Original Research Article

Urban Growth Analysis of National Capital Region of India Using Geospatial Technology

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Abstract

The urban growth refers to the movement of people from rural areas to urban areas, where there is a higher level of human population, economic activity, infrastructure, and significant expansion of land use. Urban growth is closely related to urbanization. In the National Capital Region (NCR), unplanned growth is one of the main problems. These obstacles limit the prospects for economic expansion. So, the study area of this research is the NCR of India. The study is based on the growth of urban areas from 1901 to 2011. The data is taken from the Census of India, Registrar General, and Census Commissioner, New Delhi. It has counted the total towns and population in Delhi, NCR, since 1901 and 2011. The District Census Handbook has been used for the collection of urban population and total population data for that district. Google Earth Pro has been used for the kml format of towns. ArcGIS 10.7 software has been used for mapping purposes. The number of towns has increased from 1901 to 2011. There have been found 182 towns in 2011. The towns also show positive and negative growth from 1901 to 2011. The maximum growth of towns was found after the liberalization period. The maximum growth of towns has been found in the Uttar Pradesh sub region. And most of the towns have transformed into urban regions.

Key Words: Urban Growth, NCR, GIS, Land Use

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INTRODUCTION:

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The term "urban growth" describes the flow of people from rural to urban areas, which are characterized by a large population, a high degree of economic activity, developed infrastructure, and dramatically higher land use. Urbanization and urban growth are closely related (Singh and Kumar, 2012). Urban growth is expressed in numbers, while urbanization is expressed in terms of a percentage or ratio of the total population. Growth in the urban sector is dependent on the development of industries and economic activities such as schools and colleges, hospitals, recreational facilities, IT (information technology) sectors, etc.

Van den Berg et al. (1982) and Klaassen et al. (1981) envision four stages of urban development. First, urbanization is the process by which some communities expand at the expense of the surrounding rural area. Second, the expansion of the urban ring (commuter belt) at the expense of the urban core is known as suburbanization, or exubanization. Third, disurbanization, also known as counterurbanization, is the process by which the population of the agglomeration decreases as a result of the urban core's population loss outpacing the ring's population growth. Fourth, reurbanization: the population of the central area begins to increase again after declining previously as a result of environmental and socio-economic problems. The National Capital Region (NCR) is the world`s largest urban agglomeration (UA). UA comprises a large number of towns, including municipal towns, census towns, revenue villages, outgrowth (such as factory townships, railway colonies, residential and commercial complexes), and cities in a particular region (Ghosh, and Ghosh, 1998, Tong et al, 2017). A town is generally larger than a village and smaller than a city, having 2500 to 20,000 residents. Cities are larger than towns and have 1 million populations or more. Revenue village, or administrative village, consists of one or more settlements or large central villages surrounded by a number of smaller hamlets. Revenue village consist with a population of 5,000 people or more (Ramachandran, 1989). The National Capital Region (NCR) is continuously spreading due to congestion in the city of Delhi, and the result has led to the emergence of suburbs and satellite towns such as Gurugram, Faridabad, Noida, and Ghaziabad (Kushwaha and Nithiyanandam, 2019). The identification of urban places in hierarchical patterns such as Hamlet-Villages-Towns-Cities constitutes the basic structural elements of India`s cultural landscape. Settlements consist of clusters of ten or more houses. Urban and rural societies differ in terms of their value systems and patterns of social behavior. Whereas urban areas have a higher concentration of people within a small area, the density of population is higher than rural areas (Ramachandran, 1989).There are three categories of urban places recognized in the Census of India, such as metropolitan areas, cities, and towns. Metropolitan area is the population with a million people or more, while cities are applied to all places with a population of one lakh or more. Towns are further subdivided into six classes on the basis of size. First class refers to the population of 100,000 or above and is termed a city. Class II towns have a population of 50,000 to 100,000, Class III towns (20,000 to 50,000), Class IV towns (10,000 to 20,000), Class V towns (5000 to 10,000), and Class VI towns (less than 5000).Urban areas with corporations, municipalities, cantonments, or notified towns (also referred to as statutory towns) were the first category of urban places as defined by the Census of 1981. Second, any location that met all the requirements—which included having a minimum population of 5,000, at least 75% of male workers in the non-agricultural sector, and a population density of at least 400 people per square kilometer—was considered a Census town. Understanding the evolution of urban stages and the differential growth that demonstrates the degree of rural to urban migration may be aided by looking at urban growth by size class town Bhagat, 2004).The municipal committee is a transitional area with a

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population not exceed 50,000. The municipal council is a smaller urban area with a population exceeding 50,000 but not exceeding 3 lakh (Kumar, 2015). In 1971, the Census introduced the Standard Urban Area: the minimum population size of a core town should be about 50,000. It covers not only built-up cities but also the rural belt, which is likely to be urbanized in the future (Ramachandran, 1989). In 1981, urban structure in India was identified in such a way: metropolises (million cities), cities (class I cities), medium towns (class II and class III), small towns (class IV and class V towns), and mini towns (class VI towns) (Ramachandran, 1989). A new town concept emerged a long time ago that tried to create new planned settlements far away from the big metropolitan cities and also came to be called "satellite towns" (Cirolia, 2014).One of the most important indicators of economic growth and one of the main factors influencing the Indian economy is urbanization. Migration from other regions of the nation leads to economic growth. Thus, one of the main causes of the population growth in a given region over time is migration.

ORIGIN:

The development of urban areas was linked to changes in human societies at the beginning of the Neolithic period (6000–10000 years BP) and associated with the development of human control through domestication of animals, irrigation, and crop production. The story of urbanization in India is a story of spatial and temporal discontinuities. The urban history of India is divided into five time periods on the basis of temporal discontinuities. First, the pre-historic period (2350 to 1800 BC); second, the early historical period (600 BC to 500 AD); third, the medieval period (600 AD to 500 AD); fourth, the British period (1800 AD to 1947); and fifth, the post-independence period (since 1947 onward). Urbanization began in the Indus Valley due to the migration of people from other places (mostly Mesopotamia) because of the presence of fertile land, abundance of water availability, etc. India`s first census was launched in 1872. Every 10 years, the census will provide information on the growth of cities and towns in India. The 19th century saw the emergence of a new class of towns in the hilly areas of Himalaya and the south. The post-independence period saw the beginning of city planning in India. A town and country planning organization established by the central government prepared a master plan for Delhi in 1957. The recommendation of the first master plan for Delhi in 1962 that drives a broad area of Delhi and surrounding towns. It should be developed as a metropolitan region to reduce population pressure. The National Capital Region and its Planning Board were created under the three National Capital Planning Board Acts of 1985 that concerned state government for the growth of outside of the NCR. This act provides a plan for the development of the NCR and coordinates, monitors, and controls the land- use and development of infrastructure in the NCR. The 1985 Act includes the Haryana districts of Gurugram, Faridabad, Sonipat, and Rohtak (including Jhajjar tehsil) and Rewari tehsil, then Mahendragarh district; Uttar Pradesh districts include Bulandshahr, Meerut,

