BELT	AGRICULTURE/GREEN BELT	**0.94**	
21	135	**E**	AGRICULTURE/GREEN BELT	AGRICULTURE/GREEN BELT	**42.14**	
22	54	**F**	GOVT. LAND GREEN BELT RESIDENTIAL PUBLIC & SEMI-PUBLIC TRANSPORTATION COMMERCIAL	GOVT. LAND RESIDENTIAL RECREATIONAL PUBLIC & SEMI-PUBLIC TRANSPORTATION	**593.58**	
23	65	**F**	RECREATIONAL TRANSPORTATION	RECREATIONAL PUBLIC & SEMI PUBLIC	**189.52**	DISTRICT PARK CITY PARK
24	74	**F**	RECREATIONAL	RECREATIONAL	**4.44**	CITY PARK DISTRICT PARK
25	50	**F & J**	URBANISABLE AREA AGRICULTURE/GREEN BELT RESIDENTIAL RECREATIONAL PUBLIC & SEMI PUBLIC	RECREATIONAL, RESIDENTIAL PUBLIC & SEMI PUBLIC GOVT. LAND TRANSPORTATION WATER BODY	**703.83**	
26	66	**F & J**	RECREATIONAL TRANSPORTATION RESIDENTIAL	RECREATIONAL TRANSPORTATION RESIDENTIAL	**44.48**	REGIONAL PARK
27	69	**F & J**	RECREATIONAL TRANSPORTATION	RECREATIONAL TRANSPORTATION	**72.96**	REGIONAL PARK
28	110	**F & J**	RECREATIONAL URBANISABLE AREA PUBLIC & SEMI PUBLIC	RECREATIONAL RESIDENTIAL WATER BODY	**4477.85**	REGIONAL PARK SPORTS UNIVERSITY
29	115	**F & J**	PUBLIC & SEMI-PUBLIC TRANSPORTATION	PUBLIC & SEMI PUBLICTRANSPORTATION	**2.4**	
30	49	**G**	AGRICULTURE/GREEN BELT	AGRICULTURE/GREEN BELT TRANSPORTATION	**8.99**	
31	56	**G**	GOVT LAND	GOVT LAND	**6.61**	
32	64	**G**	RESIDENTIAL TRANSPORTATION	RESIDENTIAL TRANSPORTATION	**6.54**	
33	149	**G**	DRAIN RECREATIONAL	DRAIN RECREATIONAL	**13.61**	DISTRICT PARK CITY PARK

NATURAL CONSERVATION ZONES						
S.NO	**FID_NCZ**	**Zone Name**	**MPD 2021 -LAND USE**	**ZDP LAND USE**	**Area (Ha)**	**REMARKS**
						COMMUNITY PARK
34	147	**G & K-I**	DRAIN	DRAIN RECREATIONAL	**4.56**	RIVER BED
35	148	**G & K-I**	DRAIN	DRAIN RECREATIONAL	**18.46**	
36	51	**J**	URBANISABLE AREA	RESIDENTIAL PUBLIC & SEMI PUBLIC TRANSPORTATION	**92.26**	
37	52	**J**	URBANISABLE AREA	RESIDENTIAL PUBLIC & SEMI PUBLIC	**16.16**	
38	53	**J**	AGRICULTURE / GREEN BELT	AGRICULTURE / GREEN BELT	**1.37**	
39	67	**J**	RECREATIONAL	RECREATIONAL RESIDENTIAL	**0.77**	REGIONAL PARK
40	68	**J**	RECREATIONAL	RECREATIONAL	**9.5**	REGIONAL PARK
41	70	**J**	RECREATIONAL	RECREATIONAL	**3.24**	REGIONAL PARK
42	71	**J**	RECREATIONAL URBANISABLE AREA	RECREATIONAL RESIDENTIAL	**34.57**	REGIONAL PARK
43	72	**J**	RECREATIONAL URBANISABLE AREA PUBLIC & SEMI PUBLIC	RECREATIONAL RESIDENTIAL TRANSPORTATION	**79.53**	REGIONAL PARK UNIVERSITY
44	73	**J**	RECREATIONAL	RECREATIONAL	**0.08**	REGIONAL PARK
45	111	**J**	URBANISABLE AREA RECREATIONAL	RESIDENTIAL PUBLIC & SEMI PUBLIC RECREATIONAL TRANSPORTATION	**12.02**	REGIONAL PARK
46	112	**J**	RECREATIONAL URBANISABLE AREA RESIDENTIAL	RESIDENTIAL PUBLIC & SEMI PUBLIC RECREATIONAL AGRICULTURE / GREEN BELT TRANSPORTATION	**758.44**	REGIONAL PARK
47	113	**J**	URBANISABLE AREA	RESIDENTIALPUBLIC & SEMI PUBLICTRANSPORTATION	**58.46**	
48	114	**J**	RECREATIONAL URBANISABLE AREA	RECREATIONAL AGRICULTURE / GREEN BELT WATER BODY	**80.99**	REGIONAL PARK
49	116	**J**	RECREATIONAL	RECREATIONAL	**5.08**	REGIONAL PARK
50	117	**J**	URBANISABLE AREA	RESIDENTIAL	**0.44**	
51	118	**J**	URBANISABLE AREA	RESIDENTIAL	**1.07**	
52	150	**J**	RECREATIONAL	RECREATIONAL	**6.39**	REGIONAL PARK
53	153	**J**	RECREATIONAL PUBLIC & SEMI PUBLIC	RECREATIONAL INDUSTRY TRANSPORTATION	**7.67**	UNIVERSTIY REGIONAL PARK
54	155	**J**	RECREATIONAL	RECREATIONAL	**0.95**	REGIONAL PARK
55	28	**K-I**	URBANISABLE AREA	RESIDENTIAL	**7.19**	
56	29	**K-I**	URBANISABLE AREA	PUBLIC & SEMI PUBLIC	**3.67**	

NATURAL CONSERVATION ZONES						
S.NO	**FID_ NCZ**	**Zone Name**	**MPD 2021 -LAND USE**	**ZDP LAND USE**	**Area (Ha)**	**REMARKS**
57	30	**K-I**	URBANISABLE AREA	RESIDENTIAL	**1.28**	
58	140	**K-I**	DRAIN	RESIDENTIAL, DRAIN	**6.85**	RIVER BED
59	141	**K-I**	DRAIN	DRAIN	**1.35**	RIVER BED
60	142	**K-I**	DRAIN	DRAIN	**7.58**	RIVER BED
61	143	**K-I**	DRAIN	DRAIN	**3.59**	RIVER BED
62	144	**K-I**	DRAIN	DRAIN	**22.98**	RIVER BED
63	145	**K-I**	DRAIN	DRAIN	**1.21**	
64	146	**K-I**	DRAIN	DRAIN	**1.96**	
65	152	**K-I**	DRAIN	DRAIN	**1.04**	RIVER BED
66	46	**K-I & L**	DRAIN	DRAIN	**38.24**	
67	47	**K-II**	AGRICULTURE / GREEN BELT	AGRICULTURE / GREEN BELT	**5.44**	
68	48	**K-II**	AGRICULTURE / GREEN BELT TRANSPORTATION COMMERCIAL	AGRICULTURE / GREEN BELT COMMERCIAL TRANSPORTATION	**11.88**	
69	31	**L**	URBANISABLE AREA	RESIDENTIAL, TRANSPORTATION PUBLIC & SEMI PUBLIC, RECREATIONAL	**37.99**	DISTRICT PARK CITY PARK COMMUNITY PARK
70	32	**L**	AGRICULTURE / GREEN BELT	AGRICULTURE/GREEN BELT FOREST RESIDENTIAL	**39.82**	
71	33	**L**	AGRICULTURE / GREEN BELT	AGRICULTURE/GREEN BELT	**19.85**	
72	34	**L**	AGRI./GREEN BELT , WATER BODY	AGRICULTURE/GREEN BELTWATER BODYRECREATIONAL	**32.32**	DISTRICT PARKCITY PARK COMMMUNITY PARK
73	35	**L**	AGRICULTURE / GREEN BELT	AGRICULTURE/GREEN BELT	**17.86**	
74	36	**L**	URBANISABLE AREA	TRANSPORTATION PUBLIC & SEMI PUBLIC RESIDENTIAL RECREATIONAL	**25.55**	DISTRICT PARK CITY PARK COMMUNITY PARK
75	37	**L**	URBANISABLE AREA	PUBLIC & SEMI-PUBLIC TRANSPORTATION	**4.3**	
76	38	**L**	URBANISABLE AREA	RECREATIONAL RIVER RESIDENTIAL TRANSPORTATION PUBLIC & SEMI PUBLIC	**63.54**	
77	39	**L**	AGRICULTURE / GREEN BELT	AGRICULTURE/GREEN BELT	**4.11**	
78	41	**L**	AGRI./GREEN BELT, WATERBODY	AGRICULTURE/GREEN BELT WATER BODY	**31.1**	
79	42	**L**	AGRICULTURE / GREEN BELT	AGRICULTURE/GREEN BELT	**12.06**	
80	43	**L**	AGRICULTURE / GREEN BELT	AGRICULTURE/GREEN BELT TRANSPORTATION	**7.81**	
81	44	**L**	AGRICULTURE / GREEN BELT	FOREST RESIDENTIAL AGRICULTURE/GREEN BELT	**59.13**	

NATURAL CONSERVATION ZONES						
S.NO	**FID_NCZ**	**Zone Name**	**MPD 2021 -LAND USE**	**ZDP LAND USE**	**Area (Ha)**	**REMARKS**
				WATER BODY		
82	45	**L**	URBANISABLE AREA	TRANSPORTATION, RESIDENTIAL, PUBLIC & SEMI PUBLIC	**8.89**	
83	27	**M & H**	UTILITY,RECREATIONAL,RESIDENTIAL	UTILITIES, RECREATIONAL	**58.76**	
84	22	**N**	URBANISABLE AREA	RESIDENTIAL	**9.02**	
85	23	**N**	AGRICULTURE / GREEN BELT	GREEN BELT	**12.23**	
86	24	**N**	AGRICULTURE / GREEN BELT	GREEN BELT	**9.43**	
87	25	**N**	URBANISABLE AREA	RECREATIONAL	**78.68**	
88	26	**N**	AGRICULTURE / GREEN BELT	GREEN BELT	**6.95**	
89	40	**N**	URBANISABLE AREA	COMMERCIAL TRANSPORTATIONPUBLIC & SEMI PUBLIC RESIDENTIAL RECREATIONAL	**72.61**	
90	19	**N & M & P-I**	UTILITY RECREATIONAL COMMERCIAL TRANSPORTATION	UTILITIES COMMERCIAL AGRICULTURE/GREEN BELT TRANSPORTATION	**73.76**	ELECTRICAL SUB STATION WATER TREATMENT PLANT
91	75	**O**	TRANSPORTATION RIVER	RIVER TRANSPORTATION RECREATIONAL	**24.72**	WATER BODY
92	76	**O**	RIVER	RIVER UTILITY	**0.38**	RIVER BED
93	77	**O**	RIVER	RIVER	**17.5**	RIVER BED
94	78	**O**	RIVER	RIVER	**1.43**	RIVER BED
95	79	**O**	RIVER TRANSPORTATION	RIVER RECREATIONAL TRNSPORTATION	**7.92**	RIVER BED
96	80	**O**	RIVER	RIVER	**29.44**	RIVER BED
97	81	**O**	RIVER	RIVER	**4.55**	RIVER BED
98	82	**O**	RIVER	RIVER RECREATIONAL	**9.89**	RIVER BED
99	83	**O**	RIVER	RIVER	**9.94**	RIVER BED
100	84	**O**	RIVER	RIVER	**53.01**	RIVER BED
101	85	**O**	RIVER	RIVER	**50.37**	RIVER BED
102	86	**O**	RIVER	RIVER	**18.48**	RIVER BED
103	87	**O**	RIVER	RIVER	**40.36**	RIVER BED
104	88	**O**	RIVER	RIVER	**22.37**	RIVER BED
105	89	**O**	RIVER	RIVER	**4.1**	
106	90	**O**	URBANISABLE AREA RECREATIONAL	RIVER RECREATIONAL UTILITIES	**4.43**	DISTRICT PARK CITY PARK COMMUNITY PARK
107	91	**O**	URBANISABLE AREA RECREATIONAL	RIVER RECREATIONAL	**4.45**	DISTRICT PARK CITY PARK COMMUNITY PARK
108	92	**O**	RIVER TRANSPORTATION	RIVER	**3.3**	RIVER BED
109	93	**O**	RIVER	UTILITIES	**338.12**	RIVER BED

