WRI INDIA

WORKING PAPER

Verticality and horizontal growth trends across 3,777 Indian cities

Urban and peri-urban growth from 1990 to 2020 and implications for planning and governance

Tintu Sebastian, Rejeet Mathews, Raj Bhagat Palanichamy, Abhimanyu S. and Paramjeet Chawla

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Highlights

- India is among the fastest-growing major economies, and its cities have witnessed rapid urban expansion beyond municipal limits. The Contiguously Built Urban Agglomeration (CBUA) methodology is, therefore, relevant for understanding the true spatial extent of urbanisation.
- About one-third of the built-up area and one-fourth of the built volume were outside all municipal boundaries in peri-urban areas in 2020. This growth is relative to the 2010 statutory town boundaries and is subject to data limitations.
- The 11 very large CBUAs held the highest concentration of the largest establishments, had the highest mean building height among all CBUA classes, and housed more than a quarter of the total urban population.
- Among the very large CBUAs, Mumbai leads in verticality, especially through redevelopment of its core areas to accommodate tall buildings. Delhi and Bengaluru expanded more horizontally, with pockets of tall buildings concentrated around knowledge-intensive service sectors, while Kolkata witnessed the least horizontal and vertical expansion.
- Among the medium and small CBUAs, Gangtok, Darjeeling, Shimla, and Dalhousie, which are all hill cities, dominate in verticality.
- 53 percent of the census towns in 2011, were noted to be in the contiguous periphery of statutory towns. Peri-urban growth raises concerns about land speculation, hazard preparedness, and equitable access to services, and such areas reveal a complex multi-jurisdictional reality.
- India's urban growth is significantly peri-urban, requiring better recognition and policy frameworks to counter unplanned urbanisation beyond municipal boundaries.

Executive summary

Background

India will account for a substantial share of the world's future urban population growth, with urbanisation occurring when availability of natural resources and investment capacity are subject to significant constraints. India is one of the world's fastest-growing major economies and, along with Africa and China, witnessed the fastest urban land expansion rates between 1970 and 2000 (Seto et al. 2011). Consequently, several cities have expanded beyond their municipal boundaries with the emergence of peri-urban areas that lack planning and public infrastructure services and face higher risks of environmental degradation.

The lack of a uniform method to delineate and measure the true extent of agglomeration and identify peri-urban areas beyond municipal boundaries is a challenge. While there have been initiatives by the Government of India and a few states to address these concerns, peri-urban areas remain largely unrecognised in official data systems and in planning and policy frameworks. Another aspect that requires further understanding is that Indian cities in the 2010s showed both rapid outward and upward growth in cities with a population of more than five million (Frolking et al. 2024). Finally, the administrative characteristics of such agglomerations have not been comprehensively captured at a national scale.

About this working paper

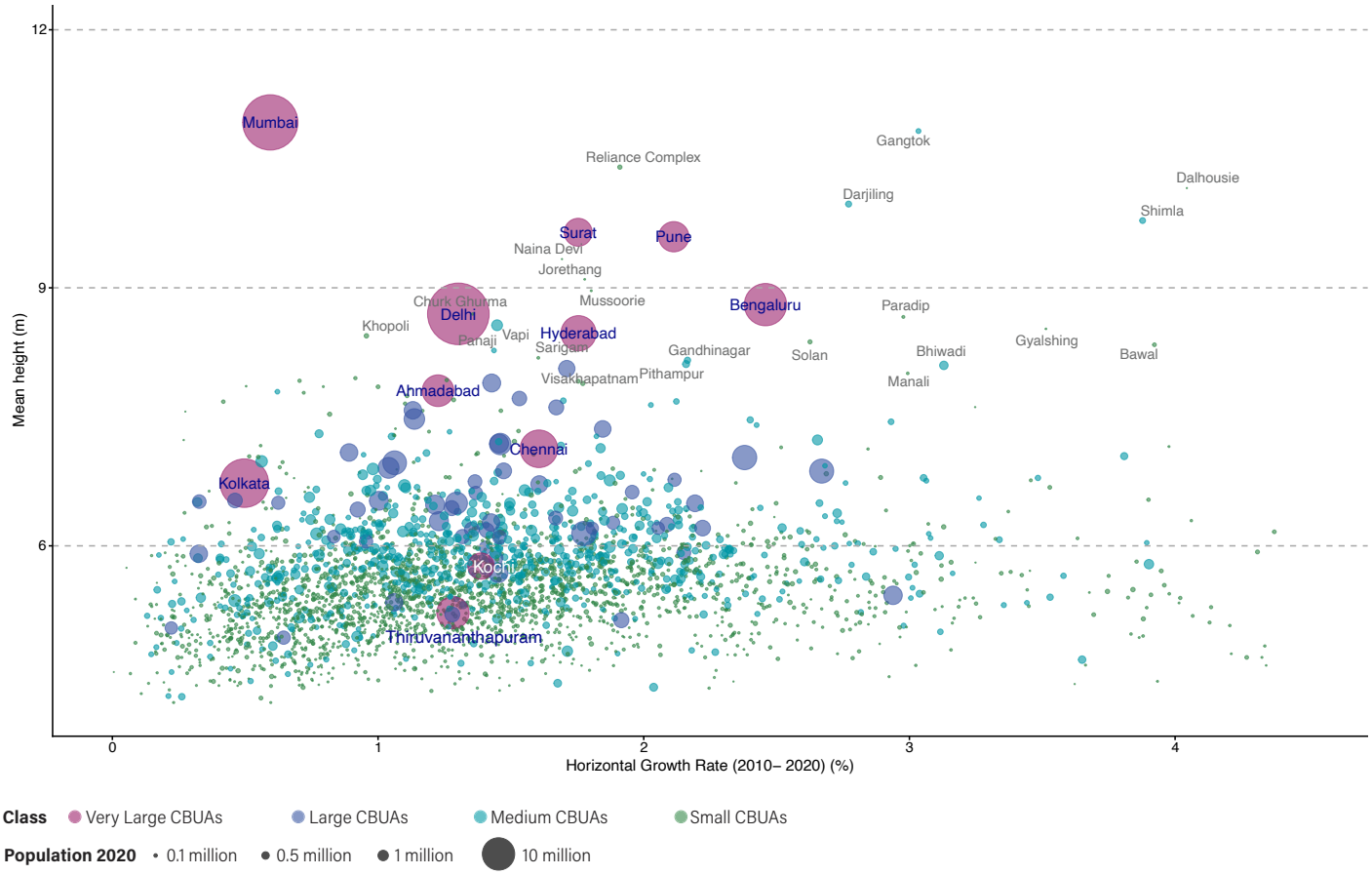
This working paper addresses the gaps in the identification and measurement of the true extent of urban agglomerations through the Contiguously Built Urban Agglomeration (CBUA) methodology. Using geospatial analysis, it delineates the urban extent of statutory towns (ST) based on their contiguous spatial built-up footprint rather than administrative boundaries. Using Dynamic World and Global Human Settlement Layer (GHSL) built-up area data, this paper delineates 3,050 CBUAs for India's 3,777 statutory towns. It focuses on the spatial extent of urbanisation, growth rate of built-up areas from 1990 to 2020, horizontal urban expansion beyond administrative boundaries, status of verticality, and administrative characteristics of the 3,050 contiguous agglomerations across the four category sizes of CBUAs.

Key insights

- **Statutory towns and their respective CBUAs across all size classes witnessed horizontal built-up area expansion outside their municipal boundaries.** Whereas built-up area share outside all statutory town boundaries in peri-urban areas grew by 3 percentage points, from 29 percent to 32 percent, between 2010 and 2020, the corresponding share of built volume in 2020 was only 23 percent. These estimates are relative to the 2010 statutory town boundaries and are subject to data limitations. Such widespread peri-urban growth raises concerns regarding environmental degradation, threats to water security and resilience, and equitable access to services.
- **Eleven very large CBUAs housed about one quarter of all the CBUA population, hosted the largest establishments employing over 500 employees, and contained about one-third of the built-up areas (31 percent) lying outside ST limits in 2010.** While all CBUAs expanded horizontally between 1990 and 2020, there was a decline in the annual exponential horizontal growth rate during 1990-2000, 2000-2010, and 2010–2020, which aligns with the trend of many cities around the world.
- **The Delhi CBUA has the most spread-out area in terms of horizontal built-up, whereas Mumbai, which accommodated over 77 percent of the country's tall buildings over 150 metres (m) tall, leads in verticality** (Confederation of Indian Industry, n.d.) (see figure ES1). Bengaluru showed the fastest growth in terms of horizontal urban expansion, with pockets of verticality, whereas Kolkata remained the slowest in terms of urban expansion from 2010 to 2020 and had relatively less verticality.
- **Taller buildings in several very large CBUAs were noted to be located around knowledge-intensive service sectors.** Service-sector establishments in high-skill sectors such as finance, real estate, Information Technology/ Information Technology enabled services (IT/ITes), education, and insurance have a positive and significant effect on the completion of new tall buildings (Curci 2015).
- **Among the medium and small CBUAs, Gangtok, Darjeeling, Shimla, and Dalhousie, which are all hill cities, exhibited significant verticality but had relatively less absolute built-up area in 2020.** For instance, Darjeeling and Dalhousie CBUA had 0.56 square kilometres (km^2) and 0.01 km^2 of built-up area in 2020, less than the average built-up area of their counterparts in the medium and small CBUA categories. Despite topographic constraints, the hill cities of Gangtok, Darjeeling, Shimla, and Dalhousie witnessed significant verticality and a relatively higher horizontal expansion between 2010 and 2020. The carrying capacity limits of hill towns have also come into focus. In a majority of the small CBUAs, buildings typically did not exceed two storeys (6 m) in height, unlike those in larger CBUAs.
- **The administrative characteristics of the CBUAs indicate the presence of multi-jurisdictional agglomerations that cut across contiguous sets of statutory and census towns and villages and sometimes across districts and states.**

Notably, approximately 53 percent of the census towns, recorded in 2011, were located within the spatial extent of

Figure ES 1 | **Mean height and horizontal growth rate (2010-2020) across all CBUAs**



Note: 58 CBUAs having horizontal growth rates above 4.5 m are not represented in the chart.

Source: Authors' analysis based on GHSL 2020, Open Buildings 2.5D Temporal Dataset from 2020–2023, the Shrug (DDL) Database, and Census of India 2011.

the CBUAs. This fragmented governance creates disparities in service provision standards, urban planning, and municipal capacity across a single agglomeration.

Conclusion and way forward

India's urbanisation is considerably peri-urban, and addressing urban areas that lie within statutory urban boundaries alone will result in substantial underestimation of the scale and dynamisms of India's cities. Current growth patterns have already locked India's urbanisation into long-term maladaptive forms, contributing to the loss of natural infrastructure, environmental degradation, and inequitable access to services while creating a future need for expensive retrofits. However, more than 50 percent of urban growth, in terms of new infrastructure, buildings and urban services required by 2050, is yet to be built (World Bank Group 2025).

Land management policies must, therefore, not only address inner-city revitalisation but also rapid peripheral growth through a regional planning approach that also ensures economic competitiveness. Differential growth trends across size classes require context-specific infrastructure delivery models tailored to local geography, population density, and land availability to ensure equitable universal access to services and amenities. Expanding cities must understand the suitability of land for different purposes, including carrying capacity limits to manage vertical and horizontal growth.

The Census of India 2027 must also capture the growth dynamism of the entire CBUA beyond the separate tabulation of its constituent statutory towns, census towns, and contiguous villages across districts and states. This will further prompt a much-needed reimagining of urban governance for such complex agglomerations and for addressing the related issues of planning, municipalisation, and financing.

This working paper highlights the need for methodological advancements, such as the CBUA, that identify and measure the true extent of urban agglomerations. Despite its limitations, the CBUA reinforces the need to plan and govern the morphological understanding of contiguous urban agglomeration in an integrated manner.

India's expanding urban footprint and the need for a new spatial framework

India, Nigeria, Pakistan, the Democratic Republic of Congo, Egypt, Bangladesh, and Ethiopia are projected to together account for more than half of the global increase in city dwellers between 2025 and 2050 (United Nations 2025). These countries are urbanising in a context of constrained financial, institutional, and natural resources, while the costs of delivering essential services such as housing, clean water, sanitation, electricity, and public transportation remain significantly high (Mahendra et al. 2021). The UN estimates that small cities (with populations of fewer than 0.25 million) and medium-sized cities (with populations of 0.25 million to 1 million) will dominate the world's urban population (United Nations 2025).

While cities in developed countries must focus on modernising their ageing infrastructure and managing the challenges presented by shrinking and declining cities, developing countries face a different set of urban challenges (UN-Habitat 2022). These countries should focus on addressing rising poverty levels, expanding access to infrastructure and affordable housing, the widespread growth of slums, high youth unemployment, and strengthening the role of secondary cities through targeted investment. The urban theories and planning frameworks of the Global North can no longer be fully applied in developing countries (Verdini et al.2025).

Urbanisation, as both a process and concept, has been understood through multiple lenses as transformative, which unfolds differently across the globe (Yussif et al. 2023). There is a renewed focus on understanding what constitutes "urban" and how it goes beyond the spatially bounded unit and beyond the existing mainstream discourses. The planetary urbanisation lens has shifted from analysing "urban" as a distinct or settlement type to considering it as a process that moves beyond the traditional urban-rural dichotomy (Jain and Korzhenevych 2022). This concept establishes the social, economic, ecological, and infrastructural networks between the city core, urban periphery, and metropolitan region. This understanding has increasingly informed urban population estimation, including the UN's Degree of Urbanisation method, which delineates settlement typologies along a rural–urban continuum. A recent WRI India report on India's urbanisation has explained five prevalent methods for identifying urban expansion and peri-urban growth (Chatterjee et al. 2026a). This study proposes a new method based on contiguous built-up areas, building on existing methods and focusing on these areas.

Similarly, "subaltern" urbanisation focuses on non-metropolitan and smaller settlements that have grown autonomously. It investigates the historical aspects of land and culture that affect the peripheries and economically relevant smaller towns and cities that may or may not be considered peripheral to the metropolis (Denis et al. 2012). Subaltern urbanism also addresses the urban poor, adopts social and equity lenses, and necessitates attention to the heterogeneity of the socio-political dimensions of urbanization, gender, caste, and class (Cowan 2018). Complementary WRI India research on Transitional Urban Areas as a form of subaltern urbanism categorises peri-urban settlements into distinct typologies, each requiring differentiated planning and governance responses (Chatterjee et al. 2026b). The CBUA methodology developed in this study offers a new, satellite-based method to consistently measure the spatial extent of contiguous built-up areas outside statutory towns, capturing one kind of transitional area at a national scale and providing an empirical basis to inform typology-specific governance design.

Urbanisation, in the Indian context and Global South, goes above and beyond the understanding of "the city" and "the urban" and is deeply affected by rural or agrarian dynamics owing to issues such as socio-political changes, land-tenure systems, and the caste system (Rathi 2021).

India is one of the world's fastest-growing major economies and has the most populous system of rural and urban settlements. India, China, and Africa had the fastest rates of urban land expansion between 1970 and 2000 (Seto et al. 2011). An analysis of 478 cities with populations over one million noted that the predominant pattern of growth across these cities is either horizontal or outward, a pattern also noted in multiple global urban land expansion studies (Angel 2023; Dennehy 2019; Mahtta et al. 2019). India's urbanisation combined with rapid economic growth will drive substantial conversion of land. The nation's urban land cover is expected to increase more than fivefold by 2050, when the projected urban population of the country reaches 814 million, as compared to 373 million in 2010 (Mathews et al. 2018). An investment of approximately US$ 840 billion will be required in urban infrastructure if Indian cities are to meet the demands of their growing populations over the next 15 years (Athar et al. 2022).

