PLANNING STRATEGIES FOR A LIVEABLE CITY – A CASE OF AGRA

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by

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CERTIFICATE

It is certified that the work contained in this thesis entitled **"PLANNING STRATEGIES For A LIVEABLE CITY – A CASE OF AGRA** by **VIKAS** (Roll No. 1200106021), for the award of **Master of Urban and Regional Planning** from Babu Banarasi Das University has been carried out under my/our supervision and that this work has not been submitted elsewhere for a degree.

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<div align="right">VIKAS</div>

ABSTRACT

Urbanization is a companion and stimulus of development. Currently 50% of world population is living in urban area and this share is going to be increased to 70% by 2030. However, the speed and scale of urbanization brings challenges. These challenges are threatening their basic needs of survival. The influx of the population in urban areas are resulting into urban poverty, environmental degradation, traffic congestion, increase in shanty town houses, and other factors related socio-economic concerns. This leads to deterioration of the living conditions of a region. Cities around the world are re-examining their urban assets and remaking themselves to enhance competitiveness.

Liveability is currently a key urban issue across the world. The concept of it is very vast and varied. No single definition can define liveability properly as the mean of liveability changes from time, place and context. Among the various components of liveability, this thesis study aims to improve the physical nature of built environment to enhance the liveability of the place. City of Agra, Uttar Pradesh has been selected as my study area in which area is analysed in terms of its connectivity, convenience, comfort and conviviality. Further in studies, issues and development opportunities will be identified from the analysis and various strategies and proposal will be formed to enhance the built environment which in result will improve the liveability of the place.

The Liveability Index by Indian institute of competitiveness has been published since 2010 for the search for the most liveable Indian city the index is an annual study that maps key factors of living, including quality of life and determine the degree of liveability of 110 cities in India. The index is a composite measure of the social, environmental, economic and civic factors that directly provides insight into the quality of life available. Agra is placed on 55th position in the list of 110 Indian city. Mumbai, Chennai, Hyderabad, Bengaluru and Delhi are the top 5 cities in the liveable index respectively.

Liveability can be defined as, "the potential of a city to offer favourable conditions to its residents and others on the parameters of social, natural, economic and

physical environment". The liveability index draws its outline on a similar note. It determines the degree of liveability of cities in India. In other words, it is an array of distinct functions that are directly or indirectly related to livelihood of a resident. It is supported by an integrated theme containing equity, dignity, accessibility, conviviality, participation and empowerment.

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1. Introduction

1.1 Background

Liveability or liveable city is not a new phenomenon; it's been practiced from many years in the form of efforts by urban planners in making ideal cities for living. The term "Liveability" is an umbrella to a variety of meanings, which depend both on the objects of measurement and on the perspective of those making those measurements. Among the various components of liveability, this study focused on effect of built environment on liveability and how liveability can be improved by built environment is studied.

1.2 Need of the Study

Cities everywhere are the centre of wealth and act as a magnet for commercial and industrial activities. In developing countries more than 80% of the global GDP originates in cities. Urbanization is a companion and stimulus of development. As per UN Report, currently 50% of world population is living in urban area and this share is going to be increased to 70% by 2030. However, the speed and scale of urbanization brings challenges; including meeting accelerated demand for affordable housing, well-connected transport systems, and other infrastructure, basic services, as well as jobs, particularly for the nearly 1 billion urban poor who live in informal settlements to be near opportunities. These challenges threatening their basic needs of survival.

**Figure 1.1 Urban and rural population of the world**
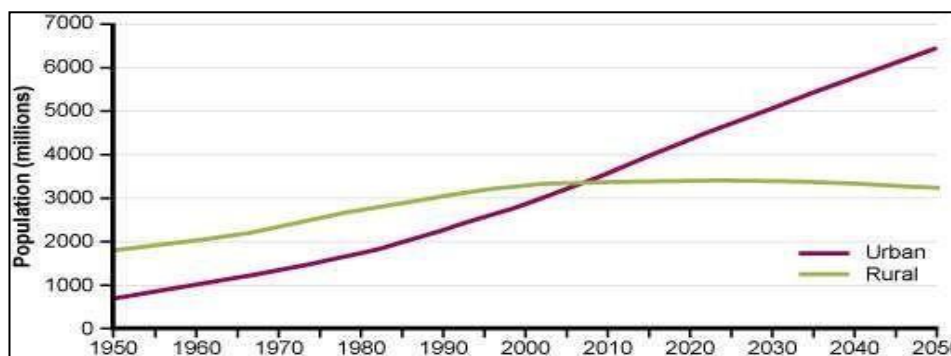
Source: UNDESA, 2014

The influx of the population in urban areas are resulting into urban poverty, environmental degradation, traffic congestion, increase in shantytown houses, and

other factors related socio- economic concerns. This leads to deterioration of the living conditions of a region.

Robert Solow once said: "Liveability is not a middle-class luxury; it is an economic imperative." Under globalisation, cities have become more, not less, important. Cities around the world are re-examining their urban assets and remaking themselves to enhance competitiveness.

Liveability and vibrancy of the built environment are discussed increasingly on a global scale. Greater attention is given to quality of life. McNulty et al. (1985) in assessing the links between quality of life and the economic success of cities concluded that cities that are not liveable places are not likely to perform important economic functions in the future. If we agree with McNulty et al. (1985), enhancing liveability would then be a central objective in every city's economic transition strategy. [1]

Figure 1.2 Liveability of different cities around the world; Source: McNulty
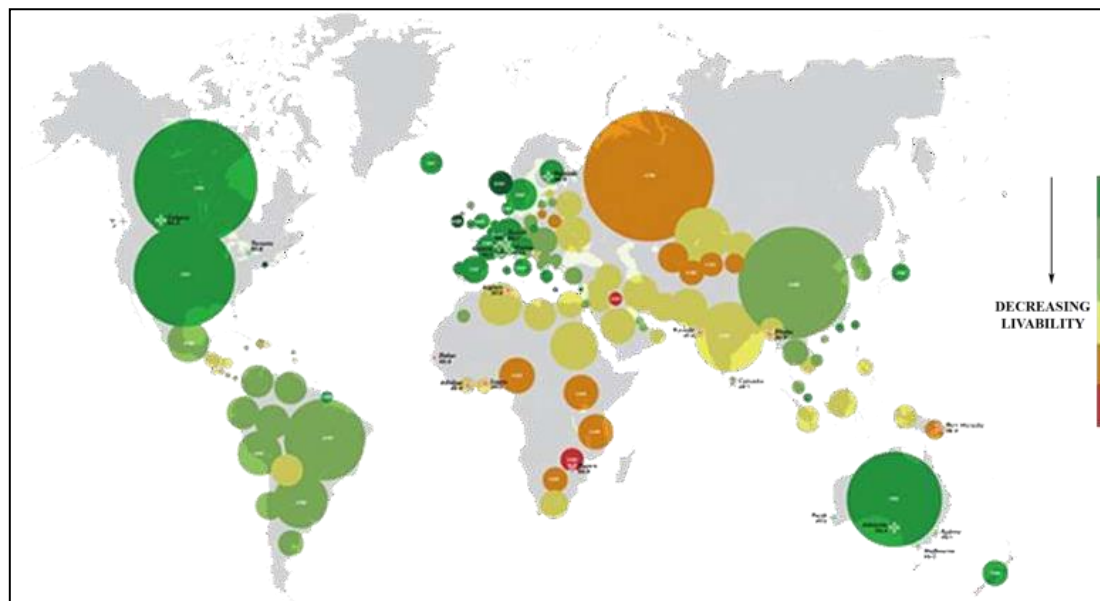

Source: McNulty

1.3   Liveability and Indian Cities

India's urbanisation is a paradox of sorts. The country's urban population is undoubtedly vast at 377 million (2011 Census). In international terms, however, India's urban growth can hardly be described as rapid. Despite the fact that the fastest urbanization rates are being witnessed in the developing world, India's

urban population increased from 17.3 per cent in 1971 to just 23.3 per cent in 1981, and 27.78 per cent in 2001. The 2011 Census figures reveal that just over 31 per cent of the country's population is presently living in urban areas, lower than, for example, China, Indonesia, Mexico or Brazil. But there are over 80 million people living below the poverty line in India's urban centres; a quarter of the total urban population lives in slums. Informal settlements, informal livelihoods, homelessness, insecurity, various types of pollution and declining green areas are the bane of most Indian cities.

Figure 1.3 Number of metropolitan 53 cities and share of urban population
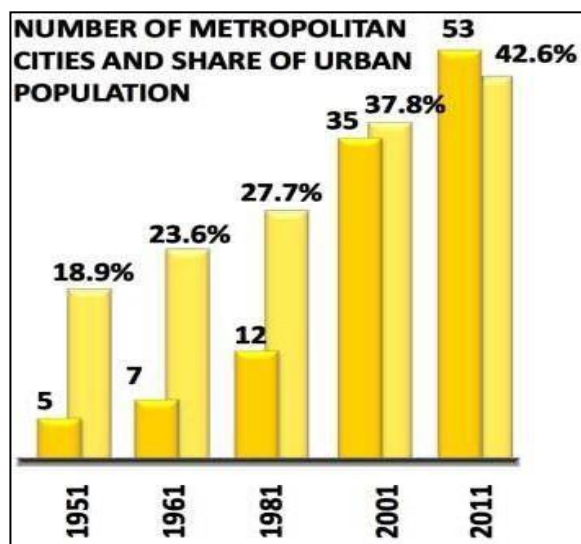
Source: TCPO

The other characteristic of India's urbanisation is that it is 'top-heavy', which means that the larger cities have witnessed much more rapid growth than smaller towns. Till 2011, 42.6% of urban population was living in 53 metro cities (fig. 3). Such Cities, generate new kinds of problems, difficulty in waste management, scarcity of resources, air pollution, human health concerns, traffic congestions, and inadequate, deteriorating and aging infrastructures are among the more basic technical, physical, and material problems.

Hyderabad (Rank 139), Pune (Rank 145), Bengaluru (Rank 146), Mumbai (Rank 154) and New Delhi (Rank 161) are the 5 most liveable cities in India according to Mercer's Quality of Life survey, but these cities are far behind to the world most liveable cities and their ranking haven't improved from last survey report.

McKinsey Global Institute (MGI) report published in April 2010 mentions that "across all major quality of life indicators, India's cities fall well short of delivering even a basic standard of living for their residents". Although, norms were already laid down by the government and local bodies for development regarding provision of open space, internal roads, building byelaws and social infrastructure

but at times they fall well short on measures that are critical in determining the desired liveability. Thus, pointing the gravity of the problem in Indian context.

1.4 Aim and Objectives of the Study

A. Aim:

To improve physical and social nature of built environment in the form of physical and policy initiatives for better liveable scenarios in Agra, Uttar Pradesh.

B. Objectives:

Following are the Objectives of Study that to be achieved during the study:

- To explore the relationship between built environment and liveability of a place.
- To study the current practices, methods to plan for liveable built environment.
- To analyse the existing scenario of built environment of selected area with respect to liveability and identify issues and areas of improvements
- To propose/recommend possible interventions for improving liveability and built environment.

## 1.5 Scope of Work and Limitation

- The study is focused only on physical nature of built environment that can influence or increase the liveability of a place.
- As per the time and study limitation, a particular area in the city is selected for the study based on need and importance of development of that area.
- Study incorporates various aspect of built environment like road connectivity, walkability, open and green space etc. but other associated aspects and concern like impact on micro climate, pollution is beyond the purview of the study.

1.6 Methodology

Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. Typically, it encompasses

concepts such as paradigm, theoretical model, phases, and quantitative or qualitative techniques. A methodology does not set out to provide solutions - it is, therefore, not the same as a method. Instead, a methodology offers the theoretical underpinning for understanding which method, set of methods, or best practices can be applied to specific case, for example, to calculate a specific result.

Figure 1.4 Methodology
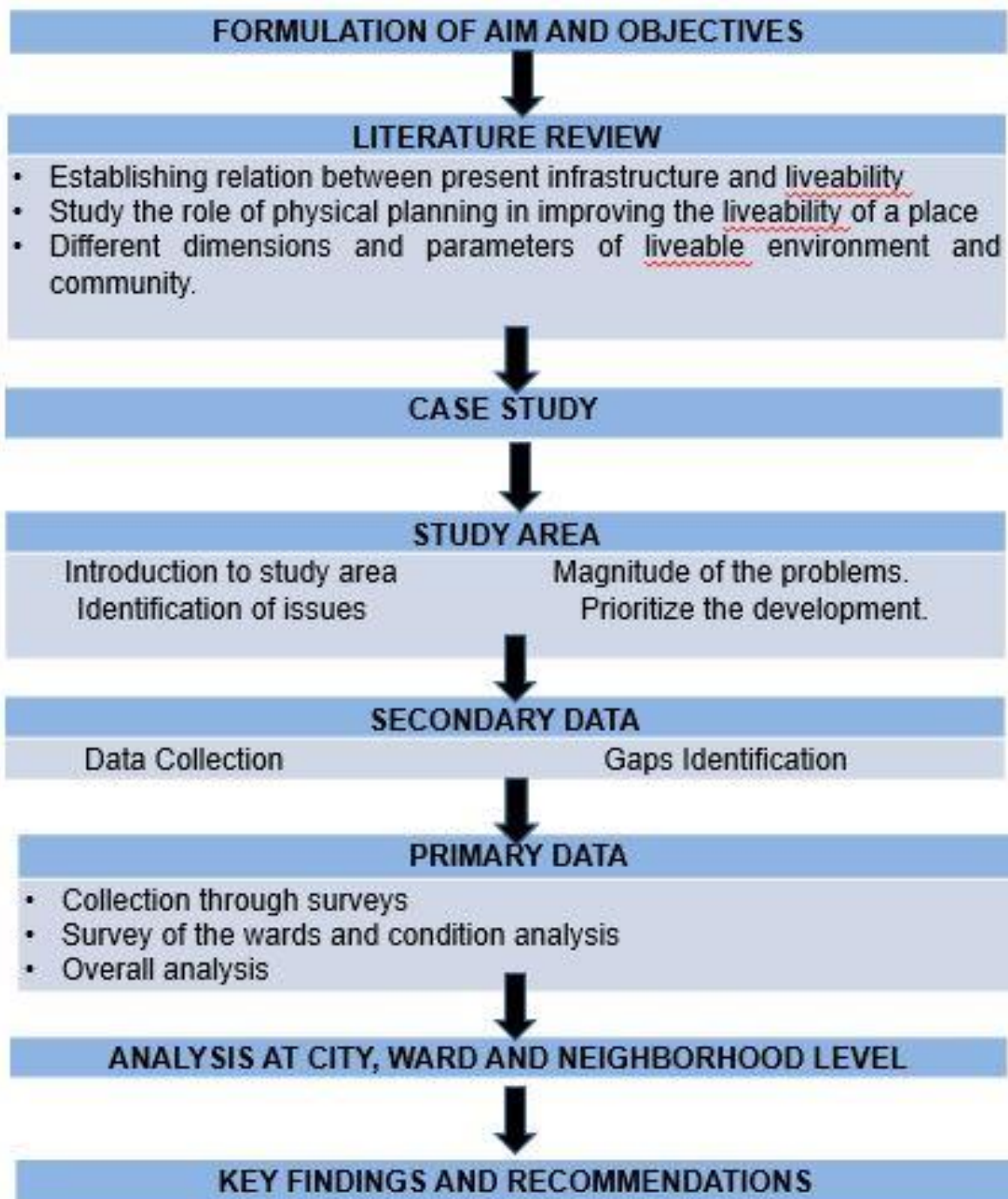
2. Literature Review

2.1 Concepts of Liveability

Liveability is currently a key urban issue across the world. The concept of it is very vast and varied. No single definition can define Liveability properly as the mean of Liveability changes from time, place and context. For some, 'Liveability' is intrinsically tied to the physical environment such as parks and green spaces; for others to cultural, career opportunities, economic dynamic, or some degree of reasonable safety within which to raise a family. Young people may prefer great nightlife or active spots in the city while the older users favour a city with more green spaces. Apart from various meanings and definitions general understanding of Liveability is always relates to "Well-being", "Quality of life" and "Life satisfaction".