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and Ghaziabad (then including Hapur tehsil); and some parts of the Rajasthan district include Alwar. Gautambuddha Nagar district was created in 1997 from the existing districts of Bulandshahr and Ghaziabad. In 1997, the Baghpat district was created from the Baghpat tehsil of Meerut district. In July 2013, NCR included three more districts of Haryana, like Bhiwani and Mahendragarh, as well as Bharatpur in the state of Rajasthan. Charkhi Dadri district was separated from Bhiwani in 2016. On June 15, 2015, the Government of India approved including three more districts in the NCR, such as Jind and Karnal in the state of Haryana and Muzaffarnagar in the U.P. and in december 2017, Shamli district of Uttar Pradesh was included in the NCR. In January 2018, the government of Uttar Pradesh formally proposed the extension of the NCR to include the districts of Aligarh, Hathras, Bijnor, and Mathura, which are pushing to have the district of Agra in the NCR. Punjab is also forcing the districts of Patiala and Mohali to be included in the NCR. Bhadra district of Rajasthan is also included in the future extension plan. The development of counter-magnet areas in the NCR was envisaged in the 2001 regional plan; such areas are located away from the NCR. The regional plan of 2001 identified the counter-magnet area to the NCR for the first state, such as Hisar in Haryana, Patiala in Punjab, Gwalior in Madhya Pradesh, Kota in Rajasthan, and Bareilly in Uttar Pradesh. The policy for NCR Plan 2021, environmentally sustainable development and redevelopment for NCT Delhi and the Central National Capital Region (CNCR), includes the notified area of the adjoining towns of Gurugram-Manesar, Ghaziabad-Loni, Noida, Faridabad-Ballabhgarh, Bahadurgarh, and Sonipat-Kundli. The total area of CNCR would be about 2000 sq km (excluding NCT Delhi). The CNCR and highway corridor zones are comprised of both urban and rural areas. The approximate area of this zone would be about 29,795 sq. km. The regional plan for 2021 has identified the two major centers: First, metro centers include Faridabad-Ballabhagarh, Gurugram-Manesar, Ghaziabad-Loni, Noida, Sonipat-Kundli, Greater Noida, and Meerut. Second, regional centers include Bahadurgarh, Panipat, Rohtak, Palwal, Rewari-Dharuhera, Bawal, Hapur-Pilkhua, Bulandshahr-Khurja, Baghpat, Baraut . Alwar, Greater Bhiwandi, Shahjahanpur, Neemrana, and Behror.

RESEARCH PROBLEMS:

In the NCR, unplanned growth is one of the main problems. India's unplanned growth is a result of the country's post-independence adoption of the Town and Country Planning Act 1947 of the United Kingdom. Even though the National Capital Region (NCR) has two master plans and the NCT (National Capital Territory) has three master plans, the NCR as a whole faces a number of challenges, including poor housing, water shortages, traffic congestion, power outages, and other issues that lead to a decline in healthcare, education, and other aspects of quality of life. Growth in the economy is hampered by these issues. Urban expansion has an effect on the surrounding areas, either directly or indirectly. This includes cropland erosion, ecological degradation, climate change, and the urban heat island effect. Agrarian

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societies are impacted by changes in land use patterns brought about by the expansion of urban areas. The National Capital Region (NCR) of Delhi faces various obstacles in managing the swift urban expansion, including unbridled land expansion, inadequate use of limited resources like water and land, elevated pollution levels, and other fundamental aspects like standard of living. The quality of life, healthcare, education, and sanitation all suffered as a consequence. Numerous issues have arisen as a result of the quick development of millions of cities, including the lack of affordable housing for the less fortunate members of society and their disproportionate concentration on either public or private property. Unplanned urban sprawl has resulted in the physical expansion of major cities into outlying villages. Therefore, the majority of the major cities are now surrounded by a rural-urban fringe. One of the biggest issues facing the cities is providing basic services to the slum dwellers and the outlying villages, such as paved roads, sewerage, drainage, and piped water supplies. Delhi's population has more than doubled in the last 20 years, adding to the strain on already limited resources. The city itself faces challenges like 1000 million liters of water per day and roughly 2,103 km/100 sq. ft. of high road density. As a result, population growth has been spreading to neighboring areas of Gurugram, Faridabad, the New Okhla Industrial Development Authority, Noida, and Ghaziabad. All of these cities, including Delhi, refer to CNCR, which experiences significant immigration.

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OBJECTIVE:

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To analyses the urban growth and distribution of different class towns in NCR Delhi.

DATA SOURCES AND METHODOLOGY:

Methodology is a major part of any research. It is a system of methods, which means which types of techniques are used to identify, select, process, and analyze the information about the topics. A brief overview of source materials and methodology is used for urban development and growth. The details of the source materials are given in references. India is very rich in secondary sources of information for urban studies. The study is based on the growth of urban areas from 1901 to 2011. The data is taken from the Census of India, Registrar General, and Census Commissioner, New Delhi. It has counted the total towns and population in Delhi, NCR, since 1901 and 2011. The District Census Handbook has been used for the collection of urban population and total population data for that district. Google Earth Pro has been used

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for the kml format of towns. Table maps and charts have been used for analysis purposes. ArcGIS 10.7 software has been used for mapping purposes.

The study of the gathered data, mainly from the census of India brought by the Registrar General and Census Commissioner, includes the following:

- Census of India: Population Enumeration Data—Primary Census Abstract Data Tables (India & States/UTs—Towns/Villages/Ward Level).
- Census of India: Decadal variation in population since 1901.
- Census of India: A-4 Towns and Urban Agglomerations classified by Population Size Class in 2011 with Variation since 1901.

The data is obtained from different sources using suitable statistical techniques for urban growth. The techniques used for:

Urban Percentage: $(P_2/P_1) \times 100$

Where P_2 = total urban population and P_1 = total population

Growth Rate (r): The annual average rate of change in population size for a given country or geographic area during a specific time period. It expresses the ratio between the annual increase in population size and the total population for that year, which is usually multiplied by 100.