Urban expansion beyond the administrative boundaries of statutory towns (STs) faces challenges of infrastructure deficits, environmental degradation, and climate change vulnerabilities. As cities experience demographic transitions and economic growth and attract investment, their outward expansion often occurs haphazardly, with low adherence to municipal or master-plan boundaries. This leads to challenges such as unequal access to physical and social infrastructure, an increase in impermeable concrete surfaces, environmental degradation, ecological fragmentation, high energy consumption, and increased vulnerability to climate change (Angel et al. 2021; Dennehy 2019; Goswami et al. 2022; Mahendra and Seto 2019; Rangwala et al. 2024; World Bank 2013).

Even though the 74th Constitutional Amendment Act (CAA) 1992 recognised the presence of transitional areas and recommended the creation of town panchayats, there have been inconsistencies and administrative ambiguity across the states in how such areas are formally recognised and integrated into urban governance structures. The Government of India has made efforts to plan for urban expansion through schemes such as the Pilot on the Formulation of Local Area Plans (LAP) and Town Planning Schemes (TPS) (MoHUA 2018). However, the TPS have not had much success beyond the states of Gujarat and Maharashtra where it has been practiced for decades (Mathews et al. 2018). Other such recent efforts include the Ministry of Rural Development's Rurban Mission, recognition of peri-urban areas by the Central Finance Commission, and, most recently, the Urban Challenge Fund that encourages the integrated regional development of cities (Ministry of Rural Development 2022; MoHUA 2026; Sixteenth Finance Commission 2026).

Urban growth outside of administrative boundaries is not adequately captured in the official data systems and requires advanced methods for recognition and for informing policy planning frameworks, and governance mechanisms. India's urban system as per Census 2011 comprised 4,041 STs, characterised by uneven and highly diverse urbanisation patterns. While the contiguity of urban spread is the primary criteria for identifying an Urban Agglomeration (UA)[2], the Census of India 2011, neither recognises agglomerations that spread across different district and state boundaries other than for the cities of Kolkata, Chennai, and Mumbai nor recognises rural expansion that adjoins STs. This reflects the inadequacy of current approaches to capturing the true extent of urban agglomeration. While the existence of peri-urban growth outside municipal boundaries is understood and acknowledged, there has been limited quantification of the same across different sizes of cities to enable an understanding of the scale of the issue and its implications at a national level.

This paper adopts a methodology to delineate Contiguously Built Urban Agglomerations (CBUAs) to understand the growth of Indian cities. This is explained in the next section, followed by an analysis of how STs are expanding horizontally and the status of their verticality. Following an illustration of the complexity of multi-jurisdictional governance across CBUAs, the paper closes with a discussion of its findings and a conclusion.

Research design

This study adopts a mixed-methods research design with an urban planning and development lens combining statistical and geospatial analytics with exploratory research. The purpose is to understand how Indian cities are growing horizontally, the status of their verticality, and their administrative characteristics.

Research questions

The key research question and related sub-questions are as follows:

How are Indian cities growing in terms of their horizontal built-up area and what is the status of their verticality?

i. To what extent are statutory towns (STs) expanding horizontally and forming contiguous agglomerations across population sizes?

ii. What is the status of their verticality in these contiguous agglomerations?

iii. What are the administrative characteristics of these contiguous agglomerations?

The first research question provides an understanding of urban growth trends and the quantification of peri-urban areas across different sizes of contiguous agglomeration of statutory towns, which is essential for planning infrastructure, service delivery, and future urban expansion. Knowing the verticality status of contiguous agglomeration is critical to understanding how Indian cities are responding to current development trends and the implications for planning agglomerations. The third research question investigates the administrative structure of contiguous agglomerations that span statutory towns, census towns, and villages, thereby providing evidence for framing governance structures aligned with the spatial structure of the urban areas.

Methodology, data sources, and limitations

This section of the working paper provides an overview of existing methodologies to measure agglomerations, the rationale for the CBUA methodology, and the detailed steps followed in the process with their respective data sources and limitations.

Review of existing methodologies

Cities expand with population increase, often by growing in area and by converting more land for urban use (Angel 2023). Because urban growth is not bound by city administrative boundaries, assessing urban growth trends requires a framework that goes beyond the rural-urban dichotomy and an appropriate method to delineate the urban boundary for growth trend analysis.

The concept of agglomeration is widely used to measure urbanization (Angel et al. 2016; Denis and Marius-Gnanou 2010; Fang and Yu 2017; Moriconi-Ebrard et al. 2016). Global urban data sets released by World Urbanization Prospects (WUP) use Urban Agglomeration (UA) as the standard area of reference for city-level data (UNDESA 2018). The UN's latest WUP adopted the degree of urbanisation method that uses built-up area as the key covariate for delineating human settlements on a rural-urban continuum.

In the Geopolis method, the formula of a minimum of 10,000 inhabitants in a contiguously built-up area with less than 200 metres (m) between buildings is applied to identify an urban geographic entity, irrespective of national definitions and the official status of the locality (Moriconi-Ebrard et al. 2016). The Asian Development Bank delineated the geographic extent of urban agglomerations across 42 economies in developing Asia using night-time satellite imagery of human settlements available since 1992. These urban contours were termed "natural cities" to distinguish them from administratively defined urban areas (Yi 2020).
The UN's Food and Agricultural Organisation used travel time and contiguous geographic area with high population density to define urban centres and their catchment areas in their City-Region Explorer tool (De Simone et al. 2025). Another global study on urban expansion considered contiguous built-up areas containing several municipalities that function as one labour market and a minimum threshold of 10,000 population to define a city (Angel et al. 2016). The UN's rationale for the use of UA in urban studies is to analyse cities as a whole, that is the built-up area comprising the city centre and the suburbs forming a continuous settlement, which is termed an "urban agglomeration" (UN-Habitat 2004). A city's geographic limit, determined by its spatial growth process and continuously built-up areas around a main settlement, irrespective of their administrative status, represents the ideal/conceptual approximation of real-world cities (Ramachandran 1989), making the case for built agglomeration extent as a way to assess urban growth.

Rationale for CBUA

To be able to gauge how every statutory town in India has been growing and how much built-up area lies within or outside its municipal boundaries, the true extent of growth must be captured. The key contribution of this paper is the introduction and application of the "Contiguously Built Urban Agglomeration (CBUA)" as a concept and analytical framework for measuring the physical extent of urban growth around statutory towns.

It is designed to capture the actual spatial footprint of urbanisation as observed through built form, which has been used by multiple studies (Angel et al. 2016; Denis and Marius-Gnanou 2010; Mahtta et al. 2019) to analyse growth trends, rather than relying only on administrative boundaries or census-defined urban agglomeration categories. This is important, as census-defined agglomerations are typically restricted, because it doesn't recognise an agglomeration's spread beyond a district or state boundary. Further, it does not recognise villages with built-up areas contiguous with STs as part of the urban agglomeration if they lack urban-like features.

A CBUA is defined as a continuous stretch of built-up area, delineated from satellite imagery within and around a statutory town, that transcends both urban and rural local body boundaries to form a single spatially connected agglomerated settlement. CBUA delineation is based on high-resolution satellite data derived from Google/WRI Dynamic World, which provides a measure of built-up area. Other data sources, such as night-time lights, are coarser and may either under- or over-estimate urban phenomenon, while travel-time data has feasibility and measurement constraints that do not align with the research questions of this paper.

The CBUA method contributes to the evolving literature on defining urban agglomerations morphologically as it provides a consistent and spatially explicit measure of the physical extent of urbanisation around India's statutory towns. It enables an assessment of how much a statutory town has expanded, how much built-up area lies within or outside municipal boundaries, and where peri-urban growth and cross-boundary expansion are occurring. This is particularly important in the absence of recent and consistently available data on population, employment, and economic activity at fine spatial scales. As an analytical framework, CBUA neither replaces Census UAs nor claims to measure functional urban areas or single labour markets. Rather, it complements existing constructs by identifying the morphological extent of cities—the contiguous built-up footprint that administrative definitions often undercount. For the formulation of urban development schemes and policies, this can support a more realistic assessment of infrastructure demand, service delivery gaps, peri-urban governance challenges, and the need for coordination across municipal, district, and state boundaries.

Methodology, data sources, and limitations

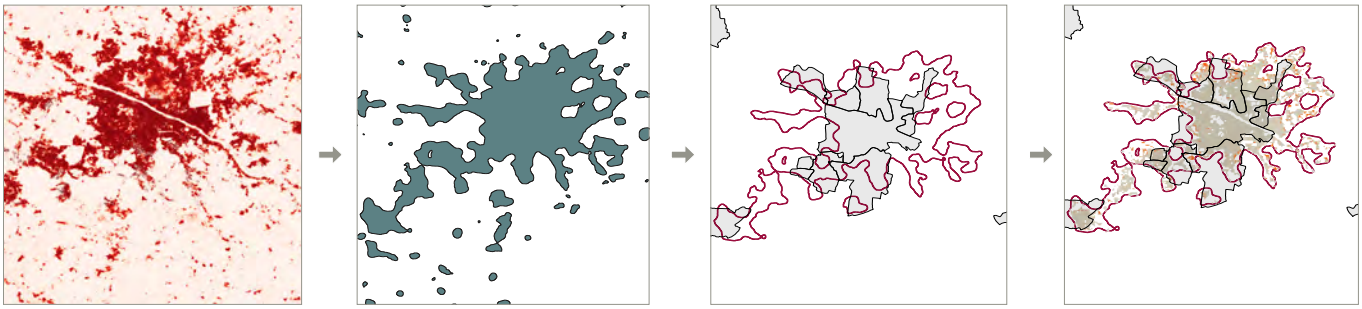
This section presents the process followed in delineating CBUAs, describes the steps taken to address each research question, and specifies the data sources referred to at each step (detailed further in Appendices A1 and A2) with their limitations and disclaimers. Step 1 delineates the urban extent of all statutory towns. The delineated area, referred to in this study as the CBUA, forms the spatial basis for the subsequent analysis. Steps 2 and 3 classify and present a brief profile of the CBUAs. These steps are important for disaggregating the analysis by population size and for understanding the broad characteristics of different categories of CBUAs. Steps 4 and 5 address the first research question by assessing how far CBUAs have expanded over time and estimating the extent of the built-up area that has occurred beyond the statutory town boundaries encompassed within each CBUA. Step 6 addresses the second research question by examining the verticality of CBUAs and provides an overview of their horizontal built-up area and mean height. The final step addresses the third research question by providing an overview of the CBUAs' administrative characteristics (see Table 1).

Table 1 | **Step-by-step description of the research method and limitations**

DESCRIPTION AND DATA SOURCE	LIMITATIONS
Step 1: Delineation of CBUA for all statutory towns (STs)	
▪ Digitised ST boundaries of 3,777 STs are taken from the SHRUG Database that sources Census 2011 data. ▪ CBUA delineation accounts for both the built-up area and ST boundaries contiguity. To identify the contiguous ST area, its boundaries from the SHRUG database mentioned above were used. The statutory town with the largest population is assigned as the primate. ▪ Built-up pixels in the Google/WRI Dynamic World dataset were initially identified using a probability threshold of greater than 70% (Brown et al. 2022). A 500-m focal mean filter was then applied to smoothen isolated patches and emphasise regions of spatial concentration of built-up area. Finally, a secondary threshold of 0.15 was applied to further smoothen the output and was spatially unified (see Figure 1 and Appendix A2 for a detailed description).	▪ Contiguity alone determines the agglomeration extent of STs. Socio-economic factors, travel time, and economic interactions, which determine the extent of functional urban area, are not considered. Limitations and concerns arising from this aspect are detailed in Appendix 2. ▪ The Google/WRI Dynamic World V1 2020 dataset has a higher resolution dataset (10 m) and inbuilt algorithms to delineate agglomerations that help delineate CBUAs more accurately. However, as this data is available only from 2016 onwards, this paper relies on Global Human Settlement Layer data to assess the built-up area growth trends from 1990 to 2020. ▪ While the analysis through CBUA methodology captures places that are physically connected through built form, it may exclude non-contiguous settlements that commute to the city and may include contiguous areas that are not equally integrated through daily labour market interactions.
Step 2: Classification of CBUAs based on population size	
▪ All CBUAs are categorised into four classes, based on population size.	
Step 3: Profiling of CBUAs by size class	
▪ Demographic descriptions, based on GHSL 2020 estimates ▪ Economic descriptions, based on Economic Census 2013–14 ▪ Literature review	▪ Economic Census is from 2013–14, which is dated; however, percentage shares are used for descriptions and not absolute numbers. ▪ It only describes the foundational morphological understanding of urban areas. This CBUA methodology can then be complemented with commuting patterns, functionality, and other socio-economic characteristics.
Step 4: Quantification of horizontal built-up area within the CBUAs	
▪ Horizontal built-up area of CBUAs is taken from GHSL database due to temporal availability over three decades i.e., 1990, 2000, 2010, and 2020. ▪ The method for calculating CBUA built-up area and share of built-up area are described in Appendix A2 ("Formulae for calculating horizontal built-up area trends").	▪ Built-up area share outside STs for 2020 is estimated using the ST boundaries of 2011. This may affect the estimations of growth due to changes in the ST boundaries that may have occurred after 2010. This data limitation is noted in the relevant sections of the working paper.
Step 5: Determination of horizontal growth trends	
▪ Annual Exponential Growth Rate (AEGR) of horizontal built-up area over three decades is computed using GHSL data for CBUAs, STs, and villages; the formula can be found in Appendix A2 ("Formulae for calculating horizontal built-up area trends").	
Step 6: Determination of verticality and comparison with horizontal built-up area	
▪ Verticality is assessed and compared across CBUAs based on the CBUA's mean building height using Open Buildings 2.5D temporal data (2020–2023) from Google (see Appendix A2, "Determination of verticality"). ▪ Scatter plots are used to study (1) horizontal built-up area 2020 and mean height of all CBUAs, and (2) horizontal built-up area growth rate (2010–2020) and mean height by CBUA typology. ▪ Illustration of verticality of six CBUAs selected based on vertical profile, horizontal growth trend, and CBUA size (see Appendix A3 for the methodology).	▪ Open Buildings 2.5D temporal data sets (4 m) have higher resolution than global urban microwave backscatter data and GHSL. Accuracy is about 82%, and building heights are capped at 100 m. ▪ The data has a mean absolute error in height estimates of 1.5 m, less than a one-storeyed building (Quinn 2024).
Step 7: Determination of horizontal growth trends	
▪ Number of STs, CTs, and villages in all CBUAs is tabulated using Census 2011 administrative entity data. ▪ Illustration of six CBUAs (administrative structure and tables showing composition) (see Appendix A3 for the method of selecting the six cases).	

Source: Authors' tabulation.

Figure 1 | **Concept explanation of CBUA using the case of Madurai city**

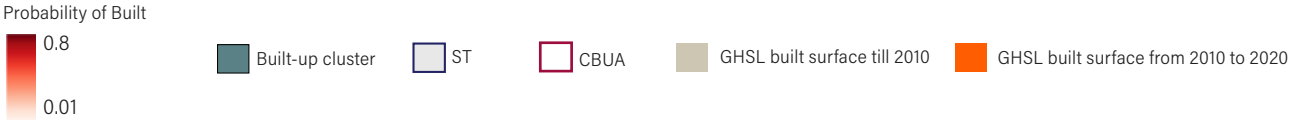


1. Built probabilities from Google Dynamic World identified using a probability threshold of greater than 70%.

2. Contiguous Built Area obtained after applying suitable filters and thresholds to smoothen isolated patches of built-up.