According to Australian cities 2013 report, the liveability of a city is judged by the health, wellbeing and the quality of life of people living within it. Although difficult to define precisely, urban liveability can be measured both subjectively for example, by asking people how they feel about their quality of life in their cities and objectively for example, by examining social and economic measures for urban populations such as income, wealth, education, health, economic and community infrastructure assets, opportunities and services.[1]

2.2 What is Liveability?

Perspectives on liveability vary by geography, such as from resident to resident, community to community, and region to region. In addition, what is considered liveable varies based on industry and responsibility, such as from agency to agency or industry to industry. Having many definitions for liveability is not necessarily a problem. The challenge is to find a definition of liveability suited to the context. For example, a community discussing local transportation issues will use a different, more specific definition of liveability than a federal agency looking at transportation issues and needs for the future. The following are descriptions of liveability from several national agencies or organizations:
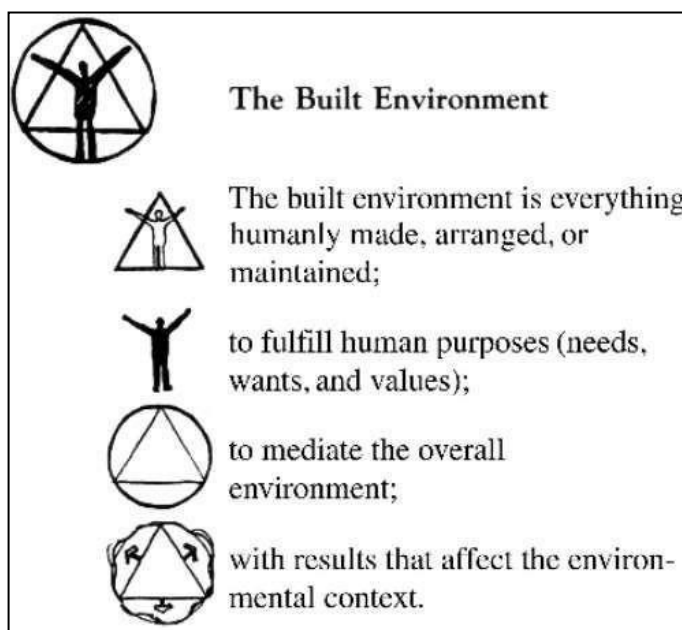
2.3 Liveability and Built Environment

Built environment is the outcome of human needs and actions. All human beings are surrounded by abundance of physical and manmade elements which constitute the built environment and provide setting for human actions. The built environment has a role to play in creating capabilities for individuals and communities to attain a high quality of life, fulfil their potential for personal growth and well- being.

The built environment encourages the creation or support of existing neighbourhood and support networks, help develop a sense of identity, and provide opportunities for education and employment and studies shows that these are the characteristics which are positively connected to quality of life and liveability of an area.

The built environment provides the setting and backdrop by which we live our lives, and impacts on our senses, our emotions, participation in physical activity and community life, our sense of community, and general wellbeing. Meanings are generated by buildings and spaces, which we 'read' as we pass through them. Places are created and shaped by those in control of resources and with certain interests, which affects our degree of access to, and the way we use, those spaces.[2]

Figure 2.1 Built environment and its related characteristics

Source: UNDESA, 2014

According to Peter Naess (2016), dissimilar to the natural environment, the human-made urban fabric is unquestionably socially constructed. It might be sensible to consider the urban built environment as a specific sub-set of social structures, with its own particular emergent powers and liabilities.

built infrastructure, aesthesis of the place, comfortable built environment etc. In

conclusion, Liveable Built Environment Ensure that all elements of the built environment, including land use, transportation, housing, energy, and infrastructure, work together to provide sustainable, green places for living, working, and recreation, with a high quality of life. [2]

2.4 Common Themes Related to Liveability

NARC researched and reduced reoccurring Liveability themes contained in the literature and requested information from metropolitan planning organizations (MPOs), regional councils of government (COGs), the American Public Works Association (APWA), the International City/County Management Association (ICMA), the National Association of Counties (NACo), the National League of Cities (NLC), the American Public Transportation Association (APTA), and other federal, state, and local organizations about their familiarity with, and implementation of, Liveability mechanisms. [3]

After identification and reduction, the following Liveability themes emerged as the most commonly occurring themes and represent ways in which practitioners achieve their Liveability goals. These themes include:

- Smart Growth
- New Urbanism
- Complete Streets
- Transit-Oriented Development
- Lifelong Communities
- Placemaking
- Safe Routes to school
- Context Sensitive Solutions/Design

3. Case Studies

3.1 Case Study 1: Planning for Liveable Communities and Neighbor, Study of Melbourne, Australia

Table 3.1 Melbourne demography and Liveability Ranking

Location	
Population	4,641,636
Area	9990.5 km^2
Density	453 Person/km^2
Liveability Ranking	EIU RANKING – 1ST MERCER'S RANKING – 16TH MONOCLES RANKING – 6TH

Source: Melbourne Development Board

Melbourne is recognised as one of the world's most liveable cities. The city didn't achieve its status as the world's most liveable city by chance. The city and suburbs known today reflect the vision and effort of many preceding generations. Over the past 150 years, governments and the private sector, planners and developers have worked in partnership to make the most of Melbourne's location and physical assets. Melbourne's international reputation for Liveability and its demonstrated ability to attract investment and tourists are based to a considerable extent on the quality of that environment. Key features of the city's liveability include our distinctive suburbs, green and leafy character, and the legacy of high-quality design of buildings, streets and places. The Victorian Government is committed to maintaining and extending physical and human services throughout metropolitan Melbourne.

3.1.4 Current and Future Scenarios

Melbourne Today: Melbourne is an internationally recognised city with strong global business, educational, cultural and sporting connections. The City of Melbourne (from 1993 to 2013) has the fifth-fastest population growth of all

Australian local governments and has seen the creation of over 120,000 new jobs in the last decade.

In a globalised economy, there can be no greater asset for a city than the diversity and skills of its population. Melbourne has a highly educated and well-trained workforce4 and is one of the world's most harmonious and culturally diverse cities. With its people coming from more than 200 countries, speaking more than 230 languages and following more than 130 religious' faiths, Melbourne is well-equipped to engage in global markets.

Melbourne provides a very high quality of life for its residents, with good-quality housing, education, transport, community, public safety, health and environmental services provided in most parts of the city. Melbourne is a city of suburbs, each with its own distinctive character.

Melbourne's transport system includes modern port, airport, road, rail, tram, bus and cycling infrastructure. It has an extensive freeway and arterial road network. Its rail network provides good radial access to the central city and major centres in the suburbs, and the tram system is the largest in the world.

3.1.5 Melbourne's Growing Pressures

Melbourne's recent population growth has been profound. Over the past decade, the city has added over 600,000 new residents, with almost 60 per cent making their home in the outer suburbs. This rate and pattern of growth has placed strains on the city's infrastructure and service systems. The city's liveability and competitiveness over the coming decades could be undermined if the issues like affordability, congestion, changing climate, sprawl etc. are not addressed.

3.1.6 Strategies Adopted for Liveable Communities and Neighbourhoods

- **Strategy 1: Create a city of 20-minute neighbourhoods**

Plan Melbourne aims to create a city of 20-minute neighbourhoods where people have safe and convenient access to the goods and services, they need for daily life within 20 minutes of where they live, travelling by foot, bicycle or public transport. This includes a variety of housing choices, shops and commercial services,

schools, parks and recreation opportunities and good walking and bicycle infrastructure.

Following are the initiatives proposed to achieve 20-minute neighbourhood:

- ❖ Support a network of vibrant neighbourhood centres
- ❖ Prepare a practice note giving guidance for deciding permit applications for shops and supermarkets in the reformed commercial zones.
- ❖ Develop policy and guidelines on establishing new village cafe and shopping strips in inner and middle suburbs, including for the expansion of existing village precincts.
- ❖ Prepare a practice note giving guidance for deciding permit applications for shops and supermarkets in the reformed commercial zones.
- ❖ Support Local Governments to Plan and Manage Their Neighbourhoods

Achievement of the 20-minute neighbourhood can be assisted by local governments planning and managing their neighbourhoods using the principles of:

- ❖ Improving walkability, cycling and safety to provide healthier communities
- ❖ Improving housing choice and diversity
- ❖ Increasing the usability of, and access to, safe open space
- ❖ Improving local economic opportunities
- ❖ Encouraging adequate local services and infrastructure
- ❖ Ensuring access to public transport.
- • **Strategy 2: Create neighbourhoods that support safe communities and healthy lifestyles**

As Melbourne grows, local governments and other stakeholders works to create healthier communities, where people of all ages have the opportunity to lead active and healthy lifestyles and have access to high-quality health and community facilities.

Following are the initiatives proposed to achieve safe and healthy neighbourhood:

- ❖ Implement design guidelines to promote walking and cycling neighbourhoods for healthy living

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❖ Update the State Planning Policy Framework to support design guidelines that promote walking and cycling in new and existing neighbourhoods. This should be done in consultation with groups that promote walking and healthy living.

❖ Review policies for the application of the Residential Growth Zone to ensure that well- located neighbourhoods that are walking and cycling-friendly can accommodate an appropriate level of new housing, so that more Melburnians can benefit from the healthy lifestyle available.

❖ Ensure that urban renewal structure plans address walking, cycling and healthy living.

- **Strategy 3: Make our City Greener**

Melbourne is not just bricking and mortar – it contains an urban forest of trees and vegetation on our properties, lining our streets and on public lands. Increasing tree and vegetation cover across an urban area results in many environmental, social and economic benefits.

❖ Develop A New Metropolitan Open Space Strategy

❖ Prepare a metropolitan open space strategy. The strategy will include measures to improve the provision and protection of open space, and determine the need for new open space in areas that are expected to grow substantially; and will update regulations outlining the role of all levels of government.

❖ Extend the Landscape and Vegetation Cover Of Metropolitan Melbourne

❖ Address impediments to planting canopy trees along roads, including identifying priority roads (such as boulevards) where removing overhead power lines can be considered.

❖ Encourage local governments to undertake community tree-planting programs by building on the success of the 2 Million Trees Project beyond 2014.

- Other Strategies in Plan Melbourne 2050 For Liveable Neighbourhood:
❖ Plan for future social infrastructure
❖ Create greater public places throughout Melbourne

❖ Respect our heritage as we build for the future

❖ Achieve and promote design excellence

❖ Protect Melbourne and its suburbs from inappropriate development.

4.Introduction to the Study area: Agra

4.1 Location

Agra is a city on the banks of the river Yamuna in the northern state of Uttar Pradesh, India. It is a major tourist destination because of its many Mughal-era buildings, most notably the Taj Mahal, Agra Fort and Fatehpur Sikri, all of which are UNESCO World Heritage Sites. Agra is included on the Golden Triangle tourist circuit, along with Delhi and Jaipur; and the Uttar Pradesh Heritage Arc, tourist circuit of UP state, along Lucknow and Varanasi. It falls within the Braj cultural region. Agra city is spread over an area of 141 sq. km. along the banks of the river Yamuna, is one of the major cities of Uttar Pradesh. The city of is situated on the Western Bank of river Yamuna on National Highway 2 at about 200 Kms from Delhi in the state of Uttar Pradesh.

Figure 4.1 Location of Agra
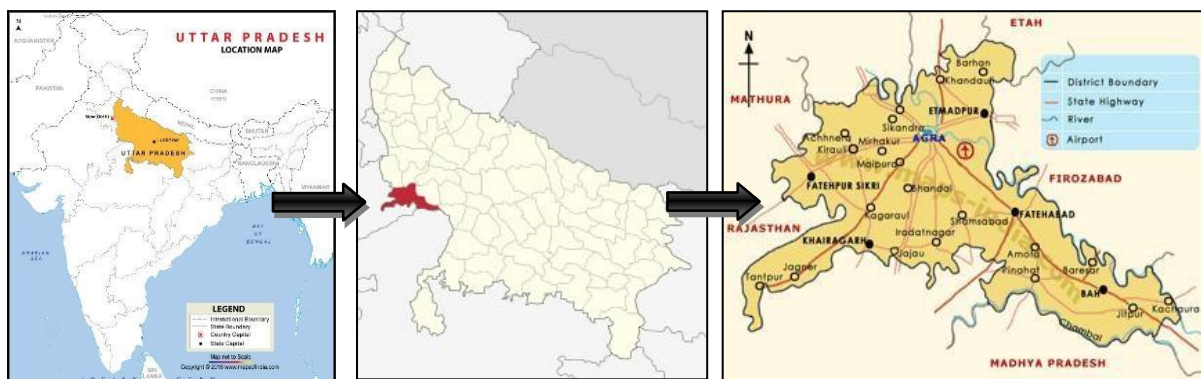
Source: Maps of India

Agra is geographically located at 27˚12' North latitudes and 78˚12' East longitudes. The city stretches for about 9.0 kms along the Yamuna river. The major part of the city is on the Western side of Yamuna and has grown beyond the river on the eastern side and is called the Trans Yamuna area while the original part is called as CIS Yamuna. Agra is a main center of political, economic, commercial and cultural activities. Being centrally located on the national map, Agra forms an important regional urban center. All traffic weather by rail or road going south invariably passes through Agra thus making it a major transport node at the regional level as well as at the national level.[5]

It has an extremely strategic location on the confluence of three distinct geo-physical regions namely the plain of Uttar Pradesh, the plateau of Madhya Pradesh and the desert of Rajasthan. The city also falls in the center of the four-culture areas-Braj, Bundelkhand, Rajputana and western U.P. All these factors have played significant roles in shaping the life and history of the city. This resulted in attraction of more population and pressure on existing infrastructure services and facilities and also deteriorating the existing water bodies and natural habitat. This has also led to an extremely rapid and haphazard growth pattern. [5]

4.2 Connectivity

Agra is well connected by air, rail and road network. The city is on daily route of Indian Airlines and is only 30 minutes flight from Delhi. It is also on the main Delhi-Mumbai broad gauge (BG) railway line and well connected by BG to major cities like: Bharatpur, Gwalior and Kanpur. Agra is served by seven railway stations: Raja-Ki-Mandi, Agra Cantonment, Agra City, Agra Fort, Idgah, Yamuna Kinara and Bilochpura and 2 bus stations (Agra Fort and Idgah).