$(r) = (P_t - P_0)/P_0 \times 100$

Where Pt = initial population

P0 = population before 10 years

Annual Exponential Growth Rate/Geometric Growth (re): when the growth rate is proportional to the size of the population with the passing of time, creating the curve of an exponential function.

re = antilog[1/10(logPt+10-Pt)] -1

where P_t = initial population

P_t+10= Population after 10 years

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Methodology

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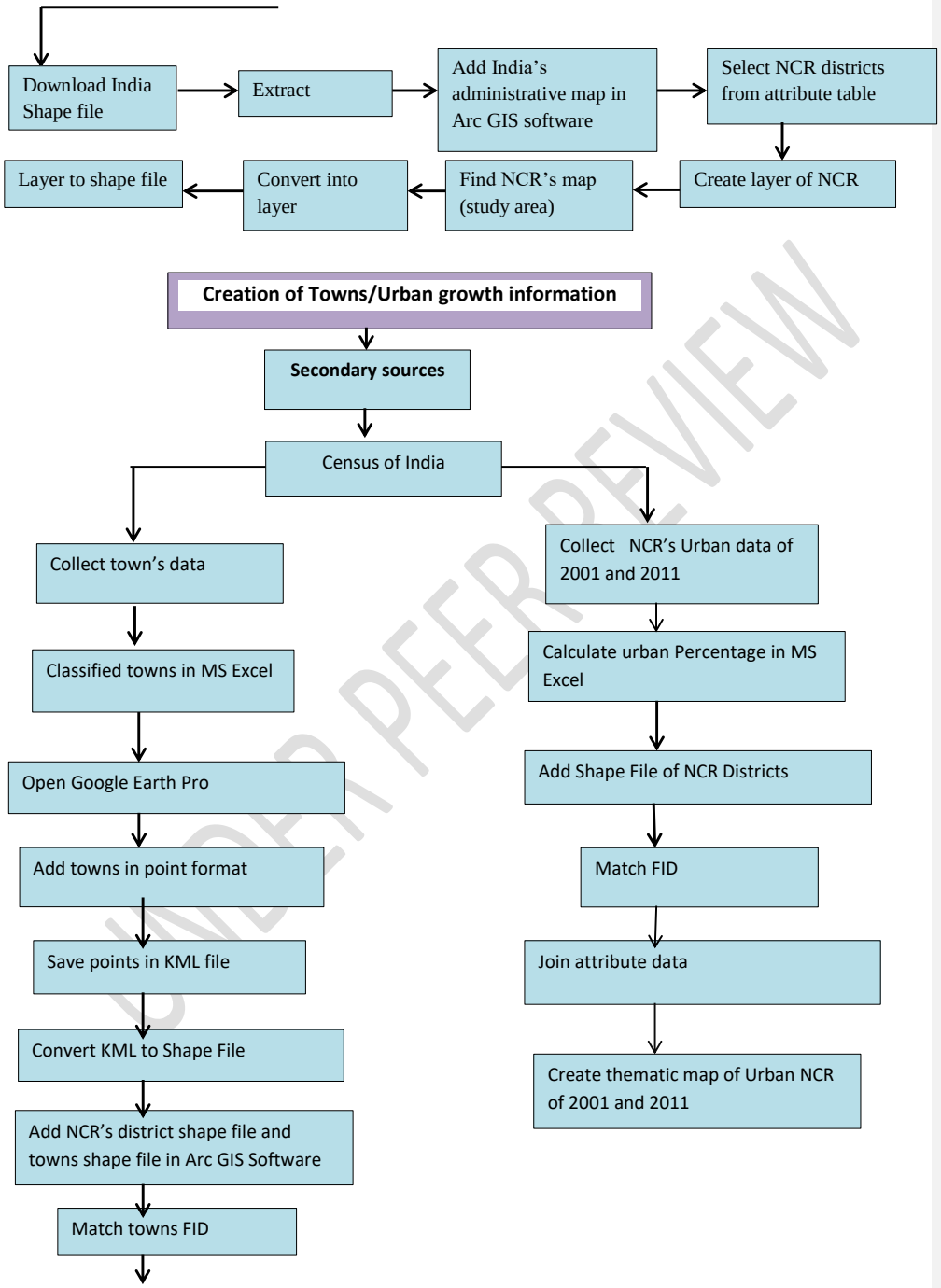

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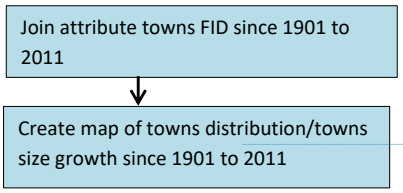

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Fig I : Methodological Flow Chart

STUDY AREA:

The National Capital Region (NCR) is a central planning region. It encompasses the entire NCT and several districts of the surrounding states of U.P., Haryana, and Rajasthan. The most prominent cities in the NCR include Delhi, Gurugram, Faridabad, Noida, and Ghaziabad. NCT consists of the NCR, including Delhi Municipal Corporation (DMC), New Delhi Municipal Council (NDMC), and Delhi Corporation (DC). Delhi NCR lies at 280 36′ 36 N latitude and 770 13′ 48 E longitude. The entire Delhi NCR has stretched about 30,242 sq. km. The entire region of Delhi NCR lies between the Himalayas in the north and the Aravalis in the south, and there are two major rivers (Ganga and Yamuna) that pass through the Delhi NCR. Delhi NCR is located in the plains region. The climate in this area is characterized by hot and dry summers and cold winters.

Map I: Study area of National capital region

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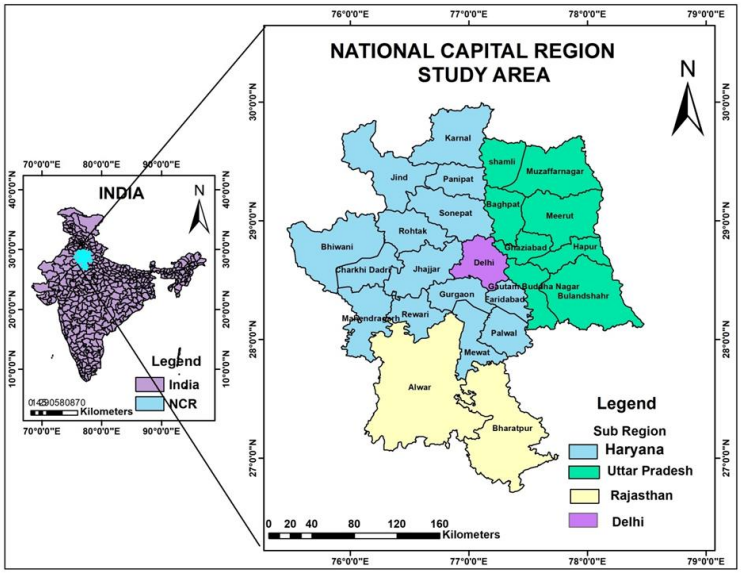

Table I -.There are total 24 districts include in NCR except NCT Delhi, which are given Table:

NCR SUB-REGION	DISTRICTS NAME	DISTRICTS No.
HARYANA	Faridabad, Gurugram, Mewat, Jhajjar, Rohatak, Panipat, Rewari, Sonipat, Karnal, Jind, Palwal, Mahendragarh, Bhiwani, Charkhi Dadri.	14
UTTAR PRADESH	Ghaziabad, Meerut, GautamBuddha Nagar, Bulandshahr, Hapur, Baghpat, Samli, Muzaffarnagar.	8
RAJASTHAN	Alwar and Bharatpur	2
DELHI	NCT Delhi	1