NATURAL CONSERVATION ZONES						
S.NO	**FID_ NCZ**	**Zone Name**	**MPD 2021 -LAND USE**	**ZDP LAND USE**	**Area (Ha)**	**REMARKS**
			UTILITY TRANSPORTATION	RECREATIONAL RIVER TRANSPORTATION		WATER TREATMENT PLANT
110	94	**O**	RIVER	RIVER	**3.62**	
111	95	**O**	RIVER	RIVER	**5.01**	RIVER BED
112	96	**O**	RIVER TRANSPORTATION	RIVER RECREATIONAL	**1.65**	RIVER BED
113	101	**O**	RIVERTRANSPORTATION	RIVER	**64.67**	RIVER BED
114	102	**O**	RIVER	RIVER	**31**	RIVER BED
115	103	**O**	RIVER	RIVER	**6.47**	RIVER BED
116	105	**O**	RIVER	RIVER	**16.53**	RIVER BED
117	107	**O**	RIVER	RIVER	**5.43**	RIVER BED
118	108	**O**	RIVER	RIVER	**12.47**	RIVER BED
119	109	**O**	RIVER	RIVER	**1.66**	RIVER BED
120	119	**O**	RIVER	RIVER	**10.58**	RIVER BED
121	120	**O**	RIVER	RIVER	**1.42**	RIVER BED
122	121	**O**	RIVER	RIVER	**0.8**	RIVER BED
123	122	**O**	RIVER TRANSPORTATION	RIVER	**1.57**	
124	123	**O**	RIVER	RIVER RECREATIONAL	**1.5**	RIVER BED
125	124	**O**	RIVER	RIVER RECREATIONAL	**6.7**	
126	128	**O**	RIVER	RIVER RECREATIONAL	**1.51**	RIVER BED
127	129	**O**	RIVER	RIVER RECREATIONAL	**0.51**	RIVER BED
128	130	**O**	RIVER	RIVER RECREATIONAL	**0.65**	RIVER BED
129	131	**O**	RIVER	RIVER RECREATIONAL	**0.48**	RIVER BED
130	132	**O**	RIVER	RIVER TRANSPORTATION	**1.15**	RIVER BED
131	136	**O**	RECREATIONAL PUBLIC & SEMI PUBLIC	PUBLIC & SEMI PUBLIC RECREATIONAL	**12.41**	DISTRICT PARK CITY PARK, COMMUNITY PARK
132	137	**O**	RECREATIONAL	RECREATIONAL	**1.16**	DISTRICT PARK CITY PARK COMMUNITY PARK
133	138	**O**	RIVER	RIVER	**19.95**	RIVER BED
134	139	**O**	RIVER	RIVER	**74.99**	RIVER BED
135	154	**O**	RIVER	RIVER	**0.58**	RIVER BED
136	125	**O & E**	RIVER TRANSPORTATION	RIVER	**6.23**	DISTRICT PARK CITY PARK COMMUNITY PARK
137	127	**O & E**	RIVER	RIVER	**2.1**	RIVER BED
138	104	**O & F**	RIVER RESIDENTIAL TRANSPORTATION	RIVER TRANSPORTATION	**15.54**	RIVER BED
139	106	**O & F**	RIVER	RIVER	**6.15**	RIVER BED
140	13	**P-I**	RECREATIONALREATIONAL	RECREATIONAL,	**50.23**	CITY FOREST
141	14	**P-I**	AGRICULTURE/GREEN BELT UTILITY	AGRICULTURE/GREEN BELT UTILITY	**10.44**	ELECTRICAL SUB STATION
142	15	**P-I**	INDUSTRIAL RECREATIONAL	INDUSTRIAL COMMERCIAL	**16.58**	

NATURAL CONSERVATION ZONES						
S.NO	**FID_NCZ**	**Zone Name**	**MPD 2021 -LAND USE**	**ZDP LAND USE**	**Area (Ha)**	**REMARKS**
			TRANSPORTATION	RECREATIONAL TRANSPORTATION		
143	16	**P-I**	AGRICULTURE/GREEN BELT	AGRICULTURE/GREEN BELT	**39.54**	
144	17	**P-I**	AGRICULTURE/GREEN BELT	AGRICULTURE/GREEN BELT	**47.46**	
145	18	**P-I**	RESIDENTIAL PUBLIC & SEMI PUBLIC TRANSPORTATION	RESIDENTIAL PUBLIC & SEMI-PUBLIC COMMERCIAL TRANSPORTATION	**27.11**	
146	20	**P-I**	PUBLIC & SEMI PUBLIC	PUBLIC & SEMI PUBLIC TRANSPORTATION AGRICULTURE/GREEN BELT	**3.8**	
147	21	**P-I**	AGRICULTURE / GREEN BELT	AGRICULTURE / GREEN BELT	**23.79**	
148	151	**P-I**	RESIDENTIAL	RESIDENTIAL	**3.89**	WATER BODY
149	0	**P-II**	URBANISABLE AREA	RESIDENTIAL	**1.23**	
150	1	**P-II**	URBANISABLE AREA	RECREATIONAL	**9.3**	FOREST AREA
151	2	**P-II**	UTILITY	RECREATIONAL UTILITIES TRANSPORTATION	**25.38**	SEWERAGE TREATMENT PLANT
152	3	**P-II**	URBANISABLE AREA	RESIDENTIAL	**11.54**	
153	4	**P-II**	RESIDENTIALIDENTIAL	RESIDENTIAL TRANSPORTATION	**15.25**	
154	5	**P-II**	URBANISABLE AREA	RESIDENTIAL	**1.62**	
155	6	**P-II**	URBANISABLE AREA	RESIDENTIAL	**0.72**	
156	7	**P-II**	DRAIN RECREATIONAL TRANSPORTATION	DRAIN RECREATIONAL TRANSPORTATION	**21.19**	WATER BODY

Annexure G

In December 2016, Delhi proposed the Graded Responsibility Action Plan (GRAP), a series of measures to call under poor, very poor, severe and emergency polluting conditions. This was approved by the Supreme Court, giving the Environmental Pollution Control Authority (EPCA) the authority to oversee implementation for the National Capital Region (NCR).

Table: Annual emission inventory of pollutants (kt/year) in Delhi city and NCR, 2016

SECTOR	DELHI						NCR					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	NMVOC	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	NMVOC
TRANSPORT*	12.8	12.4	126.9	1.1	501.1	342.1	68.6	66.5	528.9	4.4	1750.9	886.5
INDUSTRIES	1.3	1.1	1.6	4.6	0.2	0.0	288.3	127.4	85.2	556.2	620.0	27.0
POWER PLANTS	6.1	3.5	11.2	23.6	3.5	0.9	73.7	41.1	132.5	297.1	13.4	9.4
RESIDENTIAL	2.9	2.0	3.7	0.2	61.1	12.7	204.3	131.5	36.0	16.8	1700.3	374.1
AGRICULTURAL BURNING	0.5	0.4	0.1	0.0	2.7	0.3	174.1	102.2	30.6	9.0	781.1	209.2
ROAD DUST	24.0	5.8	0.0	0.0	0.0	0.0	137.2	30.6	0.0	0.0	0.0	0.0
CONSTRUCTION	14.2	2.7					43.7	7.8				
DG SETS	0.1	0.0	0.7	0.0	0.2	0.1	3.7	3.2	53.0	3.5	11.4	4.3
REFUSE BURNING	1.4	1.2	0.5	0.1	4.6	2.7	17.5	14.4	5.5	0.7	56.0	33.3
CREMATORIA	0.4	0.2	0.1	0.0	2.2	1.2	1.5	0.8	0.2	0.0	7.7	4.3
RESTAURANT	1.4	0.8	0.4	1.3	2.5	0.4	1.7	1.0	0.5	1.6	2.9	0.4
AIRPORT	0.1	0.1	6.6	0.5	13.6	7.0	0.1	0.1	6.6	0.5	13.6	7.0
WASTE INCINERATORS	0.5	0.3	4.1	1.6	0.9	0.0	0.5	0.3	4.1	1.6	0.9	0.0
LANDFILL FIRES	1.8	1.5	0.6	0.1	5.8	2.2	1.9	1.6	0.6	0.1	6.1	2.3
SOLVENTS						57.3						112.8
TOTAL	68	32	156	33	598	427	1017	528	888	892	4,964	1671

Source: Graded Action Plan, 2016

From the above table it is inferred that road dust contribute the most for PM10 concentration whereas concentration of PM 2.5 contributed by transport sector in NCT- Delhi.

Annexure I

RELEVANCE OF REGIONAL RAPID TRANSIT SYSTEM (RRTS) FOR DELHI:

Context

Delhi is one of the fastest growing states in terms of growth in Gross State Domestic Product (GSDP). With a significant share of growth driven by service sector, the city creates many

economic opportunities for a diverse workforce. The opportunities on employment front and availability of social infrastructure attract people from various parts of country to Delhi. This is clearly visible by the fact that Delhi's average decadal growth since (since 1981 to 2001) was about 40% almost twice that of all-India average of 21%. A significant growth trend in migration of people to Delhi has been observed. In 2016, 33% of the population growth! in Delhi was due to influx of migrant population. This trend is likely to continue in view of rapid urbanization, increased need for mobility for employment, academic, healthcare and other economic opportunities. As per the report published by United Nations Department of Economic and Social Affairs/ Population Division, titled "World Urbanization Prospects: The 2018 Revision", highlights by 2030 Delhi shall surpass Tokyo to be most populous city in the world. The upsurge in population has obvious challenges on infrastructure, environment and quality of life for residents of Delhi.

The development of new growth centers and clusters in NCR have also contributed to increased mobility needs for citizens in Delhi. These growth centers include IT and BPO hubs in Gurugram and Noida, Industrial Hubs in Manesar, MSME and Educational Hubs in Ghaziabad, Sonepat and Meerut, etc. A sizeable number of citizens move from Delhi to these centers and vice versa daily.

Besides the above, a huge number of population influx to Delhi is of transient in nature, i.e., with no permanent settlement in Delhi. The same is emphasized by the fact that the cars that entered Delhi daily from cities of NCR were more than the total cars registered in the city in 2014-15 (as per a study by Centre for Science and Environment). Further, as per the Functional Plan on Transport for NCR, 2032, more than 1 million (about 1,107,043) vehicles cross Delhi borders in a day (based on 2007 data). About 4th of vehicular traffic is of transient nature, i.e., NCR to NCR crossing Delhi.

Such increase in migration, population density and transient population has led to an unprecedented load on civic amenities and mobility demand both within the city and in the region, further resulting in severe levels and huge economic loss. congestion on roads, high pollution levels and huge economic loss.

A local urban transportation mode such as MRTS or BRTS is not suitable to shift those commuters whose origin lie outside of Delhi to the public transport in the city. This highlights that an alternative mode of regional transportation can relieve the roads of significant vehicular traffic travelling within NCR but do not have origin or destination within Delhi. This note highlights the role that Regional Rapid Transit System (RRTS) will play in generating positive externalities both in short-term and long-term for Delhi as it becomes the backbone of public transportation in Delhi and allied NCR.

The RRTS corridors, proposed as a dedicated inter-state rail based, high-speed (with design speed of 180 kmph), high-frequency, high throughput, and a reliable regional commuter transit system in India. Once operational it will be the fastest, most comfortable and safest mode of commuter transport in NCR. Besides, being a high throughput and energy efficient system, it will reduce congestion, vehicular pollution and carbon emissions significantly in the region.

Further, RRTS will bring significant direct benefits such as reduced travel time, reduced vehicle operating costs, reduced accident, pollution and road congestion, and economic benefits such as agglomeration benefits, improved productivity, and induced employment contributing to the GDP of NCR.

Short-term impact of RRTS

- Modal shift from private to public transportation: A high speed, high-capacity, reliable, comfortable and safe connectivity option like RRTS will naturally attract commuters to use RRTS. This will further be encouraged by the affordability of RRTS compared to other modes of transportation.
- Reduce road congestion & provide option for land use: Roads already occupy approximately 21 percent of the total area of the city, which clearly limits the potential for increase in road spaces. Hence increase in use of public transport means is necessary for sustainable growth.
- Reduction in pollution and environmental benefits: Use of private vehicles and road congestion directly impacts cities pollution levels. However, with a shift of commuters to RRTS, there will be significant benefits in terms of reduction in hazardous pollution and improved environmental conditions, along with other positive externalities such as health benefits to citizens in Delhi.
- Reduction in road accidents: With increased share of public transport by implementation of RRTS, such increase in road accidents can be curtailed.
- Employment opportunities (during construction stage): The project shall also generate indirect employment opportunities in other sectors which include professional services, real estate, retail, health & social services, finance etc.