The city is falling on the corridor of Golden Quadrilateral under the ever since major scheme of NHDP. Moreover, it is located on the junction of four National Highways namely Delhi - Kolkata (NH-2), Agra - Mumbai (NH-3), Agra - Jaipur (NH-11) and Agra - Aligarh (NH-93) and two State Highways namely Agra - Fatehabad (SH-62) and Agra – Jagnair (SH-39). The city is also a part of the 'golden triangle' consisting of Delhi – Agra – Jaipur.

In addition to this, it is not only creating pressure on existing sewerage and solid waste management systems but also due to lack of operation and maintenance of existing infrastructure facilities in the city, these are creating having adverse impacts on population. [5]

4.3 History and Evolution

Agra is a city of historic importance which is evident from the numerous amounts of monuments present in the city. The city is referred to as 'Agraban', part of Brij Bhoomi, the homeland of Lord Krishna in the Hindu epic Mahabharata. The origin

and growth of Agra can be traced to several hundred years, which witnessed a series of historical events leading to its present form, structure, character, culture and economy. The growth of Agra started with the imperial flavor, as a seat of emperor of India. In the process of development, the city started influencing over the vast region and became the regional capital, which initiated its growth during the British and post-independence period.

Legend has it that Agra was founded during the reign of Ugrasen, grandfather of Lord Krishna. The existence of Agra city was accounted for in 1080 A.D., by Khawaja M.S. Salman, a poet, as a flourishing city with a string fortress built amidst river and lake hills. This was ruined by the invader Muhammad Gazni in 1080 A.D., which reduced Agra to a small town. Agra continued as a village until the core of the present city, was laid by Raja Badal Singh around 1475 A.D. The city was the capital seat of Mughals in ancient times. The heritage of the city is linked with the Mughal dynasty but numerous other rulers also contributed to the rich past of this city. [5]

Figure 4.2 Evolution of the city
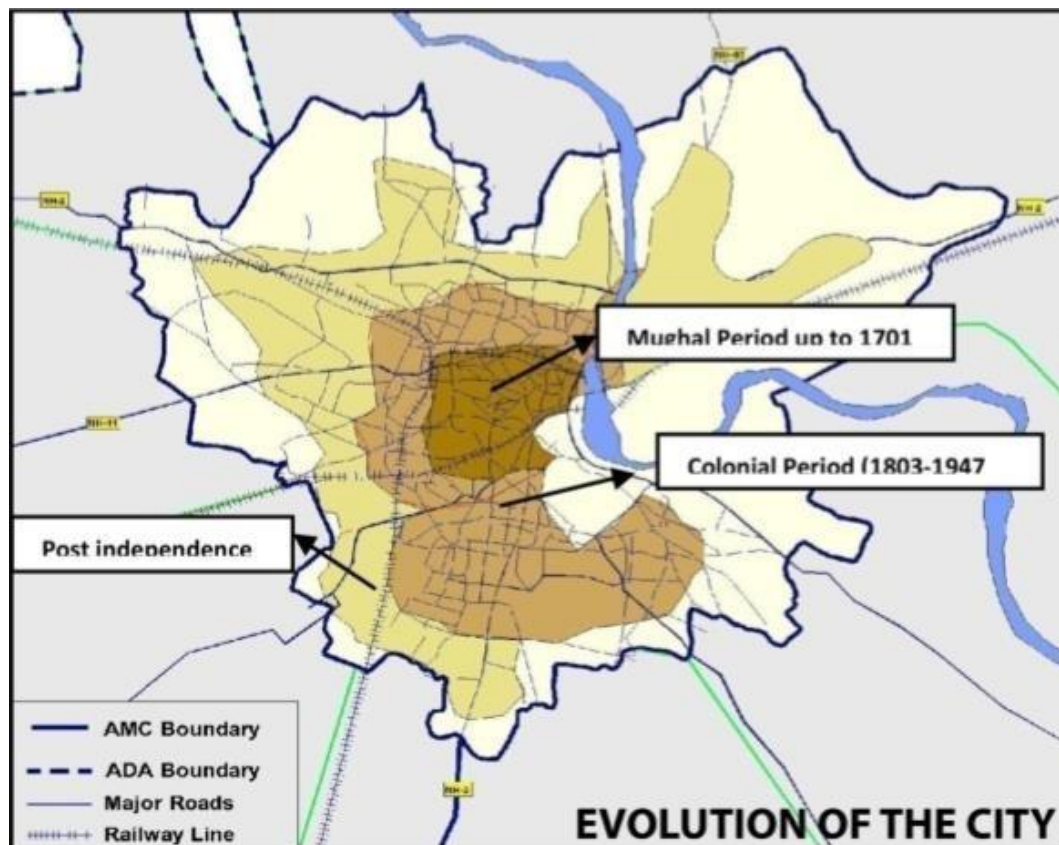
Source: CDP, Agra

Babar also stayed in Agra for some time and introduced the concept of square Persian-styled gardens. Emperor Akbar built Agra fort and Jehangir did the beautification with gardens and palaces. The city has a proud possession of "Taj Mahal" as one of the seven wonders of the world, now declared as World Heritage Site. The city has two other world heritage sites namely Fatehpur Sikri and Agra Fort. The post- Mughal era of Agra saw the rule of Jats, Marathas and finally the British taking over the city. The post-independence growth of the city was linked to the large-scale influx of refugees as well as migration from rural areas. [5]

4.4 Demographic Profile

Agra is experiencing a steady growth in the population. The population of the city as per Census 2011 is 15.75 lakhs inhabiting in an area of 141.0 sq. km with a population density of about 120 persons per hectare. The master plan for the city has projected a population of 22.50 lakhs for the year 2021.

A decrease in the growth rate was observed during 1961-71 due to the demarcation of the Taj Trapezium Zone many industries in the area were affected. The growth rate was 25.22 % during the year 1981-91 due to the extension of the municipal limits.

Table 4.1 Demographic Profile of Agra

Demographic characteristics	Census 2011	Remarks
Population	15,74,542	Male population: 849771, Female Population: 724771 Sex Ratio: 853 per 1000 males % of population in slum areas: 41.2%
Households	221423	No. of households in slum areas: 131797
Average family size	7.5	6 (2017)
Area	141 sq.km.	
Density	11167 persons/sq.km.	Density above average in slums
Average Literacy rate	73%	Less than the country average of 74%

Source: Census, 2011

Figure 4.4 Age wise population

Age wise population in Agra in %

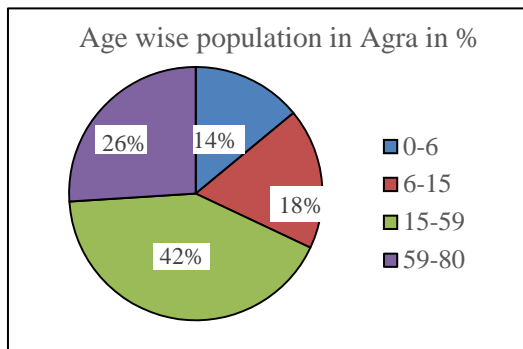- 0-6
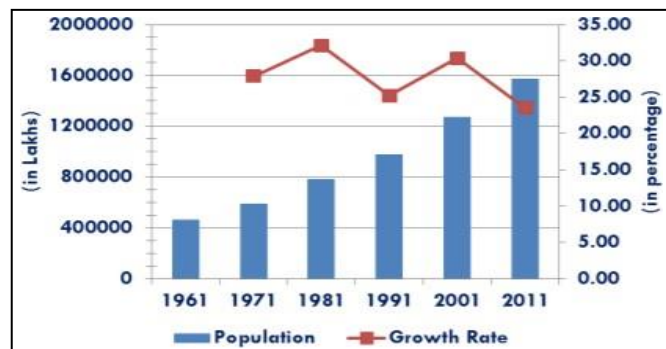- 6-15
- 15-59
- 59-80

14% 18% 42% 26%

Figure 4.3 Graph showing population growth rate

Source: Census, 2011

As evident from the graph, the decadal growth rate of Agra is constantly decreasing. This implies that outmigration from the city is becoming a prevalent phenomenon.

4.5 Economic Profile

Due to the presence of the Taj Mahal and other historic monuments, Agra has a booming tourism industry as well as royal crafts like Pietra Dura, marble inlay and carpets. Today 40% of the population depends largely on agriculture, and others on the leather and footwear business and iron foundries. Agra is the second most self-employed in India in 2007, behind Varanasi, followed by Bhopal, Indore and Patna. According to the National Sample Survey Organization, in 1999–2000, 431 of every 1,000 employed males were self-employed in the city, which grew to 603 per 1,000 in 2004–05. Tourism contributes to the economy of Agra. Agra is home to Asia's largest spa called Kaya Kalp – The Royal Spa, at the Hotel Mughal in Agra.

Figure 4.6 Marble inlay work
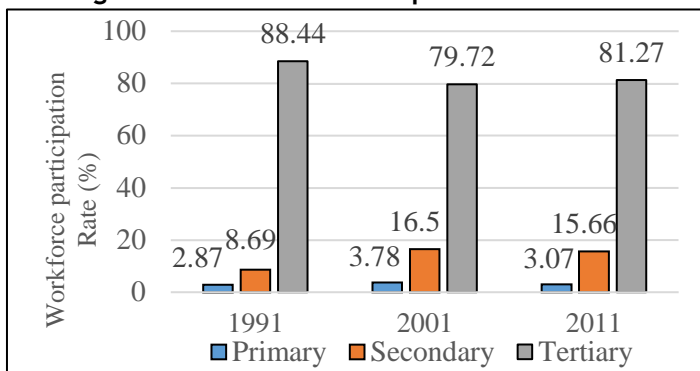
Figure 4.5 Sadar Bazaar, Agra

Source: Primary Survey

Agra has many industries. Uttar Pradesh's first plant biotech company Harihar Biotech is located near the Taj. There are about 7,000 small scale industrial units. Agra city is also known for its leather goods, the oldest and famous leather firm Taj Leather World is in Sadar bazar. The carpets, handicrafts, *zari and zardozi* (embroidery work), marble and stone carving and inlay work. Agra is known for its sweets (Petha and Gajak) and snacks (Dalmoth), garment manufacturers and exporters and automobile industry. Carpet making was introduced to the city by Moghul Emperor Babur and since then this art has flourished. The city centre place at Agra has jewellery and garments shops. The silver and gold jewellery hub are at Choube Ji Ka Fatak. The Shah Market area is an electronics market while Sanjay Place is the trade centre of Agra.
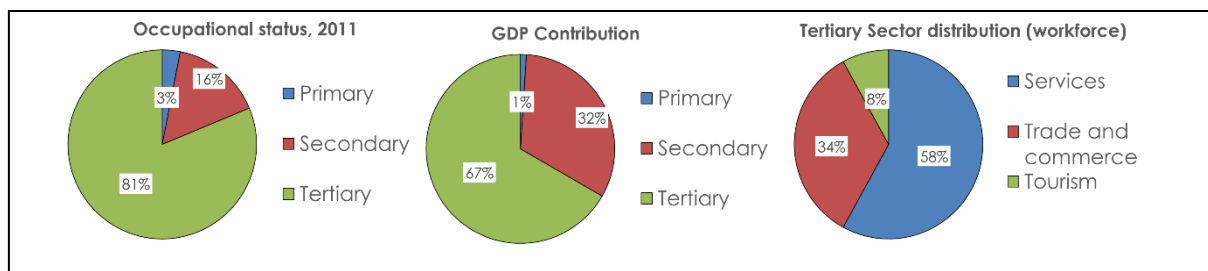
Agra is basically a commercial city the major part of its industrial activity is in the form of small-scale and house- hold industries and its booming tourism. The work force participation rate (WFPR) of the city is 25.5 per cent with 74 % non-workers. As evident from the graph, where there has been an increase in the secondary sector workforce from 1991 – 2001 and a consequent drop in the tertiary sector workforce. The situation is reversed in the subsequent decade. This is due to the fact that many industries were closed in effect to the Taj Trapezium Zone project and continue to do so. [5]

Figure 4.7 Growth of occupational structure

Source: Census, 2011

Figure 4.8 Economic profile of the city

Source: Census, 2011

The decadal growth rate of Agra is constantly decreasing. Along with this, the workforce participation in the tertiary and secondary sector is constantly decreasing. This is a very alarming situation, as a huge share of the GDP is contributed by the primary as well as the secondary sector only.

4.6 Land Use

• Agra is an Urban Agglomeration coming under category of Million Plus UA/City.

• Agra Metropolitan Areas Agra comprises of Agra, Azizpur, Dayalbagh, Dehtora, Deoretha, Dhanauli, Kalwari, Kaulakha, Nainana Jat, Nainana-Brahman, Rohta, Swamibagh.

• Agra city is governed by Municipal Corporation and is situated in Agra Urban Region.

• Agra constitutes of 8 planning zones and 90 wards as per the present information from Agra Nagar Nigam.

• Area under planning boundary: 484.2 sq.km.

• Area under municipal boundary: 141 sq.km.

Map 4.2 Map showing various boundaries Map 4.1 Map showing various planning zones
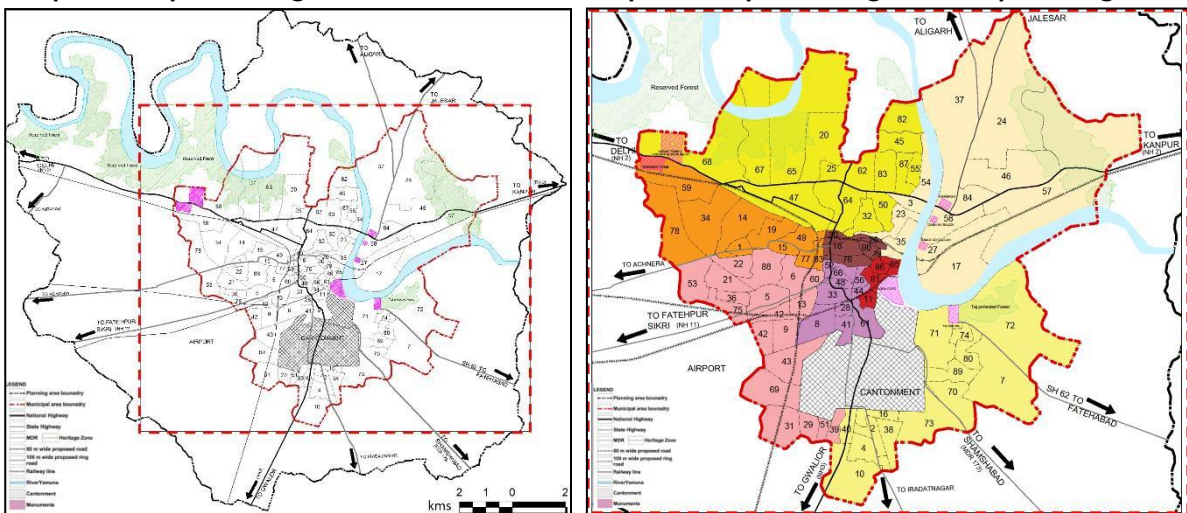
Source: Agra Development Authority