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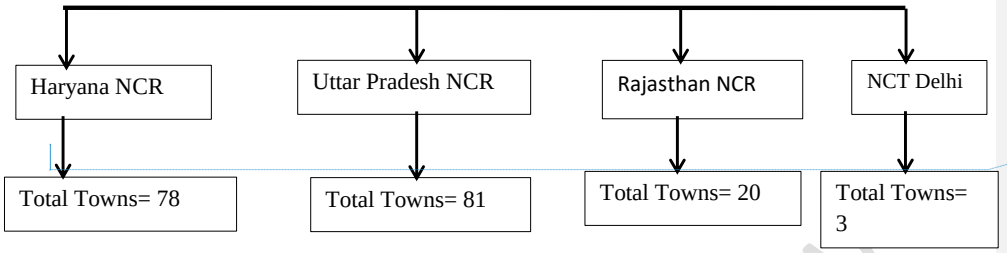
Fig II. There are total 182 towns in Delhi NCR, following below:



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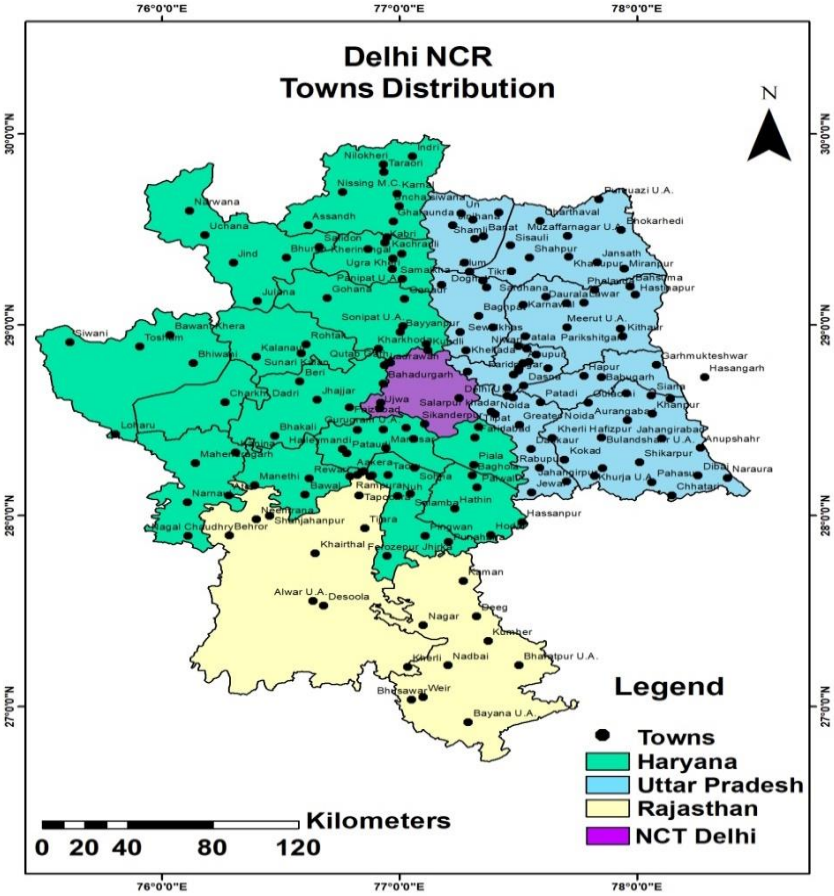
Map II: Towns distribution in NCR



ANALYSIS:

An analysis of the growth pattern of the population in the National Capital Region since 1901–2011 is based on the growth of population in towns and population projection, which clearly indicate that urbanization

and urban population have registered a rapid increase in population in comparison to their rural counterparts. The NCR is a rural-urban region with a population of over 46,069,000. The 1985 boundary of the NCR covered an area of 34,144 km^2. After including many districts in the NCR, the area has expanded. Now, the total area covers 54,984 km^2.

Growth of Towns in NCR:

The analysis looks at different features of towns of different sizes. There are total 182 towns located in NCR. Where, the majority of towns are located in the Uttar Pradesh sub region, followed by Haryana, Rajasthan, and Delhi. The maximum number of towns lies in town size class IV, which is given in Table II.

Table II : The total number of towns in sub region of NCR

Sub-Region of NCR	Number of Towns	Class I (Above 100,000)	Class II (50000-99,999)	Class III (20,000-49,999)	Class IV (10,000-19,999)	Class V (5,000-9,999)	Class VI (Below 5,000)
Haryana	78	11	5	21	18	21	2
Uttar Pradesh	81	10	5	22	29	15	-
Rajasthan	20	3	-	10	3	4	1
Delhi	3	1	-	-	-	2	1
NCR	182	24	10	53	50	42	4

Note: Delhi, U.A., lies in class I, and only three towns in Delhi have emerged, such as Qutub Garh and Jafar Kalan, which lie in class V, and Ujawa, which lies in class VI.

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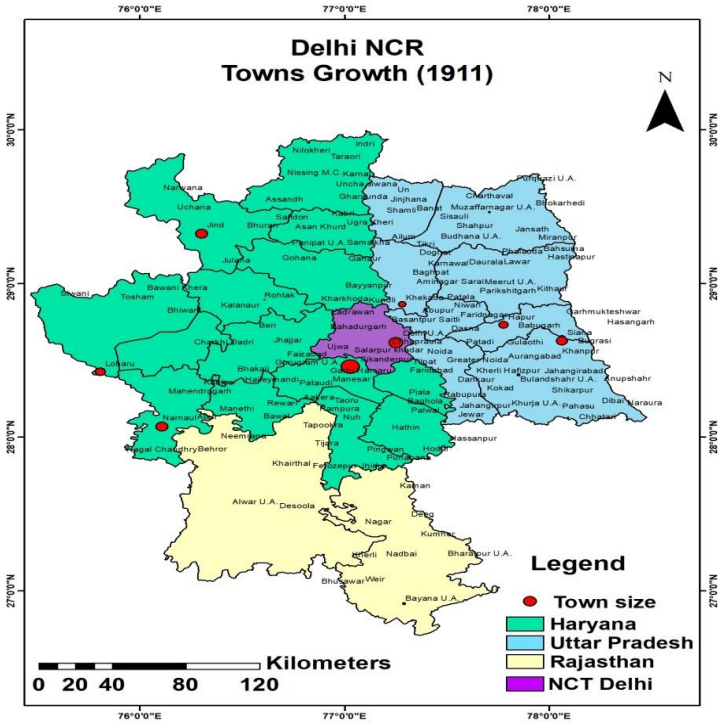
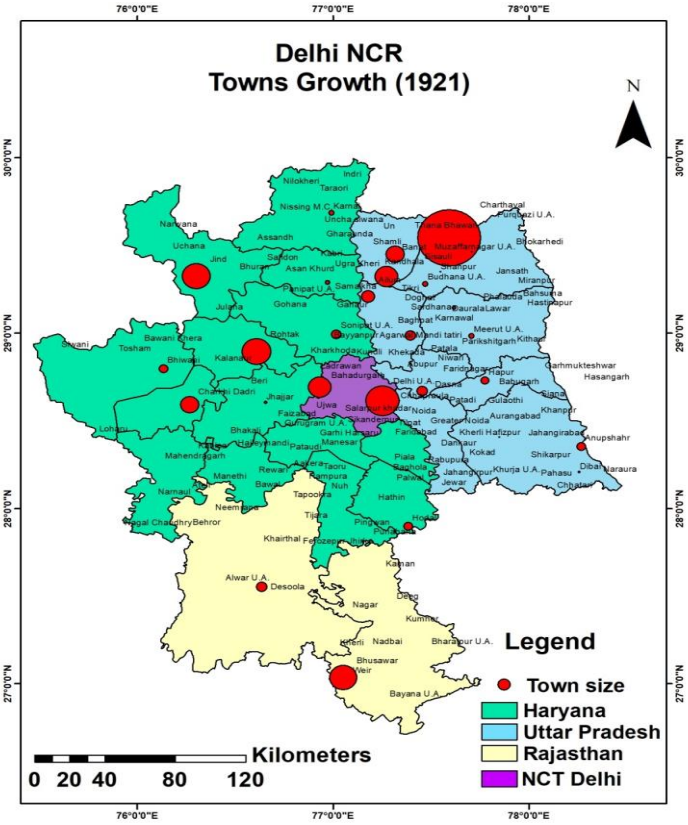
Growth of Town size in the sub region of NCR:

