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A Spatial Pattern Of Population Growth And Urban Development In Dibrugarh City, Assam

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ABSTRACT
This case study examines the growth and development of Dibrugarh City in Assam over the past few decades. It analyses the current and past settlement areas, demographics, and municipal records to study both its population and land area expansion over the years. The results show that Dibrugarh has gradually and economically expanded core areas of the city, driven by population growth, improved infrastructure. The growth of the city has also increased the number of residential neighbourhoods, commercial centres, industrial zones, and educational institutions. A detailed examination of the wards indicates that the population growth is not balanced some areas are significantly overpopulated relative to others, demonstrating the city's uneven development. The city is also dealing with rapid changes in land use, strained infrastructure systems, and the dangers of haphazard urban sprawl. The findings of the study provide Dibrugarh's urban planners and policymakers with awareness of the city's dynamics to better assist in building a more balanced urban development.
Keywords: *Population Growth, Urban growth, Dibrugarh city*

INTRODUCTION

Urban growth and development in Indian cities show a wide variety of patterns shaped by historical, geographical, economic, and policy-related factors. Broadly, these growth styles can be classified into linear, radial, infill, leapfrog, and sprawl patterns, each with different impacts on infrastructure, the environment, and socio-economic conditions. For example, many cities such as Delhi, Mumbai, and Kolkata have grown radially from a historical core, following Burgess' Concentric Zone Model (Burgess, 1925), where expansion happens outward in rings, often along transport routes and economic hubs. Cities like Chandigarh and Jaipur display linear growth along major roads or railways, which is explained by the Harris and Ullman Multiple Nuclei Model (Harris & Ullman, 1945), where multiple centers of activity develop based on accessibility and function. Rapidly urbanizing cities such as Bengaluru, Pune, and Hyderabad often show leapfrog growth, where certain areas are skipped over during development, creating fragmented land use patterns (Bhatta, 2010). In contrast, Gurugram and Noida have seen significant sprawl due to real estate-driven expansion, which is often unregulated and inefficient (Sivaramakrishnan, Kundu, & Singh, 2005). Metropolitan cities like Mumbai, Delhi, and Chennai also face land constraints, leading to vertical expansion with high-rise residential and commercial buildings for space optimization (Shaw, 1999). Across India, unplanned and unregulated growth threatens the sustainable development of cities and creates future challenges. (Sivaramakrishnan, Kundu, & Singh, 2005). Similar to these trends, Dibrugarh an important city in Assam has also experienced significant spatial and population growth over the years. Its expansion includes new residential, commercial, industrial, and institutional developments, spreading from the city center to the peripheries. Understanding Dibrugarh's spatio-temporal growth patterns provides insights into the driving forces behind its transformation and the varied development across different parts of the city.

MATERIALS AND METHOD

This research initially focuses on the historical growth of Dibrugarh City along with present day urban expansion. The study is primarily based on secondary data collected from research articles, journals, government organizations, newspapers, books, census and internet. First, municipal boundary map along with wards and master plan boundary map was collected from Town and Country Planning Office, Dibrugarh. The study area map was created by georeferencing the municipal boundary map in QGIS and manually digitizing it along with the wards. Population data and historical background of the city were collected from census report and Assam Gazetteers, 2022. All these

data were analysed with different statistical methods with the help of Microsoft office excel, 2021 and also visualized with the help of Quantum GIS software in order to understand the pattern of urban growth in Dibrugarh city.

RESULTS AND DISCUSSION

Origin of Dibrugarh City

Dibrugarh shares much of its history with the kingdom of Ahom as it was very prominent in northeastern India and Dibrugarh was also ruled by the leaders of Ahom. There are several connotations regarding the meaning of the name of Dibrugarh. According to some historians the name Dibrugarh has been derived from Dibarumukh, an encampment of Ahoms during the Ahom Sutiya War. Other legend ascribes the origin of Dibrugarh that the city was named after a fort built by the British along a river called Dibaru, a tributary of the Brahmaputra River. Dibaru' comes from the word 'Dimasa', which means water, whereas 'grah' means fort, which together was called Dibrugarh (The Assam Gazette, August 1, 2022, Dibrugarh University, n.d.).

The Ahom invasion in Assam was took place in 1228 AD and they were looking for fertile land for agriculture and moved place to place in eastern part of the Brahmaputra valley. Their reign was lasted for 600 years; they introduced wet rice cultivation, coins, revenue systems and established reclamation of land use dykes, embankments and irrigation systems. The Moamaria rebellion in 1769-99 and the Burmese invasion in 1824-26 ended the Ahom dynasty (The Assam Gazette, August 1, 2022).

The British had the greatest interest in Assam due to the commerce that centered on it. In 1823, they discovered tea in Sadiya region and started cultivating it using indigenous plants in Chabua, which is 20 miles away from Dibrugarh. The British took control of Dibrugarh from the Burmese after the Yandaboo Treaty in 1826. Later it experienced many important administrative and business activities. Dibrugarh town was established with the construction of a large fort in the banks of the Dibru River, which acted as a trading site for traders coming by boats, thus leading to the establishment of a market known as the Purana bazaar. Soon after, areas near Dibrugarh Town were discovered to contain oil and coal. Oil was discovered at Digboi in 1882 and Coal was found at Ledo and Margherita in 1876. These all contributed to the importance of Dibrugarh as a center for industrial, commercial, and administrative activities (Assam District Gazetteers: Present Lakhimpur and Dibrugarh District 1976).