Map 4.4 Existing Landuse
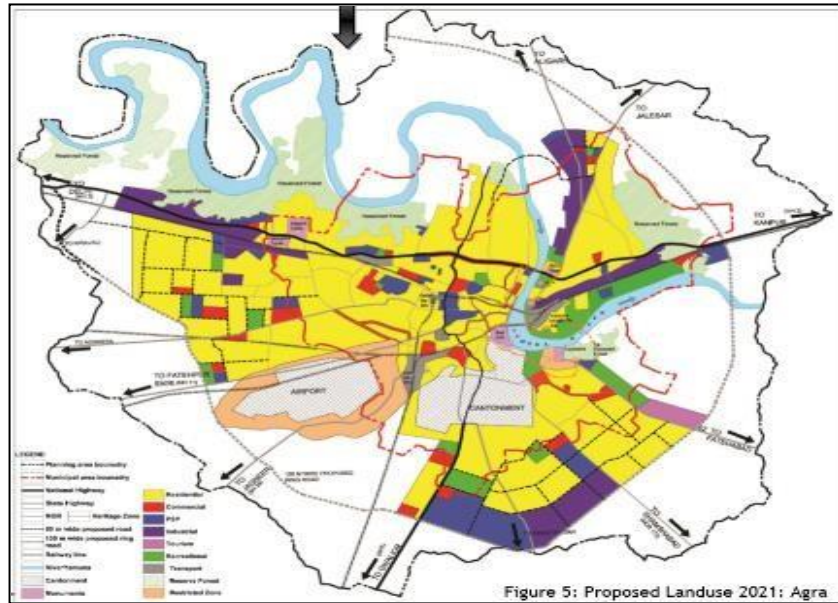
Figure 5: Proposed Landuse 2021: Agra
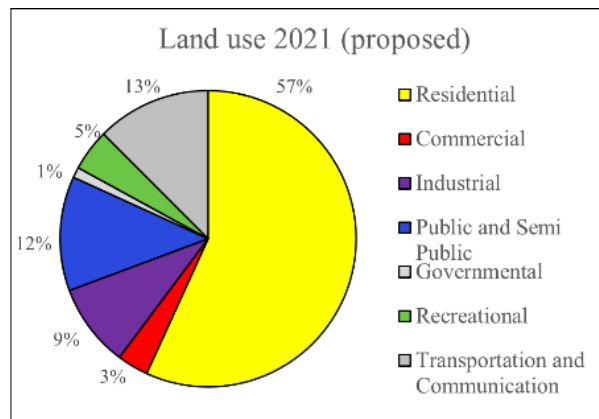
Figure 4.8   Land use 2021

Figure 4.9 Charts showing Land use 2021

The area under industrial use is lesser (by 3.1%) than it had been proposed. The number is probably due to the closure of 292 coal-based industries after the initiation of the TTZ project. The land use / land cover change shows that maximum change of land has happened from agricultural and open scrub lands to built-up and barren land. Even water bodies are getting converted to barren land which is an area of concern.Liveability scenario inAgra.

According to ease of living index, 2018, Agra ranks 55th among 110 cities.

According to ease of living index, Agra ranks 55th in 110 cities.

Institutional – 45   Social – 48   Economic – 73   Physical – 75

Some of the issues that the city is facing are as follows:

Stunted growth in the tourism sector due to city's crumbling civic infrastructure. The city is also pock marked with garbage. The air and water pollution threaten the health of its citizens and also the world-famous monuments that is visited by tourists from around the world. Supreme Court's incessant nudges since 1996 over developing green belt to beat air pollution in the Taj city seemingly has brought the percentage down to around 7 per cent against the national standard of 33 per cent. This change has affected the rainfall pattern by reducing the number of rainy days. Continuous construction of roads, expressways, flyovers and other projects had taken a heavy toll on green cover, specially trees. Illegal felling of trees continues along the Yamuna. The commercial market and the indigenous craft are facing a setback due to lack of encouragement and its weak promotion.

The increasing levels of pollution in the city and its dilapidating heritage and physical infrastructure are resulting in a loss in its economic potential and social well-being of its citizens. The tourism industry and the local craft and product base of the city are facing a prominent setback. Out migration is on a rise.

Thus, Agra has to be a liveable city which shall have the following features:

- It should be infrastructurally sound.
- It should have green and walkable neighbourhoods
- It should support lifelong communities.
- It should be age friendly and shall encourage interactive placemaking
- It should have the multiple transit options and shall encourage complete street making

A comprehensive list of indicators has been prepared with respect to the aspects which shall be studied in case of Agra. They are as follows:
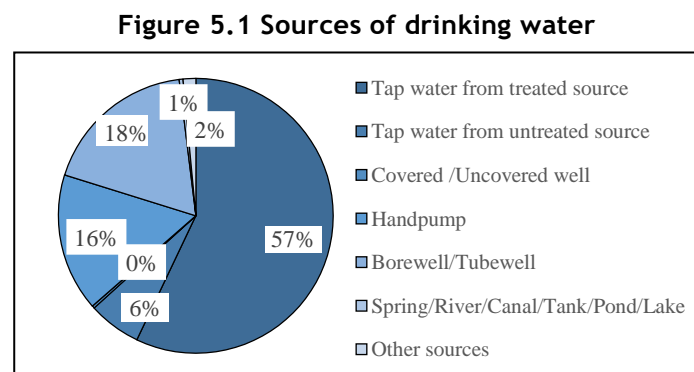
5. CITY, ZONAL AND WARD WISE ANALYSIS

For Agra with million plus population that has grown at more than 25% in last thirty years, the infrastructure development has failed to keep pace with population growth. The city of Agra has several such deficiencies and there is a need to make substantial improvement in basic infrastructure prevailing in the city to raise the standard of health, sanitation, urban environment keeping pace with rapid urbanization and growing population. City's development activities are the prime drivers of sanitation and sewerage problems and also problems in solid and liquid waste management leading to deterioration in the quality of life and the hygienic conditions of the city.

In spite of being a city known internationally for its heritage the city is in a mess when it comes to cleanliness and a good quality of life. Even though the Nagar Nigam tries to portray a good and clean impression of the city in front of the tourist, they come to know the reality as soon as one enters the city, whether it is by rail or road. The person is immediately hit by the filth of the city, the foul smell, blocked drains and the garbage spread all over. The importance of the city as a leading tourist destination has to be kept in view while designing the system to make the city clean, healthy, beautiful and attractive to the tourists visiting the city.

5.1 Water Supply

5.1.1 Source of water

The total Demand for water is 394 MLD and the total production is 418 MLD. The source of water supply in the city is mainly surface water which is drawn from the Yamuna river. There is extreme shortage of raw water in the river during summers.

Figure 5.1 Sources of drinking water

- ■ Tap water from treated source
- ■ Tap water from untreated source
- ■ Covered /Uncovered well
- ■ Handpump
- ■ Borewell/Tubewell
- ■ Spring/River/Canal/Tank/Pond/Lake
- ■ Other sources

Source: Agra Jal sansthan

Existing source of water is surface water from Yamuna river is 225 MLD (water works JEEVNI MANDI) + 144 MLD (SIKANDRA WTP), a total of 369 MLD. MLD surface water available in which Agra Municipal Corporation

gives bulk supply 91 MLD to cantonment board, railway stations, railways colony, Kheria airport authority. Due to persistent water crisis, the ground water is being exploited on an alarming rate. [5]

5.1.2 Service Area

The entire city is divided into three main water zones which are further divided into 25 sub zones.

Zone 1: Hariparbat, Kandhari, Sikandra-I, Sikandra II, Trans Yamuna I, Trans Yamuna II, Ghatwasan I, Ghatwasan II, Swami Bagh, Dayal Bagh I, Swami Bagh & Dayal Bagh II, Bodla I, Bodla II, Bodla III

Zone 2: Lohamandi, Maithan, Chatta, Kotwali, Shahganj-I, Shahganj II, Shahganj III.

Zone 3: Rakabganj, Tajganj-I, Tajganj II & Tajganj III.

Map 5.1 Water supply zones in the city and coverage of direct water supply connections
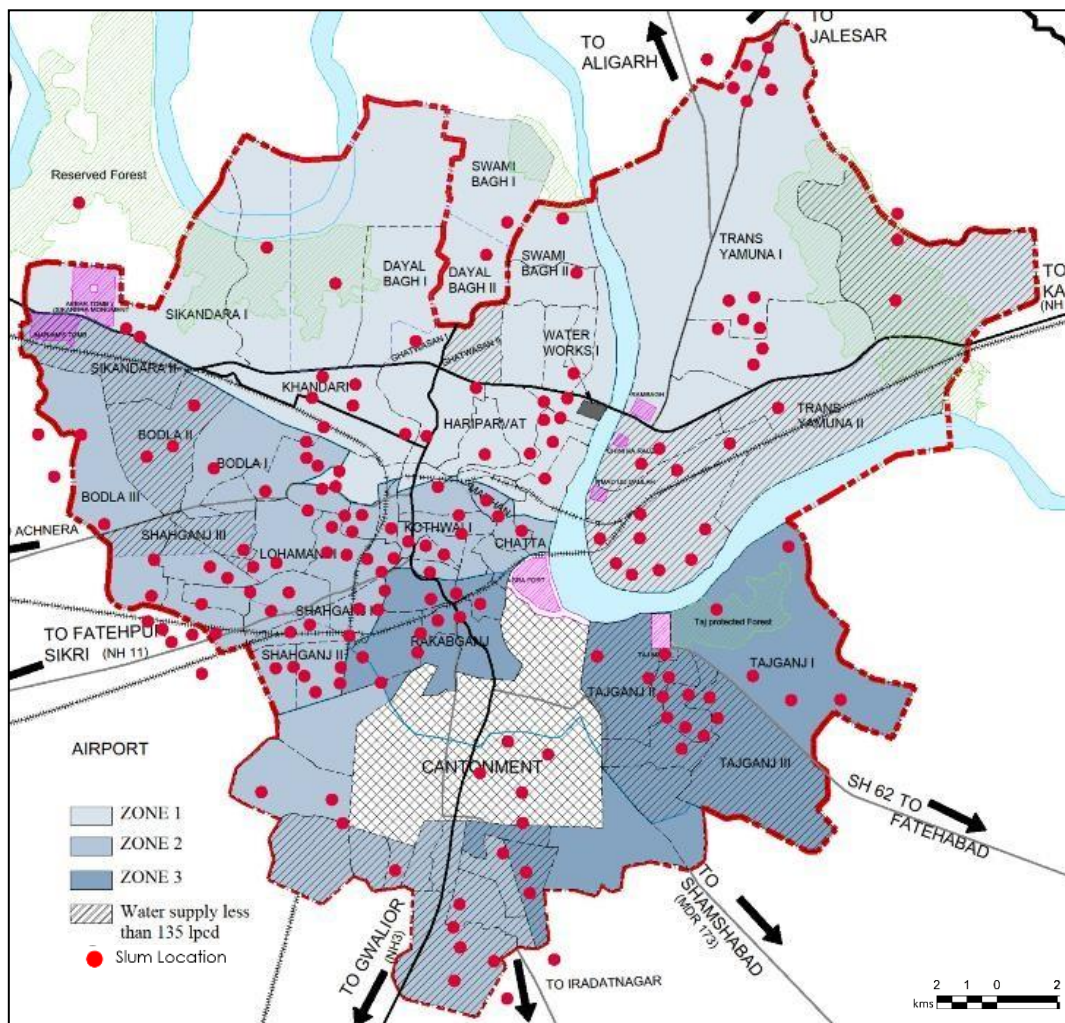
Source: Agra Jal Sansthan, 2017

5.1.3 Water Quality

The increased pollution load has impaired the river water quality to such an extent that the pre chlorination dose as high as 20mg/l is necessary to bring down the coliform count.

This is necessary to bring the water quality within the acceptable limits formulated by the CPHEEO, Govt. of India. The water quality of river Yamuna is far from satisfactory as per CPCB norms. The water quality as shown above states that even treated water is not fit for drinking as the amount of C.O.D, (12 times), Faecal Coliform (5 times) and total Ammonic nitrogen (40 times) present in it are more than the values as per CPCB standard. [5]

5.1.4 Comparison with liveability indicators under assured water supply

The Ministry of Urban Development has laid down certain service level benchmarks for the provision of physical infrastructure in cities. The following table compares the SLB for water supply with the present situation in the city.

Table 5.2 Indicators under assured water supply and its comparison with SLBs

| S.N.	Indicators	Present Status	SLB (MoHUA)
1.	Coverage of water supply connections	**58%**	100%
2.	Per capita supply of water with NRW	175 lpcd	135 lpcd
3.	Extent of metering of water connections	**37%**	100%
4.	Extent of non-revenue water	**40%**	20%
5.	Quality of water supplied	80%	100%

Source: Agra Jal Sansthan, 2017

5.1.5 Zonal and Ward wise Analysis

The maps and charts given below show the ward wise and zone wise analysis of as to how many households have direct water supply connections and what is the current scenario of extent of non-revenue water and quality of water supplied.
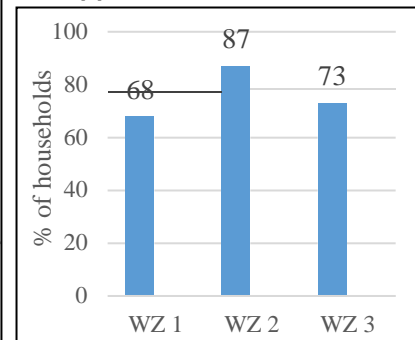
Map 5.2 Ward wise analysis of percentage of households with direct water supply connections
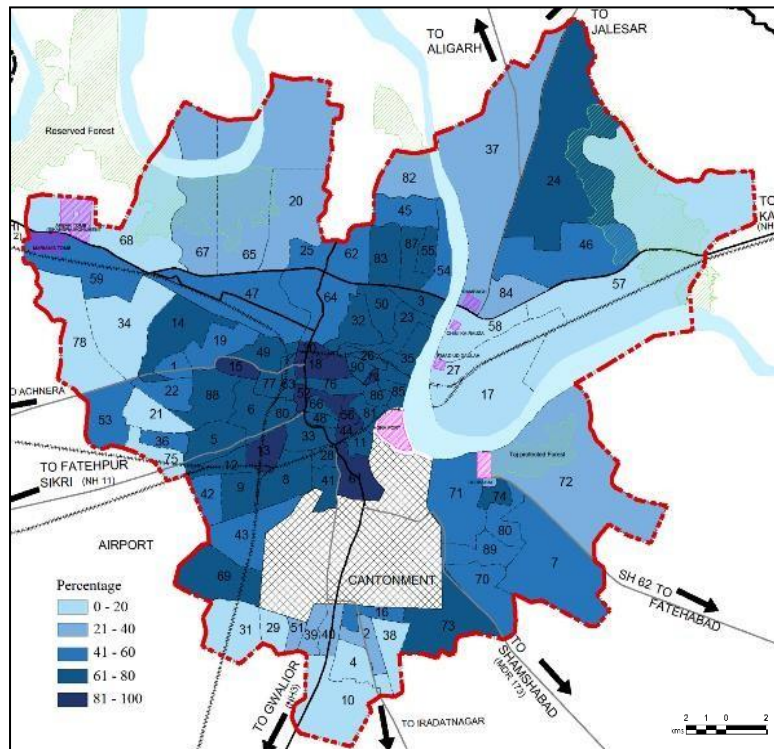
Figure 5.2 Extent of Non-Revenue Water in various
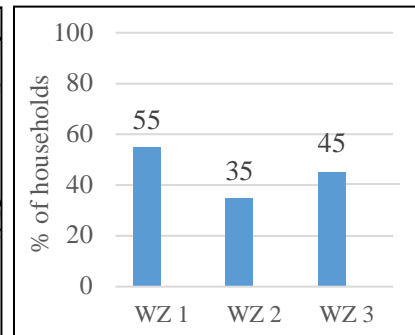
Figure 5.3 Quality of water supplied in various zones

Source: Agra Jal Sansthan, 2017

5.1.6 Inferences

- Barely half of the city (58%) is covered with the facility of clean and safe water supply.