Map III: Growth of Towns Population of NCR in 1911



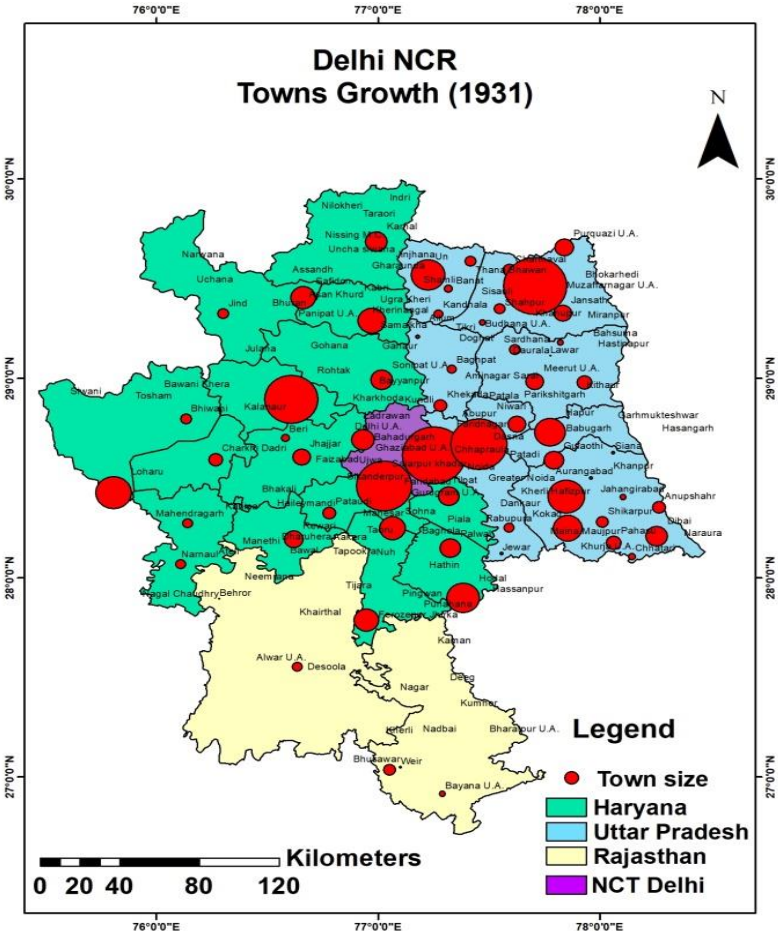
Map III: This map reveals that there were few towns located in the NCR in 1911. The population of these towns increased in 1911 as compared to 1901 because there was no growth in town population in 1901. The maximum number of towns is growing in the Uttar Pradesh sub-region of the NCR. The growth of towns includes such cities as Delhi (11.13%), Gurugram (14.61%), Jind (9.15%), Hapur (7.56%), etc.

Map IV: Growth of Towns Population of NCR in 1921



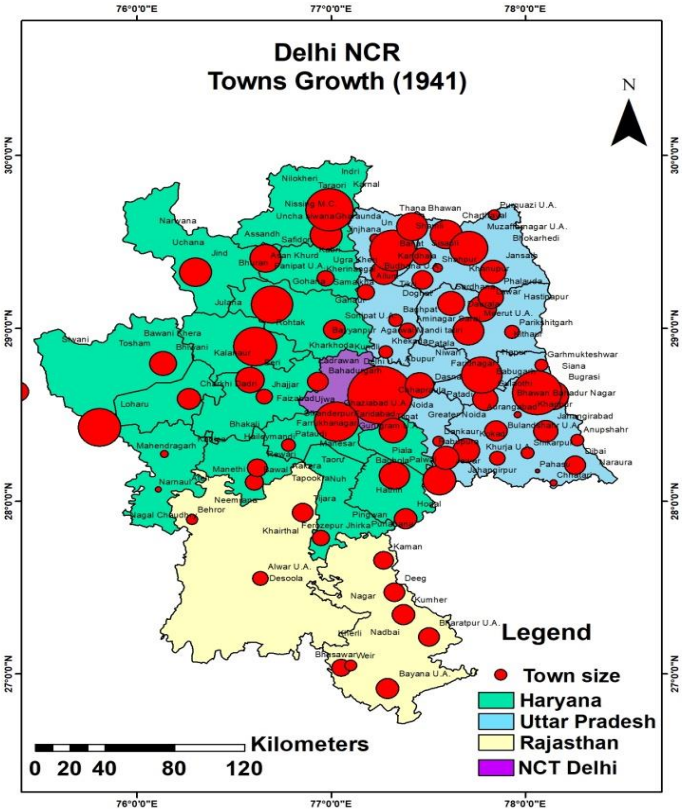
Map IV reveals that the number of towns and size of towns have increased. And some new towns emerged in 1921, but some towns are facing negative growth that emerged in 1911, such as Gurugram (-6.48%). The towns of Charthaval (53.3%) have rapidly grown from 1911 to 1921, which was negative growth in 1911. The growth of the population in Delhi (27.94%) has increased this year. The two towns of Alwar and Weir have grown in the Rajasthan sub-region this year.

Map V: Growth of Towns Population of NCR in 1931.