Dibrugarh was made the District headquarter in 1842 of Lakhimpur district and served as a primary military base and a transit camp for the evacuees of Burma during the World War II. In 1870, the District Judiciary Court was constructed. Under Bengal Act 1872; a Municipality was set up in 1873. In 1882, the first train departed from the streamer ghat in Dibrugarh and was linked to Margherita through railways.

In 1971 Lakhimpur district got bifurcated into Lakhimpur and Dibrugarh district. The first Master Plan Boundary of the town was adopted in 1977. Over a span of 139 years, the city's population grew from 2,774 in 1872 to 145,488 in 2011. (Census 1901, Assam District Gazetteers: Present Lakhimpur and Dibrugarh District 1976, District Census Handbook, Dibrugarh).

The present-day Dibrugarh is a developed town in Assam. The total area of the municipal boundary is 15.44 sq. km while the master plan boundary is about 71.83 sq. km. However, a new master plan has been proposed covering 391 sq. km, with a plan period extending to 2045. In addition, there is a proposal to expand the Dibrugarh Municipal area from the current 15.44 sq. km to 47.45 sq. km, according to municipal office.

It is emerging as a nerve centre of communication, health and industry in the Upper Assam area. On March 7, 2024, the historic town of Dibrugarh was officially designated as the second city of Assam, following the establishment of the Dibrugarh Municipal Corporation and the dissolution of the Municipal Board by the government of Assam.

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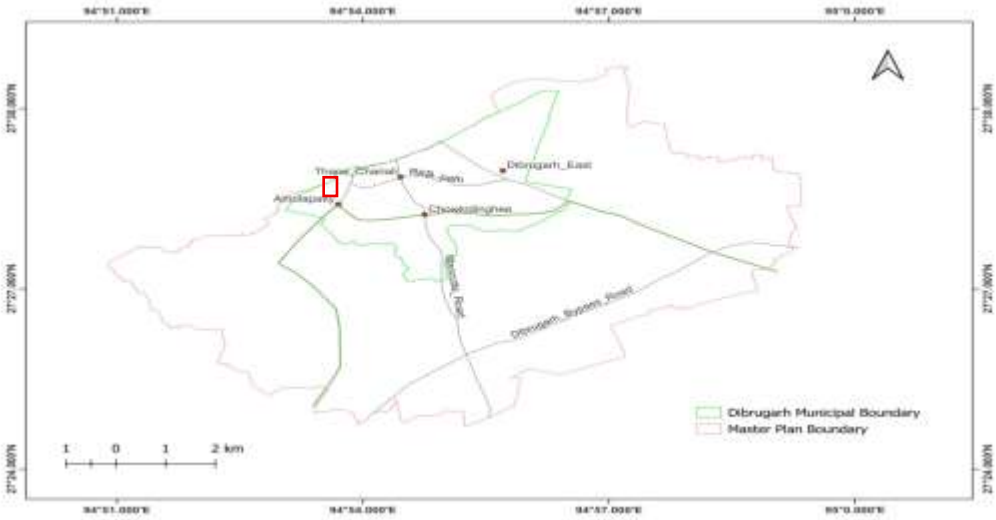


Figure 1: Municipal and master plan boundary of Dibrugarh

Spatial pattern and expansion of town

The town of Dibrugarh has been evolved over space and time and it's still evolving and expanding. The spatial pattern of growth and the evolution of urban morphology can be classified into four key periods based on social, economic, and infrastructural developments that shaped the city over time (The Assam Gazette, 2022).

a) **1842: Early Settlements and Strategic Importance**

In 1842, Dibrugarh was a small, yet strategically significant settlement of around 5000 people. The early population clusters developed around areas such as Graham Bazaar, Naliapool, Amolapatty, and Purana Bazaar. These areas likely grew due to their proximity to the Brahmaputra River, which was crucial for trade and transportation.

Strategically, Dibrugarh's importance grew as it became the headquarters of the Lakhimpur district. Its role as a military base and transit camp during World War II highlights its strategic significance. The city served as a crucial point for military operations and as a refuge for evacuees from Burma, which was then under Japanese threat.

The construction of the District Judiciary Court during this period indicates the establishment of formal governance and judicial systems, further solidifying Dibrugarh's role as an administrative center.

b) **1901: Industrial Growth and Urban Expansion**

The turn of the 20th century marked the beginning of significant industrial activity in Dibrugarh. The population was approximately 14000 in 1901. The establishment of tea plantations, the discovery of oil, and the development of the railway network were pivotal. These industries not only attracted workers but also fostered economic prosperity, leading to the expansion of the urban area.

The urban shift took place as the erosion of Purana Bazaar led to the development of the New Market area, reflecting the city's ability to adapt to environmental changes. This shift indicates the dynamic nature of urban development, driven by both economic opportunities and geographical challenges.