- The major source of drinking water is from tap water from treated source. (57%)

- In addition to the same, there is only 37% extent of metering of water connections in the city which is well below average. The city also does not practice water saving techniques like rain water harvesting.

- Water Zone 1 performs poorly in terms of NRW and quality of water supplied.

- Per capita water supply in wards like Sikandra-II, Bodla-II, Shahganj-III, Tajganj-II, III, Trans Yamuna-II & Ghatwasan-II is less than 135 LPCD.

- Wards 68, 78, 31, 29, 10, 4, 38, 58, 27, 17 are the zones where treated water supply ranges between 0 – 20%. Handpumps and borewells are major sources of water supply in these areas.

- It is observed that treated water is not fit for drinking as the amount of C.O.D, (12 times), Faecal Coliform (5 times) and total Ammonic nitrogen (40 times) present in it are more than the values as per CPCB standard.

- Wards like Sikandra-II, Bodla-II, Shahganj-III, Tajganj-II, III, Trans Yamuna-II & Ghatwasan-II are some of the critical wards in this aspect. Water Zone 1 is the most critical zone.

5.2 Sewerage

5.2.1 Service Area

City has underground sewerage system which is operated and maintained by Agra Jal Sansthan. The city is divided into 8 sewerage These are further divided into 25 sub zones. The existing system is spread over an area of 1400 hectares but devoid of proper house connection. Mostly the sewage goes into open drains. Being old, the system is badly choked and overloaded and thus needs replacement. [5]

Table 5.3 Table showing various sewerage districts/zones

Sewerage District	Area Covered
Tajganj District	Taj Ganj I, II and III zones
Northern District	Dayalbagh, parts of Sikandara I, Sikandara II, Khandari, and Ghatwasan II zones
Eastern District	Trans Yamuna-I and Trans Yamuna-II
Western District	Bodla-I, Bodla-II, Bodla-III, Shahganj-III and parts of Lohamandi, Sikandara-I, Sikandara-II, Shahganj-I and Shahganj-II
Southern - I District	Bundukatra and part of Shahganj-I
Southern - II District	Part of Shahganj-II.
Central District	Ghatwasan-I, Kotwali, Maithan, Hariparbat, Chhatta, Rakabganj and parts old Khandari, Ghatwasan-II and Lohamandi
Cantonment	Cantonment Area

Map 5.3 Various sewerage districts of Agra and the location of related infrastructure
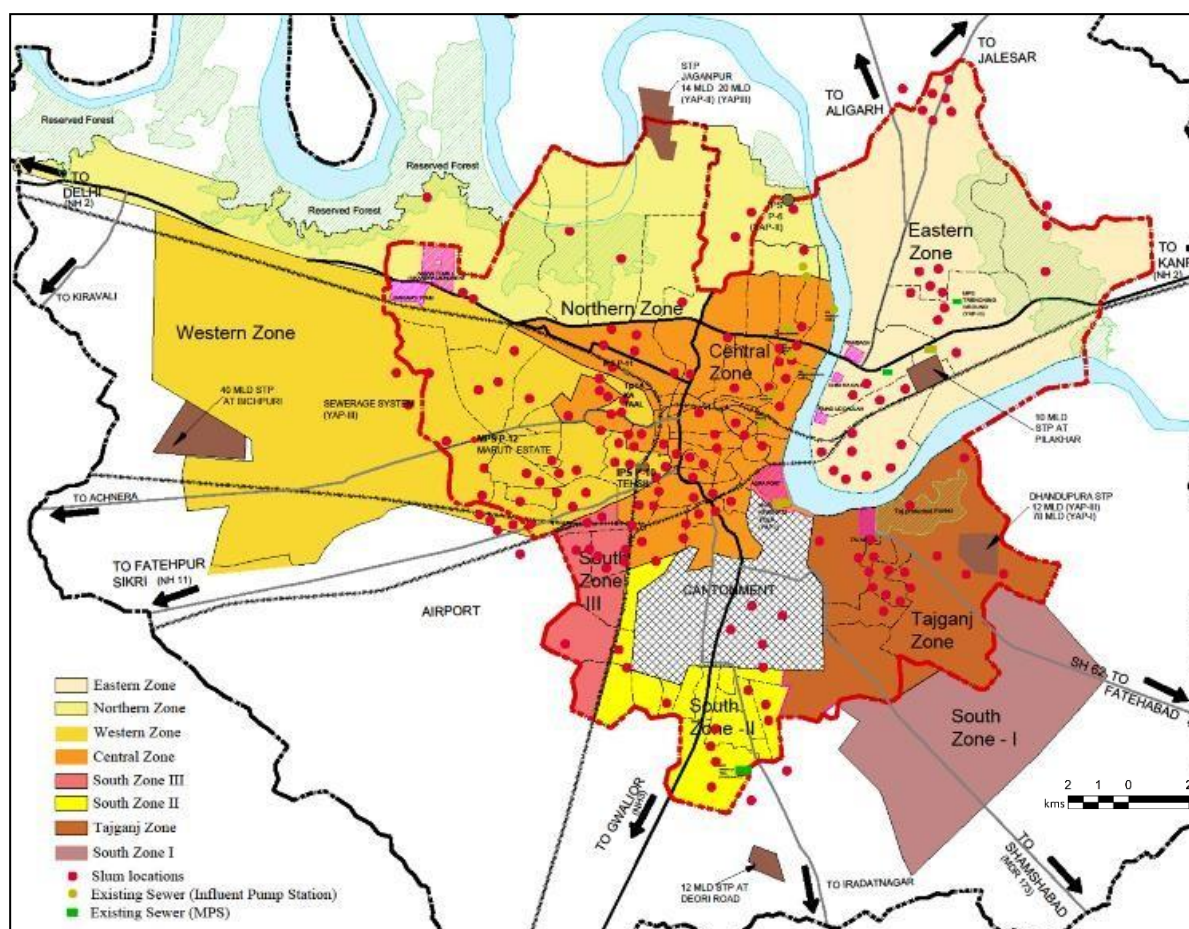
Source: Agra Jal Sansthan

5.2.2 Sewage Treatment

The city has five Sewage Treatment Plants (STPs). The STPs at Burhi ka Nagla (2.25 MLD) and Peela Khar (10 MLD) are made to perform beyond capacity, but still treat only 10% of the sewage they receive.

Table 5.4 Location and number of STPs in various sewerage districts

S No.	Sewerage Districts	Capacity of STP (in mld)			
		Existing	Under construction	Proposed	Total
1.	North Zone	16	-	20	36
2.	West Zone	40	36	-	76
3.	Central Zone	78	-	-	78
4.	Tajganj Zone	-	24	-	24
5.	South Zone – I	-	-	16	16
6.	South Zone -II	12	-	24	36
7.	South Zone -III	-	-	14	14
8.	East Zone	10	-	20	30

It is observed that three zone namely Tajganj zone, South zone-I and South zone-III lack STP. Improper means of disposal of wastewater are resulting in a serious problem of pollution of the Yamuna water. At present total sewage generated is 222mld out which 156 mld is treated.

5.2.3 Comparison with liveability indicators under sewerage management

Table 5.5 Indicators under sewerage management and its comparison with SLBs

Sl.No.	Indicators	Present Status	SLBs (MoHUA)
1	Coverage of toilets	88%	100%
2	Coverage of Sewerage network	56%	100%
3	Collection efficiency of sewerage network	70%	100%
4	Extent of reuse/recycling of waste water	0%	20% or more

Source: Agra Jal Sansthan,2017

Figure 5.2 Type of sewerage system
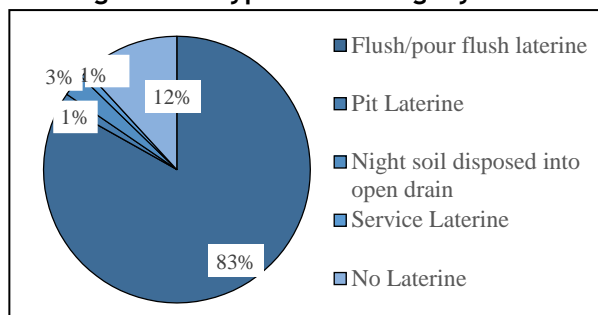
The coverage of toilets has remarkably improved in the city. 83% of the city is covered with flush/pour flush latrine.

Total no. of individual toilets: 228643
Coverage of individual toilets: 88%
No. of community toilets: 117,
Access to community toilets: 15%

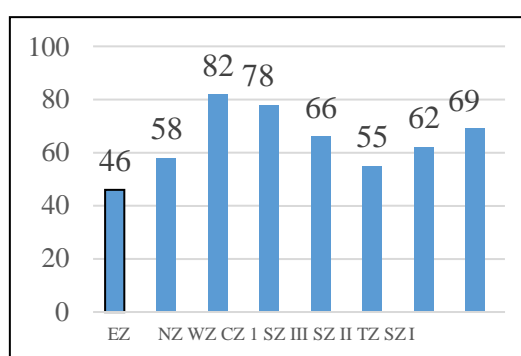### 5.2.4 Zonal and Ward wise analysis

Map 5.4 Ward wise analysis of percentage of properties with piped sewer network
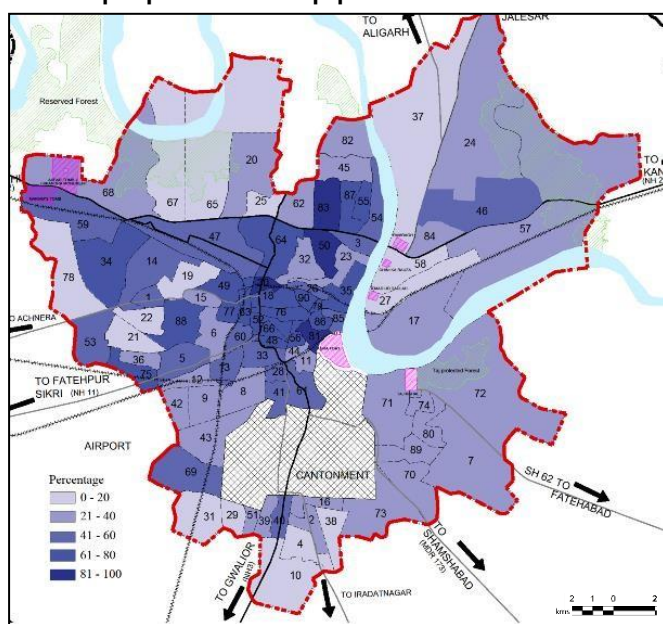
Source: Agra Jal Sansthan, 2017

Figure 5.3 Sewerage collection efficiency of various sewerage districts

Source: Agra Jal Sansthan, 2017

As evident from the bar graph and the ward wise analysis map, the Eastern Zone is the most deficient in terms of proper sewerage facilities.

5.2.5 Inferences

- Wards 67, 65, 78 21, 22, 19, 31, 29, 10, 4, 8, 37, 58, 27 are the zones where piped sewer system ranges between 0 – 20%.

- These areas have the provision of septic tank where water is not treated adequately.

- About 85% of the households have latrine facilities. But, only about 56 % of the households within the municipal boundary are connected to the piped sewerage network.

- Taj Ganj, South zone I and South zone III lack the provision of adequate STP facilities. Only 70 % of the waste generated is treated.

- The Eastern as well as the Southern Zone II have the least collection efficiency in terms of sewerage.

5.3 Storm water drainage

5.3.1 Service Area

City is divided into two major zones: CIS Yamuna and TRANS Yamuna based on major physical boundary River Yamuna. These are further divided into 11 drainage zones. The drainage system of Agra was laid about 55 years back and drains are in bad condition. The system comprises hierarchy of natural and man-made drains that ultimately discharge surface run off and sewage to River Yamuna because at most part of the city there is no sewerage system. Natural nalas are the main carriers of the storm water. There are about twenty-five major drains in CIS and Trans Yamuna areas, which directly falls into the river Yamuna and there are about thirty-eight secondary drains. Mantola nallah is the longest nallah of the city and covers around one third of the city catchments. [5]

Table 5.6 Drainage zones and areas covered

Name of zone/details	Area Covered
Zone 1 (Karamyogi)	Karamyogi Nalla, Anurag Nagar Drain, Rajwaha Drain, Balkeshwar, Nallah
Zone II (Dayal Bagh)	Nalla Nagla Bopdi
Zone III (Shastripuram)	Bapu Nagar Nalla, Bi-pur Nala

Zone IV (City)	Water works drain, Krishna colony nalla, Vedant Drain, Bhairon Nalla, Khoja Nalla, Pipe mandi Nalla
Zone V (Mantola)	Mantola
Zone VI (Taj)	Nil
Zone VII (Kheria Airbase)	Nil
Zone VIII (Naripura and Dewri Road)	Nil
Zone IX (Taj Nagri Phase – II)	Nil
Zone X (Foundry Nagar)	Ram Bagh Nalla, Foundry nagar Nalla, Etmad-ud-daulah Drain, Moti mahal Nalla, Ram Bagh chaurah drains, Yamuna bridge station drains,
Zone XI (Peelakhar)	Peelakhar Nalla, Nunihai Industrial drain, Kalindi Vihar drain