Long-term impact of RRTS

- Reduce migration influx: RRTS will connect suburban regions like Manesar, Bilaspur, Rewari, etc., with Delhi and will bring such areas within a travel time of 30-60 minutes. With such an improvement in access to Delhi, migration from nearby areas of Delhi will get limited. Further, the availability of affordable housing option in these regions combined with accessibility to Delhi will drive additional migrants to these regions and thus relive Delhi from the additional housing and infrastructure demands.
- Multiplier effect: The economic impact through investments in public/ mast transit infrastructure has a multiplier effect on the associated supply chain industries, which generates additional employment opportunities, i.e. indirect and induced employment.
- Containing the urban sprawl of Delhi: High-speed mode of transportation such RRTS can curtail urban sprawl of Delhi as it offers commuters to live far from the city limits. Such a convenience could decrease permanent migration from suburban regions to Delhi and offer balanced and sustainable development for the entire region.

From the above assessment, RRTS can provide a much-needed fillip to issues of congestion, pollution and strained urban infrastructure in Delhi.

Annexure J

SOLID WASTE MANAGEMENT IN SDMC

To ensure to implementation of the Solid Waste Management Rules-2016 and guidelines provided by CPHEEO Manual for managing the solid waste, the SDMC has developed an extensive system

for collection, segregation, storage, transportation and treatment/processing/disposal of Municipal Solid Waste through various Scientific/ Modern Technologies. SDMC comprises four zones namely Central Zone, South Zone, West Zone and Najafgarh Zone. SDMC has a total area of 656.91 sq. kms having population of approximately 70.00 lacs, and 104 Municipal wards within its territorial jurisdiction. SDMC collects, segregates, transports and disposes of all Municipal Solid Waste (MSW), Construction and Demolition (C&D) Waste/Malba and drain silt in all the colonies falling under its jurisdiction.

1. WASTE SEGREGATION AT SOURCE

The awareness of the public regarding the duties of waste generators under implementation of Solid Waste Management Rules 2016, through public notices, IEC activities etc. highlighting the segregation of waste was/are being issued, by SDMC as well as through concessionaires Notices have been issued to defaulters/offenders.

2. WASTE COLLECTION

At present about 3600 M.T of solid waste is collected daily from about 92 nos. of storage/receptacles /collection centers/ Fixed Compactor Transfer Station (FCTS)/Portable Compactor Transfer Station (PCTS) etc. existing at different places in all four zones of SDMC thorough concessionaires. DDA is requested to provide adequately such kind of spaces to SDMC as per existing Master Plan of Delhi.

3. MATERIAL RECOVERY FACILITIES (MRF)

SDMC has provided FCTS/ PCTS for secondary storage of solid waste in all four zones through concessionaires. However, DDA has not provided land to SDMC for material recovery facilities. DDA is requested to provide required land to all four zones of SDMC for setting up of Material Recovery Facilities

4. ROAD/STREET SWEEPING

SDMC carries out street/road sweeping by deploying departmental Safai karmacharies (SKs) and Mechanical Road Sweeping Machines (MRSMs).

5. INTEGRATION OF INFORMAL WASTE PICKERS KABARIWALAS

As per Swachh Bharat Mission, Municipal Solid Waste Management Manual Part-l, 2016 serial no. 2.11, the informal sector, constituting of the kabaddi system and waste pickers, plays an important role in the Municipal Solid Waste Management value chain by recovering valuable material from waste. DDA IS requested to provide sufficient land in all four zones of SDMC for development of facilities to integrate waste pickers with kabariwala.

6. ATTENDANCE OFFICES

Collection of solid waste is one of the crucial components of the solid waste management. To have effective control in the field as well as on the work, DDA is requested to provide required land for construction of offices of sanitary inspector/Assistant Sanitary Inspector in all four zones of SDMC as per existing Master Plan of Delhi.

7. DOOR TO DOOR COLLECTION SEGREGATED SOLID WASTE.

i. Door to door collection of segregated solid waste has been started in all four zones by the zonal level through Concessionaires/RWA's.
ii. To prevent littering on roads green and blue dustbins have been provided at various locations especially near bus stands, markets, along roads and other places having movement of people. About 7000 nos. of green and blue dustbins of different capacity have been provided in the past two years and installed at various locations for segregation of waste.

8. PROVIDE TRAINING ON SOLID WASTE MANAGEMENT To INTEGRATION WASTE PICKERS AND WASTE COLLECTORS.

Training on solid waste management to integration waste pickers and waste collectors are being provided by SDMC through concessionaires from time to time. DDA is requested to provide required land to SDMC for Construction of Training Centers.

9. WASTE TRANSPORTATION

All Concessionaires are using covered vehicles for transportation of waste from all four zones of SDMC to processing facilities at Waste to Energy Plant Okhla, Compost Plant Okhla or disposal site at SLF Okhla.

10. WORKSHOP AND PARKING FACILITIES FOR MAINTENANCE AND PARKING OF VEHICLES

In West zone and Najafgarh zone there are workshop and parking facilities for vehicles. However, there is no workshop and parking facilities available in Central zone and South zone. However, DDA is requested to provide required land to SDMC as per existing Master Plan of Delhi.

11. TREATMENT AND DISPOSAL OF WASTE

I. SDMC is transporting waste for treatment and disposal through concessionaires at Waste to Energy Plant, Okhla, Compost Plant Okhla and Sanitary Land Fill Okhlal /Jaitpur.

II. SETTING UP WASTE TO ENERGY PLANT AT TEHKHAND, OKHLA (2000 TPD OF MSW):

DDA had handed over a piece of land approx. 47.347 acres at Tehkhand near SLF Okhla to SDMC for Solid Waste Management Facilities on 1.11.2017. SDMC has already awarded the work of setting up of Waste to Energy plant for processing of 2000 MTD of Solid Waste on 15 acres land to the concessionaire. The work of development of site for setting up of plant has already been started at site. It is expected that New Waste to Energy Plant will be made operational by Dec 2021.

12. DECENTRALIZATION OF WASTE PROCESSING FACILITIES

a. SDMC has started decentralised processing of waste facilities by Bio-methanation plants having capacity of 5 TPD and 1 TPD of Solid Waste in each zone.

b. Further SDMC proposes to install 5 TPD composters for processing of wet waste (one in each zone) for which sites have been identified and sanction obtained. Tender process has been initiated.

c. SDMC has started involvement of communities in solid waste management and promotion of home composting, bio-gas generation decentralized processing of waste at community in all four zones.
d. SDMC also started processing of Solid Waste by 109 nos. Commercial Bulk Generators.
e. SDMC also proposes setting up of 2 nos. of Biogas Plants (200 TPD capacity each of cattle dung) at Nangli Dairy Colony, Najafgarh and Goyla Dairy Colony, Najafgarh. These plants are likely to be operational by March 2021.

13. DEVELOPMENT OF SANITARY LANDFILL FOR DISPOSAL OF RESIDUAL WASTE AT TEHKHAND.

i. DDA had handed over a piece of land approx. 47.347 acres at Tehkhand near SLF Okhla to SDMC for Solid Waste Management Facilities on 1.11.2017. SDMC has also initiated the work of Engineered Sanitary landfill site on 32.347-acre land. The permission to fell/transplant trees granted by Office of the Deputy Conservator Forests (South), GNCTD on 4.3.2020. The process for development of Sanitary landfill facility has been initiated.

ii. FUTURE DEVELOPMENT OF SANITARY LANDFILL SITE FOR DISPOSAL OF RESIDUE

DDA has provided about 32.347-acre land at Tehkhand for development of Sanitary landfill for disposal of residue. The expected life of this site is about 5 years. Thereafter, no land will be available for disposal of residue in SDMC. DDA is requested to provide sufficient land to SDMC for disposal of residue for further use for next 20-25 years.

14. DISPOSAL OF INERT LIKE SOIL FINE FRACTION ETC GENERATED AFTER BI0-MINING/BIO-REMEDIATION OF LEGACY WASTE AT SLF OKHLA (DUMP SITE).

Inert like soil fine fraction materials etc. generated after bio-mining/bioremediation of legacy waste at SLF Okhla is being disposed at NTPC ECO park and SLF Tajpur/Jaitpur. It is expected that approx. 7 lacs Cubic meter of inerts can be dumped in both these sites after which it will be saturated and thereafter there will be no land available for disposal of inerts. DDA is requested to provide suitable land preferably abandoned mines/deep pits for disposal of about 42 lacs cubic meter of inerts like soil fine fraction materials etc. generated after bio-mining process to SDMC in order to follow the direction of Hon'ble National Green Tribunal in letter & spirit.

15. CONSTRUCTION & DEMOLITION (C&D) WASTE PLANTS

i. SDMC has notified 65 locations in various wards for collection of C&D waste at ward level notified through various newspapers.
ii. Construction& Demolition (C&D) Waste Plant for processing of C&D waste with capacity of 500 MT (expandable up to 1000 MT) already been operational at Bakkarwala. This Plant is catering to two out of four zones namely, West and Najafgarh Zone to collect C&D Waste.
iii. DDA handed over a piece of land measuring approx. 4.309 acres to SDMC for setting up of Construction & Demolition (C&D) waste processing plant at Maidangarhi and Satbari area on 31.5.2019. Process for change of land use is with DDA. Once the change of land use is approved, bids for this project shall be invited. This Plant would cater to two remaining zones namely; Central and South Zone.

16. STATE POLICY AND STRATEGY ON SOLID WASTE MANAGEMENT

State policy and strategy on Solid Waste Management has been notified by GNCTD vide no. F. No. 13 (183)/SWM-NP/MB/UD/2017/P.F.AWol-l1/5586-92 dated 8.12.2017 and the same is being followed by SDMC.

17. BYE-LAWS FOR SOLID WASTE MANAGEMENT

Bye-laws for solid waste management in SDMC has been notified by GNCTD vide notification 15.1.2018 and the same is being implemented.

18. COLLECTION OF USER FEE FROM THE WASTE GENERATORS

SDMC has started process for collection of users free from the waste generators through concessionaires. Initially user charges are being collected from commercial establishment. Further the residential area will be covered in due course.

19. WASTE GENERATORS NOT TO LITTER 1.E. THROW OR DISPOSE OF ANY WASTE OR BURN OR BURRY WASTE ON STREETS, OPEN PUBLIC SPACES, DRAINS.

The awareness of the public regarding the duties of waste generators under implementation of Solid Waste Management Rules 2016, through public notices, IEC activities etc. highlighting the segregation of waste including not to litter i.e. throw or dispose of any waste or burn or burry waste on streets, open public spaces, drains are being done, through concessionaires regularly. Defaulters/ offenders are being challans and amount recovered from them as per bye-laws.

20. DEVELOPMENT OF FACILITIES FOR PROCESSING/DISPOSAL OF PLASTIC WASTE

DDA is requested to provide required land for all four zones of SDMC for development of facilities for processing/disposal of Plastic waste

Annexure K

Additional data provided by Sr. Manager, TPDDL via GNCTD letter dated 31.07.2020

"Revised"

Power Generation from Renewable Sources

Renewable Energy generation in India may lead to combat with climate change, reduce air pollution and enhance energy security. Delhi is in a land locked position with high land cost and paucity of barren land within its borders. Also there is no potential for wind or hydro power in Delhi. Therefore, focus on rooftop solar as a primary source of renewable energy may reduce its reliance on conventional energy while increasing its energy security.

Table 6.1 Installed capacity of Renewable energy

Solar Generation	167.845 MW
Waste to Energy	52 MW (Timarpur -Okhla 16MW, Ghazipur -12MW, Narela-Bawana 24MW)
Total	219.845 MW

Solar Energy

Delhi is a highly favorable for solar power generation as the city receives irradiation with 250-300 days of clear sun in a year. The city's total solar potential is as high as 2.5 GW with roof-top space availability for solar panels at an estimated 31 sq. km. Delhi has the potential to cut its electricity expense, improve energy security and shave off Over 30 percent of peak demand by 2025, reducing the new PPAs of this potential, 26 percent is in the Government/Public Sector, 25 percent in Commercial/Industrial Sector and 49 percent in Domestic Sector.

Solar Energy is the need of the hour, since there is a huge difference between the peak demand in summers and winters. This peak demand curve incidentally matches the energy generation Curve of Solar Power plants, making solar a preferred choice for energy generation in the NCT of Delhi. To this end, the Government of NCT of Delhi Policy, 2016" effective from 27.09.2016, installations with capacities of 1 kW or more. released the "Delhi Solar which is applicable to solar Delhi Govt. formed "Energy Efficiency & Renewable Energy Management Centre (EE&REMC)" to work as 'State Designated Agency' (SDA) to coordinate, regulate and enforce Energy Conservation Act, 2001 in Delhi in association with Bureau of Energy Efficiency (BEE). The centre was assigned the role of State Nodal Agency (SNA), to implement New & Renewable Energy projects in the city of Delhi in association with Ministry of New & Renewable Energy (MNRE), Govt. of India. The policy focuses on promoting investments under multiple financial models such as CAPEX and Renewable Energy Service Company (RESCO) models. The policy includes generation targets, regulations, mandates and incentives. It applies to all electricity Consumers and entities that develop and operate power projects in Delhi.