3. Contiguously Built Urban Agglomeration (CBUA) footprint derived by computing a spatial union of contiguous built area within contiguous statutory town boundaries

4. Final Contiguously Built Urban Agglomeration (CBUA) footprint within statutory towns and villages



Source: Authors' illustration based on data from Google Dynamic World and Census of India 2011.

Table 2 | **Classification of CBUAs, based on population**

S.NO.	CLASS	POPULATION RANGE
1.	Very large CBUA	5 million and above
2.	Large CBUA	From 1 million to 5 million
3.	Medium CBUA	From 0.1 million to 1 million
4.	Small CBUA	Below 0.1 million

Source: Authors' tabulation.

Rationale and classification of CBUAs by population size

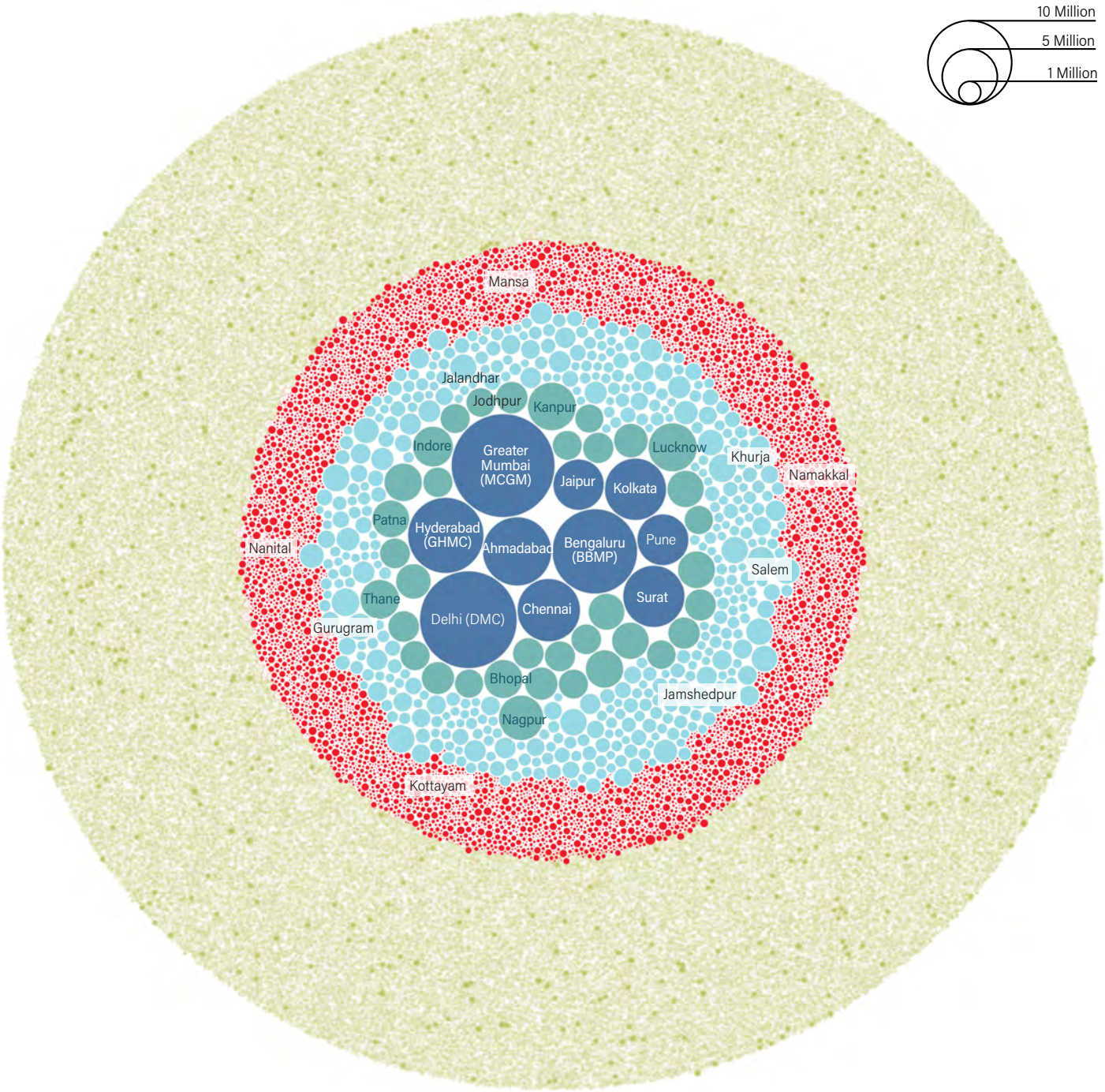
Urban studies researchers classify cities and urban agglomerations based on their population size, and there is often no commonality in the minimum threshold population for each category. The WUP Revision 2025 (United Nations 2025), ADB's natural cities study (Yi 2020), a study on Africa's urbanisation dynamics (Moriconi-Ebrard et al. 2016), and the Urban and Regional Development Plans Formulation and Implementation (URDPFI) guidelines (MoHUA 2015) all classify cities based on their population sizes but use different size categories. Following an analysis of these literature, this paper proposes classifying CBUAs based on population size, as shown in Table 2. This addresses the gaps in the current categorisation of cities in India.

The Census of India classifies cities into six categories (from Class 1 to Class 6) based on the population size of the urban settlements (Figure 2). This administratively bound classification considers all towns with a population above 0.1 million as Class 1 cities without differentiating between cities having populations of 0.1 million and 10 million. Hence, a differentiated classification approach is needed, which allows for a nuanced analysis of CBUAs by population size.

What qualifies as peri-urban areas in the CBUAs

Rural and urban communities exist as an interdependent system of settlements as many households live, work, and depend on both ecosystems to sustain human life beyond the political and administrative spheres (UN-Habitat 2019). This rural–urban continuum is most visible at the geographic periphery of cities, where developments within the urban limits diffuse into the rural landscape.

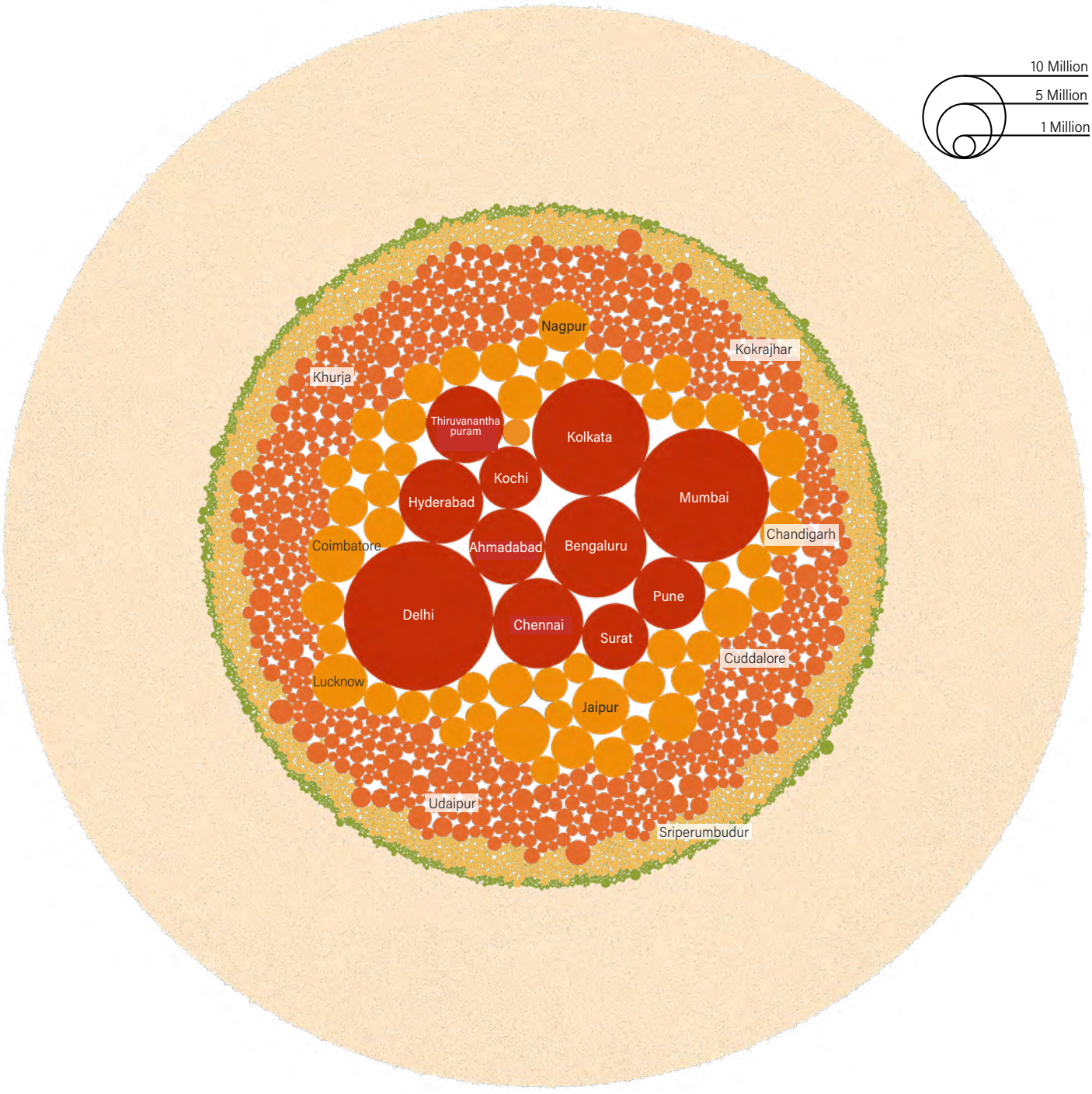
Figure 2 | **Urban and rural settlements sizes in India as per Census of India 2011**



- Class I cities with population > 3 million (10 in number, total population: 64 million)
- Class I cities with population range: 1 to 3 million (36 in number, total population: 51 million)
- Class I cities with population range: from 0.1 million to 1 million (450 in number, total population: 108 million)
- Class II to VI towns with population < 0.1 million (7,437 in number, total population: 149 million)
- Villages (5,97,618 in number, total population: 834 million)

Source: Author's illustration using Census of India 2011 data.

Figure 3 | **Graphical representation of CBUAs, census towns, and villages outside of CBUAs in India**



- Very large CBUAs (population > 5 million) (11 in number, total population: 140 million)
- Large CBUAs (population range: from 1 million to 5 million) (55 in number, total population: 110 million)
- Medium CBUAs (population range: from 0.1 million to 1 million) (710 in number, total population: 180 million)
- Small CBUAs (population < 0.1 million) (2,274 in number, total population: 82 million)
- Census towns outside CBUAs (1,826 in number)
- Villages (5,75,504 in number)

Source: Authors' illustration using GHSL 2020, the Shrug (Development Data Lab (DDL) Database, and Census of India 2011.

Areas that are adjacent to urban centres and are undergoing changes in land-use type due to the interactions between rural and urban elements are referred to as "peri-urban areas" (Haldar et al. 2024; Rauws and De Roo 2011). Peri-urban areas are the interface between rural and urban activities and embody transitions from rural to urban norms, legislation, and institutional settings in which the social structure, commercial activities, and the built environment are in flux (McConville 2014). Considering the absence of a universal definition for peri-urban areas and a distinct method for delineation, this study relies on the CBUA method. Villages and CTs in a CBUA that are outside the ST boundaries but accommodate contiguously spread built-up areas from the STs qualify as peri-urban areas.

The following sections detail the analysis and results pertaining to this working paper's research questions.

Constituents of CBUAs and size class-based profiles

The 3,777 statutory towns (STs) recorded in the 2011 Census of India constitute 3,050 CBUAs. These CBUAs exist as agglomerates of STs, rurally administrated CTs, and villages that vary in terms of population size, geographic distribution, and economic activities (Figure 3).

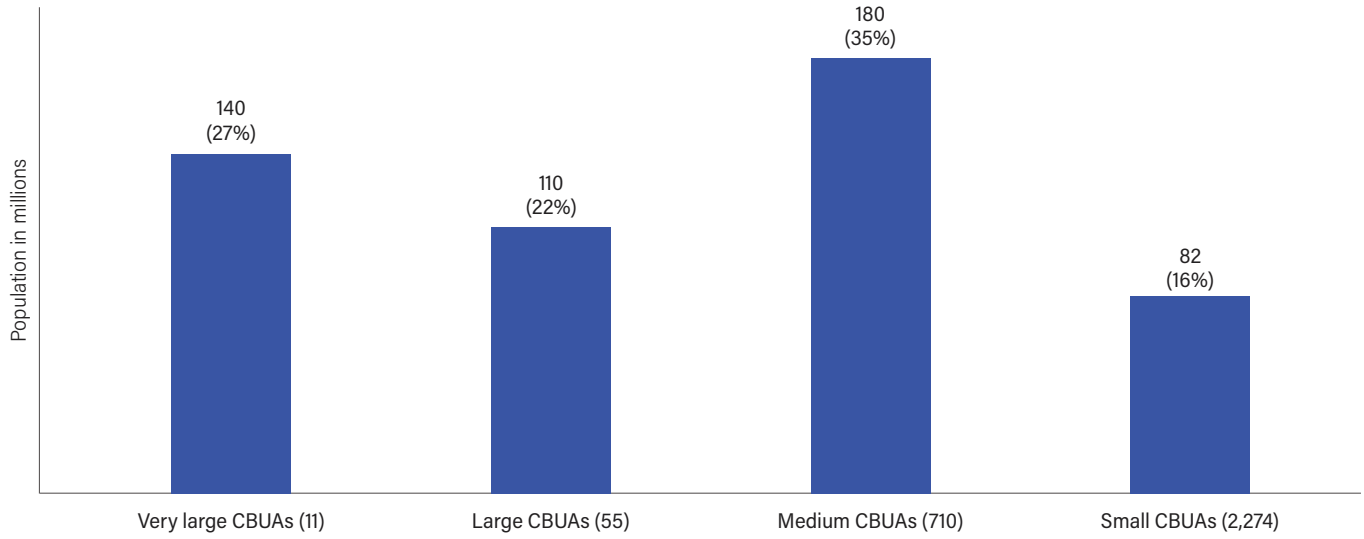
Demographic and economic profile of CBUAs

Among the four CBUA classes, very large CBUAs dominate India's urban agglomeration landscape. Just 11 of them contain 27 percent of the total population of the CBUA and 37 percent of non-agricultural employment (Figures 4 and 5).

This class includes Mumbai, Delhi, Kolkata, Bengaluru, and Chennai, which were among the world's 30 largest urban agglomerations in 2018 (United Nations 2018). Hyderabad, Ahmedabad, Pune, and Surat, along with Thiruvananthapuram and Kochi, are also among the very large CBUAs. Thiruvananthapuram and Kochi in Kerala, though not comparable with other very large CBUAs in terms of their national economic contribution, still qualify as very large CBUAs because of population size. Because of its unique rural-urban continuum spatial pattern, Kerala has contiguous stretches of built-up area extending over vast areas, covering several major cities within a single CBUA. While small CBUAs are larger in number, they hold the least share of population among the four CBUA classes.