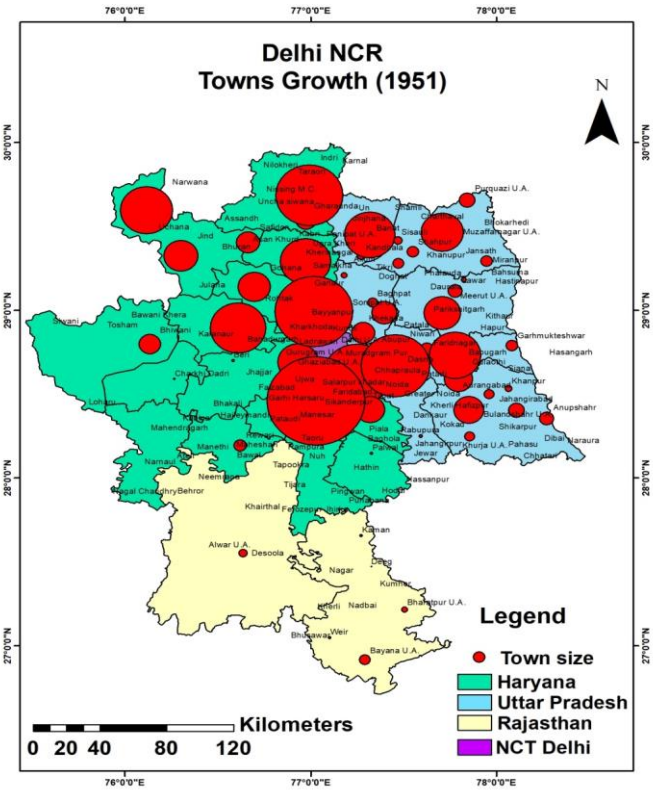
Map V shows that the number of towns has increased and grown to a larger size since 1901 to 1931. The maximum number of towns has grown around NCT Delhi.

Map VI: Growth of Towns Population of NCR in 1941.



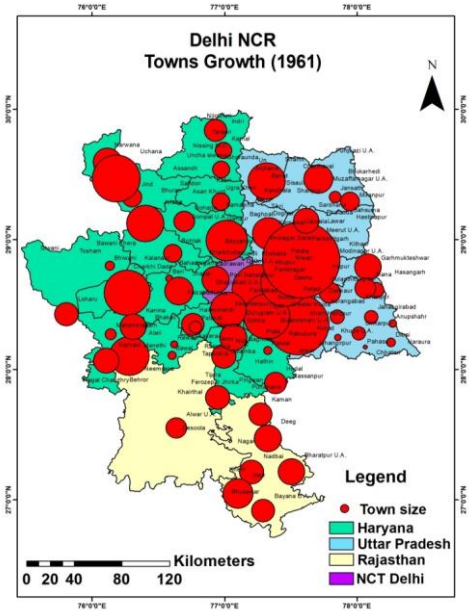
Map VI reveals that some areas of the NCR experiencing town agglomeration due to the growth of population in towns. The maximum growth of towns was experienced in the Uttar Pradesh sub-region. The number of towns has increased in the Rajasthan sub-region as compared to 1931.

Map VII : Growth of Towns Population of NCR in 1951

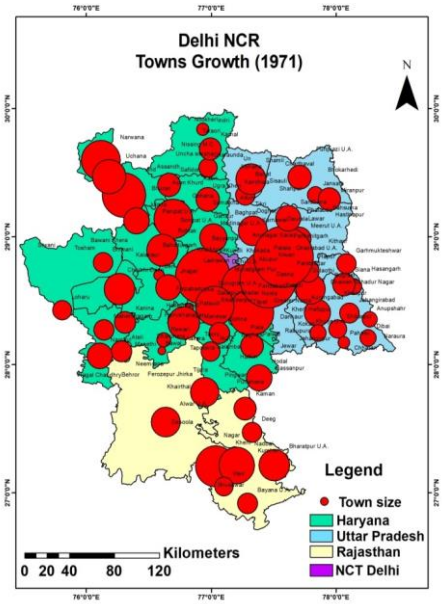


Map VII reveals that after independence, the maximum number of towns near the NCT Delhi grew. And most of the towns are transformed from towns to urban. But most of the towns have experienced negative growth in the sub-region of the NCR.

Map VIII: Growth of Towns Population of NCR in 1961.



Map IX: Growth of Towns population of NCR in 1971.



According to maps VIII and IX, the maximum number of towns has increased significantly since 1951. Town growth in 1971 was marginally slower than in 1961. Since until 1971, the population of the po towns has grown at an accelerated rate. And in 1961 and 1971, the majority of them became urban instead of rural.

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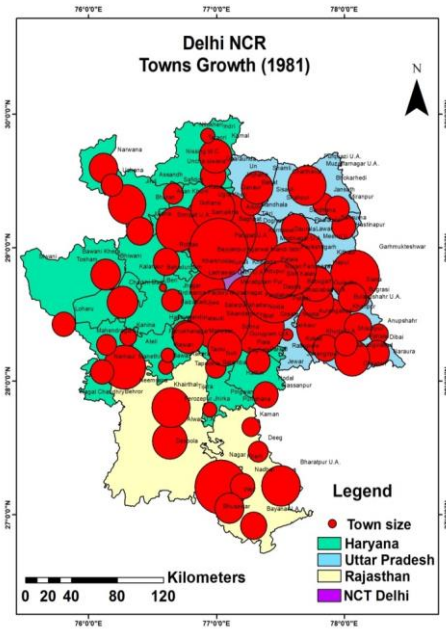
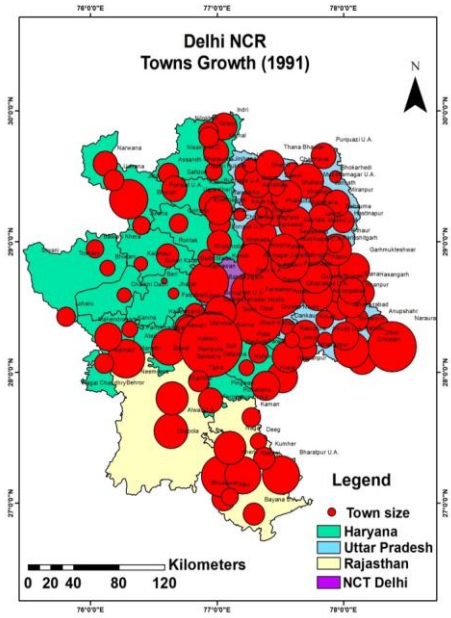
Map X: Growth of Towns Population of NCR in 1981.

Map XI: Growth of Towns Population of NCR in 1991.