The Delhi Electricity Regulatory Commission (DERC) had notified the Group Net metering and Virtual Net metering Guidelines on 3i1" May, 2019. Group Net Metering framework is applicable to all the consumers of NCI of Delhi and Virtual Net Metering Framework shall be applicable for residential The Group Housing Societies, offices of Government/Local Consumers, Authorities and Renewable Energy Generators registered under Mukhyamantri Kisaan Aay Badhotari Yojna. Since, 1 MW of solar system requires 4-5 acres of land therefore ground-mounted solar is not a feasible option for Delhi, due to land constraints. Hence, Roof Top Solar is being promoted to harness the region's huge solar potential.

Rooftop Solar Plan

Under the budget for 2020-21, the Government of Delhi has proposed a number of initiatives to increase share of renewable energy and decrease the dependence on fossil fuels. Delhi Discoms have committed to procure at least 2090 MW(Wind-750 MW & Solar-1340 MW) of Renewable Power from wind and solar energy sources. The NCT has 167.845 MW of installed solar capacity and 52 MW of installed Waste-to -Energy capacity as of May, 2020 while about 51.5 MW (Government Buildings 21.5 MW & Residential Sector 30 MW through Discoms) of solar capacity is in the pipeline. As per Delhi Solar Policy all Government Buildings having area 500 Sq. mt. or above are mandatorily install Solar Photovoltaic (SPV) panels.

Annexure L

Additional data provided by Indraprastha Power Generation Company Limited and Pragati Power Corporation Limited via GNCTD letter dated 31.07.2020

Table 6.1 Effective Generation Capacity versus installed Capacity within Delhi

S, No.	Power Station	Capacity of Power Station for FY 2019-20 (MW)	Gross Generation for FY 2019-20 (MUs)	Plant Availability Factor for FY 2019-20 (%age)
1	IP Gas Turbine Power Station	270	501.50	86.46
2	Pragati Power Station-I	330	1529.30	96.95
3	Pragati Power Station -III	1371.2	4013.90	89.25
	Total	1971.2	6044.70	

From table 6.1, it may be inferred that IPGCL & PPCL Power plants have achieved more than 85% Plant Availability Factor in 2019-20. With present installed capacity, IPGCL & PPCL are able to meet around 50% of the average electricity consumption of Delhi. However, they are generating around 17.55% of the average electricity consumption of Delhi due to the Non availability of the adequate Domestic gas. 1371.2 MW PPS-Ill, Bawana plant having very efficient advanced class gas turbines with pollution level much below the permissible limits is also facing shortage of Domestic gas for Module-I1.

Table - Generation in Delhi (installed capacity in MW)

Gas Turbine	270
PPCL	330
Bawana - PPCL	1372
TOWMCL	16
EDWPCL	12
DMSWL	24
Total	2024

Table - DTL Availability year wise

S No.	Details	System Availability (%)
1	2005-06	97.71
2	2006-07	98.87
3	2007-08	98.5
4	2008-09	98.78
5	2009-10	98.39
6	2010-11	98.58
7	2011-12	98.38
8	2012-13	97.17
9	2013-14	97.43
10	2014-15	98.6
11	2015-16	99.03
12	2016-17	98.01
13	2017-18	99.948
14	2018-19	99.106
15	2019-20	98.953

2019-20

Months	Peak demand met in MW	Date of peak demand	Time of peak demand

April 19	5664	30.04.2019	23:03:05
May 19	6461	31.05.2019	15:50:19
June 19	6904	12.06.2019	15:34:28
July 19	7409	02.07.2019	15:35:07
August 19	6473	29.08.2019	15:12:28
September 19	6626	11.09.2019	22:56:24
October 19	4605	03.10.2019	15:32:09
November 19	3631	15.11.2019	10:46:00
December 19	5245	31.12.2019	10:45:48
January 20	5226	01.01.2020	10:45:00
February 20	4447	07.02.2020	09:55:25
March 20	3775	06.03.2020	10:37:25
Peak	7409	02.07.2019	15:35:07

Max Demand 2019-20:7409MW on 02.07.2019 at 15:35:07 hrs.

Annexure M

Additional data provided by Planning Department, Government of NCT of Delhi on the 04.09.2020.

TABLE : 1

COMPARATIVE STATEMENT OF SDP OF DELHI v/s ALL INDIA

New Series: 2011-12

At Current Prices

ITEM		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17 (3rd RE)	2017-18 (2nd RE)	2018-19 (1st RE)	2019-20 (AE)
GSDP/GDPS (Rs. Lakh)	DELHI	34379750	39138764	44395989	49486302	55080370	61608506	68682358	77487033	85611232
	All India	*8736329000*	*9944013000*	*11235522000*	*12467959000*	*13771874000*	*15391669000*	*17008304000*	*18971237000*	*20339849000*
% change over previous year	DELHI		13.84	13.43	11.45	11.32	11.85	11.48	12.82	10.48
	All India		*13.8*	*13.0*	*11.0*	*10.5*	*11.8*	*11.1*	*11.9*	*7.2*
NSDP/NDPS (Rs. Lakh)	DELHI	31465002	35740011	40484181	44848665	50052365	55854560	62072955	70452910	77964705
	All India	*7819154000*	*8883108000*	*10037547000*	*11125668000*	*12322177000*	*13800337000*	*15534357000*	*17399161300*	*18221249000*
% change over previous year	DELHI		13.59	13.27	10.78	11.60	11.59	11.13	13.50	10.66
	All India		*13.6*	*13.0*	*10.8*	*10.8*	*12.0*	*11.1*	*10.8*	*7.2*
PER CAPITA INCOME (Rs.) #	DELHI	185001	205568	227900	247289	270261	295558	322000	358430	389143
	All India	*63462*	*70983*	*79118*	*86647*	*94797*	*104880*	*115293*	*126521*	*134226*
% change over previous year	DELHI		11.12	10.86	8.47	9.32	9.36	8.95	11.31	8.57
	All India		*11.9*	*11.5*	*9.5*	*9.4*	*10.6*	*9.9*	*9.7*	*6.1*

At Constant Prices

ITEM		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17 (3rd RE)	2017-18 (2nd RE)	2018-19 (1st RE)	2019-20 (AE)
GSDP/GDPS (Rs. Lakh)	DELHI	34379750	36662837	39290838	41835515	47562259	51176524	54830419	59056914	63440769
	All India	*8736329000*	*9213017000*	*9801370000*	*10527674000*	*11369493000*	*12308193000*	*13175160000*	*13958142600*	*14565951000*
% change over previous year	DELHI		6.64	7.17	9.01	11.83	7.60	7.14	7.71	7.42
	All India		*5.5*	*6.4*	*7.4*	*8.0*	*8.3*	*7.0*	*6.1*	*4.2*
NSDP/NDPS (Rs. Lakh)	DELHI	31465002	33419330	35652751	38763874	43172959	46159238	49239503	52973871	56826536
	All India	*7819154000*	*8202356000*	*8700760000*	*9349032900*	*10098503000*	*10934667000*	*11696400900*	*12372051000*	*12899397000*
% change over previous year	DELHI		6.21	6.68	8.73	11.37	6.93	6.67	7.58	7.27
	All India		*4.9*	*6.1*	*7.5*	*8.0*	*8.2*	*7.0*	*5.9*	*4.2*
PER CAPITA INCOME (Rs.) #	DELHI	185001	192220	200782	213669	233115	244255	255431	269505	283636
	All India	*63462*	*65538*	*68572*	*72805*	*77659*	*83003*	*87828*	*92085*	*96954*
% change over previous year	DELHI		3.90	4.41	6.46	9.10	4.78	4.58	5.51	5.24
	All India		*3.3*	*4.6*	*6.2*	*6.7*	*6.9*	*5.8*	*4.8*	*3.1*

Note: (3rd RE):- Third Revised Estimates, (2nd RE):- Second Revised Estimates, (1st RE):- First Revised Estimates, (AE):- Advance Estimates

#:- Latest Population Projections prepared by National Commission on Population have been used.

$: (Provisional Estimates) of All India for the year 2019-20 released by NSO on 29.05.2020 and (1st RE) of All India for the year 2018-19, (2nd RE) of All India for the year 2017-18 & (3rd RE) of All India for the year 2016-17 released by NSO on 31.01.2020

Table: 3

PERCENTAGE CHANGE OVER PREVIOUS YEARS IN GSVA AND GSDP (At Current Prices)

(In %)

Sl No.	Industry	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17 (3rd RE)	2017-18 (2nd RE)	2018-19 (1st RE)	2019-20 (AE)
1.	Agriculture, forestry & fishing		-9.59	0.13	-4.30	-1.80	2.84	14.40	8.35	10.19
1.1	Crops		10.34	1.32	-30.35	0.03	2.64	3.31	8.27	7.74
1.2	Livestock		-15.70	-0.38	6.30	-2.31	2.88	17.50	8.47	10.82
1.3	Forestry & Logging		-1.57	-4.14	-4.46	-4.74	-3.11	-6.56	-6.49	-7.66
1.4	Fishing		1.91	12.74	3.27	5.29	10.60	11.78	0.31	9.87
2.	Mining & Quarrying		-3.41	36.03	-5.10	-21.62	-13.87	6.25	9.43	1.22
	Primary		*-5.07*	*26.80*	*-4.91*	*-17.57*	*-9.80*	*8.51*	*9.11*	*3.83*
3.	Manufacturing		23.50	8.51	-7.71	33.39	-3.46	8.41	8.47	1.34
4.	Electricity, Gas, Water Supply & other Utility Services		77.35	24.89	9.91	31.86	27.46	22.69	11.59	17.54
5.	Construction		7.18	10.99	0.18	4.80	18.64	14.86	16.80	13.35
	Secondary		*22.22*	*11.89*	*-1.87*	*22.44*	*9.85*	*13.98*	*12.35*	*9.76*
6.	Trade, hotels & restaurants		16.45	15.25	3.01	11.56	7.10	12.70	11.85	11.06
6.1	Trade & Repair Services		17.13	15.90	2.81	11.76	6.34	13.06	12.23	11.39
6.2	Hotels & Restaurants		10.15	7.91	5.17	9.42	15.26	9.14	7.98	7.64
7.	Transport, Storage & Communication		15.37	10.24	30.44	5.59	8.42	10.75	14.57	8.89
7.1	Railways		8.64	24.92	14.74	4.89	39.28	-1.42	8.14	10.92
7.2	Road transport		6.18	-0.72	0.60	17.58	9.41	7.93	15.17	11.43
7.3	Water transport		9.39	-9.38	6.13	19.67	2.10	23.31	7.13	9.35
7.4	Air transport		80.63	-17.98	67.30	79.21	10.03	1.30	6.19	2.69
7.5	Services incidental to transport		16.03	11.32	41.17	-1.32	7.64	17.70	14.93	9.04
7.6	Storage		14.23	13.99	0.16	6.08	-13.18	10.49	6.29	2.96
7.7	Communication & Services related to broadcasting		12.04	20.69	15.16	9.26	1.27	-8.34	19.51	7.65
8.	Financial Services		11.22	7.61	8.26	4.45	6.44	11.85	12.74	8.50
9.	Real estate, ownership of dwellings & professional services		13.72	16.70	21.05	12.33	16.61	15.21	12.85	11.85
10.	Public Administration		-7.88	4.10	9.02	14.94	11.68	8.35	20.01	12.47
11.	Other Services		14.30	12.63	17.53	9.88	17.32	17.34	13.05	12.92
	Tertiary		*12.28*	*12.38*	*15.66*	*9.41*	*11.63*	*13.34*	*13.38*	*10.56*
	TOTAL GROSS STATE VALUE ADDED At Basic Prices		*12.98*	*12.65*	*12.52*	*10.26*	*10.94*	*13.35*	*13.14*	*10.35*
	Product Taxes		21.13	17.24	2.53	20.51	17.32	-0.58	10.41	11.38
	Product Subsidies		29.82	0.91	-18.60	43.94	10.35	-5.77	8.78	10.23
	GROSS STATE DOMESTIC PRODUCT At Market Prices		*13.84*	*13.43*	*11.45*	*11.32*	*11.85*	*11.48*	*12.82*	*10.48*
	Population		2.22	2.17	2.13	2.08	2.04	2.01	1.97	1.93
	Per Capita GSDP		*11.37*	*11.02*	*9.13*	*9.05*	*9.61*	*9.29*	*10.64*	*8.39*

Note: (3rd RE):- Third Revised Estimates, (2nd RE):- Second Revised Estimates, (1st RE):- First Revised Estimates, (AE):- Advance Estimates

#:- Latest Population Projections prepared by National Commission on Population have been used.