The burgeoning tea and oil industries required improved infrastructure, which likely included better roads, communication networks, and housing for the growing population. The railway, in particular, connected Dibrugarh to other parts of Assam and India, facilitating the movement of goods and people.

c) **1951: Post-Independence Expansion and Urbanization**

In 1951 the city population was 37991. The introduction of the city bus service in 1956 made Dibrugarh a pioneer in urban transport in the Northeast. This development was crucial for managing the growing population and connecting different parts of the expanding city.

The establishment of Assam Medical College was a significant milestone, making Dibrugarh a center for medical education in the region. This not only attracted students from across the region but also brought in medical professionals and their families, contributing to the city's growth.

d) **2011: Modern Infrastructure and Institutional Growth**

In 2011 city population was recorded as 154296. The modern Dibrugarh introduce itself as an economic and educational hub in the region. The city saw the establishment of engineering and commerce colleges, enhancing its reputation as a center for higher education and attracting students from across the Northeast.

This period is also known for development of transportation infrastructure. The opening of the airport and the new railway station on the outskirts of the city marked a significant upgrade in transportation. These developments improved connectivity, making the city more accessible and further boosting trade, tourism, and economic activities. The city's expansion during this period was more planned compared to previous decades, with new residential areas, commercial centers, and infrastructure projects. The development of modern amenities and services helped Dibrugarh evolve into a key urban center in Assam.

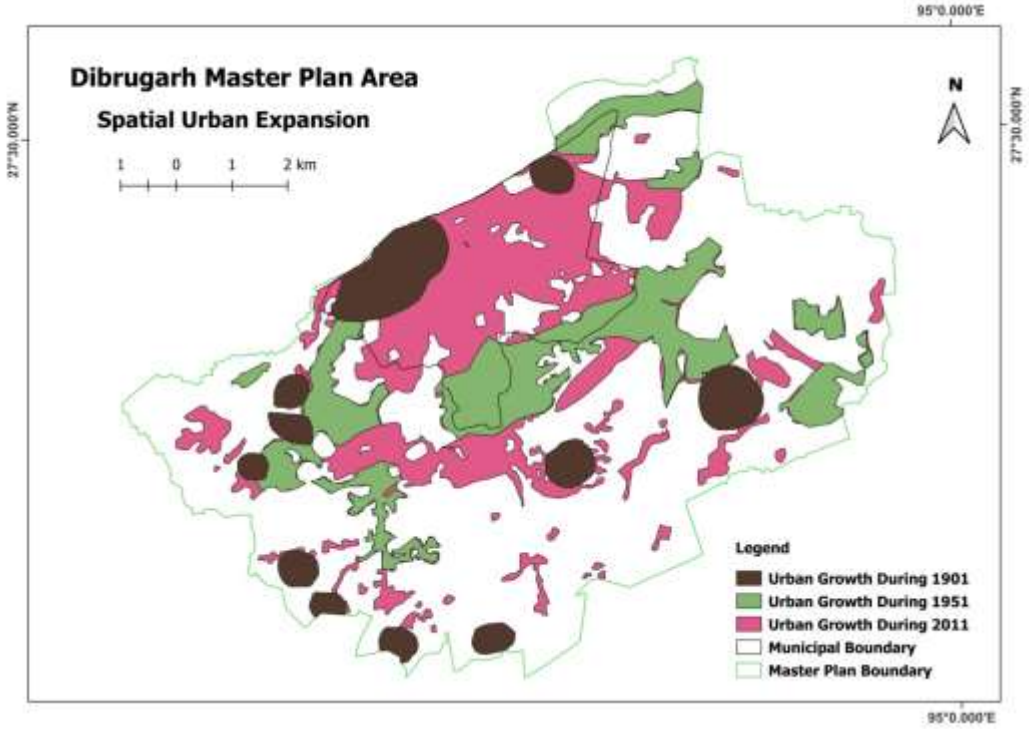


Figure 2: Spatial urban expansion of Dibrugarh

Absolute Population growth pattern

Between 1951 and 2001, Assam's population grew by 232%, compared to the national growth rate of 184% during the same period. According to the 2011 Census, India's population growth rate was 17.64%, while Assam's growth rate was slightly lower at 16.93%. Nationally, the urban population increased by 31.80% between 2001 and 2011, accounting for 31.16% of the total population. In Assam, the urban population constituted 14.08% of the total population, with a growth rate of 27.61% over the same period. Dibrugarh district saw a population increase of 11.92%, reaching 1,326,335 in 2011, compared to 1,185,072 in 2001, contributing 4.25% to Assam's total population. The district's urban population decreased from 19.3% to 18.38%.