Very large CBUAs dominate in terms of non-agricultural employment and the concentration of large and very large establishments employing over 100-500 workers in 2013–14 (Appendix A4, Table A4.1). Notably, around 49 percent of large non-agricultural establishments were concentrated in very large CBUAs, underscoring their ability to attract large-scale businesses and manufacturing jobs. The Delhi National Capital Region (NCR), Bengaluru, Hyderabad, Chennai, and Kolkata represent the core economic centres of India, with each showcasing diverse strengths in finance, governance and commerce, technology, manufacturing, and traditional industries (Trade Brains 2025). Large agglomerations provide economies of scale, skilled labour pools, and consumers, as well as infrastructure and other support networks that attract firms to such locations (Fujita and Krugman 2004; Sridhar and Wan 2010).

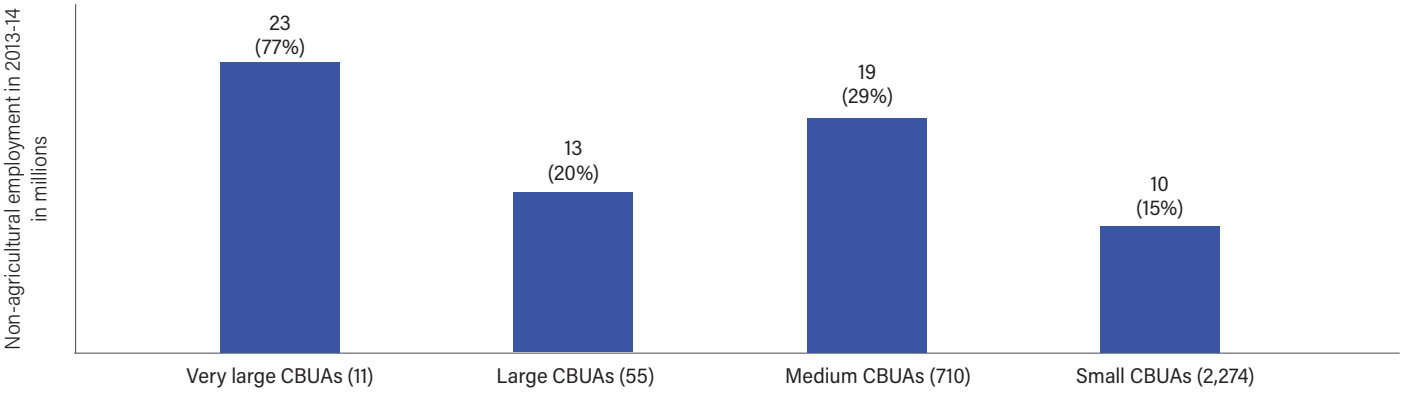
Figure 4 | **CBUA populations in millions (percentage share of population) in 2020**



Source: Authors' tabulation using GHSL 2020 and the Shrug (DDL) Database.

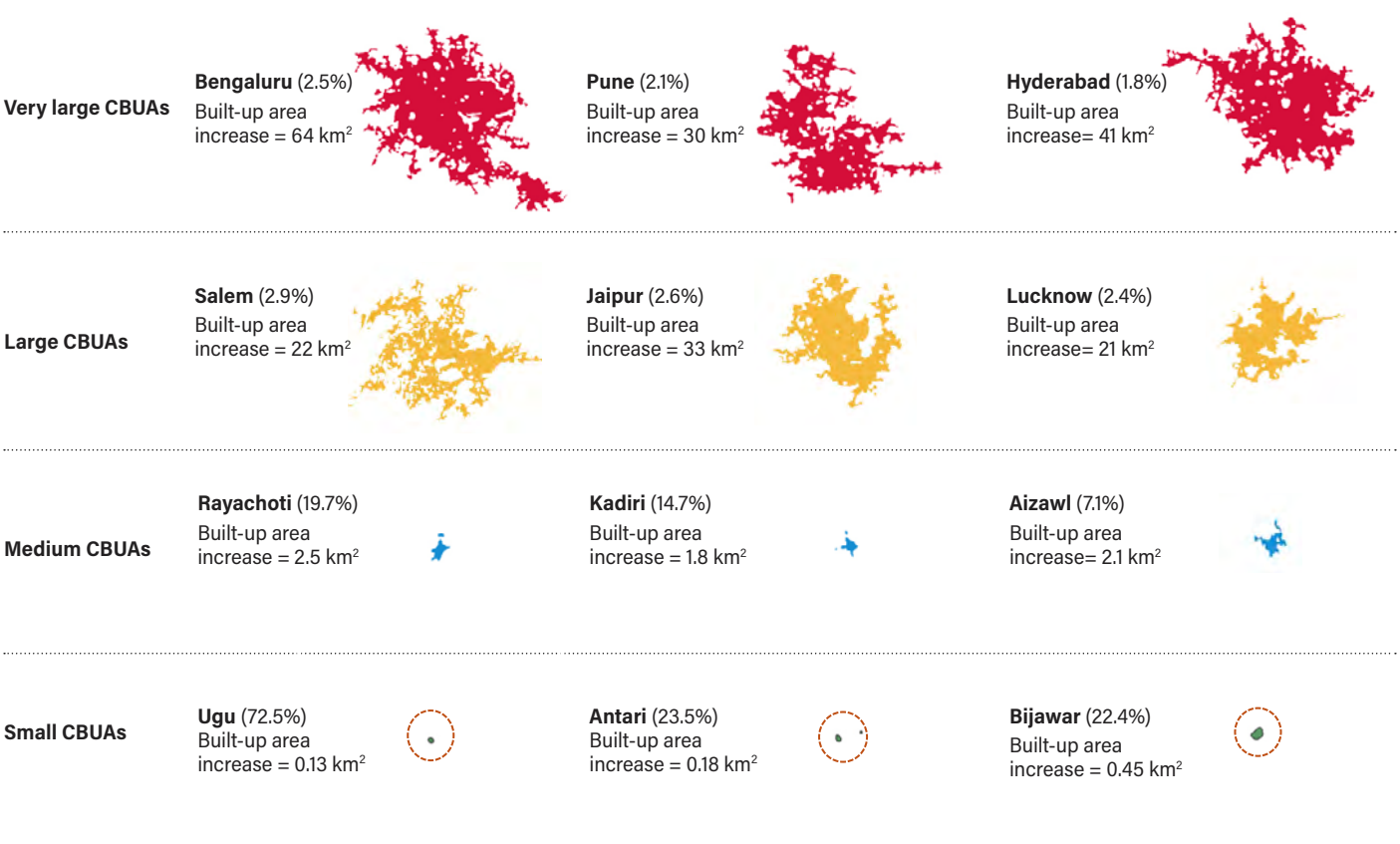
Economic activity in all CBUAs was predominantly in the service sector, with the majority of the employment provided by establishments with fewer than ten workers. While retail trade was the primary contributor of employment across all CBUAs, the garment industry was the second-largest employer for the very large and large CBUAs as per the Sixth Economic Census 2013–14. Indian cities and towns with higher shares of relatively vibrant manufacturing firms are associated with faster city growth (Hasan et al. 2017; Sridhar 2010). In the medium and small CBUAs, the primary sector involving animal production served as the second-largest contributor to employment, again as per the Sixth Economic Census, highlighting the rural-urban economic overlaps in these agglomerations.

Figure 5 | **Non-agricultural employment (percentage share of non-agricultural employment) of CBUAs in 2013–14**



Source: Authors' tabulation using GHSL 2020, the Shrug (DDL) database, and Sixth Economic Census 2013–14.

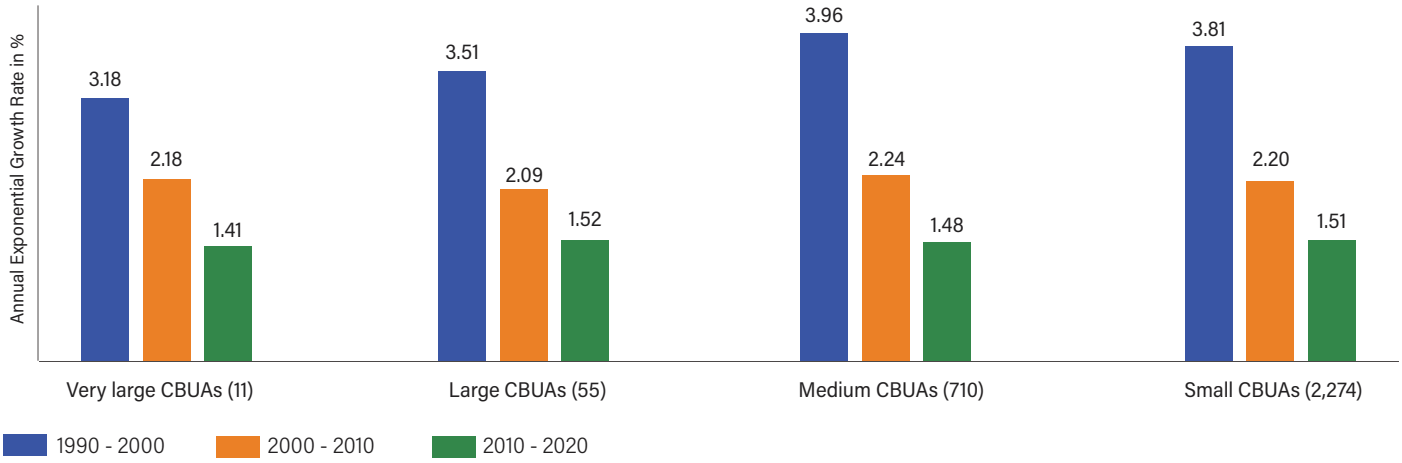
Figure 6 | **Top three CBUAs based on annual built-up area growth rates 2010–2020**



Note: Absolute built-up area increase in the map is between 2010 and 2020. Maps in last row (circled) are at a different scales (2 X zoom) than the other maps.

Source: Authors' analysis based on GHSL 2010–2020.

Figure 7 | **Annual Exponential Growth Rate of built-up area across all CBUAs (1990–2020)**



Source: Authors' analysis from GHSL 1990 - 2020.

Horizontality is all pervasive, while verticality is prominent in very large and hill city CBUAs

All CBUAs are growing horizontally, with a declining trend in growth rates

The total of the built-up area in all CBUAs together is 10,398 km^2 in 2020, with a substantial increase of 5,383 km^2 over the last three decades (1990–2020). All CBUAs, irrespective of their population size, experienced this surge in built-up area. Bengaluru, Salem, Rayachoti, and Ugu, in the very large, large, medium, and small categories respectively, recorded the most rapid expansion between 2010 and 2020 (Figure 6). For a detailed understanding, the decriptive statistics pertaining to the CBUA growth rates across size-classes are presented in Appendix A6.

While the horizontal built-up area of CBUAs continued to expand in absolute terms between 1990 and 2020, the pace of growth slowed significantly. The annual horizontal built-up area growth rate declined from 3.63 percent during 1990–2001 to 2.18 percent in 2001–2010 and further to 1.48 percent in 2010–2020, indicating a reduction in the overall horizontal growth rate of agglomerations. Irrespective of size class, this decline was experienced by all CBUAs and was similar across all time periods (Figure 7). The declining trend in built-up area growth rates aligns with the findings of a study on a global sample of 200 cities, which noted a declining trend in average urban extent growth rates from 1990–2000 to 2000–2014 (Blei et al. 2018).

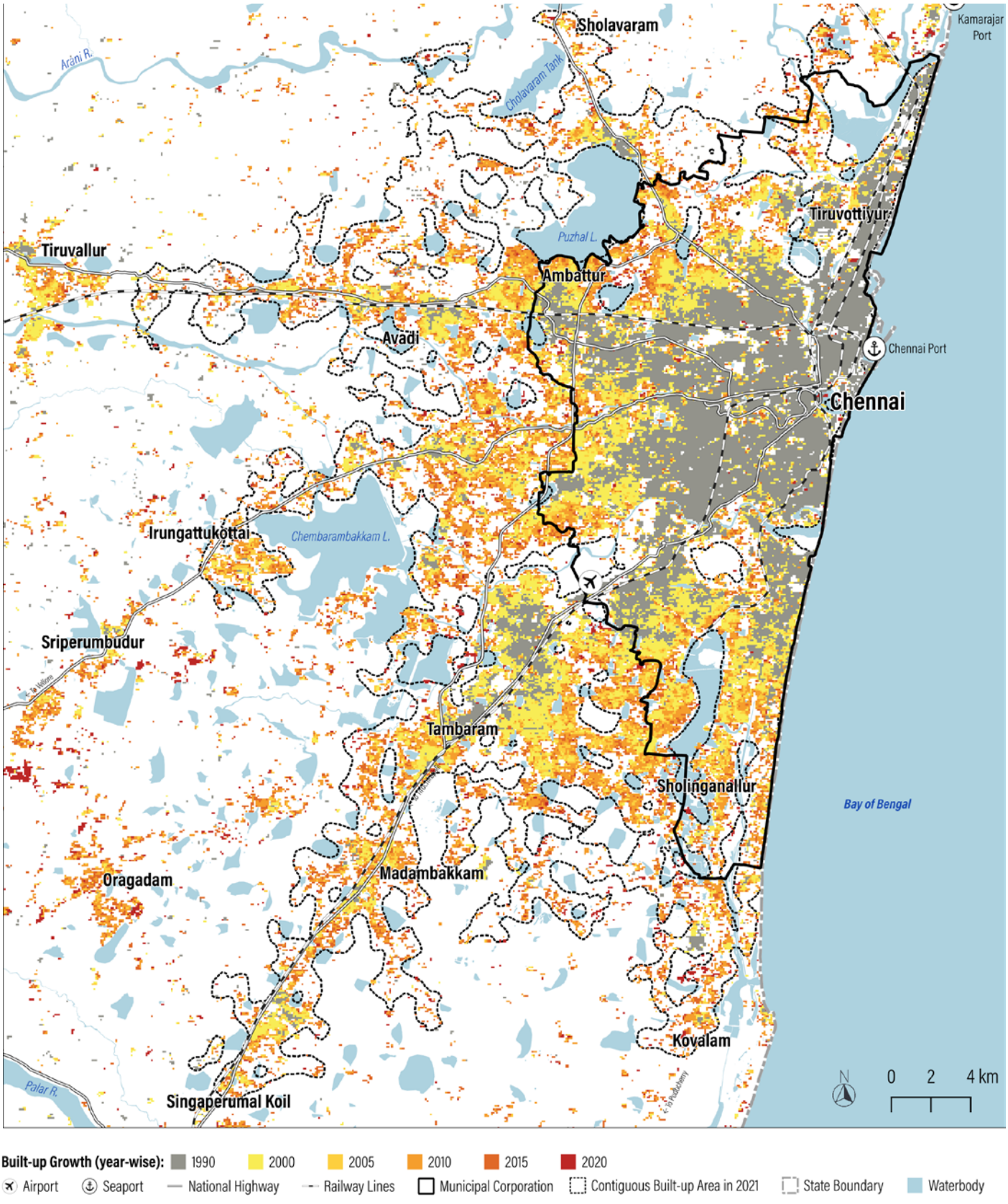
The horizontal built-up area growth in several CBUAs has not followed the municipal boundaries but was observed to have spread along major transport corridors and around other strategic projects such as airports and special economic zones (Figure 8). A significant number of CBUAs have a much smaller contiguous built-up area as compared to the corresponding jurisdictional area of their primate cities. Several STs, such as Surat and Visakhapatnam, have very large municipal extent, with substantial areas within the boundaries remaining non-built-up. While regulatory controls and natural features, such as water bodies, rivers, and, forest, land can reduce the total developable area within the municipal boundaries of STs, other factors causing mismatches between the built-up area boundary and the municipal boundaries of STs require further research.