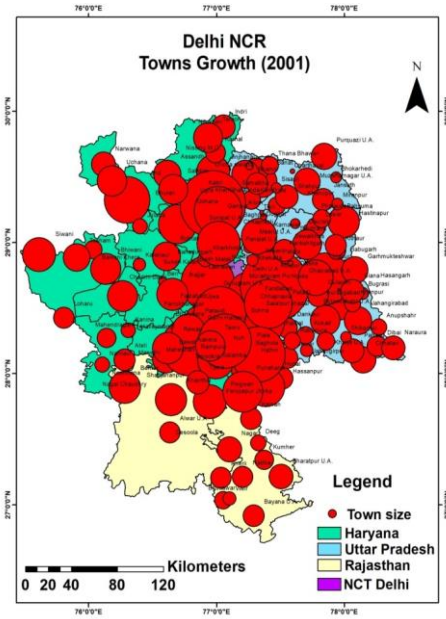


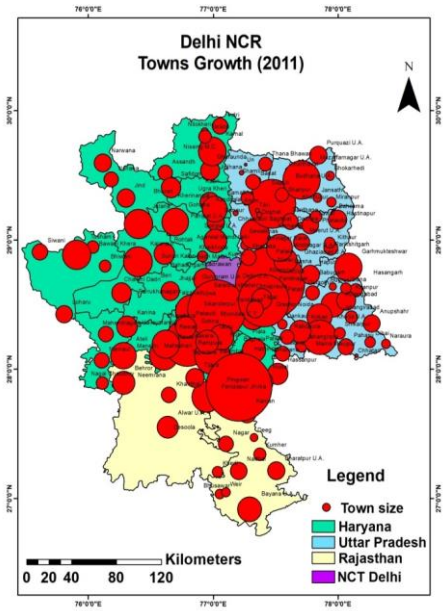
Map X reveals the rapid and maximum growth of towns around NCT Delhi, such as the districts of Panipat, Sonipat, Gurugram, Ghaziabad, etc. The western part of the Haryana subregion and the central and southern sub-regions of Uttar Pradesh have rapidly grown compared to previous decades.

Map XI reveals that the maximum number of towns have grown in the Uttar Pradesh sub-region and experienced closer and closer towns as compared to the Haryana and Rajasthan sub-regions. And the northern part of the Uttar Pradesh sub-region has seen a growth in population as compared to 1981. And the central region of Bharatpur district has also experienced the growth of towns.

Map XII : Growth of Towns Population of NCR in 2001.

Map XIII : Growth of Towns Population of NCR in 2011.





In all NCR sub-regions, the maximum number of towns has increased as of 2001 (Map XII). After 1991 (the start of the liberalization policy), the number of towns that grew the fastest were Ghaziabad, Gurugram, Gautam Buddha Nagar, Panipat, etc. Additionally, most of the NCR's sub-regions saw a decrease in town population growth in 2011.

Growth of Urban Population in sub-region of NCR:

Growth of Urban Population in Uttar Pradesh Sub Region:

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The NCR includes the districts of Baghpat, Ghaziabad, Bulandshahr, and Meerut. In 2015, the government gave its approval for Shamli and the Muzaffarnagar district to be included. Up until now, the NCR has encompassed a total of 8 districts located in Uttar Pradesh. The population growth in these districts is shown in Table III.

Table III: Growth of Urban Population in sub region of NCR

Sr. N.	NCR Sub Region	Growth of Urban Population in %	
		2001	2011
1	Baghapat	13.83	21.11
2	Bulandshahr	32.66	24.79
3	Gautam Buddha Nagar	8.68	59.12
4	Ghaziabad	76.22	67.55
5	Hapur	35.72	36.94
6	Meerut	67.43	51.08
7	Muzaffarnagar	3.2	28.75
8	Shamli	30.84	31.49
9	Bhiwani	35.48	19.66
10	Faridabad	19.18	79.51
11	Gurugram	35.58	68.82
12	Jhajjar	22.17	25.39
13	Karnal	40.01	30.21
14	Jind	_	22.9
15	Mahendragarh	13.49	14.41
16	Mewat	7.51	11.39
17	Palwal	24.92	22.69
18	Panipat	40.53	46.05
19	Rewari	17.79	25.93
20	Rohatak	35.06	42.04
21	Sonipat	25.12	31.27
22	Charkhi Dadri	_	_
23	Alwar	46.82	17.81
24	Bharatpur	19.46	19.43

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According to Table III, Gautam Buddha Nagar's urban population grew by 8.68 percent in 2001 and is now growing at a faster rate, reaching approximately 59 percent in 2011. There was also a sharp rise in Muzaffarnagar, which went from 3.20 percent in 2001 to 28.75 percent in 2011. However, between 2001 and 2011, Bulandshahr, Ghaziabad, and Meerut saw declines. As per the 2001 census, Meerut, U.A., has become a city with a population of one million or more. The Delhi neighborhood is responsible for both the growth rate increase and decrease observed in recent times.

Growth of Urban population in Haryana Sub Region:

In Haryana, the NCR encompasses fourteen districts. In comparison to the rural population of Uttar Pradesh, the rural population in these districts is growing at a faster rate. The rate of population growth from rural to urban areas varies as well. In Haryana's NCR districts, the growth of the urban population is influenced by the comparatively higher percentage growth of the rural population. According to Table III, the district of Faridabad has experienced a consistent rise in its urban population, with 19.18 percent in 2001 and 79.51 percent in 2011. Gurugram has also experienced this trend, with 35.58 percent in 2001 and 68.82 percent in 2011. Between 2001 and 2011, the population of other urban districts, including Bhiwani, Karnal, and Palwal, decreased. There is no data available for Charkha Dadri in 2011 because this district was included in the NCR in 2016 after being separate from Bhiwani.

Growth of Urban Population in Rajasthan Sub Region:

The Alwar district comes under the NCR in the National Capital Region Planning Board Act of 1985. And Bharatpur district was included in the NCR in 2013. The growth of the rural population in these districts is relatively constant or higher. And the growth of the urban population depicts a different trend. Table III reveals that the Alwar district saw a rapid increase in urban population in 2001, but after one decade, the growth of the urban population has declined rapidly. And also, the growth of population in Bharatpur district has decreased at a rate of 0.03 percent.

Growth of population in NCT Delhi:

NCT Delhi was always the center of attraction for the people, and the population has increased since 1901 to 2011 due to migration. The urban population in 1901 was 11.13 percent, and this has increased to 67.49 percent since 2011. The maximum number of urban residents increased by 92.9 percent in 2001. And the rural area is shrinking rapidly. Table IV depicts the percentage variation in population since 1901 to 2011.

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Table IV: Decadal variation/Growth in urban population in Delhi

Census Decades	1901-1911	1911-1921	1921-1931	1931-1941	1941-1951	1951-1961	1961-1971	1971-1981	1981-1991	1991-2001	2001-2011
Urban Population (%)	11.13	27.94	46.98	55.48	90.58	64.17	54.57	58.16	46.87	92.97	67.49

RESULT AND DISCUSSION:

There are 182 towns in the National Capital Region. The growth of the town population in NCR has been represented since 1901 to 2011. The number of towns has increased since 1901. The towns are included in Delhi (3 towns), Haryana (78 towns), Uttar Pradesh (81 towns), and Rajasthan (20 towns). Since 1901, most of the towns have merged into urban areas.

The growth of towns has occurred in large numbers since 1901 to 2011. The growth of town population since 1901 to 2011 such as Alwar (-27.24 % to 28.26%), Aurangabad (-2.77 % to 32.08%), Bhaghapat (-10.48 % to 38.28%), Bhiwani (-13.41 % to 38%), Bawal (-7.09 % to 38.40%), Bharatpur (-22.21 % to 23.19%), Deeg (-14.68 % to 10.13%), Gurugram U.A. (14.61 % to 76.75%), Jhajjar (-13.17 % to 24.16%), Jind (9.15 % to 23.36%), Khekada (5.43 % to 20.68%), Khurja U.A. (-6.46 % to 44.60%), Mahendragarh (-2.23% to 19.75%), Rewari (-9.21% to 36.03%), Sohna (-14.71% to 32.58%), Weir (-10.17% to 11.80%) and others.