Table 1: Pattern of growth of population in relation to State and the Dibrugarh District (2001-2011)

SL No.	Geographical Unit	Growth Rate	
		2001	2011
1	India	21.54	17.64
2	Assam	18.92	17.62
3	Dibrugarh District	13.62	11.92

Source: Census of India, 2001 & 2011

Table 2: Pattern of growth of urban population in relation to State and the Dibrugarh city (2001-2011)

SL No.	Geographical Unit	Growth in %
1	India	31.16
2	Assam	27.61
3	Dibrugarh District	6.69
4	Dibrugarh Municipal Board Area	14.31

Source: Census of India, 2001 & 2011

Table 3: Population growth pattern of Dibrugarh Municipality.

SL No.	Census Year	Absolute Growth	Decadal Growth rate
1	1872	2774	----------
2	1881	7153	157.8587
3	1891	9876	38.06794
4	1901	11227	13.67963
5	1911	14563	29.71408
6	1921	16007	9.915539
7	1931	18734	17.0363
8	1941	23191	23.79097
9	1951	37991	63.81786
10	1961	58480	53.93119
11	1971	80344	37.38714
12	1981	98971	23.18
13	1991	120127	21.37
14	2001	122075	1.623
15	2011	139547	14.31
16	2021	193431	38.61

** The population for the years 1981 and 2021 has been estimated using the Logistic Curve Method.*
Source: Census 1901, Assam District Gazetteers: Lakhimpur District, District Census Handbook, Dibrugarh.

Table 4: Population growth pattern of Dibrugarh Master Plan area.

Sl. No.	Census year	Population of Existing Master Plan Area	Population of Proposed Master Plan Area
1	1991	----------	268842
2	2001	190421	305974
3	2011	226787	361337
4	2021	270098	451676

Source: Census of India, 2001 & 2011, Assam Gazetteers, 2022
** The Existing Master Plan population for the year 2021 has been estimated using Exponential Growth Model.*
The Proposed Master Plan population for the year 2021 has been estimated using the Logistic Curve Method.

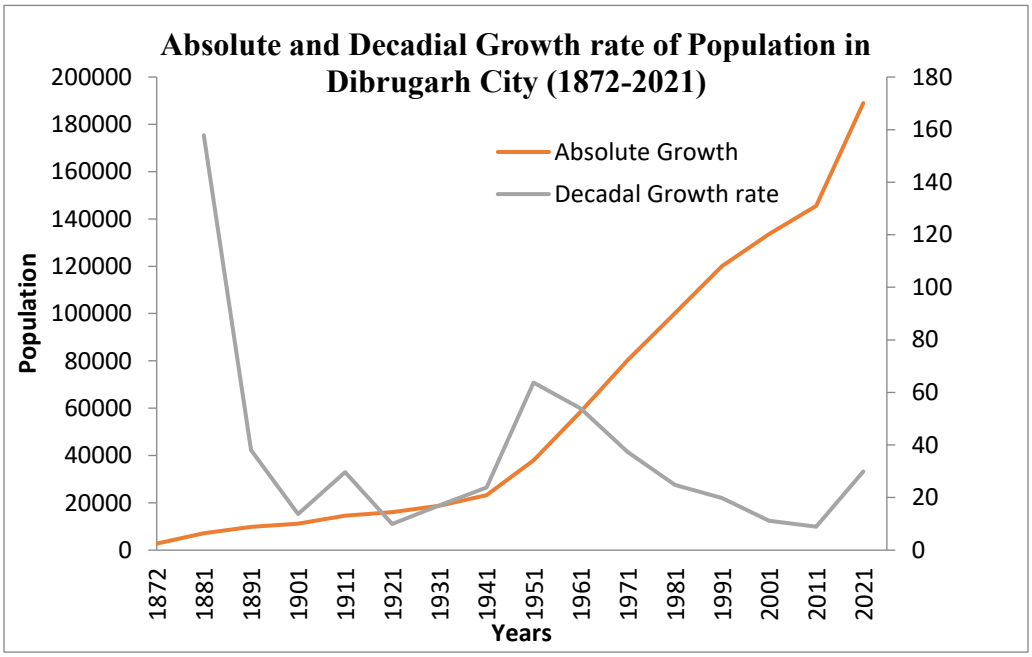


Figure 3: Trend of population Growth in Dibrugarh Municipality

This table provides population data for different wards over two different years, 2001 and 2011. Some wards have experienced population growth, while others may have seen a decline. Additionally, the changes in population can be calculated by subtracting the 2001 population from the 2011 population for each ward to understand the extent of the changes in each ward's population over the decade. Positive values in the table indicate population growth, while negative values indicate a population decline. The table shows negative growth for ward number 2, 3, 11, 18, 19, 20 while others have experienced positive growth.

Decadal growth pattern

In 1872, the population was 2,774, and no decadal growth rate is provided since it is the starting point. Between 1872 and 1881, the population increased significantly to 7,153, indicating a growth rate of 157.8% over the decade. From 1881 to 1891, the population increased further to 9,876, with a growth rate of 38.06% over the decade. This pattern continues for subsequent years, where the population increases and the decadal growth rates are calculated based on the changes.

The overall trend of population growth for Dibrugarh town shows steady growth since 1901 to 1951.The two decades, 1951-1961 and 1971 to 1991 showed a spectacular rise in population, consequent upon the influx of more population both from inside and outside the state and the natural increase, while during 2001-2011shows a steep rise in population which may be accounted due to fall of death rate resulting from advance medical facilities and all.