Various factors, including demographic, economic, institutional, geographical, and topographical factors, drive urban expansion (Wang et al. 2026). While large metropolitan centres expand due to agglomeration forces, several smaller and remote towns exhibit varied growth trajectories ranging from peri-urban expansions to dispersed forms of urbanisation driven by remittance-led local economic restructuring in migration-dependent regions (Van Duijne et al. 2023; World Bank and Asian Development Bank 2025). Further research is needed to understand what drives urban growth and expansion across various categories of CBUA.

Nearly a third of horizontal built-up areas lie outside municipal limits

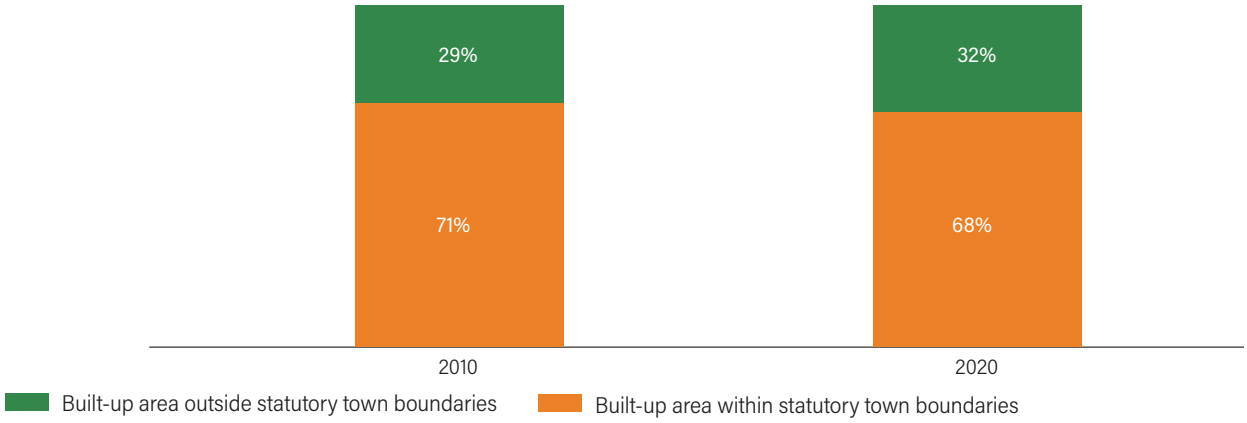
Within the CBUAs, about 29 percent of built-up area was outside the ST boundaries in 2011 (Figure 9). Keeping the 2011 ST boundaries constant, the share of built-up area outside the municipal limits in the peri-urban areas increased to 32 percent in 2020. This growth is measured relative to 2010 ST boundaries, which may have changed over time and, therefore, may affect subsequent estimates. While all CBUAs witnessed expansion beyond their municipal boundaries, the medium-sized CBUA category witnessed the highest share of built-up area beyond their 2010 municipal limits in both 2010 and 2020 (Figure 10).

Figure 8 | **Horizontal built-up area expansion of Chennai (1990–2020)**



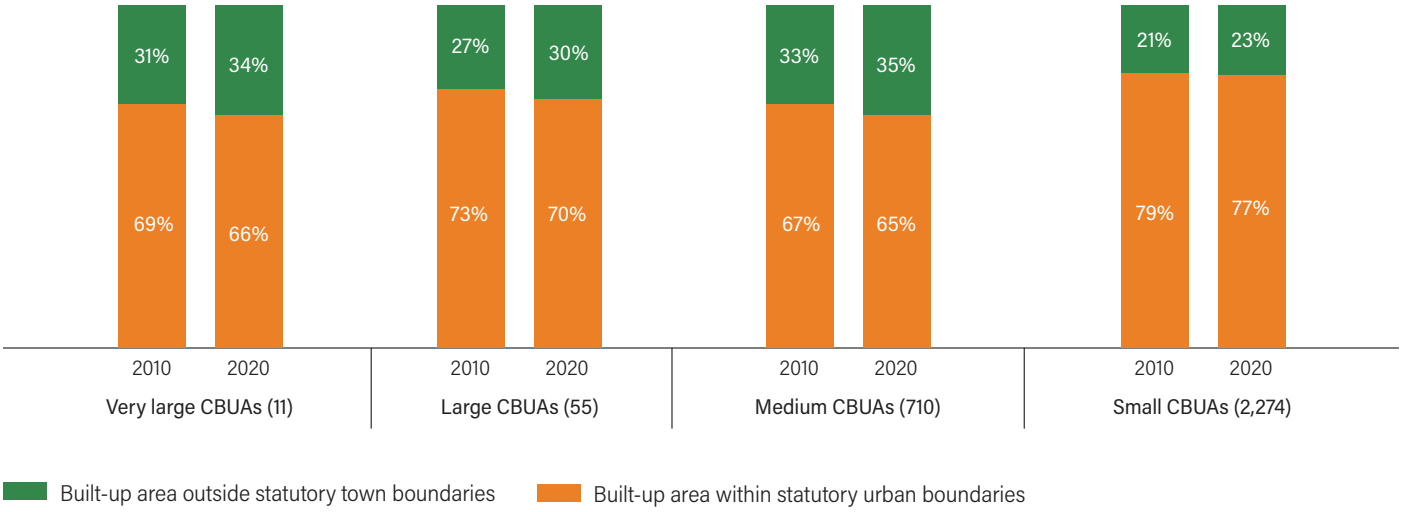
Source: Authors' illustration based on data from GHSL 1990–2020, the SHRUG (DDL) database, Census of India 2011, TNGIS, Central Water Commission, and Open street map.

Figure 9 | **Share of built-up area within and outside the statutory urban boundaries of CBUAs in 2010 and 2020**



Source: Authors' analysis based on GHSL 2010 – 2020, the Shrug (DDL) database, and Census of India 2011.

Figure 10 | **Share of built-up area within and outside the statutory urban boundaries across CBUAs by size class in 2010 and 2020**



Source: Authors' analysis based on GHSL 2010–2020, the Shrug (DDL) database, and Census of India 2011.

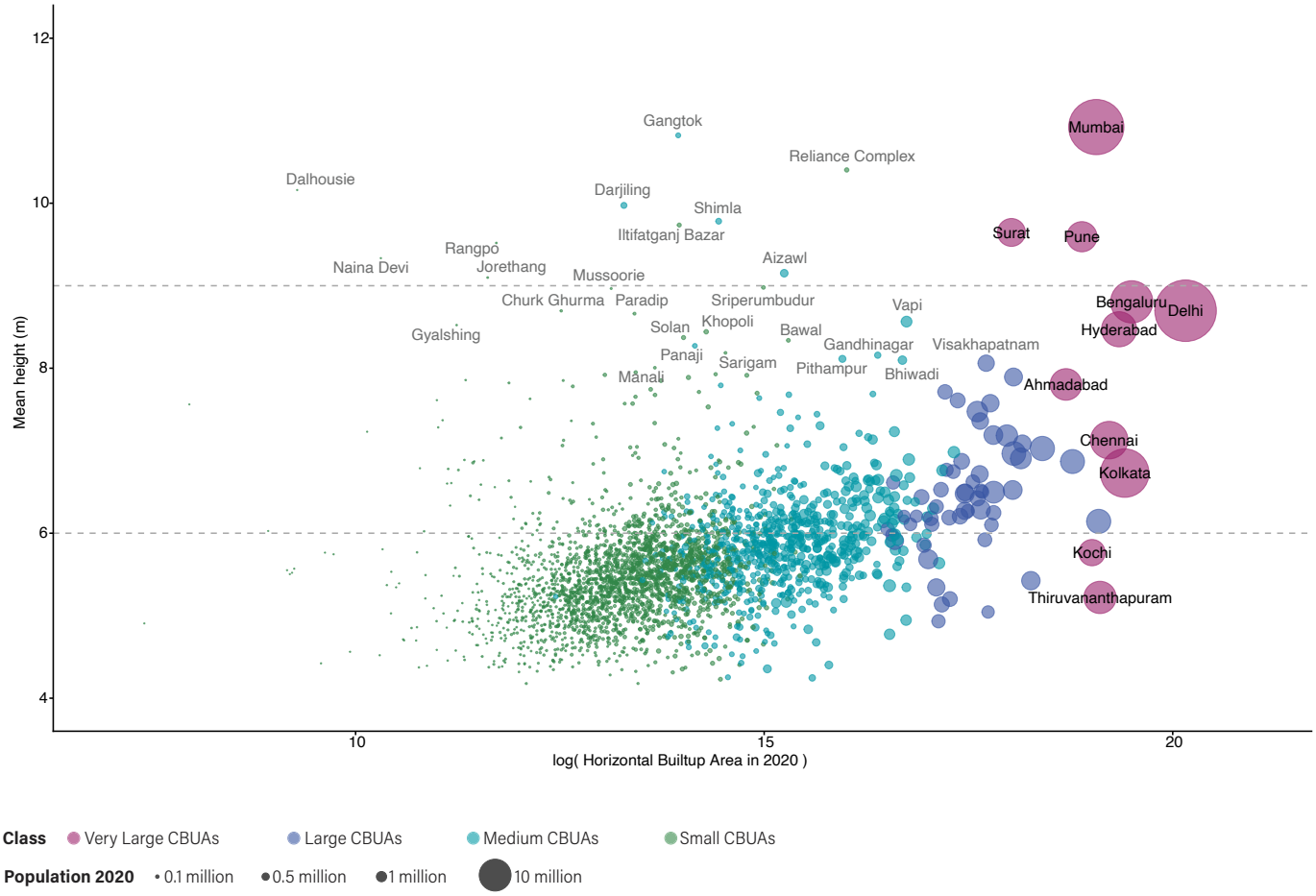
Studies show that land expansion processes are initially fragmented and often leapfrog over vacant open spaces on the urban fringe, which typically fills gradually as outward expansion continues (Angel 2023).

After the 2011 Census, several CBUAs such as Delhi, Chennai, Surat, and Bhopal expanded their municipal boundaries to accommodate such peri-urban growth. This paper, however, does not explore whether such boundary expansions have addressed the challenges of peri-urban areas and taken proactive steps to prime such areas before their amalgamation into the city limits. Such boundary changes after 2011 would affect the percentage share of built-up area recorded within and outside the municipal boundaries for 2020, which is a limitation of this study. In 2020, about 23 percent of the total built volume (analysed at 100 m resolution) was outside the 2011 ST boundaries of the CBUAs.

Very large and several hill city CBUAs dominate in verticality

Most of the very large CBUAs and several hill city CBUAs dominate in verticality with higher mean building heights when compared with other CBUAs (Figure 11). Mumbai CBUA with a mean building height of 10.9 m leads in terms of number and scale of skyscrapers, which by Indian standards are any buildings with over 40 floors or at a significant height relative to their surroundings (Berealty 2025).

Figure 11 | **Mean height of CBUAs versus absolute horizontal built-up area (log) of CBUAs**

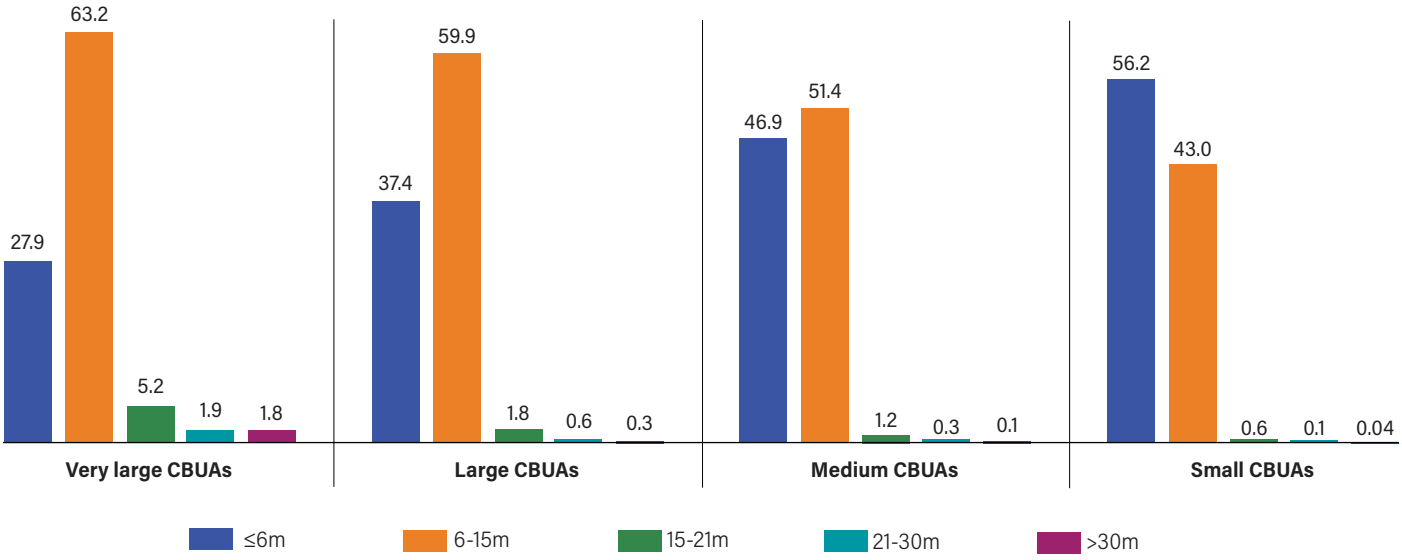


Note: As there is wide variation in the actual built-up area across CBUAs, the x-axis uses the logarithm of the 2020 horizontal built-up area to reduce skewness in the distribution.
Source: Authors' analysis based on GHSL 2020, Open Buildings 2.5D Temporal Dataset from 2020–2023, the Shrug (DDL) Database, and Census of India 2011.

Thiruvananthapuram and Kochi CBUAs do not follow the verticality pattern of very large CBUAs owing to their unique urbanisation patterns. Following Mumbai CBUA is the hill city CBUA of Gangtok (Sikkim) with a mean height of 10.8 m. Other hill cities such as Shimla and Dalhousie (Himachal Pradesh) with mean building heights of 9.8 m and 10.1 m respectively and Darjeeling (West Bengal) with a mean height of 9.9 m dominate in verticality when compared to their counterparts located in the flat terrain. A few notable outliers are industrial towns such as the Reliance Complex Industrial Notified Area (Gujarat) and Iltifatganj Bazar (Uttar Pradesh) which have recorded very high average heights due to the presence of tall industrial structures such as chimneys, cooling towers, and storage silos.

Driven by limited land availability and exorbitantly high land prices, high-rise constructions became economically attractive in the primate cities of the very large agglomerations (Arora 2025). In the hill town CBUAs, high-rise developments proliferated due to limited availability of flat land for construction. Several hill towns are being developed beyond the load-bearing capacity of their slopes and operate under severe land constraints, within fragile ecology, and with limited transport accessibility (Pradhan 2026). Barring the hill cities that dominate in verticality, small and medium CBUAs have mostly grown horizontally with less verticality (Figure 13). Very large CBUAs shift to vertical densification in response to rising land prices and limited land availability, with Thiruvananthapuram and Kochi being exceptions. Besides these, other factors such as development control regulations embedded within urban planning frameworks, willingness to pay higher premiums for high-rise development, housing preference, and access to infrastructure also influence vertical development (Arora 2025; Department of Economic Affairs 2025). Buildings that range in height from ground to about 4 storeys or up to 15 m is the predominant built form across all CBUAs (Figure 12).