Source: Agra Jal Sansthan

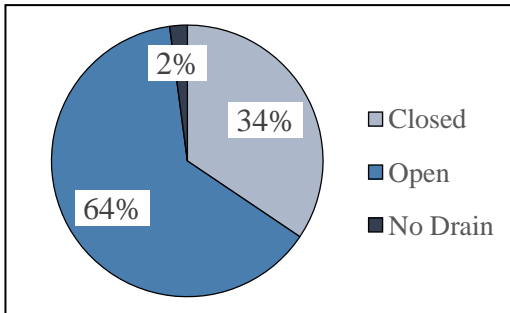**Map 5.5 Map showing various drainage zones and waterlogged areas**
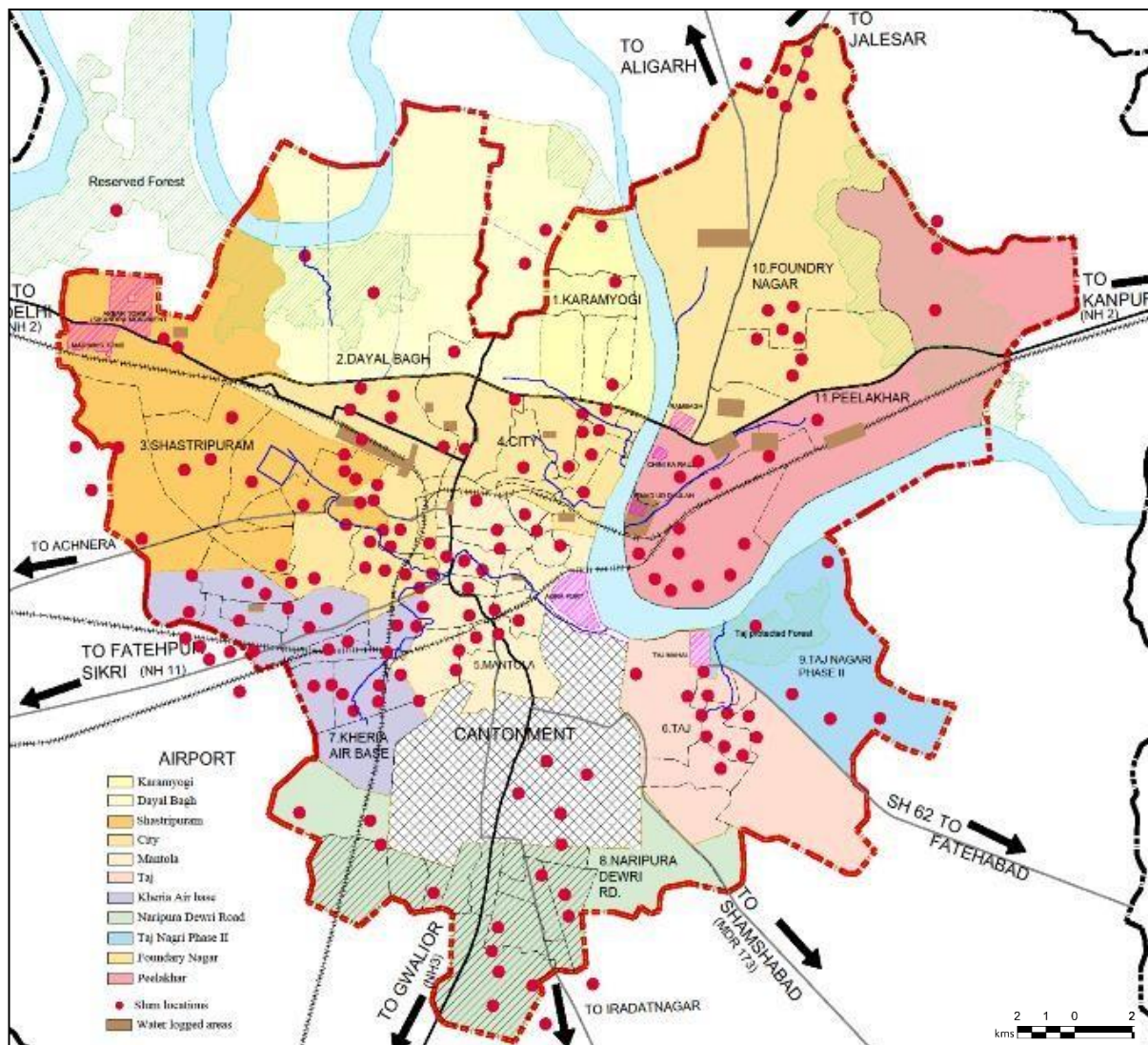
Source: Agra Jal Sansthan

- Primary and secondary nalas are of mixed type: Kuccha (34%) and Pucca (66%). These are mainly made in thick masonry mainly without plaster. They are heavily silted and broken in many places.

Figure 5.4 Type of waste water outlet in various properties

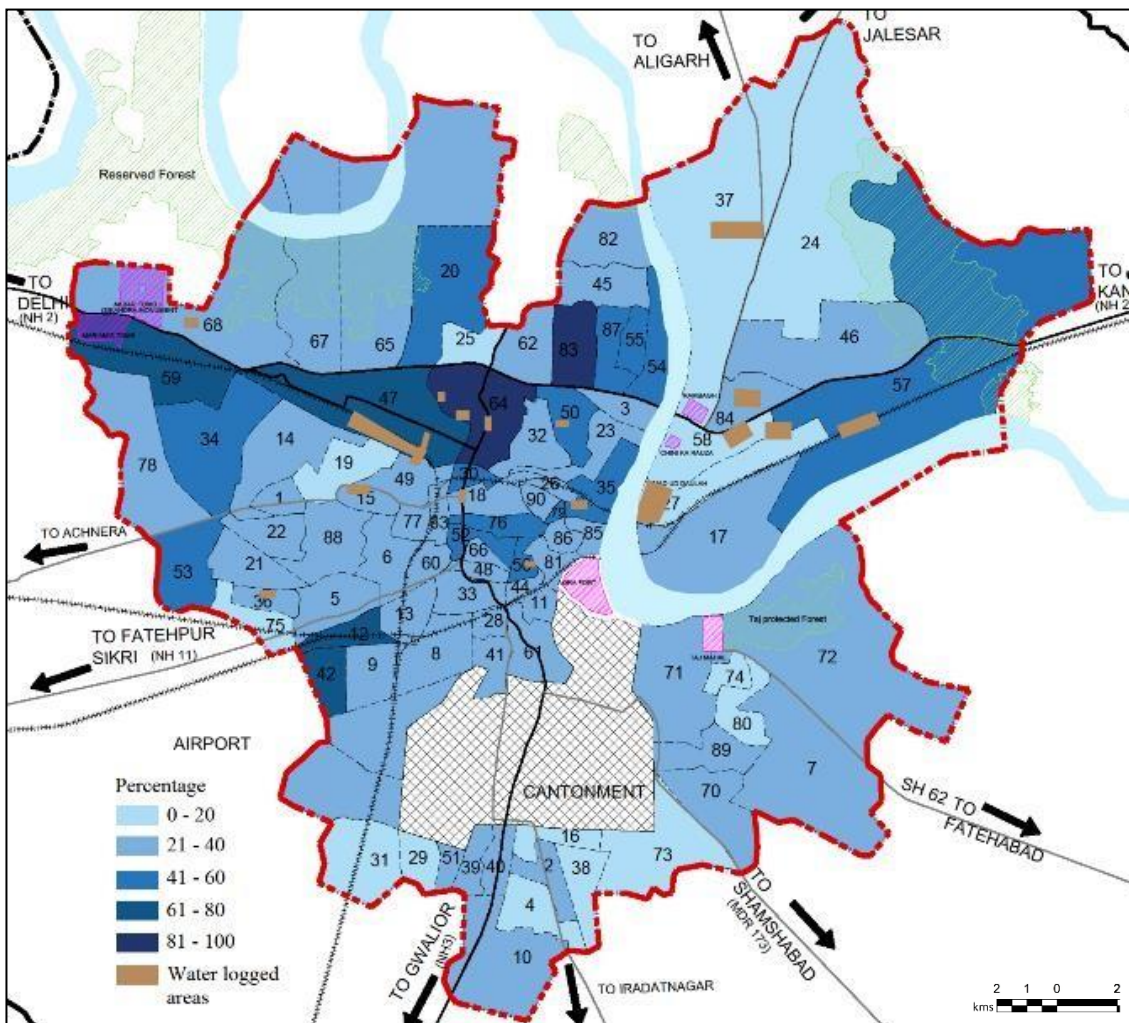- The maximum properties and establishments are connected to open drainage system. Zones 6,7,8 and 9 do not have any storm water drain.

- Properties with separate sewer system: 28%, Properties with combined sewer system: 72%

Source: Agra Jal Sansthan,2017

5.3.2 Zonal and ward wise analysis

Map 5.6 Percentage of properties having closed drainage system

Source: Agra Jal Sansthan, 2017

5.3.3 Inferences

- Wards 37, 24, 29, 31, 10, 4, 38, 58, 27, 16, 73, 74, 80 are the zones where treated water supply ranges between 0 – 20%.

- There are many places in the city where water logging takes place especially in the Trans Yamuna area.

- The reasons behind this water logging are mainly silting of the drain, variation in the ground level, dumping of debris and garbage into open drains and Nalas.

- The drains are unlined and there is an increase in the surface runoff due to increase in the impervious area.

- Also, the city has a dominant percentage of combined sewer systems and open drains.

5.4 Solid Waste management

Solid Waste Management (SWM) is an organized process of storage, collection, transportation, processing and disposal of solid refuse residuals in an engineered sanitary landfill. It is an integrated process comprising several collection methods, varied transportation equipments, storage, recovery mechanisms for recyclable material, reduction of waste volume and quantity by methods such as composting, waste-to-power and disposal in a designated engineered sanitary landfill. Accumulation of solid waste in open areas is an eyesore, diminishing real estate and property value and a breeding ground for insects. It also causes odour nuisance, reflects the unorganized nature of the community and creates a poor environment for the tourists coming to the city. [5]

5.4.1 Waste generation in the city

The total solid waste generated in the city per ANN is 824 metric tonnes per day, translating to 550 grams per capita per day which is higher than the standard/norms prescribed in the Manual on Municipal Solid Waste Management. Prominent locations of waste generation:

➢ The major source of waste generation in the city is the domestic waste and the major waste generation points in the city are Kotwali, Noori gate, and Lohamandi.

➢ There are more than 50000 shops & commercial establishment registered at Nagar Nigam. The commercial areas identified in Agra city are situated throughout the city and include Sanjay Palace, Bhagwan Talkies chaurah, Bijlighar chaurah, Naiki Mandi, Rakabganj, Dayal Bagh Road, Bhagirath Marg etc.

➢ The leather and rubber trimming from footwear industry is accounted largely at Mantola, Dholikhar, Khattipara, Azamganj, Gobarchowki, pankisarai, Nai ki Mandi, Shakuntala Nagar, Raj Nagar, khaitana road, gopal pura, Nand pura, Devi road, Mohan pura, Budhvihar, Tila Nand Ram, Kajipara and many other.

As per the Agra Nagar Nigam, there is merely 46.3% of the household level coverage of solid waste management services, although the efficiency of collection of municipal solid waste is only 65%.

Table 5.7 Sources of solid waste

Sl.No.	Source of Solid Waste	Solid waste generated	% of total
1.	Households	395	48
2.	Street Sweepings	40	5
3.	Hotels and Restaurants	39	5
4.	Markets (vegetable markets, mandis etc.)	27	3
5.	Commercial Establishments	49	6
6.	Other sources	276	33

Source: Agra Nagar Nigam

### 5.4.2 Comparison with liveability indicators under solid waste management

Table 5.8 Indicators under solid waste management and their comparison with SLBs

Sl.No.	Indicators	Present Status	SLBs (MoHUA)
1	Household level coverage of MSW	76.3%	100%
2	Efficiency of collection of MSW	**65%**	100%
3	Extent of MSW recovered through reuse	**7%**	80% or more
4	Extent of segregation of MSW	**37%**	100%

Source: Agra Nagar Nigam, 2017

5.4.3 Zonal and ward wise analysis

Map 5.8 Ward wise analysis of percentage of properties with solid waste segregation at source
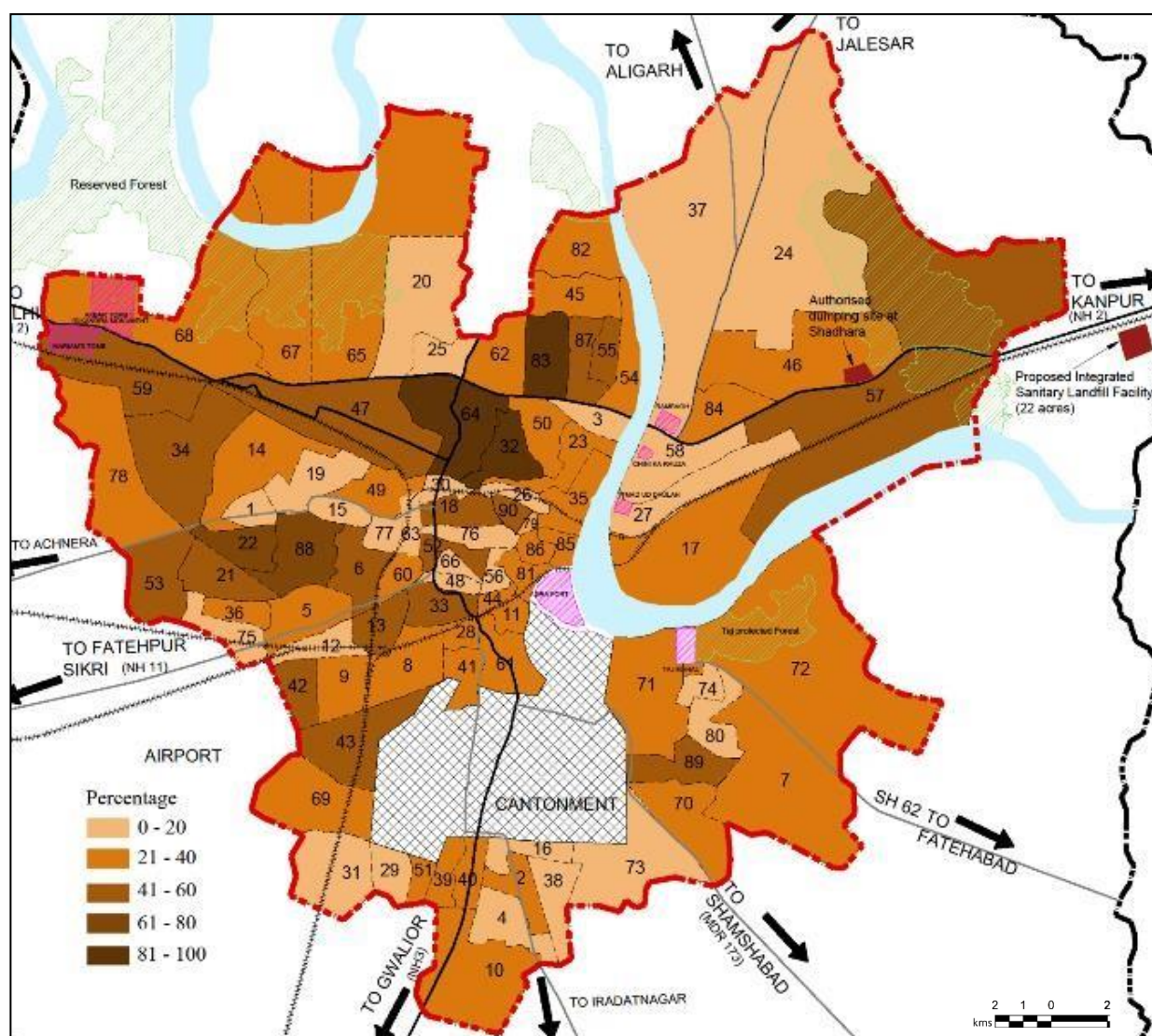
Source: Agra Nagar Nigam, 2017

As evident from the ward wise analysis and bar graph, the Jamunapar ward, Shahganj and Tajganj wards do not perform well in terms of door to door collection efficiency.

Door-to-door waste collection service has to be provided to households. The roadside waste collected by street sweepers must be directly dumped into a separate bin at the secondary waste collection point.

- Secondary storage of solid waste is unorganized.

It is observed that at places wherever dustbins are available, either they are rusted or damaged. At other places, waste is dumped on open dumps which have evolved over time. In the absence of secondary storage facility for MSW, it is dumped at any location in the vicinity – drains, vacant plots, street corners, low lying areas, and other open areas.