POPULATION PRESSURE AND DENSITY

Ward Wise distribution of Population

Table 5. Ward wise population distribution (2001 &2011)

Ward no.	Population (2011)	Population (2001)	Difference
Ward 1	3032	1968	1064
Ward 2	7974	8032	-58
Ward 3	3357	4146	-789
Ward 4	9172	7847	1325

Ward 5	7046	4700	2346
Ward 6	9005	7745	1260
Ward 7	5214	3962	1252
Ward 8	8446	7574	872
Ward 9	7017	5702	1315
Ward 10	4336	3470	866
Ward 11	1934	2313	-379
Ward 12	5371	3657	1714
Ward 13	5860	5303	557
Ward 14	4824	4590	234
Ward 15	5403	5387	16
Ward 16	7419	4813	2606
Ward 17	5629	3622	2007
Ward 18	8687	9275	-588
Ward 19	7047	7737	-690
Ward 20	4207	4724	-517
Ward 21	5507	4832	675
Ward 22	13060	10676	2384
Total	139547	122075	17472

Source: Town and Country Planning, Dibrugarh

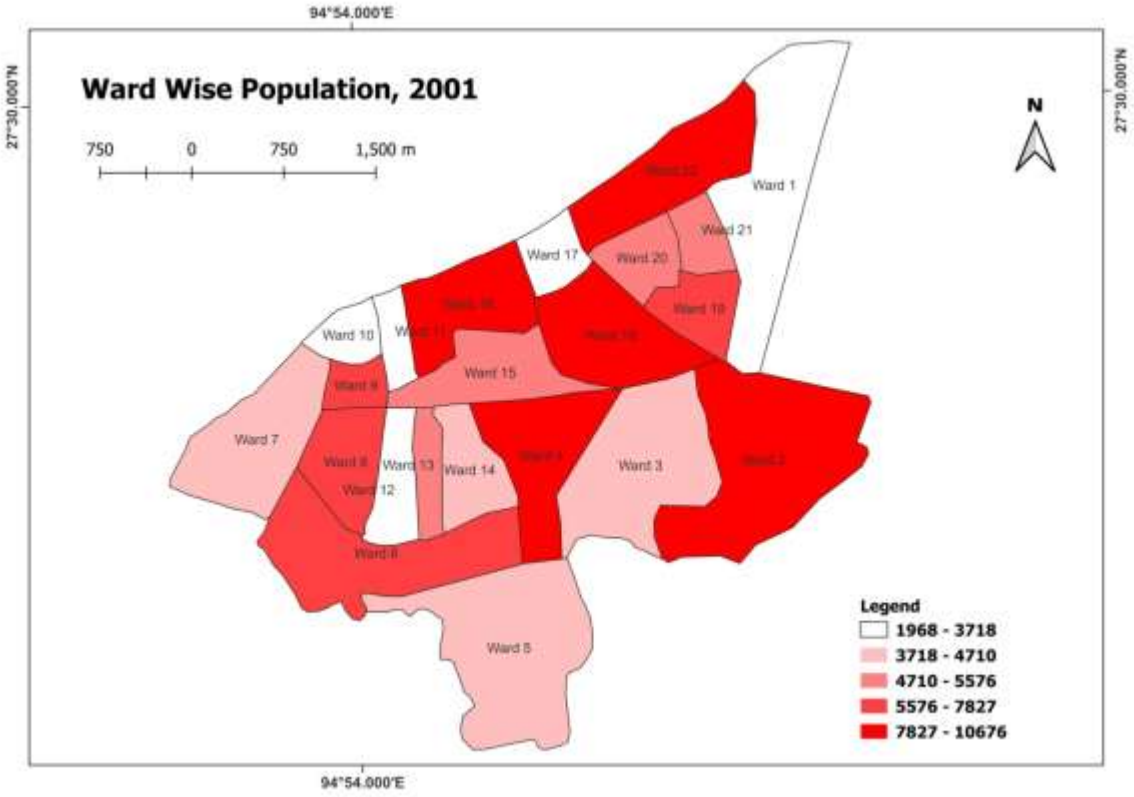


Figure 5: Ward wise population of Dibrugarh Municipality, 2001

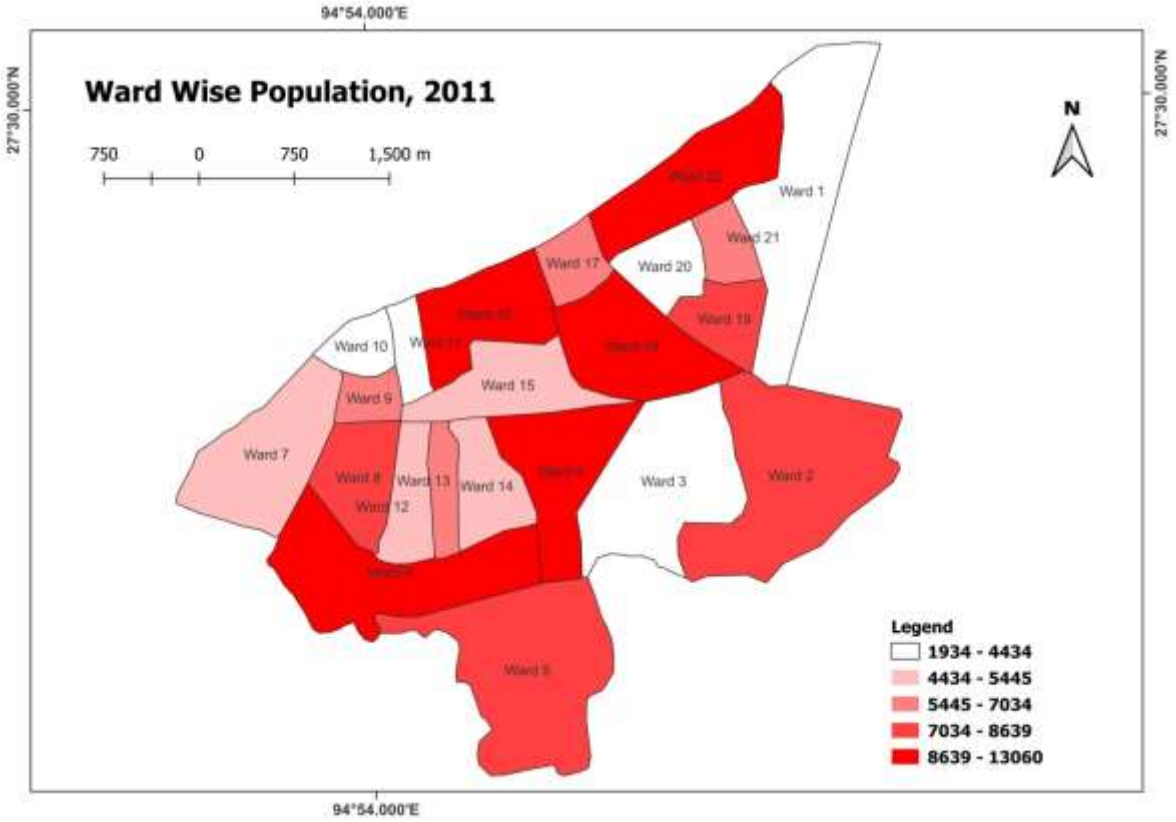


Figure 6: Ward wise population of Dibrugarh Municipality, 2011