Totals may not tally due to rounding off.

Table: 5

GSVA AND GSDP BY ECONOMIC ACTIVITY (At Constant Prices)

(In Rs. Lakhs)

Sl. No.	Industry	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17 (3rd RE)	2017-18 (2nd RE)	2018-19 (1st RE)	2019-20 (AE)
1.	Agriculture, forestry & fishing	285663	223585	208539	181518	166190	171205	182266	194639	208103
1.1	Crops	65965	60904	55187	27752	21598	21776	19884	20292	19760
1.2	Livestock	217865	161036	151777	152233	143096	147975	160915	172971	186935
1.3	Forestry & Logging	1007	874	796	779	704	628	572	520	471
1.4	Fishing	826	771	760	753	793	826	895	876	916
2.	Mining & Quarrying	772879	682516	853635	931402	987245	889967	944914	817214	869890
	Primary	*1058542*	*906101*	*1062174*	*1112920*	*1153436*	*1061173*	*1127180*	*1011872*	*1077993*
3.	Manufacturing	1890728	2203494	2293900	2059873	2805646	2687146	2845148	2993560	3041635
4.	Electricity, Gas, Water Supply & other Utility Services	410629	676885	805799	847377	1081183	1293893	1512208	1633619	1871661
5.	Construction	1666852	1631484	1680635	1608184	1623918	1833738	2007447	2296305	2522153
	Secondary	*3968208*	*4511864*	*4780234*	*4515435*	*5510747*	*5814777*	*6364803*	*6923484*	*7435449*
6.	Trade, hotels & restaurants	4212068	4589077	5028156	5120383	5931558	6245682	6846492	7362435	8060666
6.1	Trade & Repair Services	3806351	4170957	4599189	4674138	5424481	5670979	6238043	6728030	7387242
6.2	Hotels & Restaurants	405718	418120	429056	446245	507077	574703	610449	634405	673424
7.	Transport, Storage & Communication	3918648	4319489	4803614	6083862	6609819	6727079	7276487	7831270	8084867
7.1	Railways	189925	197386	241272	258189	263921	332426	322009	341960	373219
7.2	Road transport	664297	685228	658151	674288	818177	842530	884644	954144	1005846
7.3	Water transport	546	569	499	539	666	640	770	772	799
7.4	Air transport	98961	170441	135235	230684	426631	441828	436245	403866	421496
7.5	Services incidental to transport	2368549	2620504	2822007	4057020	4131633	4185811	4801878	5168324	5331127
7.6	Storage	21247	22705	24598	24344	26810	22871	24549	25024	25340
7.7	Communication & Services related to broadcasting	585124	622656	721851	838798	941981	900972	806392	907182	927041
8.	Financial Services	5388295	5914328	6218539	6621044	6758425	7200558	7501453	7847183	8420027
9.	Real estate, ownership of dwellings & professional services	7248036	7515151	8027468	9229795	9883994	10949303	12044047	13244810	14213135
10.	Public Administration	1956780	1662494	1604411	1663411	1844708	1978354	2054062	2390859	2598537
11.	Other Services	2562671	2674740	2837901	3235928	3399058	3822056	4415519	4773538	5113609
	Tertiary	*25296499*	*26675279*	*28380089*	*30956422*	*34427562*	*36923031*	*40138060*	*43450095*	*46490841*
	TOTAL GROSS STATE VALUE ADDED At Basic Prices	*30323249*	*32093243*	*34162477*	*37554777*	*41091745*	*43799981*	*47630042*	*51385451*	*55004283*
	Product Taxes	4442090	4998368	5527879	5564295	6861981	7782894	7590342	8070298	8801074
	Product Subsidies	385589	428775	399518	313556	391476	405351	389965	398835	364588
	GROSS STATE DOMESTIC PRODUCT At Market Prices	*34379750*	*36662837*	*39290838*	*42805515*	*47562250*	*51176524*	*54830419*	*59056914*	*63440769*
	Population (in '00)	170080	173860	177640	181420	185200	188980	192770	196560	200350
	Per Capita GSDP (in Rs.)	*202139*	*210876*	*221182*	*236012*	*256816*	*270804*	*284439*	*300452*	*316650*

Note: (3rd RE):- Third Revised Estimates, (2nd RE):-Second Revised Estimates, (1st RE):- First Revised Estimates, (AE):- Advance Estimates

#:- Latest Population Projections prepared by National Commission on Population have been used.

Totals may not tally due to rounding off.

Table: 7

PERCENTAGE DISTRIBUTION OF GSVA BY ECONOMIC ACTIVITY (At Constant Prices)

(In %)

Sl. No.	Industry	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17 (3rd RE)	2017-18 (2nd RE)	2018-19 (1st RE)	2019-20 (AE)
	Primary	*3.49*	*2.82*	*3.10*	*2.96*	*2.80*	*2.42*	*2.36*	*1.97*	*1.96*
1.	Agriculture, forestry & fishing	0.94	0.69	0.60	0.48	0.40	0.39	0.38	0.38	0.38
1.1	Crops	0.22	0.19	0.16	0.07	0.05	0.05	0.04	0.04	0.04
1.2	Livestock	0.72	0.50	0.44	0.41	0.35	0.34	0.34	0.34	0.34
1.3	Forestry & Logging	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.4	Fishing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.	Mining & Quarrying	2.55	2.13	2.50	2.48	2.40	2.03	1.98	1.59	1.58
	Secondary	*13.09*	*14.06*	*13.99*	*12.01*	*13.41*	*13.28*	*13.37*	*13.48*	*13.52*
3.	Manufacturing	6.24	6.87	6.71	5.48	6.83	6.14	5.97	5.83	5.53
4.	Electricity, Gas, Water Supply & other Utility Services	1.35	2.11	2.36	2.25	2.63	2.95	3.18	3.18	3.40
5.	Construction	5.50	5.08	4.92	4.28	3.95	4.19	4.22	4.47	4.59
	Tertiary	*83.42*	*83.12*	*82.91*	*85.03*	*83.79*	*84.30*	*84.27*	*84.55*	*84.52*
6.	Trade, hotels & restaurants	13.89	14.30	14.72	13.62	14.44	14.26	14.37	14.33	14.65
6.1	Trade & Repair Services	12.55	13.00	13.46	12.44	13.20	12.95	13.09	13.09	13.43
6.2	Hotels & Restaurants	1.34	1.30	1.26	1.19	1.23	1.31	1.28	1.24	1.22
7.	Transport, Storage & Communication	12.96	13.46	13.48	16.19	16.09	15.35	15.28	15.23	14.70
7.1	Railways	0.63	0.61	0.71	0.69	0.64	0.76	0.68	0.66	0.68
7.2	Road transport	2.19	2.14	1.93	1.79	1.99	1.92	1.86	1.86	1.83
7.3	Water transport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.4	Air transport	0.33	0.53	0.40	0.61	1.04	1.01	0.92	0.84	0.77
7.5	Services incidental to transport	7.81	8.17	8.26	10.79	10.06	9.56	10.08	10.06	9.69
7.6	Storage	0.07	0.07	0.07	0.06	0.07	0.04	0.05	0.05	0.05
7.7	Communication & Services related to broadcasting	1.93	1.94	2.11	2.23	2.29	2.06	1.69	1.76	1.68
8.	Financial Services	17.77	18.43	18.20	17.62	16.45	16.44	15.75	15.27	15.31
9.	Real estate, ownership of dwellings & professional services	23.90	23.42	23.50	24.56	24.05	25.00	25.29	25.78	25.84
10.	Public Administration	6.45	5.18	4.70	4.43	4.49	4.52	4.31	4.65	4.72
11.	Other Services	8.45	8.33	8.31	8.61	8.27	8.73	9.27	9.29	9.30
	TOTAL GROSS STATE VALUE ADDED At Basic Prices	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*

Note: (3rd RE):- Third Revised Estimates, (2nd RE):- Second Revised Estimates, (1st RE):- First Revised Estimates, (AE):- Advance Estimates

Totals may not tally due to rounding off.

Table: 9

PERCENTAGE CHANGE OVER PREVIOUS YEARS IN NSVA AND NSDP (At Current Prices)

(In %)

Sl. No.	Industry	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17 (3rd RE)	2017-18 (2nd RE)	2018-19 (1st RE)	2019-20 (AE)
1.	Agriculture, forestry & fishing		-9.84	-0.16	-4.59	-1.95	2.73	14.60	8.42	10.31
1.1	Crops		10.04	0.34	-33.17	-0.90	1.88	2.83	8.40	7.88
1.2	Livestock		-15.71	-0.39	6.34	-2.22	2.96	17.54	8.54	10.89
1.3	Forestry & Logging		-1.59	-4.19	-11.23	-4.32	-12.57	-10.19	-16.77	-19.37
1.4	Fishing		2.34	13.54	4.60	5.83	11.57	12.80	0.29	10.61
2.	Mining & Quarrying		-3.48	32.57	-5.92	-22.75	-13.55	6.97	13.18	2.65
	Primary		***-5.33***	***23.48***	***-5.62***	***-18.02***	***-9.13***	***9.32***	***11.65***	***5.05***
3.	Manufacturing		26.23	9.83	-9.96	40.05	-3.79	8.51	9.29	1.13
4.	Electricity, Gas, Water Supply & other Utility Services		79.09	26.16	9.31	36.87	23.50	24.83	13.73	20.35
5.	Construction		6.56	10.05	0.39	4.73	18.40	14.51	16.88	13.32
	Secondary		***21.17***	***11.75***	***-3.38***	***24.92***	***8.22***	***13.73***	***13.07***	***9.77***
6.	Trade, hotels & restaurants		16.08	15.02	2.24	11.43	6.60	12.18	12.36	11.24
6.1	Trade & Repair Services		16.70	15.72	1.98	11.90	5.77	12.50	12.80	11.58
6.2	Hotels & Restaurants		10.24	8.04	5.01	6.50	15.74	8.97	7.83	7.54
7.	Transport, Storage & Communication		13.44	9.23	32.97	5.72	7.86	9.95	16.32	9.09
7.1	Railways		7.15	20.88	14.67	5.79	45.33	-4.41	9.11	11.54
7.2	Road transport		8.54	-0.53	0.58	16.25	8.50	7.13	15.43	11.40
7.3	Water transport		0.91	-15.68	20.65	14.86	16.59	19.80	12.87	12.01
7.4	Air transport		281.80	-28.77	129.01	121.12	12.49	1.72	7.96	3.56
7.5	Services incidental to transport		12.08	12.44	43.85	-2.01	6.89	17.43	16.56	9.12
7.6	Storage		15.54	11.36	-0.71	6.24	-13.15	11.92	8.97	4.34
7.7	Communication & Services related to broadcasting		13.15	10.60	17.60	10.51	-2.36	-14.68	25.58	7.85
8.	Financial Services		11.00	7.73	8.06	4.23	6.26	11.87	12.84	8.49
9.	Real estate, ownership of dwellings & professional services		13.00	16.19	18.49	11.11	16.39	14.34	13.50	10.97
10.	Public Administration		-7.18	4.83	10.13	16.54	12.74	9.60	23.22	13.95
11.	Other Services		15.64	13.18	18.93	14.14	17.81	19.23	13.69	13.74
	Tertiary		***12.06***	***12.09***	***14.99***	***9.41***	***11.36***	***13.15***	***14.15***	***10.76***
	TOTAL NET STATE VALUE ADDED At Basic Prices		***12.59***	***12.38***	***11.85***	***10.46***	***10.53***	***13.16***	***13.97***	***10.54***
	Product Taxes		21.13	17.24	2.53	20.51	17.32	-0.58	10.41	11.38
	Product Subsidies		29.82	0.91	-18.60	43.94	10.35	-5.77	8.78	10.23
	NET STATE DOMESTIC PRODUCT At Market Prices		***13.59***	***13.27***	***10.78***	***11.60***	***11.59***	***11.13***	***13.50***	***10.66***
	Population		2.22	2.17	2.13	2.08	2.04	2.01	1.97	1.93
	Per Capita NSDP		***11.12***	***10.86***	***8.47***	***9.32***	9.36	***8.95***	***11.31***	***8.57***

Note: (3rd RE):- Third Revised Estimates, (2nd RE):- Second Revised Estimates, (1st RE):- First Revised Estimates, (AE):- Advance Estimates

#:- Latest Population Projections prepared by National Commission on Population have been used.