Figure 12 | **Percentage share of built-up area of buildings, classified based on their heights across all CBUAs**



Source: Authors' analysis based on GHSL 1990-2020, Open Buildings 2.5D Temporal Dataset from 2020-2023, The Shrug (DDL) database, and Census of India 2011.

Figure 13 | **Mean height and annual exponential growth rate of horizontal built-up areas of CBUAs (2010–2020)**



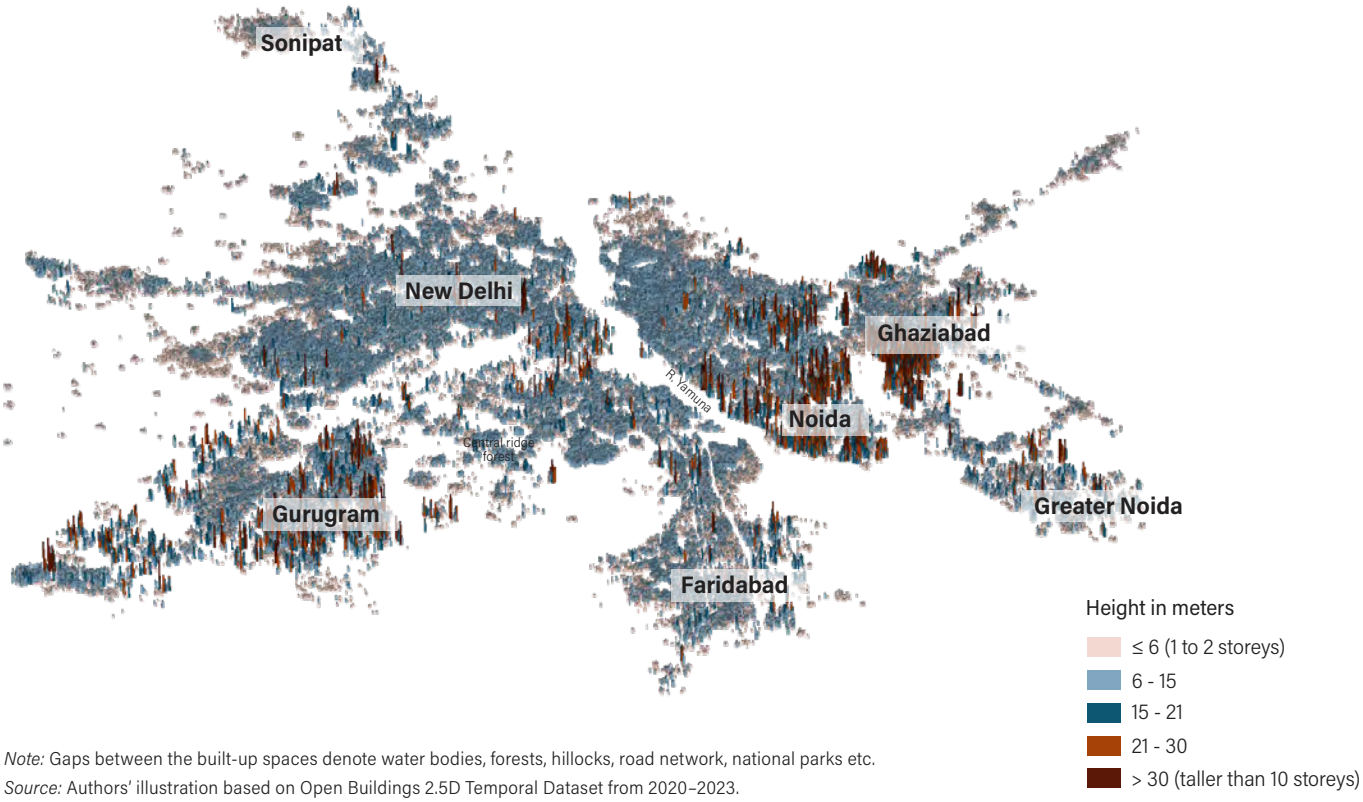
Class Very Large CBUAs · Large CBUAs · Medium CBUAs · Small CBUAs

Population 2020 0.1 million · 0.5 million · 1 million · 10 million

Note: 58 CBUAs having horizontal growth rates above 4.5 m are not represented in the chart.

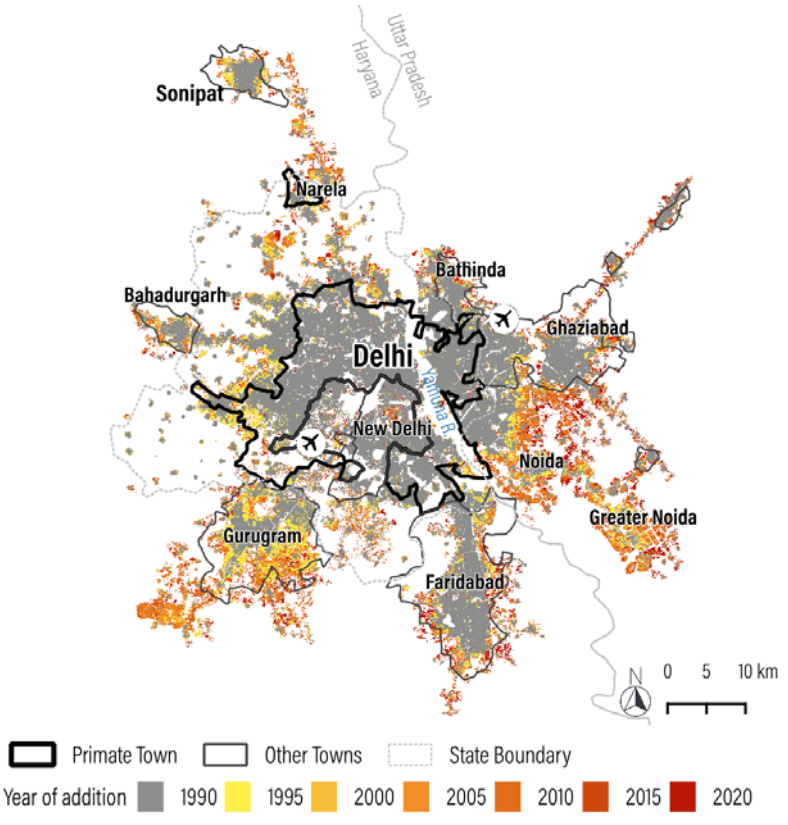
Source: Authors' analysis based on GHSL 2010–2020, Open Buildings 2.5D Temporal Dataset from 2020–2023, the Shrug (DDL) database, and Census of India 2011.

Figure 14 a | **3D view of Delhi CBUA**



Note: Gaps between the built-up spaces denote water bodies, forests, hillocks, road network, national parks etc.
Source: Authors' illustration based on Open Buildings 2.5D Temporal Dataset from 2020–2023.

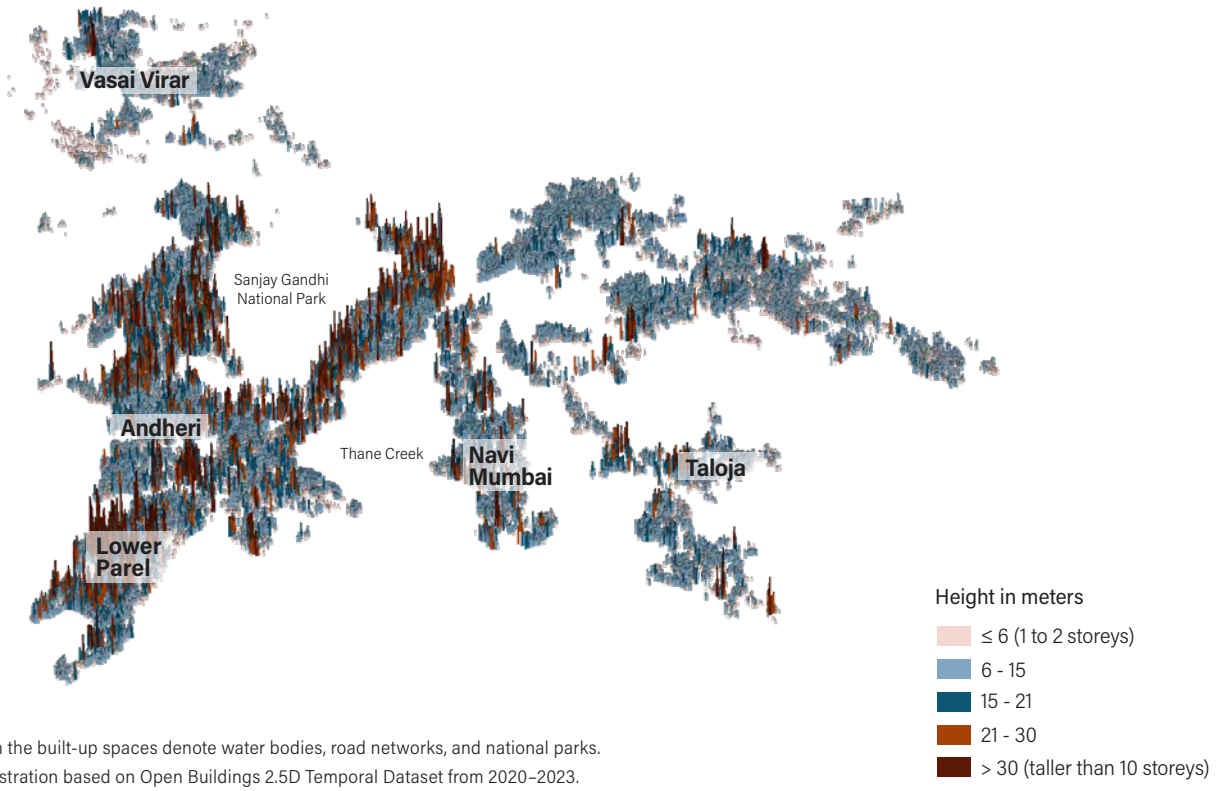
Figure 14 b | **Horizontal built-up area expansion of Delhi CBUA (1990–2020)**



Source: Authors' illustration based on GHSL 1990–2020, the Shrug (DDL) database, and Census of India 2011.

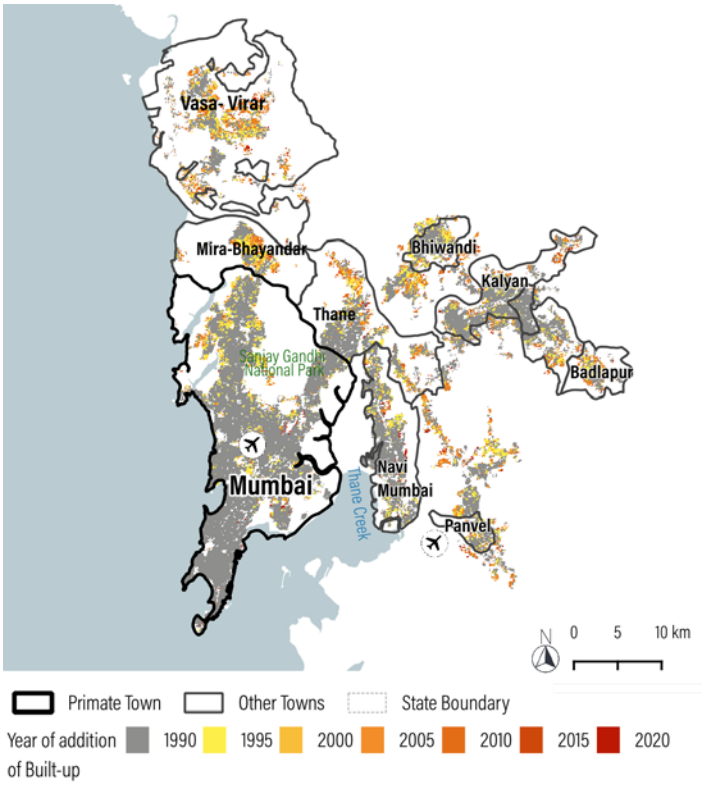
Between 1990 and 2020, Delhi, the largest CBUA by spatial extent, recorded a 66 percent increase in horizontal built-up area, with post-2000 growth extending mainly beyond the Delhi state boundaries into rapidly urbanising parts of Haryana and Uttar Pradesh (figure 14b). Built-up growth has clearly peripheralised towards Gurugram, Faridabad, New Okhla Industrial Development Authority (NOIDA), and Greater Noida, supported in part by improved metro connectivity beyond the National Capital Territory of Delhi (Mathews et al. 2023). Taller buildings and newer economies such as IT/ITeS and financial services are concentrated in Gurugram and Noida, highlighting the need for stronger coordination between urban development and industrial departments to manage peri-urban growth (figure 14a).

Figure 15 a | **3D view of Mumbai CBUA**



Note: Gaps between the built-up spaces denote water bodies, road networks, and national parks.
Source: Authors' illustration based on Open Buildings 2.5D Temporal Dataset from 2020–2023.

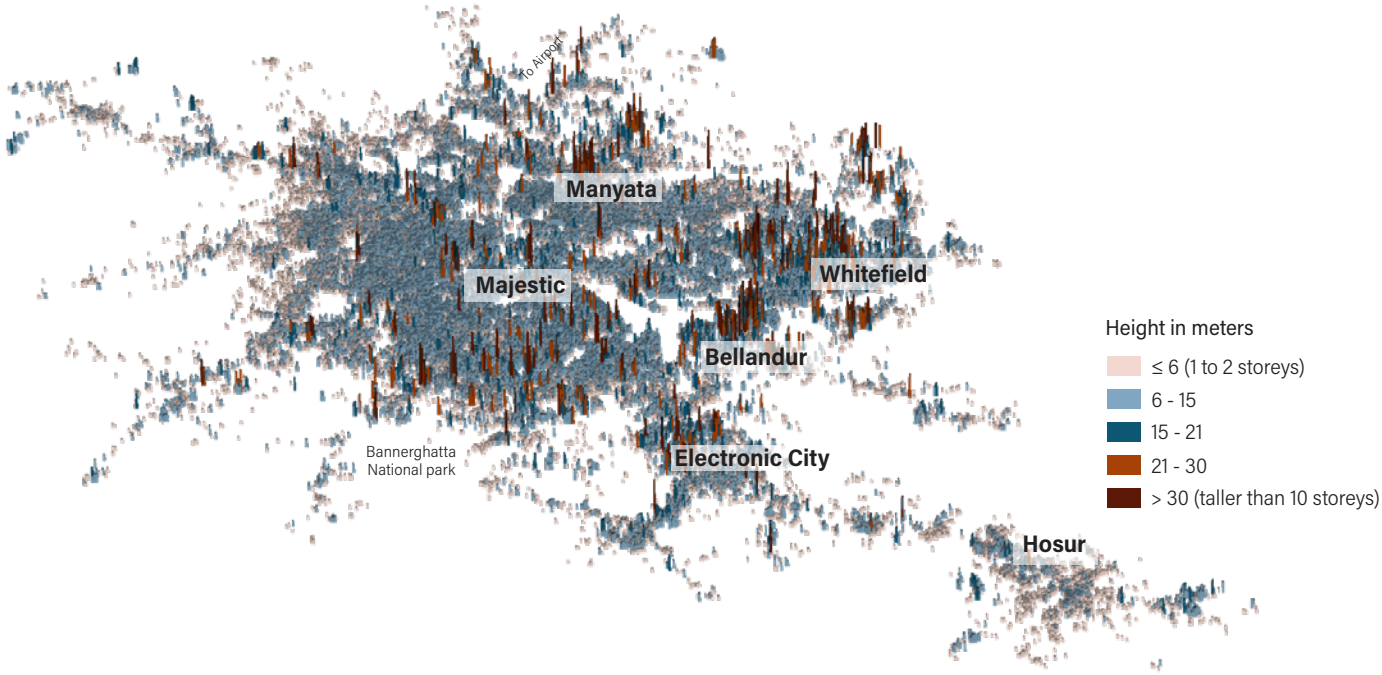
Figure 15 b | **Horizontal built-up area expansion of Mumbai CBUA (1990–2020)**



Note: Gaps between the built-up spaces denote water bodies, road networks, and national parks.
Source: Authors' illustration based on GHSL 1990–2020, the Shrug (DDL) database, and Census of India 2011.