This table provides population data for different wards over two different years, 2001 and 2011. Some wards have experienced population growth, while others may have seen a decline. Additionally, the changes in population can be calculated by subtracting the 2001 population from the 2011 population for each ward to understand the extent of the changes in each ward's population over the decade. Positive values in the table indicate population growth, while negative values indicate a population decline. The table shows negative growth for ward number 2, 3, 11, 18, 19, 20 while others have experienced positive growth.

Ward Wise density of Population

Table 6: Ward wise density of population (2011 & 2001)

Ward	Area (Sq Km)	Population density, 2001 (persons per sq. km.)	Population density, 2011 (persons per sq. km.)
1	1.41	1396	2151
2	1.65	4872	4837
3	1.25	3305	2676
4	0.81	9735	11379
5	1.57	2997	4493
6	1.19	6490	7545
7	0.63	6288	8275
8	0.46	16311	18189
9	0.19	30457	37482
10	0.23	15257	19065

11	0.15	15391	12869
12	0.35	10311	15143
13	0.22	23813	26314
14	0.35	13065	13731
15	0.63	8519	8545
17	0.26	18547	28589
16	0.61	5895	9162
18	0.85	10923	10230
19	0.36	21682	19748
20	0.27	17219	15335
21	0.24	19995	22788
22	1.86	5738	7019