Totals may not tally due to rounding off.

Table: 18

NSVA AND NSDP BY ECONOMIC ACTIVITY (At Constant Prices)

(In Rs. Lakhs)

Sl. No.	Industry	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17 (3rd RE)	2017-18 (2nd RE)	2018-19 (1st RE)	2019-20 (AE)
1.	Agriculture, forestry & fishing	279933	218119	202746	175410	160029	164867	175613	187783	200982
1.1	Crops	62741	57427	51344	23598	17277	17229	15123	15309	14557
1.2	Livestock	213467	159146	149963	150423	141395	146388	159234	171334	185328
1.3	Forestry & Logging	996	864	786	716	645	507	445	349	266
1.4	Fishing	729	682	672	672	712	743	812	792	831
2.	Mining & Quarrying	679588	596258	720020	806000	883997	804119	859311	751381	817735
	Primary	*959521*	*814377*	*922786*	*981413*	*1044026*	*968976*	*1034924*	*939164*	*1018717*
3.	Manufacturing	1991119	1892053	1992032	1744814	2500209	2385360	2531858	2686905	2735876
4.	Electricity, Gas, Water Supply & other Utility Services	261375	426142	506645	530891	691945	766295	900287	916143	1051717
5.	Construction	1588185	1541608	1567100	1499867	1508531	1689236	1835775	2106547	2310471
	Secondary	*3840678*	*3859604*	*4065777*	*3775573*	*4700685*	*4840891*	*5267920*	*5709589*	*6096065*
6.	Trade, hotels & restaurants	3917832	4263509	4656243	4715301	5464941	5723839	6255617	6729568	7375346
6.1	Trade & Repair Services	3554473	3878864	4261668	4304425	5009427	5205836	5705176	6159698	6770680
6.2	Hotels & Restaurants	373360	384645	394575	410876	455514	518003	550441	569870	604666
7.	Transport, Storage & Communication	3410354	3681336	3874209	5287848	5783592	5807573	6242447	6726298	6893646
7.1	Railways	167350	172061	203864	217151	222794	289581	271626	287919	314351
7.2	Road transport	621827	643374	639126	634649	763110	776777	811050	870810	913248
7.3	Water transport	354	338	276	343	414	443	513	532	556
7.4	Air transport	26337	95334	65566	154547	355115	372519	369324	369212	359139
7.5	Services incidental to transport	2099967	2241848	2433432	3604857	3604713	3662989	4196579	4527695	4638967
7.6	Storage	18189	19635	20723	20439	22623	19265	21026	21915	22563
7.7	Communication & Services related to broadcasting	476331	508766	531221	655862	754823	686006	572329	648214	644623
8.	Financial Services	5303210	5811414	6116374	6506996	6628969	7051013	7340146	7668562	8225481
9.	Real estate, ownership of dwellings & professional services	6659468	6837259	7218182	8133072	8575765	9394700	10203820	11179643	11901480
10.	Public Administration	1511908	1278842	1226414	1280577	1423021	1526694	1602453	1919285	2112002
11.	Other Services	2195529	2303176	2444405	2832357	3081454	3468008	4087800	4430299	4765312
	Tertiary	*23008302*	*24175556*	*25535827*	*28756150*	*30957762*	*32971828*	*35736283*	*38653655*	*41273068*
	TOTAL NET STATE VALUE ADDED At Basic Prices	*27408501*	*28849736*	*30524390*	*33513136*	*36702454*	*38781695*	*42039126*	*45302408*	*48390050*
	Product Taxes	4462090	4998368	5527879	5564295	6861981	7782894	7990342	8070298	8501074
	Product Subsidies	385589	428775	399518	313556	391476	405351	389965	398835	364588
	NET STATE DOMESTIC PRODUCT At Market Prices	*31465002*	*33419330*	*35652751*	*38763874*	*43172959*	*46159238*	*49239503*	*52973871*	*56826536*
	Population (In'00)	170080	173860	177640	181420	185200	188980	192770	196560	200350
	Per Capita NSDP (In Rs.)	*185001*	*192220*	*200702*	*213669*	*233115*	*244255*	*255431*	*269505*	*283636*

Note: (3rd RE):- Third Revised Estimates, (2nd RE):- Second Revised Estimates, (1st RE):- First Revised Estimates, (AE):- Advance Estimates

#:- Latest Population Projections prepared by National Commission on Population have been used.

Totals may not tally due to rounding off.

Table: 13
PERCENTAGE DISTRIBUTION OF NSVA BY ECONOMIC ACTIVITY (At Constant Prices)

(In %)

Sl. No.	Industry	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17 (3rd RE)	2017-18 (2nd RE)	2018-19 (1st RE)	2019-20 (AE)
	Primary	*3.50*	*2.83*	*3.02*	*2.93*	*2.84*	*2.49*	*2.46*	*2.07*	*2.10*
1.	Agriculture, forestry & fishing	1.02	0.76	0.66	0.52	0.43	0.42	0.42	0.41	0.41
1.1	Crops	0.23	0.20	0.17	0.07	0.05	0.04	0.04	0.03	0.03
1.2	Livestock	0.79	0.55	0.49	0.45	0.38	0.38	0.38	0.38	0.38
1.3	Forestry & Logging	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.4	Fishing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.	Mining & Quarrying	2.48	2.07	2.36	2.41	2.41	2.07	2.04	1.66	1.69
	Secondary	*12.54*	*13.38*	*13.32*	*11.26*	*12.80*	*12.49*	*12.53*	*12.60*	*12.59*
3.	Manufacturing	5.80	6.56	6.53	5.21	6.81	6.15	6.02	5.93	5.65
4.	Electricity, Gas, Water Supply & other Utility Services	0.95	1.48	1.66	1.58	1.88	1.98	2.14	2.02	2.17
5.	Construction	5.79	5.34	5.13	4.47	4.11	4.36	4.37	4.65	4.77
	Tertiary	*83.96*	*83.79*	*83.66*	*85.81*	*84.36*	*85.02*	*85.01*	*85.33*	*85.31*
6.	Trade, hotels & restaurants	14.33	14.78	15.25	14.07	14.89	14.76	14.88	14.86	15.24
6.1	Trade & Repair Services	12.97	13.45	13.96	12.84	13.65	13.42	13.57	13.60	13.99
6.2	Hotels & Restaurants	1.36	1.33	1.29	1.23	1.24	1.34	1.31	1.26	1.25
7.	Transport, Storage & Communication	12.45	12.76	12.69	15.78	15.76	14.98	14.85	14.84	14.75
7.1	Railways	0.61	0.60	0.67	0.65	0.61	0.75	0.65	0.64	0.65
7.2	Road transport	2.27	2.23	2.03	1.89	2.08	2.00	1.93	1.92	1.89
7.3	Water transport	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.4	Air transport	0.10	0.33	0.21	0.46	0.97	0.96	0.88	0.81	0.74
7.5	Services incidental to transport	7.66	7.77	7.97	10.76	9.98	9.45	9.98	9.99	9.59
7.6	Storage	0.07	0.07	0.07	0.06	0.06	0.05	0.05	0.05	0.05
7.7	Communication & Services related to broadcasting	1.74	1.76	1.74	1.96	2.06	1.77	1.36	1.43	1.33
8.	Financial Services	19.35	20.14	20.04	19.42	18.06	18.18	17.46	16.93	17.00
9.	Real estate, ownership of dwellings & professional services	24.30	23.70	23.65	24.27	23.37	24.22	24.28	24.68	24.60
10.	Public Administration	5.52	4.43	4.02	3.82	3.88	3.94	3.81	4.24	4.37
11.	Other Services	8.01	7.98	8.01	8.45	8.40	8.94	9.73	9.78	9.85
	TOTAL NET STATE VALUE ADDED At Basic Prices	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*

Note: (3rd RE):- Third Revised Estimates, (2nd RE):- Second Revised Estimates, (1st RE):- First Revised Estimates, (AE):- Advance Estimates

Totals may not tally due to rounding off.

Table: 15

GSDP/GDP of States, Union Territories & All India (At Constant Prices)

As on 15.03.2020

S. No.	STATE/UT	GSDP - CONSTANT PRICES (RS. IN CRORES)								
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
1	Andhra Pradesh	379402	380629	407115	444564	498606	540212	594841	621301	NA
2	Arunachal Pradesh	11063	11299	12338	14383	14240	14746	15944	16676	NA
3	Assam	143175	147342	154525	165212	191109	202081	228714	246938	NA
4	Bihar	247144	256851	269650	279482	296488	323004	356768	394350	NA
5	Chhattisgarh	158074	165977	182579	185813	191020	207326	218539	231820	NA
6	Goa	42367	35850	31568	40116	46091	51482	56742	66611	NA
7	Gujarat	615606	682650	734284	811428	894465	981342	1089811	1190121	NA
8	Haryana	297539	320912	347507	370535	413405	456659	494068	531085	572240
9	Himachal Pradesh	72720	77384	82847	89060	96274	103055	110034	117851	124403
10	Jammu & Kashmir	78256	80767	85115	82372	97001	100730	106506	112885	NA
11	Jharkhand	150918	163250	165816	186534	174881	193174	217618	232821	NA
12	Karnataka	606010	643033	704466	748429	831330	942221	1043533	1124423	1201031
13	Kerala	364048	387693	402781	419956	451210	485302	520579	559412	NA
14	Madhya Pradesh	315562	351683	365134	383944	418736	470669	493516	522009	561801
15	Maharashtra	1280369	1357942	1451615	1543165	1654284	1807102	1923797	2039074	2154446
16	Manipur	12915	12993	14115	15245	16424	17082	17744	18888	NA
17	Meghalaya	19918	20354	20726	20140	20638	21730	23742	25890	28344
18	Mizoram	7259	7778	9038	11261	12324	13595	14248	14433	16113
19	Nagaland	12177	12868	13793	14399	14660	15650	16485	17647	NA
20	Odisha	230987	243363	265892	270665	292229	337696	359050	387403	411265
21	Punjab	266628	280823	299450	312125	330052	352721	375238	397669	NA
22	Rajasthan	434837	454564	486230	521509	563340	597267	633278	677428	711627
23	Sikkim	11165	11421	12114	13071	14370	15397	16467	17629	NA
24	Tamil Nadu	751486	791824	851976	893915	967562	1036762	1116334	1207526	1295292
25	Telangana	359434	370113	389957	416332	464542	507946	559492	612828	663258
26	Tripura	19208	20873	22819	26965	26787	30538	33645	37295	NA
27	Uttar Pradesh	724050	758205	802070	834432	908241	1007010	1079879	1137469	1187277
28	Uttarakhand	115328	123710	134182	141278	152699	167703	180844	193273	NA
29	West Bengal	520485	542191	558497	574364	609545	653416	711408	800913	NA
30	Andaman & Nicobar Islands	3978	4156	4488	4742	5092	5752	6482	NA	NA
31	Chandigarh	18768	20285	22105	22870	24932	27214	30402	32398	NA
32	Delhi	343798	366628	392908	428355	475623	511765	548304	590569	634408
33	Puducherry	16818	17310	19170	18207	19060	20478	22489	24442	26526
All India - GDP		**8736329**	**9213017**	**9801370**	**10527674**	**11369493**	**12308193**	**13175160**	**13981426**	**14565951**

Source: Directorate of Economics & Statistics of respective State Governments and for All-India -- National Statistical Office

NA: Not Available

Table: 17

Per Capita Income of States, Union Territories & All India (At Constant Prices)