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Fig. III represents the positive and negative growth of the town population from 1901 to 2011. The maximum numbers of towns have grown upward during 2001 and 2011, but during 1971, they experienced negative growth in their population. And also, some towns are facing negative growth in 2011. The maximum growth of towns has been found in the Uttar Pradesh sub-region of the NCR.

Fig III: Growth of towns population in NCR since 1901 to 2011.

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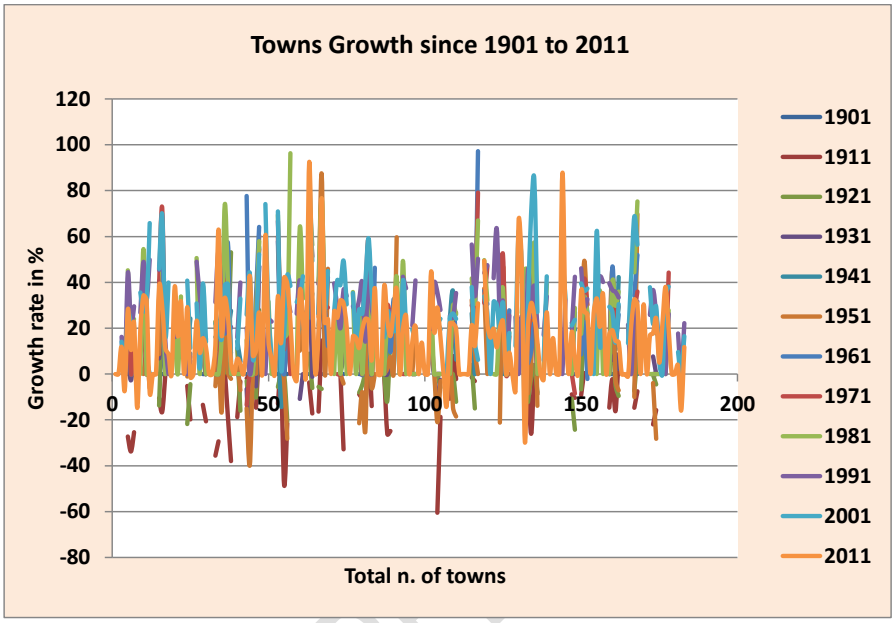

Fig. III represents the map of urban growth, which represents the growth of the urban population of the NCR from 2001 to 2011. In 2011, the urban population increased in sub-regions of the NCR like Delhi, Gurugram, Faridabad, Ghaziabad, etc. The maximum growth of town population has been shown in Gurugram (35.58% to 68.82%), Faridabad (19.18% to 79.51%), Ghaziabad, Meerut, Panipat, Rohtak, etc. since 2001 to 2011.

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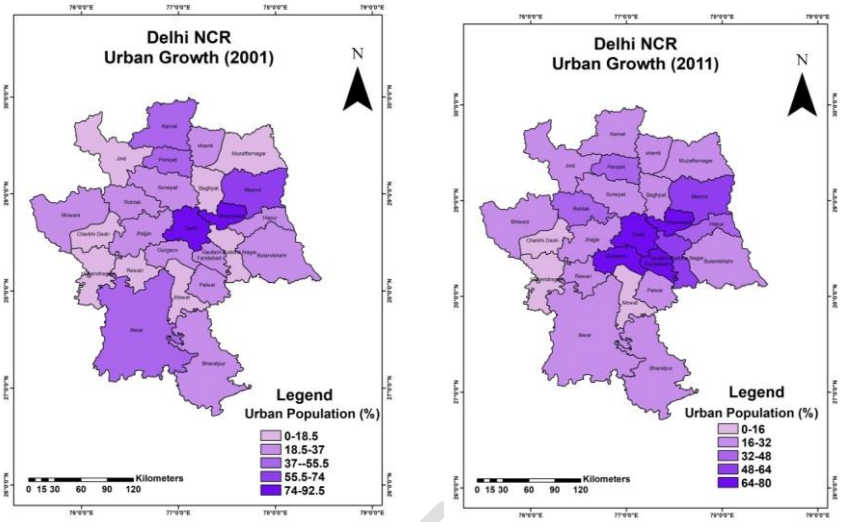
Map XIV: represent the growth of urban population in NCR since 2001 to 2011.



The study also found that most of the districts were included in the NCR after 2011, such as Charkhi Dadri from Bhiwani, Shamli from Muzaffarnagar, Hapur from Ghaziabad, and Mewat from Gurugram. Due to the rapid growth of population in the NCR, it may result in the emergence of a greater NCR in the future. NCR has achieved this with larger villages and towns, bringing more area under urban infrastructure with extended communication and facilities. The rural workforce is gradually shifting toward a variety of non-farming activities. The study found that the inclusion of large villages in smart city missions, smart village missions, or special economic zones projects will make the urbanization process viable; securing that future towns and cities will be livable. Rural-urban differences and regional imbalances have been found to be minimized by creating new regions of development beyond existing urban areas. So the number of towns has developed between the rural and urban fringes. It also shows the several challenges existing in the NCR region, such as traffic congestion, power cuts, housing shortages, water shortages, etc., which, as a result, decline the quality of life, education, sanitation, healthcare, etc. These challenges restrict the potential for economic growth. And urban growth has a direct or indirect impact on surrounding areas.

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CONCLUSIONS:

The National Capital Region studied the changing pattern of urban growth from 1901 to 2011, that is, the movement of people from rural areas to urban areas, places where there is a there is a high human population, a high level of economic activity, infrastructure, and significantly increased land use. The growth in the urban sector is dependent on the development of towns, industries, and economic activities such as schools and colleges, hospitals, recreational facilities, IT (information technology) sectors, etc. The NCR is continuously spreading due to congestion in the city of Delhi, and the result has led to the emergence of suburbs and satellite towns such as Gurugram, Faridabad, Noida, and Ghaziabad. There are a larger number of towns that have emerged and grown upward in the NCR from 1901 to 2011. The data sources for the study of the growth of the NCR were based on secondary sources such as the Census of India, the district census handbook, etc., and used Arc GIS 10.1 software and Google Earth Pro for map purposes. The number of towns has increased from 1901 to 2011. There were 182 towns discovered in 2011. The towns also show positive and negative growth from 1901 to 2011. The maximum growth of towns was found after the liberalization period. The maximum growth of towns has been found in the Uttar Pradesh subregion. And most of the towns have transformed into urban regions.

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Due to the extension of urban areas, the land use pattern changes, this affects agrarian societies. The rural-urban fringe has emerged around most of the large cities in the NCR. The provision of basic amenities such as piped water supply, sewerage, drainage, and paved roads to the slum dwellers and the fringe villages faces a major problem for the cities.

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