Source: Calculated by the author

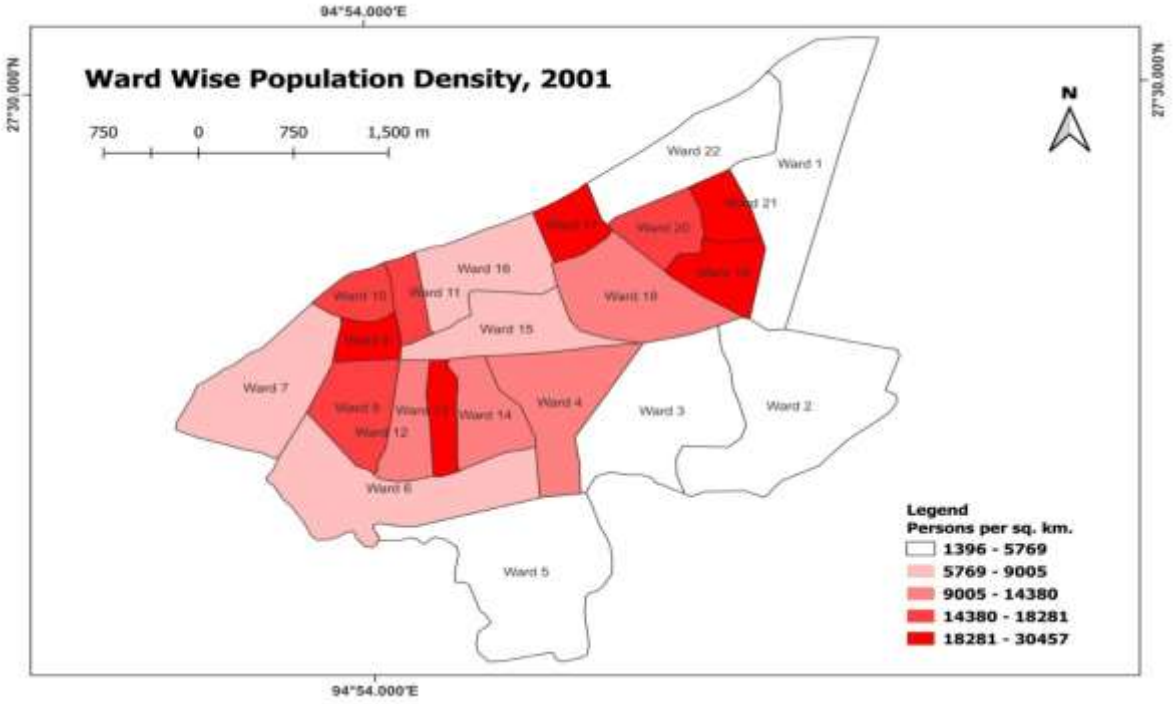
Table 8 presents data on various wards, including their ward number, area (in square kilometers), and the population density (persons per square kilometer) for both 2001 and 2011.

It is evident from the table that Ward 9 consistently had the highest population density, increasing from 30,457 in 2001 to 37,482 in 2011. Ward 3, however, experienced a notable decline in population density, dropping from 3,305 in 2001 to 2,676 in 2011. In contrast, Ward 17 saw one of the most significant increases, with population density rising from 18,547 in 2001 to 28,589 in 2011.

Similarly, Ward 13 maintained a high population density, growing from 23,813 to 26,314 over the same period. Wards such as 2, 15, and 18 remained relatively stable, with only minor fluctuations in population density between 2001 and 2011. Other wards, like 21 and 12, experienced substantial increases, indicating population growth in those areas.

Overall, the data provides a clear picture of how population density has shifted across different wards over the decade.