As on 15.03.2020

S. No.	STATE/UT	PER CAPITA NSDP AT CONSTANT PRICES (₹)								
		2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
1	Andhra Pradesh	69000	68865	72254	79174	88609	94115	103214	107241	NA
2	Arunachal Pradesh	73068	72820	77044	87973	85020	85644	90727	93191	NA
3	Assam	41142	41609	43002	44809	50642	53575	57042	60479	NA
4	Bihar	21750	22201	22776	23223	24064	25825	28101	30617	NA
5	Chhattisgarh	55177	56777	61409	61122	61504	65948	68543	71429	NA
6	Goa	259444	220019	188358	241081	278601	307412	337606	396943	NA
7	Gujarat	87481	96683	102589	111370	120683	129738	142387	155493	NA
8	Haryana	106085	111780	119791	125032	137818	150241	159892	169409	180026
9	Himachal Pradesh	87721	92672	98816	105241	112723	122208	130644	139469	146268
10	Jammu & Kashmir	53173	52406	54088	50724	59967	60946	63024	66177	NA
11	Jharkhand	41254	44176	43779	48781	44524	48826	54246	57157	NA
12	Karnataka	90263	94375	101858	105697	116813	131254	143827	153276	161431
13	Kerala	97912	103551	107846	112444	120387	129251	138368	148078	NA
14	Madhya Pradesh	38497	41142	42548	44027	47351	52782	54264	56498	59929
15	Maharashtra	99597	104008	109597	115058	122889	133691	140724	147430	NA
16	Manipur	39762	38954	41441	44101	46389	47151	47661	49579	NA
17	Meghalaya	60013	59703	58681	55880	56039	57752	61789	66223	71318
18	Mizoram	57654	60261	67594	85056	91845	99089	101252	100934	110557
19	Nagaland	53010	55482	58619	60372	60663	64939	68456	73276	NA
20	Odisha	48370	50714	54109	54210	57592	66133	69480	74325	78119
21	Punjab	83577	88915	93238	95807	100141	105848	110802	115882	NA
22	Rajasthan	57192	58441	61053	64496	68565	71394	74441	78570	81355
23	Sikkim	158667	160553	168897	180675	195066	207355	219792	232968	NA
24	Tamil Nadu	92984	96890	101559	106189	114581	121378	129328	138805	147696
25	Telangana	91121	92732	96039	101424	112267	121512	132293	143618	153927
26	Tripura	47079	50366	54429	63643	61183	69273	75462	81057	NA
27	Uttar Pradesh	32002	33908	34044	34583	36973	40641	42798	44421	45648
28	Uttarakhand	100305	106318	112803	118788	126952	138286	147204	155151	NA
29	West Bengal	51343	53157	53811	54520	57255	60618	65497	73202	NA
30	Andaman & Nicobar Islands	88177	90064	94570	100754	106237	118112	130670	NA	NA
31	Chandigarh	159116	169493	180780	183031	195551	210291	232947	245769	NA
32	Delhi	185003	192220	200702	213669	233115	244255	255431	269505	283636
33	Puducherry	119649	119196	129127	117102	121000	126556	135763	142583	150744
All India Per Capita NNI		63462	65538	68572	72805	77659	83003	87828	92085	94954

Source: Directorate of Economics & Statistics of respective State Governments and for All-India – National Statistical Office

NA: Not Available

Annexure N

DEPARTMENT OF TOURISM
GOVERNMENT OF NATIONAL CAPITAL TERRITORY OF DELHI
VIKAS BHAWAN-II, 2ND FLOOR, C-WING,
UPPER BELA ROAD, NEAR METCALFE HOUSE, DELHI-110054.
e.mail: tourism.gnctd@gmail.com

No. F2/152/TSM/2019/ 751-753 **Dated:** 03.07.2020

To

1. The Joint Director,
Urban Development Department
8th Level, IP Estate, Delhi Secretariat,
New Delhi-110002

Sub: Comments/Suggestions on the final draft Report of "Sub-Regional Plan-2021.

Sir,

In reference to your letter No.F.18 (567)/A/UD/Plg./2019-20/939-56, dated 07/07/2020, please find enclosed herewith the Comments/Suggestions on the final draft Report of "Sub-Regional Plan-2021" as received from DTTDC and DIHM & CT.

14/07/20
7/08/2020

This is for information and necessary action at your end.

Yours faithfully,

Encl: As above

(Narender Kumar)
Assistant Director (TOURISM)

No. F2/152/TSM/2019/ **Dated:**

Copy for information to:

1. P.S. to Secretary (Tourism).
2. P.A. to Spl. Secretary (Tourism).

(Narender Kumar)
Assistant Director (TOURISM)

Delhi Tourism & Transportation Development Corporation Ltd.
(A Government Undertaking)

18-A, D.D.A. SCO Complex,
Defence Colony, New Delhi-110024
E-mail: tourism@delhitourism.gov.in
Website : www.delhitourism.gov.in
CIN : U74899DL1975PLC008007

Phones :
24698431
24653177
24655596
24622364
24618026
24647005
Fax :
24610500
24697352

PLG/8887/08/2013/DTTDC/718
Date: 27-07-2020
4/8/2020

The Dy. Secretary (Tourism),
Tourism Department,
Government of NCT Delhi,
C-Wing, 2nd Floor, Vikas Bhawan - II,
Upper Bela Road,
Delhi – 110 054

Sub: Regarding implementation of Policies and proposals of Regional Plan 2021 and Functional Plans prepared by NCRPB through various projects of development of the Region.

Sir,

Kindly refer to a letter dated 6-07-2020 received from UD Department GNCTD on the above cited subject. With regard to **Chapter 13 of Heritage and Tourism,** it is informed that -

The preparation of Detailed Project Report for infrastructure development such as drinking water supply, toilet facilities, etc of Heritage sites in Delhi, are not under the jurisdiction of DTTDC. Further, with regard to tourism sites developed by DTTDC, these facilities already exist and are being maintained by DTTDC.

As far as the smaller tourist circuits with one to four days trip within the sub-region to promote tourism by DTTDC is concerned, the details of tours being operated by DTTDC, is enclosed for your ready reference.

Yours truly,

Sundari Sathiyamani

Sundari Sathiyamani
Chief Manager (Planning)

Local Sightseeing Tour of Delhi

Operational Schedule: Every day Except Monday
Time: 9.00AM to 5.45PM

Places to Visit: Morning Part

Delhi, a symbol of the country's rich past and thriving present, Delhi is a city where ancient and modern blend seamlessly together. In morning part of the Local Sight Seeing New Delhi places are covered i.e

Laxmi Narayan Temple also known as **Birla Mandir**, is one of Delhi's major temples and a major tourist attraction. The temple is dedicated to Laxmi (the goddess of prosperity) and Narayana (The preserver). The temple was inaugurated by **Mahatma Gandhi** on the condition that people of all castes will be allowed to enter the temple.

Qutab Minar is a soaring, 73 m-high tower of victory, built in 1193 by Qutab-ud-din Aibak immediately after the defeat of Delhi's last Hindu kingdom. At the foot of the tower is the Quwwat-ul-Islam Mosque, the first mosque to be built in India. An inscription over its eastern gate provocatively informs that it was built with material obtained from demolishing '27 Hindu temples'

Bahai's House of worship, this temple is built in the shape of a lotus flower and is the last of seven Major Bahai's temples built around the world. Completed in1986 it is set among the lush green landscaped gardens.

Gandhi Smriti, housed in the Old Birla House on 5, Tees January Marg, New Delhi, is the sacred place where Mahatma Gandhi's epic Life ended on 30 January 1948. Mahatma Gandhi had lived in this house on September 9, 1947, to January 30, 1948.

1) Laxmi Narayan Temple
2) Qutub Minar
3) Bahai's House of Worship (Lotus Temple)
4) Gandhi Smriti

Halt for lunch at Coffee Home / Janpath Place

Afternoon Part

The Red Fort is a historic fort in the city of Delhi in India that served as the main residence of the Mughal Emperors. Emperor Shah Jahan commissioned reconstruction of the Red Fort on 12 May 1638, after he decided to shift his capital from Agra to Delhi.

Raj Ghat is a memorial dedicated to Mahatma Gandhi in Delhi, India. Originally it was the name of a historic ghat of Old Delhi. Close to it, and east of Daryaganj was Raj Ghat Gate of the walled city, opening at Raj Ghat to the west bank of the Yamuna River. Later the memorial area was also called Raj Ghat.

Humayun's tomb is the tomb of the Mughal Emperor Humayun in Delhi, India. The tomb was commissioned by Humayun's first wife and chief consort, Empress Bega Begum, in 1569-70, and designed by Mirak Mirza Ghiyas and his son, Sayyid Muhammad, Persian architects chosen by her.

1) Red Fort
2) Raj Ghat
3) Humayun's Tomb

Tariff: Rs.276.20 (Half Day)
Rs.452.40 (Full Day)
GST Extra

SAME DAY AGRA TOUR

Operational Schedule: Wednesday, Thursday, Saturday & Sunday
Time: 07.00 AM to 10:00 PM

"Agra is the city of the Taj Mahal and capital of the erstwhile Mughal Empire. Agra is also the gateway to the legendary Braj region, the land of Lord Krishna."
Agra has been immortalized as the City of the Taj. Yet, it doesn't take much for the roving eye to discover that there's more to Agra than just the fabled Taj Mahal. The city is a virtual gateway to a world of discovery a freeze-frame from a resplendent era that's long since gone by. In the great epic 'Mahabharat' the region of Agra is described as 'Agraban' (an integral part of the Braj Bhumi or the land of Lord Krishna). The latter part of Indian history outlines the origin of Agra to 1475 A.D., the reign of Raja Badal Singh.

Taj Mahal, a world-renowned wonder, Taj Mahal sits pretty on the northern side of this green paradise. It looks the same from all the four sides. The Quranic inscriptions on its four entrances are carved in such subtle increase in size that they appear to be of the same size from top to bottom. Shahjahan invited master craftsmen from as far as Italy and Persia to help design his ambitious tribute to love.

Agra Fort "**Built by Akbar in 1565 A.D, this Fort is a masterpiece of design and construction.**" Within the Fort are a number of exquisite buildings, including Moti Masjid, Diwan-i-Aam, Diwan-i-Khas and Musamman Burj, where Emperor Shah Jahan died in imprisonment. Jahangir's Palace, Khaas Mahal and Sheesh Mahal are the other important monuments inside the Fort.

Departure Delhi by 7:00am from Central Reservation Office, Coffee Home, Connaught Place.

Enroute halt for breakfast around 08:30am, arrival Agra by noon and visit Taj Mahal.

Halt for lunch, after lunch visit Agra Fort. Depart from Agra by evening and proceed for Delhi.

Arrival Delhi by 10 pm.

Tariff: Rs.1452.40 (Adult)
Rs.1300.00 (Child) including Guide.
GST Extra.

AGRA – MATHURA–Vrindavan - FATEHPUR SIKRI
(02 DAYS)
Operational Schedule: Tuesday & Saturday

"**Mathura** is the abode of Lord Krishna and it has a great religious sanctity among the Hindus. It also has one of the oldest historical records. Even Mathura is mentioned in the epic Ramayan. It is on record that Mathura was one of the capitals of Kushan King Kanishka(130AD)."

"**Vrindavan,** 15 km from Mathura, is another major place of pilgrimage. It is noted for its numerous temples - both old and modern. The name Vrindavan evokes the playfulness and lovable characteristics of Shri Krishna. This is the wood where he frolicked with the gopis and tenderly wooed Radha."

Fatehpur Sikri "An epic in red sandstone, Fatehpur Sikri was built by the Mughal Emperor Akbar during 1572-1585 A.D. A sonless Akbar had gone to Sikri to seek blessings of Sufi Saint Sheikh Salim Chishti and he was blessed with a son. In gratitude, he constructed his capital city and named it Fatehpur Sikri. Later, due to shortage of water and unrest in north-west, Akbar had to abandon this city."

DAY 01 Departure Delhi at 7:00 am by taking Yamuna Expressway. En-route halt for breakfast. Arrival Vrindavan, Visit Banke Bihari Temple and Iskon Temple. After visiting temple proceed to Mathura. Visit Krishna Janam Bhumi Temple. Departure Mathura and proceed to Fatehpur Sikri. En-route halt for lunch. Arrival Fatehpur Sikri by afternoon, visiting Fatehpur Sikri proceeds to Agra. Arrival Agra and overnight stay in Agra.

DAY 02. Departure Hotel after breakfast. Visit Taj Mahal & Agra Fort. By noon departure from Agra. En-route halt for lunch. Arrival Delhi by 6:00 pm

Taj Mahal, a world-renowned wonder, Taj Mahal sits pretty on the northern side of this great paradise. It looks the same from all the four sides. Shahjahan invited master craftsmen from as far as Italy and Persia to help design his ambitious tribute to love.

Agra Fort "**Built by Akbar in 1565 A.D, this Fort is a masterpiece of design and construction.**" Within the Fort are a number of exquisite buildings, including Moti Masjid, Nagina Mana, Diwan-i-Khas and Musamman Burj, where Emperor Shah Jahan died in imprisonment.

Tariff: Rs.3500.00 (Adult)
Rs.3000.00 (Child) GST Extra.
(For Single person Rs.1000.00 as single supplement for separate room)

HARIDWAR – RISHIKESH TOUR (02 Days)

Operational Schedule: Saturday
Time: 07.00 AM

Uttarakhand, a state in northern India crossed by the Himalayas, is known for its Hindu pilgrimage sites. Rishikesh, a major centre for yoga study, was made famous by the Beatles' 1968 visit. The city hosts the evening Ganga Aarti, a spiritual gathering on the sacred Ganges River.