Separate colored bins must be provided at the secondary storage location for biodegradable and non-biodegradable, and recyclable wastes. The bins must be covered and cleared at the scheduled time to prevent storage of waste for a long time and littering of waste outside the bins.

- Solid waste is transported in open vehicles.

Most of the times, solid waste is transported in open trucks and trolleys. At times these vehicles are overloaded with waste, resulting in road littering during transportation. The loading and unloading of waste are done manually.

The waste transportation vehicles must be covered at all times expect while loading and unloading activities and the loaded waste should not exceed the capacity of these vehicles.

- Slaughter house waste is mixed with the MSW.
- Biomedical waste is not managed properly in all health care facilities.
- Disposal of solid waste is not appropriate.
- Manual handling of solid waste.
- Lack of awareness among city residents and civic authorities.

The ANN staff is responsible for managing MSW in Agra city in accordance with the MSW Rules 2000. However, they are completely ignorant of these rules and the implementation practices recommended in the document. Public awareness,

community participation, transparent administration, accountability at all levels is the need of hour so as to ensure success of any MSW management plan.

- **Jamunapar stands the lowest in** terms of solid waste collection efficiency. There is only 7% extent of waste reuse and recycling.

5.5   Public Open Spaces

Figure 5.6 Percentage of developed and undeveloped
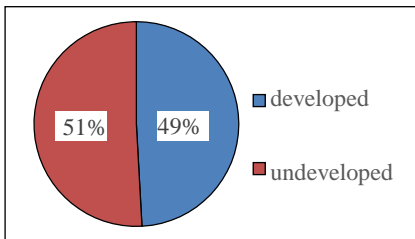
Agra constitutes of a total of **420** parks. The total number of parks under Municipal Corporation and maintained by the corporation is **346.** The total number of parks under Municipal Corporation but are maintained by NGOs are **80.** [6]

5.5.1   Service Area

For the purpose of effective management and maintenance of parks, the Agra Nagar Nigam has divided the city into 8 wards. They are as follows:

Map 5.9 Various wards for park maintenance in Agra
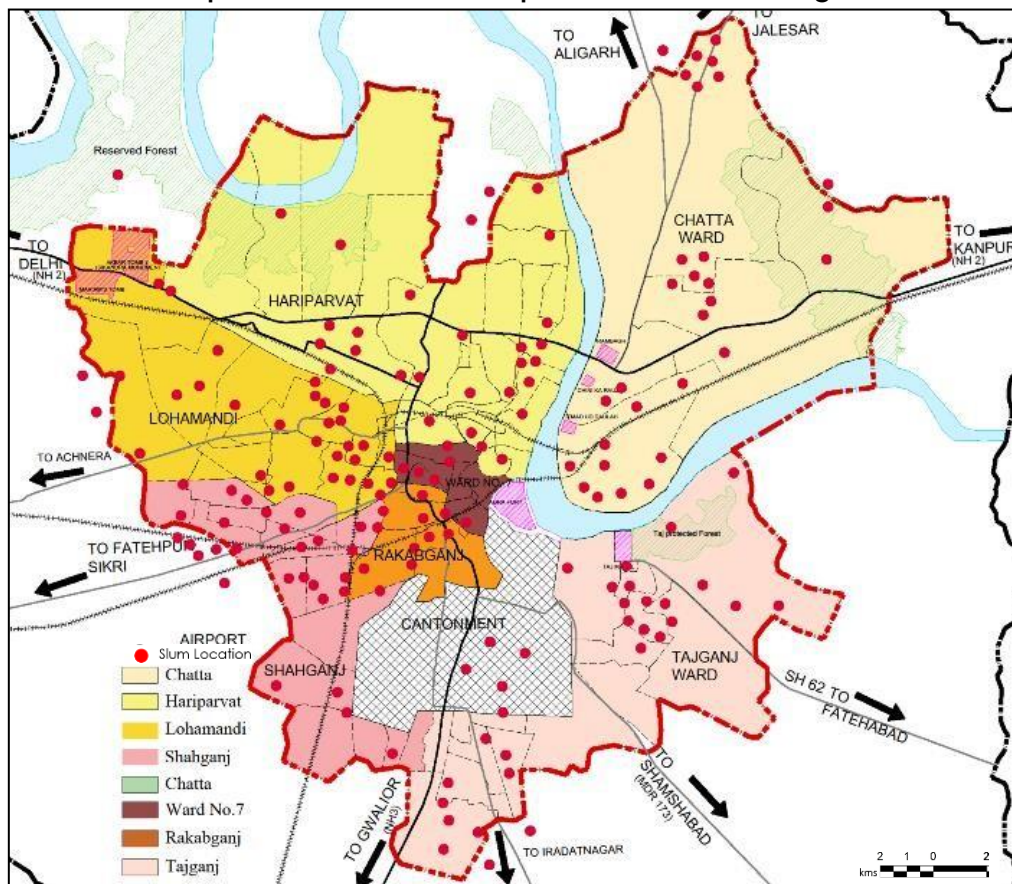
Source: Agra Nagar Nigam

Table 5.9 Various zones and number of developed and undeveloped parks

S.No.	Name of the zones	No. of Parks	Developed	Undeveloped
1.	Chatta	61	6	55
2.	Lohamandi	79	13	66
3.	Shahganj	20	16	4
4.	Tajganj	35	22	13
5.	Ward 7	5	3	2
6.	Hariparvat	140	110	30
7.	Rakabganj	6	0	6

Source: Agra Nagar Nigam

## 5.5.2 Comparison with liveability indicators under public open spaces

Table 5.10 Indicators under public open spaces and their comparison with URDPFI

S.No.	Indicators	Present Status	Benchmark
1.	Per capita availability of Green spaces (recreational spaces + organised green + common spaces)	2.4 sq.mt.	10 – 12 sq.mt.
2.	Per capita availability of public and recreational spaces (playgrounds + stadiums and sport complexes + city and district parks + neighbourhood parks and tot lots + zoological and botanical parks + multi use open spaces + waterfront, promenade and public squares)	3.7 sq.mt.	

Source: Agra Nagar Nigam, 2017

5.5.3 Zonal and ward wise analysis of Public open spaces

Map 5.10 Ward wise analysis of parks being
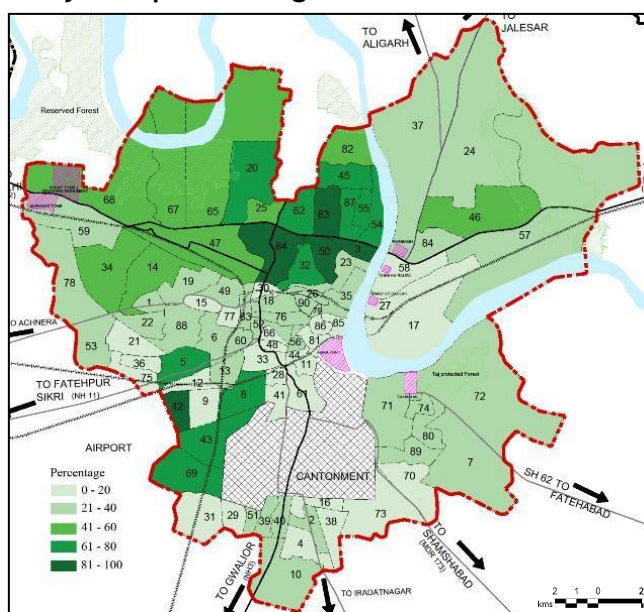
6.   Transport and Mobility

The total number of registered vehicles in the year 2017 was 89986 which is at a rate of over 245 vehicles per day. Over the past five years i.e. during 2012-2017, vehicle registration has grown at a rate of 17%. During the same period, registration of four wheelers (4W) comprising of cars, vans, jeeps have increased at a rate of 31% and two-wheelers (2W) at a rate of 16%. [8]
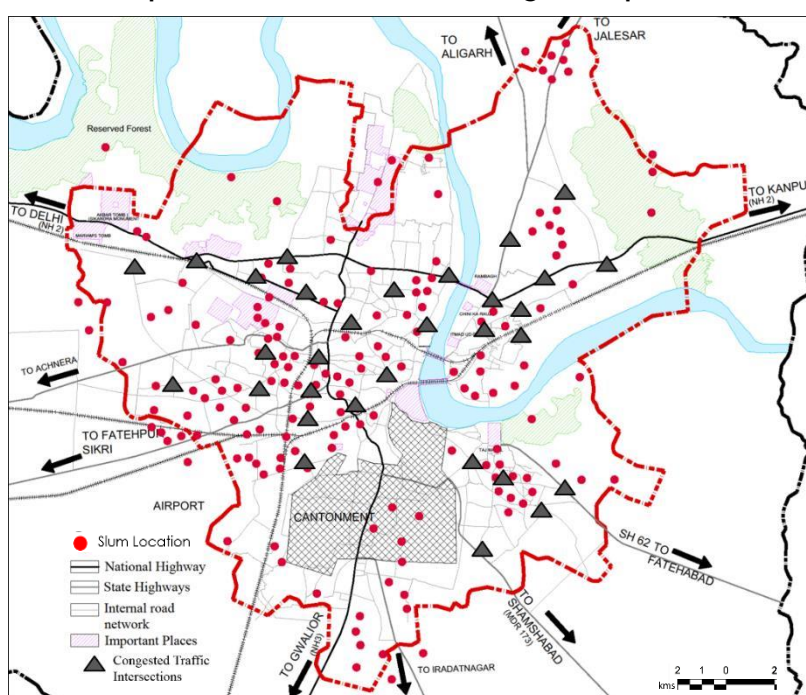
Map 5.14 Location of traffic congestion points
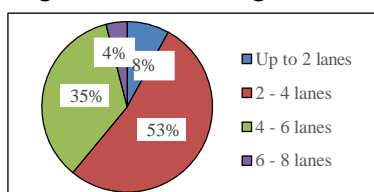
Figure 5.10 Carriage width

Figure 5.11 Vehicular
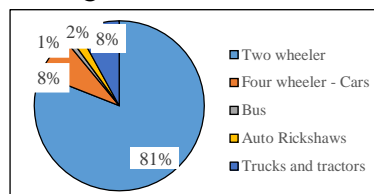
Figure 5.12 Type of travel
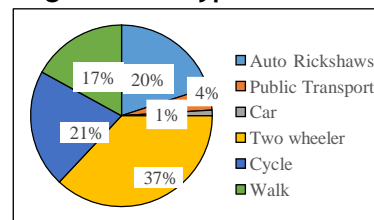
Source: Regional Transport Office, 2018

Table 5.12 Existing level of service

Sl.No.	Indicators	LOS (Existing)	Desired LOS
1	Overall public transport facilities city wide	3	1
2	Overall pedestrian infrastructure facilities	3	1
3	Overall NMT facilities	4	1
4	Availability of parking spaces	4	1
5	Road Safety	4	1

Source: Regional Transport Office, 2018

- 27% of the roads have footpath and most of the roads lack footpaths posing safety threats to the pedestrians. Further at places, where the footpath exists the design standards are not maintained.

- Encroachments by vendors and for parking leaving no space for pedestrians to walk. Further these street infrastructure does not address universal accessibility and also address the convenience and comfort of other users.

6.2 Parking

- High parking demand at Loha Mandi, Shahganj, Bodla, Dayal Bagh, Sanjay Palace resulting in heavy congestion throughout the day.

6.3 Safety and Security

Agra District in Uttar Pradesh stands 50th in all crime records in 2013. 25th in no of murders, 67th in no of rapes, 19th in no of robberies, 18th in no of thefts, 35th in no of dacoities, 9th in no of kidnappings, 30th in no of riots. Kidnapping and abduction related crimes have been constantly increasing as compared to other crimes rates. Riots have also been on an increase in the city.

Map 5.15 Location of various crime hotspots
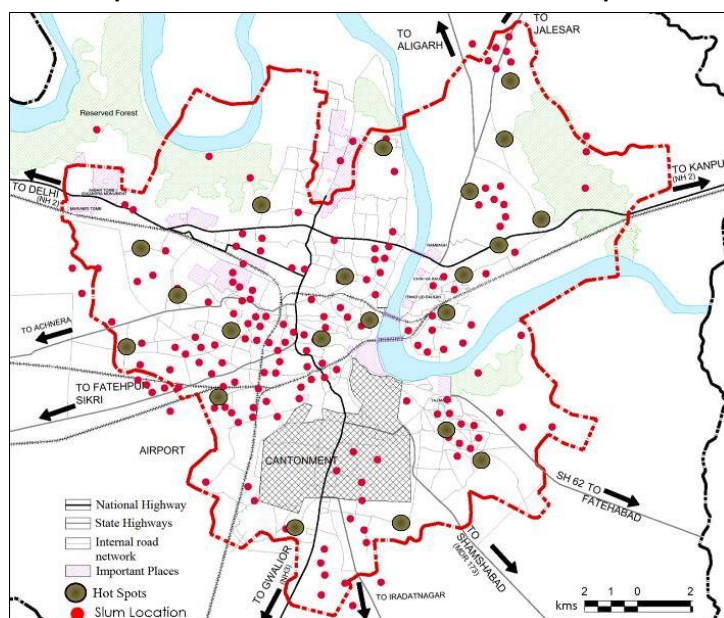
Source: Crime Statistics, 2018

The areas of Trans Yamuna colony, Nawabganj, Tajganj, Dayal Bagh, Agra Fort and St. Johns are some of the major hotspots of the city. There are no streets, public places or junctions covered through surveillance. Only 14% of the street length is covered through street lighting. Majorly, the hotspots of the city are located on major roadways and around the slum's areas.

7. ISSUES AND RECOMMENDATIONS

7.1 Water Supply

7.1.1 Issues and recommendations

7.1.1.1 Issues

- There is only **58%** household coverage of direct water supply connections.
- **Water crisis** is an evident problem in the city.
- **Non-revenue water loss** is also a major problem since the distribution system is not well maintained.

7.1.1.2 Recommendations

- Direct water supply connections have to be provided to every household. This process has to be carefully planned and **effective water resource management plans** need to be prepared.
- **Rainwater harvesting systems** have to be made mandatory for every property or a group of properties. A group of properties can have a common rainwater harvesting setup which can supply water in months of crisis.
- The percentage of green cover has to be increased, especially in the urban realms for seepage of rainwater and recharging of ground water.
- Sensitisation with respect to water consumption practices and reduction in wastage of water has to be carried out amongst the citizens.

7.1.2 Issues and Recommendations

7.1.2.1 Issues

- **Heavy non-revenue water loss.** There is about 30% distributional loss in the water supply system.
- **Water crisis and poor-quality** water supply in the urban villages.
- There is **no monitoring of water supply services** in any form. There is also no surveillance and vigilance with respect to payment of water tax.

7.1.2.2 Recommendations

- To install the **consumer meters** at consumer end that will help to measure the revenue as well as Non-Revenue water consumption accurately.

- **Billing should be done on monthly basis** instead of annual/yearly basis. This will increase the revenue of the council and self-sustainability of the water supply system.

- **To develop a water billing software** for the billing / revenue department to charge on the consumption basis from the consumers. This will add up to accountability on consumer.

- There is a need to break down the distribution network into smaller more manageable areas **(District Metering Areas)**. Acoustical leak detection, management of distribution system pressure, analysis of meter tampers, through complex data collection and automatic tool services are some of the techniques that can be used.