Figure 7: Map showing ward wise population density, 2001



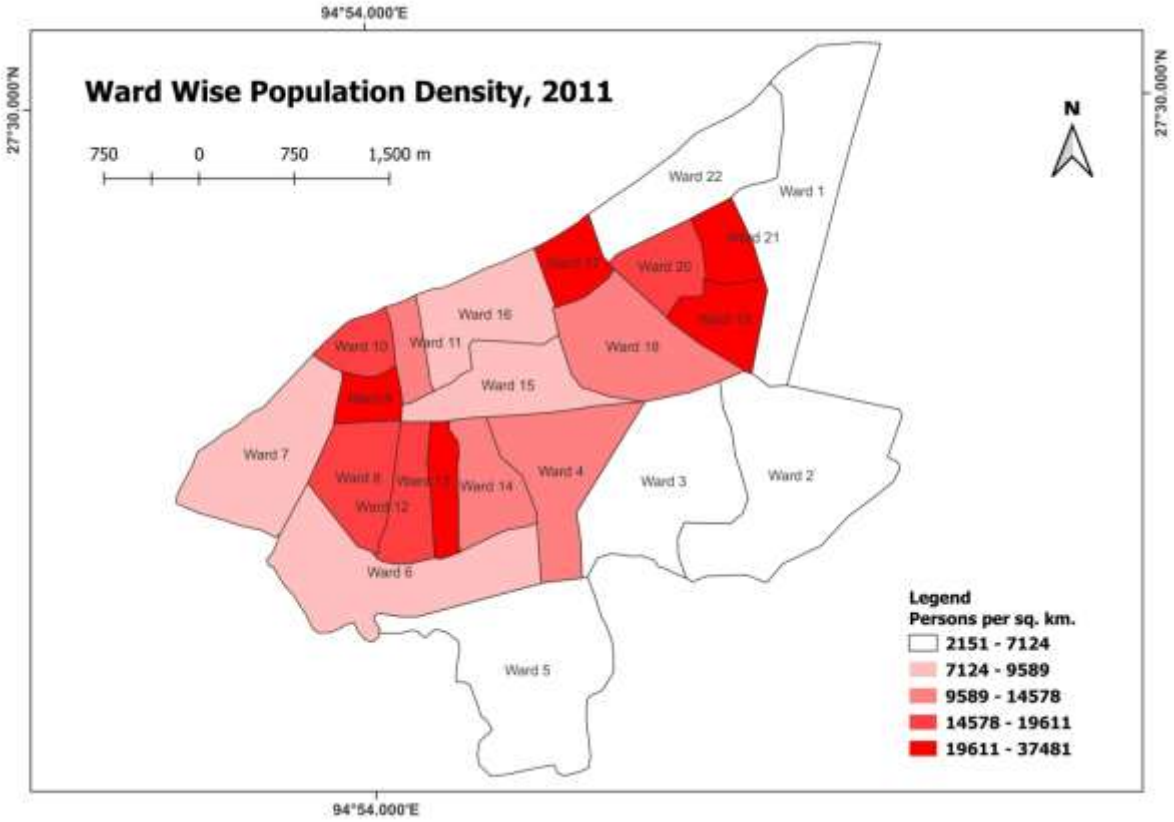


Figure 8: Map showing ward wise population density, 2011

Population Projection

The term 'projection' refers to any carefully constructed approximation to the future size and characteristics of the population of a specific area. Population projections and estimates are crucial for the operations of governments, organizations, and businesses. They are particularly important for national planning and policy-making processes (Rowland, 2003). Social scientists, administrators, and planners rely on up-to-date estimates and forecasts of socio-economic, health, and demographic trends. These projections are valuable for managing administrative programs focused on public welfare, education, healthcare, public safety, and transportation (Morrison, 2002).

The design of a water supply and sanitation system is based on the projected population of a specific city for the designated design period. Underestimating the population can lead to an inadequate system, while overestimating can result in unnecessary costs. Since the city's population changes over time, the system should be designed with consideration of the population at the end of the design period. The current and historical population data for the city can be sourced from census records. Once these figures are gathered, the population at the end of the design period is forecasted using various methods, depending on the city's specific growth pattern.

The several methods are used for the projection of Dibrugarh city population up to the year 2051. These are Exponential Growth Model, Geometric Progression Method and Incremental Increase Method.

a) Exponential Growth: Exponential population growth is a model that describes how a population increases when resources are abundant, and the growth rate stays constant, regardless of the population size. The formula for exponential population growth is

P(t) = P0(1+r)t,

Where:

P0: The initial population

r: The relative growth rate

t: The time unit

Table 7: Exponential growths

Sl. No.	Year	Dibrugarh Municipality	Dibrugarh Master Plan	Proposed Dibrugarh Master plan
1	2021	159520	270098	426717
2	2031	182351	321681	503928
3	2041	208450	383114	595109
4	2051	238284	456280	702788

Source: Computed by the researcher

b) Geometric Progression Method: In this approach, the percentage increase in population from one decade to the next is assumed to stay constant. The geometric mean is used to estimate future population growth. As this method tends to yield higher projections, it is best suited for newly developed industrial towns and should only be applied for a few decades in the early stages of development. The population at the end of nth decade 'Pn' can be estimated as:
Pn = P (1+ IG/100) n
Where, IG = geometric mean (%)
P = Present population
N = no. of decades.

Table 8: Geometric Progressions

Sl. No.	Year	Dibrugarh Municipality	Dibrugarh Master Plan	Proposed Dibrugarh Master plan
1	2021	169020	----------	403731
2	2031	204717	----------	527105
3	2041	247953	----------	786329
4	2051	300322	----------	

Source: Computed by the researcher

c) Incremental Increase Method: This method is appropriate for a medium-sized town under normal conditions, where the growth rate shows a steady upward trend. The incremental increase is determined for each decade from the past population and the average value is added to the present population along with the average rate of increase. Hence, population after nth decade is **Pn = P+ n.X + {n (n+1)/2}.Y**
Where, Pn = Population after nth decade
X = Average increase
Y = Incremental increase

Table 9: Incremental Increase Method

Sl. No.	Year	Dibrugarh Municipality	Dibrugarh Master Plan	Proposed Dibrugarh Master plan
1	2021	164781	----------	425815
2	2031	205539	----------	508525
3	2041	261821	----------	609465
4	2051	33627	----------	728637

Source: Computed by the researcher

CONCLUSION

This study focused on how Dibrugarh City has grown over the years, with significant increases in both its size and population. Dibrugarh has grown in size and now encompasses more residential, commercial, industrial, and institutional areas. The city has grown from its central areas outwards to the edges, driven by improved infrastructure and economic growth. Population trends corroborate this spatial expansion. From a population of 2,774 in 1872, Dibrugarh's municipal population grew to approximately 193,431 by 2021, with the master plan and proposed master plan areas experiencing commensurate growth. This rise results from both natural increase and migration, intensifying demands for housing, transport, education and healthcare. Ward-wise data show that population density and the number of households have not grown evenly, highlighting different development patterns in different parts of the city. While this growth attests to Dibrugarh's emerging prominence as a regional economic and administrative hub, it also presents significant challenges. Rapid expansion, often unregulated, has strained infrastructure, contributed to environmental degradation and led to encroachment upon ecologically sensitive areas such as riverbanks. Therefore, it is imperative to adopt sustainable urban planning strategies that integrate climate resilience, equitable resource distribution and environmental conservation. Future research should focus on high-resolution spatial and socio-economic analyses to refine growth projections and identify risk zones. Such studies will support informed policy-making to balance the city's ecological and social well-being. So, Dibrugarh's urban growth exemplifies its rising importance but simultaneously highlights the urgent need for prudent and forward-looking management. Effective planning and regulation will be crucial to ensure that the city's expansion remains sustainable, inclusive and resilient against future challenges.

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