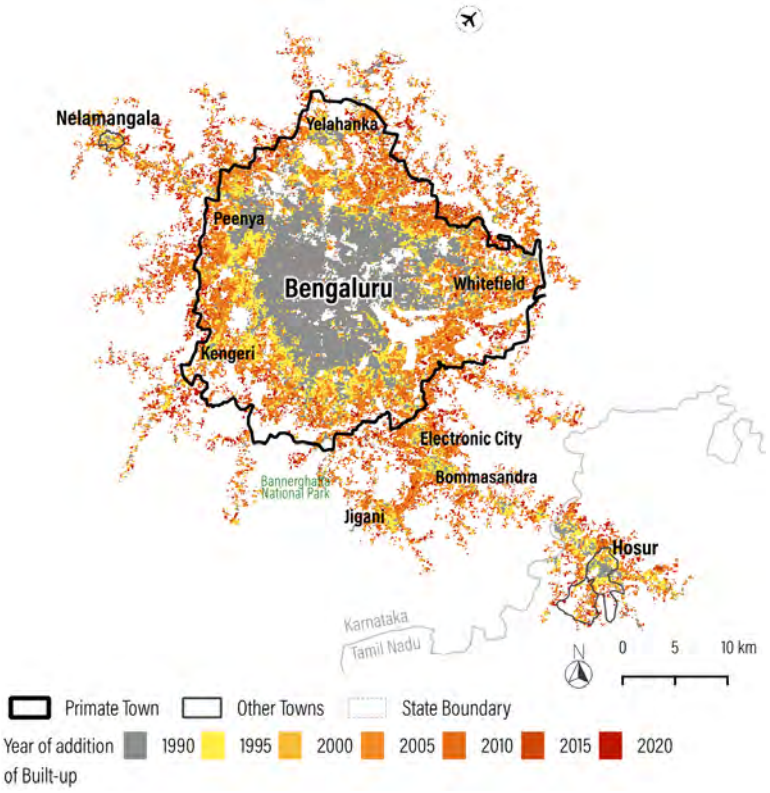
Mumbai is India's tallest CBUA, accommodating over 77 percent of the country's tall buildings above 150 m and ranking 15th globally among cities with the most skyscrapers in 2025 (Confederation of Indian Industry, n.d.). Its tallest buildings, including Lokhandwala Minerva at Mahalaxmi and Palais Royale at Worli, exceed 300 m, which can be attributed to regulatory reforms that enabled redevelopment of old chawls and defunct mills and catalysed high-rise construction in southern Mumbai. While vertical densification is the strategic response to constrained land availability, it puts additional pressure on existing infrastructure networks, utilities, and ecological resources (figure 15a and 15b). The real challenge is therefore to ensure that regional planning approaches keep pace with these development patterns and maintain and strengthen the city's liveability and resilience.

Figure 16 a | **3D view of Bengaluru CBUA**



Source: Authors' illustration based on Open Buildings 2.5D Temporal Dataset from 2020–2023.

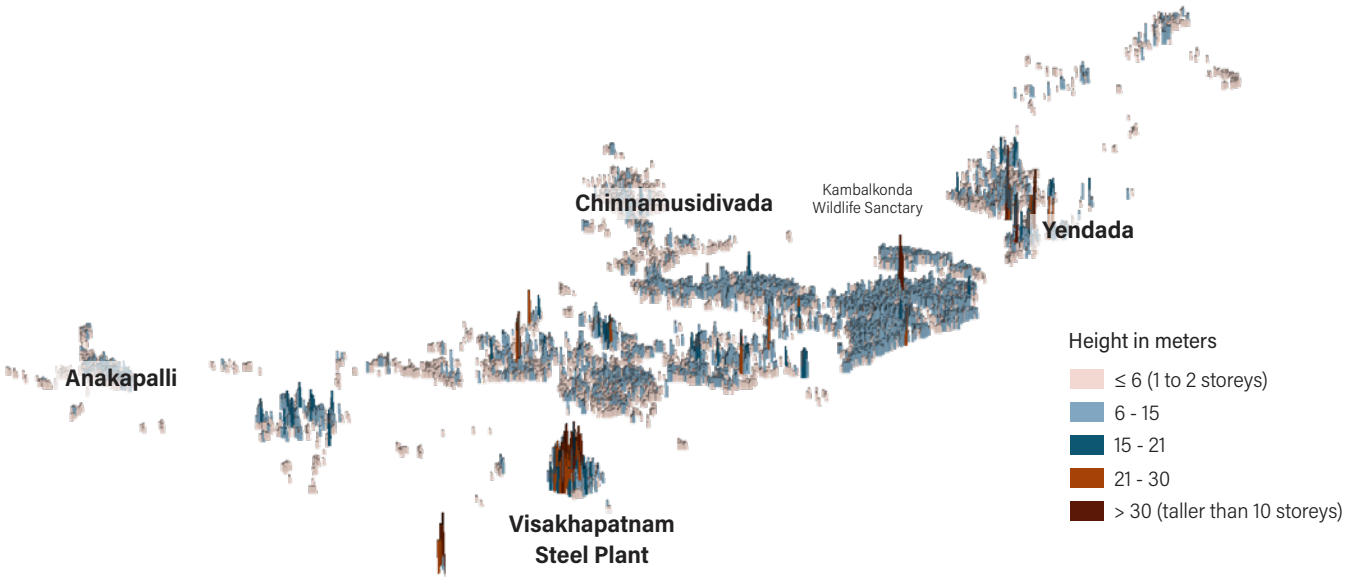
Figure 16 b | **Horizontal built-up area expansion of Bengaluru CBUA (1990–2020)**



Source: Authors' illustration based on GHSL 1990–2020, the Shrug (DDL) database, and Census of India 2011.

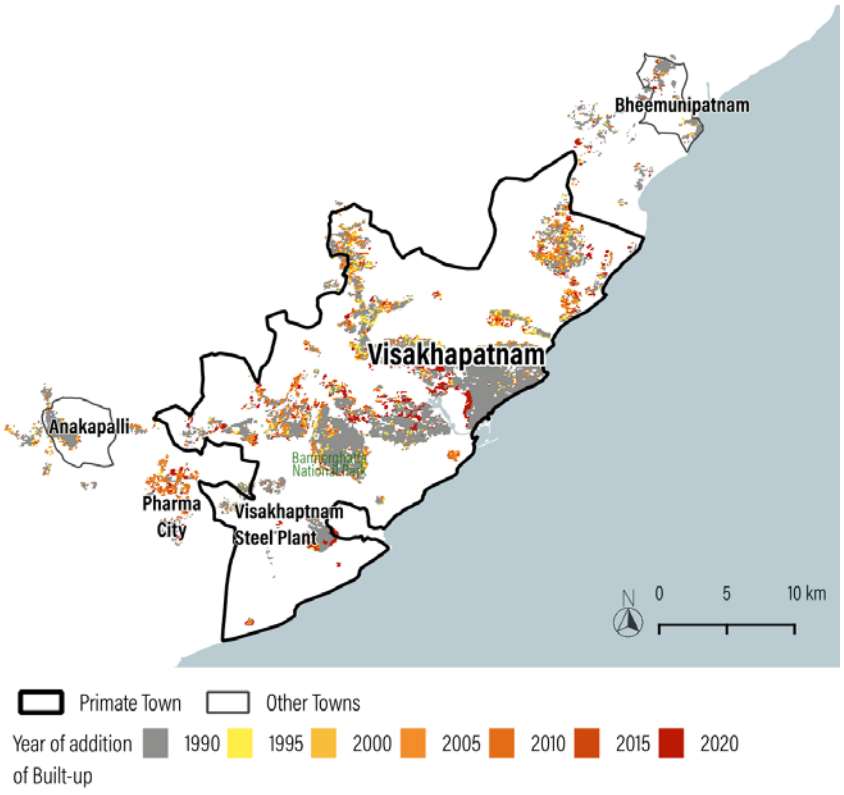
Bengaluru CBUA has expanded beyond its municipal boundaries predominantly along major transport corridors, with relatively limited verticality compared to Mumbai and a mean building height of 8.8 m (figure 16a). High-rise clusters are concentrated in IT and IT-enabled service hubs such as Hebbal, Whitefield, Bellandur, and Electronic City. This pattern is partly associated with restrictive Floor Area Ratio (FAR) regulations, which may have contributed to faster horizontal urban expansion and lower verticality (Chen et al. 2024) (figure 16b). Such sprawling development is linked to higher transport emissions, uneven access to public services in peri-urban areas, and increasing environmental stresses, including groundwater depletion, flooding, and urban heat, underscoring the need for coordinated metropolitan-scale planning (Expert Committee—BBMP Restructuring 2016; Tewari and Godfrey 2016).

Figure 17 a | **3D view of Greater Visakhapatnam CBUA**



Note: Gaps between the built-up spaces denote water bodies, forests, hillocks, road networks, national parks etc.
Source: Authors' illustration based on Open Buildings 2.5D Temporal Dataset from 2020–2023.

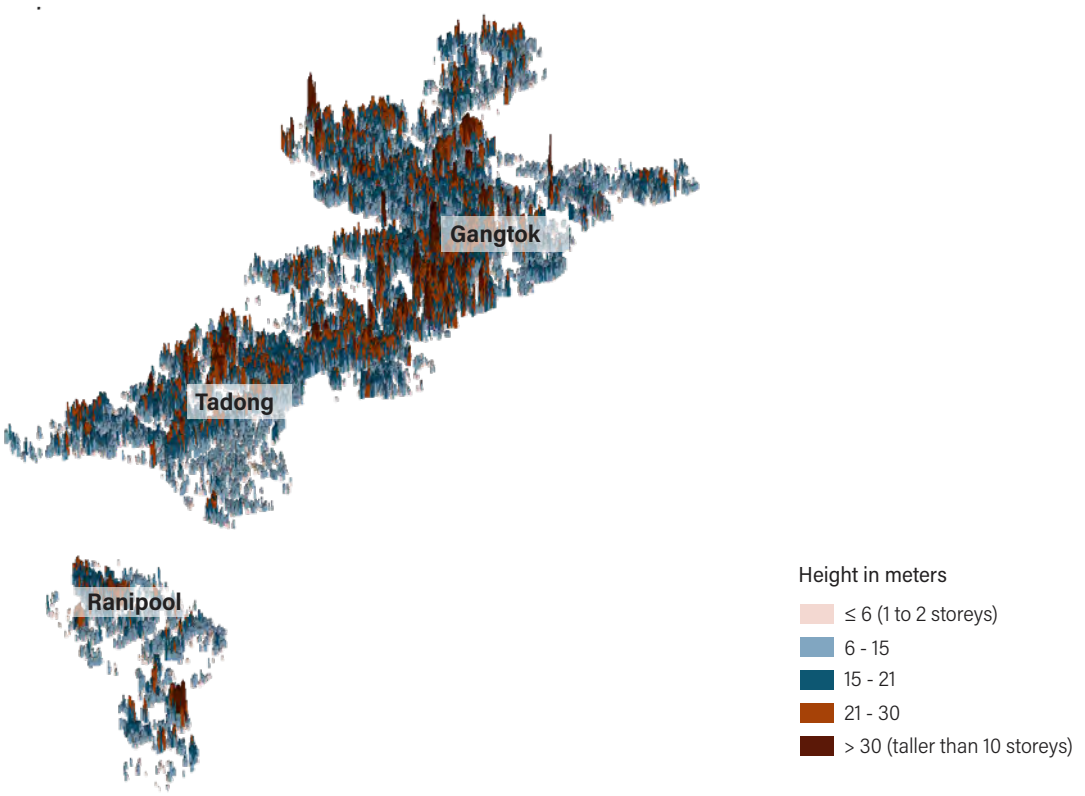
Figure 17 b | **Horizontal built-up area expansion of Greater Visakhapatnam CBUA (1990-2020)**



Among large CBUAs, Greater Visakhapatnam exhibits the highest verticality, driven by high-rise residential developments such as the 35-storey housing complex in Seethammadhara and tall industrial structures within the Visakhapatnam Steel Plant (Patnaik 2024) (figure 17a). Built-up expansion is largely within the extensive municipal limits, with recent growth concentrated along the Visakhapatnam–Araku Road corridor and the northern coastal corridor towards Bheemunipatnam, highlighting transport corridor-driven built-up expansion (figure 17b). This combination of verticality and relatively contained horizontal expansion distinguishes Visakhapatnam from many large Indian CBUAs experiencing rapid peripheral sprawl.

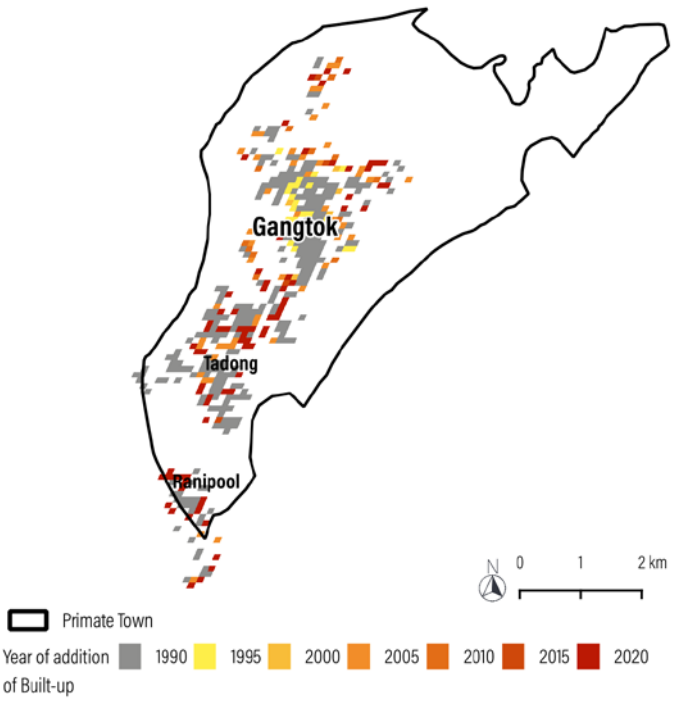
Sources: Authors' illustration based on GHSL 1990–2020, the Shrug (DDL) database, and Census of India 2011.

Figure 18 a | **3D view of Gangtok CBUA**



Note: Gaps between the built-up spaces denote forests and hillocks etc.
Source: Authors' illustration based on Open Buildings 2.5D Temporal Dataset from 2020–2023.