7.1.3 Issues and recommendations

7.1.3.1 Issues

- The urban slums of Nunihai are facing a major problem in water supply in terms of coverage as well as quantity and quality of drinking water. Although some of the slum areas have handpumps and tube wells, the major supply is through private wells and tube wells and the dirty nallahs flowing through, in some cases.

7.1.3.2 Recommendations

- The slum areas of Nunihai need to be notified and regularized in the government record and provision of direct water supply connections need to be ascertained.

- The existing distribution system has to be **well maintained and water meters be installed in every household**. Non-revenue water loss shall be monitored.

- **Water ATMs** can be provided for safe and secure drinking water.

Figure 7.1 Water ATMs

7.2 Sewerage and storm water drainage

7.2.1 Issues and recommendations at city level

7.2.1.1 Issues

- Coverage of sewerage network is only **in 56% of the properties.** Amongst the same, the combined sewer system is more prominent.

- Collection efficiency of the sewerage network is only 70%. The percentage of road length covered with open drains is also quite high.

- **Waste water recycling** is not being practiced in the city.

7.2.1.2 Recommendations

- Coverage of separate sewer system to every household shall be undertaken. For this, **sewerage management plans** shall be adopted which studies the hydrology of the city, calculates the collection efficiency and then proposes augmentation in the existing design guidelines.

- In addition to this, **developing storm water pollution prevention plans (SWPPPs), sharing best management practices, assisting with design, municipal separate storm and sewer systems, conducting regular inspections**, can also lead to effective storm water management.

- **Separate sewer system** has to be encouraged in which there are different channels of flow for waste water and storm water. This makes it easier to distribute the loads and in maintenance of the infrastructure.

Effective techniques of waste water recycling have to be conducted in the discharge system

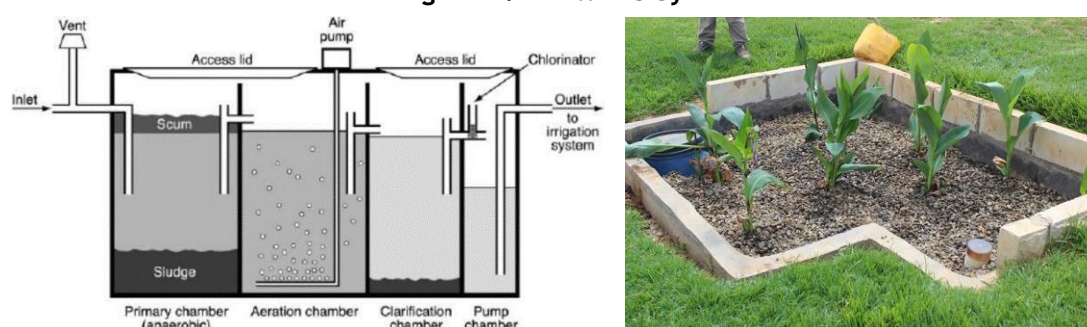### 7.2.2 Issues and recommendations

7.2.2.1 Issues

- Since the Trans Yamuna lies at a lower level than the Cis Yamuna city, it faces acute problems in relation to storm water overflow. The **system efficiency is only 46%.**

- The Etmad ud daulah drain is the major recipient of wastewater. The area also has open drain network and many potholes on the streets which act as

breeding ground of diseases, especially in the summer months. The drains are inspected and cleaned once in two months only.

7.2.2.2 Recommendations

- **The open drains should be well maintained and covered. The drains should be cleaned and maintained twice a month, especially during the monsoon months.**

- **Distilling of the drains to remove the garbage & providing screening chambers** to keep a check on the garbage being thrown into the drain.

- **An effective technique is the DEWATS system.** This is a centralised wastewater system which conveys, treats and disposes or reuses wastewater from small communities, buildings and dwellings in remote areas, individual public or private properties. Waste flow is generated when appropriate water supply is available within the buildings or close to them.

Figure 7.2 DEWATS System

7.2.3 Issues and recommendations

7.2.3.1 Issues

- Overflowing of Nunihai industrial drain is a prevalent problem. Also, there is **heavy silting of drains**. The sewerage lines are broken resulting in leakage of the sludge, causing infectious diseases in the area.

- Contamination of ground water is also a major problem as it is the major source of drinking water and thus becomes unfit for consumption. There is only one septic tank in this area which is not maintained on regular basis.

7.2.3.2 Recommendations

- **The open drains should be well maintained and covered. The drains should be cleaned and maintained** on a regular basis, especially during

the monsoon months. This, in turn will prevent the extra contamination of storm water with solid waste and would thus, not lead to formation of sludge.

- In the urban slums of Nunihai, there is a need for proper septage management and treatment of the one septic tank which it has as there is constant overflow.

- Also, as the capacity of the septic tank is not efficient enough to take the load of the whole neighbourhood, more numbers of septic tanks have to be installed and maintained regularly.

7.3 Solid Waste Management

7.3.1 Issues and recommendations at city level

7.3.1.1 Issues

- Agra generated a total of 824 metric tonnes of waste per day translating to 550 grams per capita per day and the waste collection efficiency is only 65%.
- Hierarchy of proper solid waste management practices is missing.
- Though the city fares well in terms of door to door collection, segregation of waste at source is not practiced in Agra city.
- Reuse of solid waste is not being practiced.

7.3.1.2 Recommendations

- **Solid waste management plan** has to be adopted for the city. The seven core steps of SWM plan needs to be adopted.

- **Segregation of waste at the source** has to be practiced and made mandatory. This would further help in **adopting effective reuse and recycling techniques such as vermicomposting, recycling plastic etc.**

- Sensitisation of the citizens for effective waste management practices needs to be practiced.

- The public places should have twin bin installations at every 500m of distance.

7.3.2 Issues and recommendations

7.3.2.1 Issues

- **52 metric tonnes** per day waste is being generated in this ward.

- With a collection efficiency of only **46%, only 23 MT** of waste is collected per day.

- Even when the door to door collection amounts to around 86%, the neighborhood is facing issues like **open dumping and unhygienic conditions** due to poor solid waste management.

- Also, there **are no community bins or dhalavs in order to temporarily store the waste collection**, thus leading to **open dumping.**

- Also, the frequency of waste collection is quite less, only two times per week, which leads to dumping in open plots.

7.3.2.2 Recommendations

- **Segregation at source into dry waste and wet waste** has to be effectively encouraged amongst the citizens. In places where there is no door to door collection, street collection through community bins has to be managed.

- The frequency of waste collection has to be increased **(alternate days).** In addition to this, basic infrastructure such as **dumpsters and dhalavs have to be provided** at appropriate places.

- In public places, use of underground bins shall also be implied.

- Investing in efficient collection equipment, like trucks with automated waste collection and closed containers has to be carried out.

7.3.3 Issues and recommendations

7.3.3.1 Issues

- **48 metric tonnes** per day waste is being generated in this ward.

- With a collection efficiency of only **46%, only 20 MT** of waste is collected per day.

- **Open dumping and unhygienic conditions** due to poor solid waste management.

- Also, there are **no community bins or dhalavs** in order to temporarily store the waste collection, thus leading to open dumping.

- Also, the frequency of waste collection is quite less, which leads to dumping in open plots.

Figure 7.3 Smart waste collection systems

7.3.3.2 Recommendations

- **Segregation at source into dry waste and wet waste** has to be effectively encouraged amongst the citizens. In places where there is no door to door collection, street collection through community bins has to be managed.

- The **frequency of waste collection has to be increased**. In addition to this, basic infrastructure such as dumpsters and dhalavs have to be provided at appropriate places.

- To ensure proper disposal of waste generated in informal settlements, the city introduced its **"Purchase of Garbage" initiative**. The city has designated central collection points where residents receive food baskets in ex-change for each 8-10 kg of waste they hand over.

7.4 Public Open Spaces

7.4.1 Issues and recommendations at city level

7.4.1.1 Issues

- The public spaces **lack universal accessibility** and are fairly gendered in nature.

- There are **no public amenities for female users** and **lack of proper lighting and infrastructure** also restricts the movement of female users and other genders at night.

- The frequency of maintenance has to be increased.

7.4.1.2 Recommendations

- Provision of signages prominently displayed around the parks. Functional seats have to be placed every 500m. Colour segregated bins to be provided every 250m. Drinking water facility, gym and play equipment, jogging tracks / walking lanes, waste collection equipment etc. should be available.

- Composting equipment or compost pits shall be encouraged.

- Daily inspection is required in regards to cleaning and maintenance of all these facilities.

- Monthly inspection in order to ensure repairs and deployment of adequate staff by the sanitary inspector.

7.4.2 Issues and recommendations

7.4.2.1 Issues

- Due to the **poor maintenance and lack in availability of basic services** in these parks, the residents do not prefer to visit them.

- Also, since the spatial distribution of these parks is uneven, most of the households are quite far away from **accessibility** point of view, which further discourages them to use these facilities.

- Also, there is **no appropriate pedestrian infrastructure** which can ensure ease of walking or cycling to these spaces.

7.4.2.2 Recommendations

- The parks shall be deployed with necessary infrastructure and daily as well as monthly inspection by the direct supervisor and the sanitary inspector respectively.

- Seamless connection of parks from various households through soft scaping and green corridors along the streets.

7.4.3 Issues and recommendations

7.4.3.1 Issues

- Due to **the poor maintenance and lack in availability of basic services** in these parks, the residents do not prefer to visit them.

- Also, since the spatial distribution of these parks is uneven, most of the households are quite far away from **accessibility** point of view, which further discourages them to use them.

Also, there is **no appropriate pedestrian infrastructure** which can ensure ease of walking or cycling to these spaces.

7.4.3.2 Recommendations

- The parks shall be deployed with necessary infrastructure and daily as well as monthly inspection by the direct supervisor and the sanitary inspector respectively.
- Seamless connection of parks from various households through soft scaping and green corridors along the streets.

7.5 Issues and recommendations for transport and mobility

7.5.1 Issues and recommendations at city level

7.5.1.1 Issues

- Absence of pedestrian crossing facilities on almost all intersections.
- Major congested roads are **MG Road, by pass road and NH 2.** Enforcement of traffic rules is a major focus area that needs attention.
- In Agra, most of the roads are devoid of any pedestrian/non-motorized transport (NMT).
- **27% of the roads have footpath** and most of the roads lack footpaths posing safety threats to the pedestrians. Further at places, where the footpath exists the design standards are not maintained.
- **Encroachments by vendors** and for parking leaving no space for pedestrians to walk. Further these street infrastructure does not address universal accessibility.

7.5.1.2 Recommendations

- Provision of proper pedestrian infrastructure, which shall ensure decent walking spaces and cycling tracks.

- Complete Streets or **"Street for All",** where there is segregation of vehicular and pedestrian traffic.
- Enforcement of traffic management strategies and techniques.
- Proper maintenance of roads and related infrastructure.
- Organized system of last mile connectivity.
- Adequate street lighting
- Provision of parking facilities.

Strategies such as "Intelligent Transport Systems", use of transport cards, discouraging the use of private vehicles by improving the transport network etc. have to be adopted.

7.5.2 Issues and recommendations in Neighbourhood I

7.5.2.1 Issues

Traffic Congestion

- The Sabzi mandi chowk, Manik Tiraha, and other such intersections in the neighbourhood have no enforcement of traffic rules and application of traffic management techniques is a major focus area that needs attention.

Poor Public Transport Services

- Existing supply of last mile connectivity is absent. Thus, because of unreliable and poor coverage of public transport

Poor road infrastructure

- In this neighbourhood, most of the roads are devoid of any pedestrian/non-motorized transport (NMT) infrastructure. Most of the roads lack footpaths posing safety threats to the pedestrians. Further at places, where the footpath exists the design standards are not maintained.

Encroachments by vendors and for parking leaving no space for pedestrians to walk. The roads having an ROW of 6M are reduced to 4M of active movement. Further these street infrastructure does not address universal accessibility and also address the convenience and comfort of other users.

Poor Parking facilities and absence of walkable street networks

7.5.2.2 Recommendations

- The street sections have to be designed in such a manner such that it is inclusive for all. They have to be age friendly, should support universal accessibility and encourage safe walking and cycling practices.

- Multimodal street designs need to be incorporated.

Figure 7.4 Design of road sections and crossings
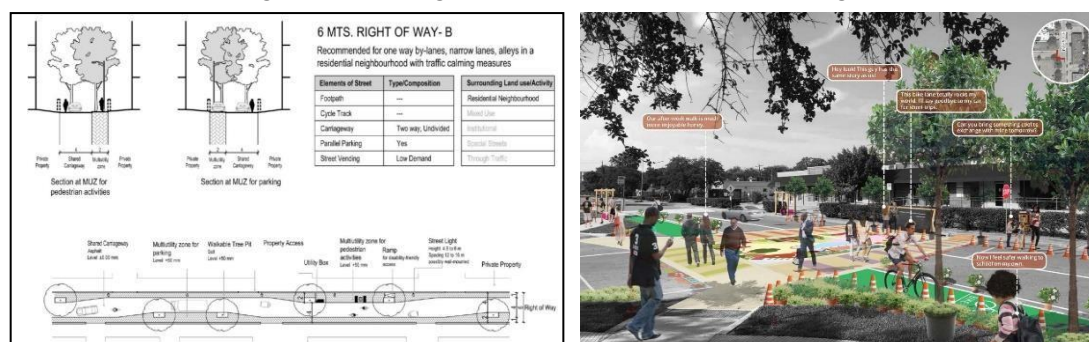
7.5.3 Issues and recommendations in Neighbourhood II

7.5.3.1 Issues

Traffic Congestion

- The Sabzi mandi chowk, and other such intersections in the neighbourhood have no enforcement of traffic rules and application of traffic management techniques is a major focus area that needs attention.

Poor Public Transport Services

- Existing supply of last mile connectivity is absent. Thus, because of unreliable and poor coverage of public transport

Poor road infrastructure

- In this neighbourhood, most of the roads are devoid of any pedestrian/non-motorized transport (NMT) infrastructure. Most of the roads lack footpaths posing safety threats to the pedestrians. Further at places, where the footpath exists the design standards are not maintained.

Encroachments by vendors and for parking leaving no space for pedestrians to walk. The roads have a ROW of only 3M. Further these street infrastructure does not address universal accessibility and also address the convenience and comfort of other users.

7.5.3.2 Recommendations

- The street sections have to be designed in such a manner such that it is inclusive for all.

- Roads having ROW of 3m should be fully paved and pedestrianized. Potted plants and green sit outs on intersections and along the streets shall be created.

- "Transit Oriented Development" along the highway has to be ensured as it is soon going to be imposed by Metro Rail.

7.5.4 Miscellaneous recommendations and strategies

Riverfront development along the Yamuna River:

- This initiative can result in active place making and creation of a city-wide recreational zone.

- It will help in maintaining the riverfront and revenue generation from the same. Also, it can be a place of interactions, festivals, fares, promotion of local crafts and the city's unique culture.

The marketplaces:

- Through "New Urbanism" and "Tactical Urbanisms", the market places can be well organised and refurbished to a well-maintained system.

Urban Agriculture

- Urban agriculture, urban farming, or urban gardening is the practice of cultivating, processing and distributing food in or around urban areas

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