Haridwar is an ancient city and important Hindu pilgrimage site in North India's Uttarakhand state, where the River Ganges exits the Himalayan foothills. The largest of several sacred ghats (bathing steps), Har Ki Pauri hosts a nightly Ganga Aarti (river-worshipping ceremony) in which tiny flickering lamps are floated off the steps.

Rishikesh is a city in India's northern state of Uttarakhand, in the Himalayan foothills beside the Ganges River. The river is considered holy, and the city is renowned as a center for studying yoga and meditation. Temples and ashrams (centers for spiritual studies) line the eastern bank around Swarg Ashram.

DAY 01: Departure Delhi at 7.00AM. Enroute halt for breakfast. Arrival Haridwar by afternoon, visit Har ki Pauri, Mansa Devi Temple/Chandi Devi Temple (at your own). Attend Evening Aarti. Departure Haridwar, proceed to Rishikesh. Arrival Rishikesh and overnight stay in Rishikesh.

DAY02: Departure Hotel after breakfast. Visit Ram Jhoola, Swarg Ashram, Parmarth Ashram, Geeta Bhawan. At noon depart from Rishikesh and proceed back to Delhi. Enroute halt for lunch.

Arrive Delhi by 8 PM.

Tariff: Rs.3300.00 (Adult)
Rs.2500.00 (Child) GST Extra.
(For Single person Rs. 1000.00 as single supplement for separate room)

AGRA – JAIPUR TOUR

(03 Days)

Operational Schednle: Tuesday & Friday

Time: 07.00 AM

"Agra is the city of the Taj Mahal and capital of the erstwhile Mughal Empire. Agra is also the gateway to the legendary Braj region, the land of Lord Krishna."

Agra has been immortalized as the City of the Taj. Yet, it doesn't take much for the roving eye to discover that there's more to Agra than just the fabled Taj Mahal. The city is a virtual gateway to a world of discovery a freeze-frame from a resplendent era that's long since gone by. In the great epic "Mahabharat" the region of Agra is described as "Agraban" (an integral part of the Braj Bhumi or the land of Lord Krishna).

Fatehpur Sikri "An epic in red sandstone, Fatehpur Sikri was built by the Mughal Emperor Akbar during 1572-1585 A.D. A sonless Akbar had gone to Sikri to seek blessings of Sufi Saint Sheikh Salim Chishti and he was blessed with a son. In gratitude, he constructed his capital city and named it Fatehpur Sikri. Later, due to shortage of water and unrest in north-west, Akbar had to abandon this city."

Jaipur is the capital of India's Rajasthan state and now it's **Heritage City of India**. It evokes the royal haunts that once ruled the region and that, in 1727, founded what is now called the Old City or "Pink City for its trademark building colour. At the center of its stately street grid (notable in India) stands the opulent, colonnaded City Palace complex. The city having an Astronomical Observatory Jantar Mantar and Amer Fort (UNESCO World Heritage site). And beautiful the City Palace, Hawa Mahal, Jal Mahal, Jaigarh Fort and a number of historical and religious places.

DAY 01: Departure Delhi at 7.00am by taking Yamuna Expressway. Enroute halt for breakfast. Arrival Agra. Visit Taj Mahal and Agra Fort. Overnight stay in Agra.

DAY 02: Departure Agra and proceed to Fatehpur Sikri. Enroute halt for breakfast. After breakfast visit Fatehpur Sikri and proceed to Jaipur. Enroute halt for lunch.

After reaching Jaipur visit Jantar Mantar & City Palace in Jaipur. Overnight stay in Jaipur.

DAY 03: Breakfast & A.M. After breakfast visit Amer Fort, Hawa Mahal (Drive Past). Afternoon halt for lunch. Arrival Delhi around 7.00 PM.

Tariff: Rs.5900.00 (Adult)

Rs.5400.00 (Child) GST extra.

(For Single person Rs.2000.00 as single supplement for separate room)

Including Accommodation & Guide.

Annexure O

2016-17 to 2019-20 Annexure-O

Approvals under Forest (Conservation) Act, 1980 (Notified Forest land) (2016-17 to 2019-20)							
Sl. No.	Name of the project under FCA	Forest Division	Area diverted (Ha)	Date of In principle approval		Date of final clearance	
1	Diversion of 9950 sqm of protected forest land at District Park Mayapuri for construction of UGR/SPS by Delhi Jal Board (General approval under FCA)	West	0.99	01.09.2017	F.No.1(44)/PS/APCCF/FCA/2017/Mayapuri/4006-13	28.11.2017	F.No.1(44)/PS/APCCF/FCA/2017/Mayapuri/6215-21
2	Diversion of 380.87 sqm of forest land for construction of Foot Over Bridge across Anuvrat Marg near Qutub Minar metro station by PWD (General approval under FCA)	South	0.038	09.08.2017	F.No.R.1597/TC(S)/TC-felling/14-15/3207-14	19.09.2017	F.No.R.1597/TC(S)/TC-felling/14-15/4442-50
3	Construction of LILO of both circuit Bamnauli Samaypur 400 kV D/C Transmission line at Tughlakabad Substation by Power Grid Corporation of India Limited	South	27.68	16.02.2018	No.8 B/ Delhi /04 /01 /2017/ FC/ 830	27.08.2018	No.8 B/ Delhi/ 04/ 01/ 2017/ FC/ 364
4	Construction of LILO of 220 kV BTPS Mehrauli TL at Tughlakabad	South	6.944	19.02.2018	No. 8 B/ Delhi/ 04/02/ 2017/ FC/ 832	27.08.2018	No. 8B/ Delhi/ 04/ 02/ 2017/ FC/ 365
5	Construction of flyover underpass between northen multipalpur bypass road and airport road near Hanuman Mandir, New Delhi	West	1.81	25.02.2019	No. 8 B/ Delhi/ 06/01/ 2019/ FC/ 655	Stage-II approval yet to be received from MoEF&CC	
6	Diversion of 1.84 ha. Protected Forest Land for construction of Cluster Bus Depot at East Vinod Nagar by Transport Department, Govt. of NCT of Delhi	North	1.84	19.07.2019	No. 8 B/ Delhi/ 09/03/ 2019/ FC/ 181	Stage-II approval yet to be received from MoEF&CC	

DIVERSION OF PROTECTED FOREST/DEEMED FOREST LAND UNDER FOREST (CONSERVATION) ACT, 1980

Sl. No.	Name of the project under FCA	Forest Division	Area diverted (Ha)	Date of in principle approval		Date of final clearance	
3	Diversion of 10 ha. deemed forest land for construction and development of Dwarka Expressway (NH-248 BB) from km 20, NH-8 (near Shiv Murti, Delhi) to km 40, NH-8 (near village Khirki Dola, Gurugram) in the NCT of Delhi-package-1-Shiv Murti to Delhi/ Haryana Border (km 0.000 to km. 5.300) by NHAI	West	10	19.06.2019	No. 8 (1)/ Delhi/ 06/02/ 2019/ FC/ 131	09.09.2019	No. 8B/ Delhi/ 06/ 02/ 2019/ FC/ 301

Annexure P

Annexure – 6

PLANTATION ACHIEVEMENT BY FOREST DEPARTMENT DURING 2011-12 TO 2019-20.

Year	No. of saplings planted	No. of saplings distributed
2011-12	280858	777158
2012-13	462538	801501
2013-14	142500	459278
2014-15	364503	646857
2015-16	353751	677626
2016-17	296310	371419
2017-18	129210	-
2018-19	451437	337696
2019-20	521319	343714
Total	**3002436**	**4415649**

REFERENCES

1. Annual Report 2016-17, Delhi Mumbai Industrial Corridor Development Corporation Limited (DMICDC Ltd.)
2. Annual Report 2018-19, Government of India Ministry of Statistics and Programme Implementation
3. Annual Report of DERC 2014-15
4. Balwant Singh Mehta, Statistical Bulletin on Work and Livelihood: A Glimpse of Delhi, Institute of Human Development
5. CEMDE - Centre for environment and degraded eco system
6. Central Ground Water Board Authority
7. Comprehensive Action Plan for Delhi, http://www.indiaenvironmentportal.org.in/files/file/Comprehensive%20Action%20Plan.pdf.
8. CPCB - Central Population Control Board
9. Delhi – Mumbai Industrial Corridor, A Hype-Busting Analysis, A Study Initiated By National Alliance Of People's Movements
10. Delhi Drainage Master Plan, 2018
11. Delhi Infographic Presentation 2019, India Brand Equity Foundation, Ministry of Commerce & Industry, Government of India
12. Delhi Jal Board
13. Delhi Mumbai Industrial Corridor (DMIC) Project, Presentation at Brainstorming Session on India-Myanmar Strategic Partnership, 4 February 2013
14. Delhi Solar Policy 2016, The Government of NCT of Delhi (GNCTD)\
15. Delhi Transco limited Delhi SLDC Annual Report 2017-18
16. DPCC - Delhi Population control board
17. Drainage Master Plan for NCT of Delhi, July 2018, Department of Civil Engineering, Indian Institute of Technology, Delhi
18. Economic Survey of Delhi 2018-19
19. Employment and Unemployment Situation in Delhi, NSS 66th Round Survey, 2009-10
20. Final Economic Survey 2017-18 report
21. Functional Plan for Economic Development of NCR- June 2016
22. Functional Plan for Ground Water Recharge in NCR- April, 2016
23. Functional Plan for Transportation in NCR - 2032
24. Functional Plan on Drainage for NCR- June 2016
25. Ground Water Scenario in India, January, 2014, CGWB
26. Ground Water Year Book for NCT Delhi, 2015-16, CGWB
27. Handbook on Service Level benchmarking, 2009, Ministry of Urban Development, Government of India
28. Hydrological Framework And Groundwater Management Plan of NCT Delhi, February, 2006
29. IMD - Indian Meteorological Department
30. India Country Report, Research Development Demonstration and Deployment of Smart Grids in India – June 2017
31. India Skill Report 2019, Confederation of Indian Industry
32. Master Plan Delhi 2021
33. Master Plan Organisation, Flood Control Wing, Delhi Administration. 1976. Master Plan For Storm Water Drainage In The Union Territory Of Delhi.

34. Meha Singla, Priyanka Kapoor, Yadunandan Batchu, Impact Cities based on proposed Industrial Corridors in India, Real Estate Research, Commonfloor.com
35. Naturalising Delhi- INTAC (2015)
36. NCR Regional Plan 2021 – Approved and Revised
37. Participation in Economy, Chapter 4, Participation in Labour force, 2014, Ministry of Statistics and Programme Implementation,
38. Pre-Baseline report, Environment -MPD-2041
39. Pre-Baseline report, Physical Infrastructure -MPD-2041
40. Pre-Baseline report, Shelter- MPD-2041
41. Primary Census Handbook 2011
42. Prof. A.K. Gosain, IIT Delhi, 2018, Solution to Save Delhi from Getting Flooded with Even Small Rain
43. Protection & Conserving Water-related Eco-systems 2019, Rejuvenation and Revival of River Yamuna, Delhi Jal Board
44. Rainwater Harvesting in Metropolitan City, 24th Report, Standing Committee on Urban Development, 2018-2019, Ministry of Housing and Urban Affairs
45. Regional Plan 2021 for National Capital region by National Capital region Planning Board
46. Reji Kumer Pillai, Smart Grids in India, India Smart Grid Forum – 24x7 Power for all a joint initiative of Govt of India and Govt of Delhi June 2016
47. Report of the steering group on foreign direct investment, Planning Commission, Govt. of India, August 2002.
48. Reports of the Study Group Constituted for Review of Regional Plan 2021 for NCR – June 2019
49. Sahana Chattaraj, Infrastructure, Institutions and Industrialisation: The Delhi-Mumbai Industrial Corridor and Regional Development in Gujarat and Uttar Pradesh, ORF Issue Brief, Issue no. 272, December 2018
50. Shashank Shekhar et al, 2008, Groundwater Management in NCT Delhi
51. Soil Survey and Landuse Plan
52. State Forest Report
53. Statistical Handbook NCT Delhi 2017
54. Study of Economic Profile of NCR -2015
55. Study on Health Infrastructure in NCR, December 2015 -National Capital Region Planning Board
56. Sub-Regional Plan Rajasthan -2021
57. Syed Khaja Mohiddin, Shashank Shekhar et al, 2006, Hydrogeological frame work and groundwater management plan of NCT Delhi
58. Through the Magnifying Glass: Women's work and Labour force participation in urban Delhi, ILO Asia-Pacific Working Paper Series, International Labour Organisation, Ratna M. Sudarshan & Shrayana Bhattacharya, May 2008
59. Transport Demand Forecast Study and Development of an Integrated Road cum Multi-modal Public Transport Network for NCT of Delhi, 2010.
60. Water Policy for Delhi, 2015