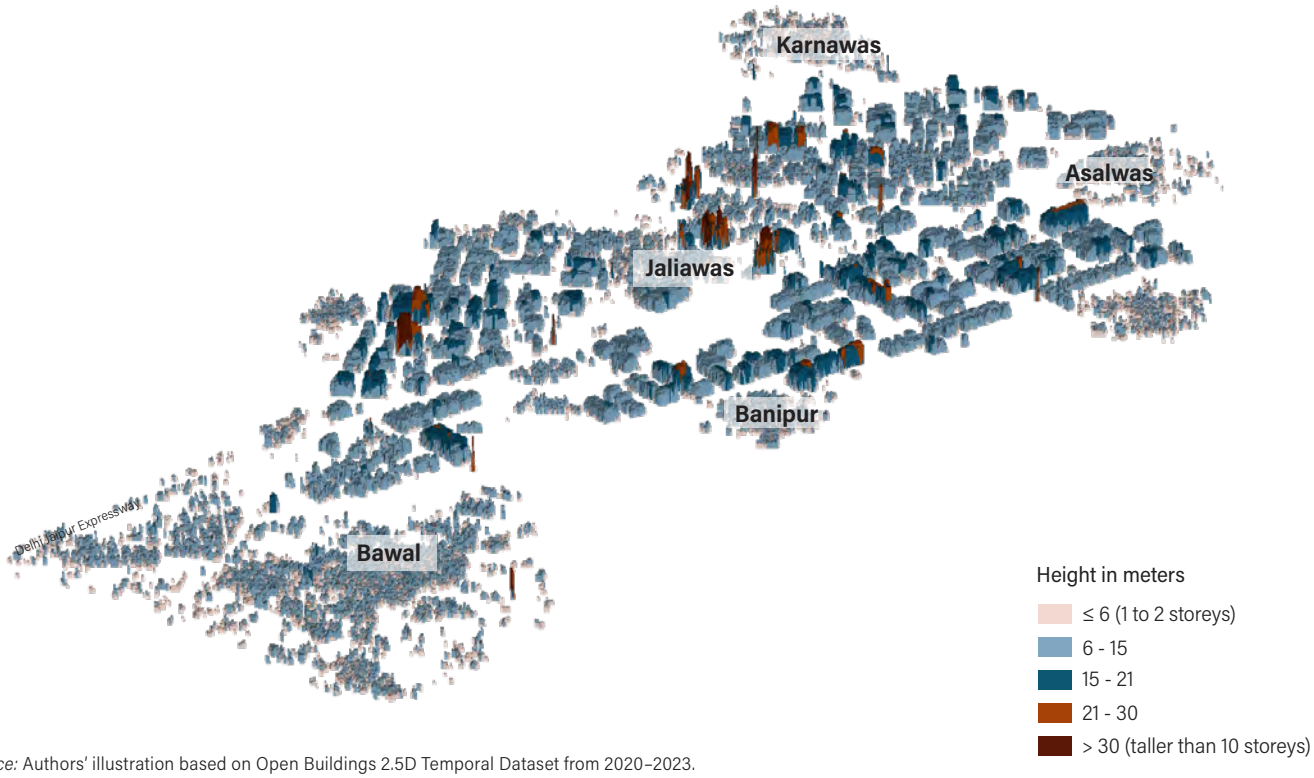
Figure 18 b | **Horizontal built-up area expansion of Gangtok CBUA (1990–2020)**



Gangtok, the capital of Sikkim, dominates in verticality among medium-sized CBUAs, with a mean building height of 10.8 m, the second-highest across all CBUAs (figure 18a). Despite significant topographic constraints, built-up expansion after 2005 extended southwards towards Tadong and Ranipool and northwards from the urban core, with annual growth rates increasing from 2.09 percent (1990-2000) to 3.03 percent (2010-2020) (figure 18b). However, intensified construction has been associated with deforestation, soil erosion, hydrological imbalances, landslides, and flooding, highlighting the need to balance urban growth with the ecological sensitivity of the Himalayan landscape (ICLEI South Asia 2020).

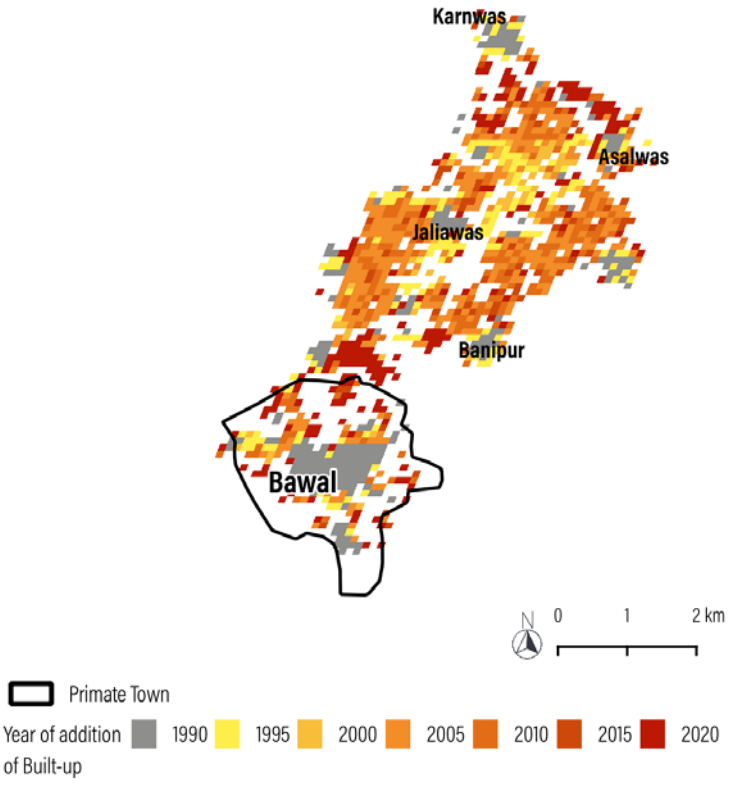
Sources: Authors' illustration based on GHSL 1990–2020, the Shrug (DDL) database, and Census of India 2011.

Figure 19 a | **3D view of Bawal CBUA**



Source: Authors' illustration based on Open Buildings 2.5D Temporal Dataset from 2020–2023.

Figure 19 b | **Horizontal built-up area expansion of Bawal CBUA (1990–2020)**



Source: Authors' illustration based on GHSL 1990–2020, the Shrug (DDL) database, and Census of India 2011.

Bawal, a small CBUA in Haryana's Rewari district, exhibits a relatively high mean building height of 8.3 m due to tall industrial structures concentrated within the Industrial Model Township near Jaliawas along the Delhi–Jaipur Expressway, although most buildings remain low- to mid-rise (figure 19a). The CBUA has expanded predominantly through horizontal growth, recording an annual built-up growth rate of 6.74 percent between 1990 and 2020, largely driven by industrial development beyond the municipal boundary to the north (figure 19b). The strong concentration of post-2000 expansion around industrial zones highlights the need for proactive planning of infrastructure, land use, mobility, and basic services to manage growth around strategic investment locations.

Having understood the horizontal built-up area trends and verticality of CBUAs, the next section provides an overview of the composition of administrative entities in the CBUAs and their characteristics.

Multi-jurisdictional realities and functional overlaps of CBUAs

Overview of administrative structure of all CBUAs

The built-up area and the population in the majority of CBUAs are spread over multiple urban or rural administrative units, and in certain cases are spread over multiple districts and across state boundaries. 245 CBUAs have more than one municipal entity or urban local body and are hence termed multi-municipal CBUAs, and 2,805 CBUAs have a single municipal body (Table 3). While a majority of these CBUAs contain several villages and CTs within them, around 501 CBUAs are contained within the administrative boundary of a single ST. Of this 501, only 12 are medium CBUAs; the remainder are all small CBUAs with marginal shares of contiguously built-up areas within their statutory urban limits.

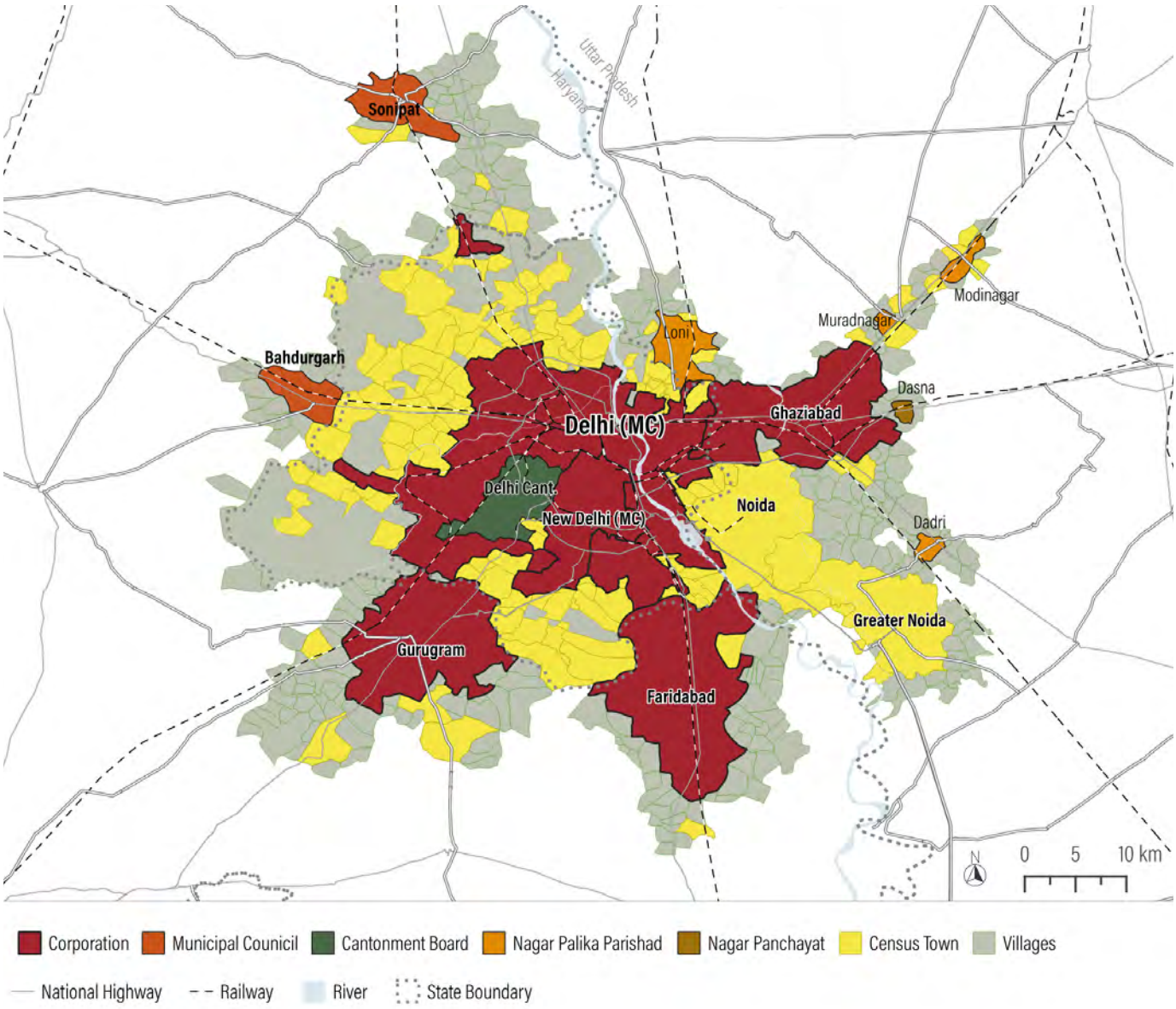
Significantly, about 53 percent of all the CTs recorded in Census 2011 are located within these CBUAs, reflecting a concentration of rapidly transforming villages in the peripheries of STs that remain rurally administered. This finding is consistent with distance-based estimates of "proximate" census towns documented across all large statutory towns (population greater than 0.1 million) in India (Roy and Pradhan 2018). As the built-up area extends into the surrounding villages and CTs, such areas are likely to have urban-like features, with transforming land uses and economic characteristics. Six illustrations of CBUAs across the four categories (very large, large, medium, and small) shows the diversities in administrative structures across the CBUAs (five illustrations are in Appendix A5).

Table 3 | **Administrative structure of CBUAs**

SL.NO.	CBUA COMPOSITION	NO.OF CBUAs	NO. OF STATUTORY TOWNS	NO. OF CENSUS TOWNS	NO. OF VILLAGES
Multi-municipal structure					
1	STs+CTs+ Villages	129	664	1,316	6,020
2	STs+ Villages	103	278	0	1,435
3	STs+CTs	3	7	27	0
4	Only STs	10	23	0	0
	Total	**245**	**972**	**1,343**	**7,455**
Single municipal structure					
1	ST	501	501	0	0
2	ST +CTs	3	3	3	0
3	ST+ Villages	1,995	1,995	0	10,415
4	ST+ CTs+ Villages	306	306	720	4,244
	Total	**2,805**	**2,805**	**723**	**14,659**
	Grand total	**3,050**	**3,777**	**2,066**	**22,114**

Source: Authors' computation based on GHSL, the Shrug (DDL) database, and Census of India 2011.

Figure 20 | **Constituent administrative bodies in Delhi CBUA**



Source: Authors' analysis based on the Shrug (DDL) Database and Census of India 2011.

Delhi CBUA's constituent urban and rural local bodies are spread across the states of Haryana, Uttar Pradesh, and Delhi. This agglomeration is part of the National Capital Region (NCR) that spans over 55,000 km^2, with a National Capital Region Planning Board to promote balanced economic and social growth across the NCR region.

Being a union territory, Delhi is administered by the President of India through a Lieutenant-General, and its local governance structure comprises the Municipal Corporation of Delhi (MCD), New Delhi Municipal Council (NDMC), and the Delhi Cantonment Board (figure 20 and table 4). The other major municipal corporations within this CBUA are Gurgaon, Faridabad, and Ghaziabad.

The agglomeration also has large and unique CTs, such as NOIDA and Greater NOIDA, with populations over 0.1 million that are governed by industrial development authorities. This reveals governance arrangements across multiple jurisdictions, where responsibilities for local administration, service delivery, and large-scale infrastructure provision are distributed among local governments, parastatal agencies, and state departments. It highlights the complexities of planning and governing such agglomerations and underscores the need for stronger vertical and horizontal coordination across these institutions to enable integrated planning, efficient service delivery, and the effective functioning of urban agglomerations.

Table 4 | **Constituent bodies and the built-up area distribution in Delhi CBUA**

SL.NO	TYPE OF LOCAL BODY	NUMBER OF ENTITIES (AS PER CENSUS 2011)	BUILT-UP AREA 2010 (KM²)	SHARE OF BUILT-UP AREA 2010 (%)	BUILT-UP AREA 2020 (KM²)	SHARE OF BUILT-UP AREA 2020 (%)
1	Municipal Corporation	5	271.3	55.1	290.8	51.8
2	Municipal Council	2	13.6	2.8	14.8	2.6
3	Cantonment	1	8.5	1.7	9.5	1.7
4	Nagar Panchayat	1	0.5	0.1	0.6	0.1
5	Nagar Palika Parishads	4	12.7	2.6	14.2	2.5
6	Census towns	137	142	28.8	165.2	29.4
7	Villages	336	44	8.9	66.2	11.8
	Total	**486**	**492.7**	**100.0**	**561.3**	**100.0**

Source: Authors' computation based on GHSL 1990–2020, the Shrug (DDL) database, and Census of India 2011.

Discussion of findings

All cities are expanding horizontally, regardless of population size

All CBUAs—very large, large, medium and small—are expanding horizontally, regardless of size class. The 11 very large CBUAs contain one quarter of the total CBUA population and a majority of the very large establishments with over 500 employees, while small establishments having less than 10 employees are prominent across all size classes. However, the horizontal expansion growth rate of the CBUAs has declined, aligning with the trend of many cities around the world. Although the pace of horizontal expansion slowed from the year 2000 onwards, the statutory towns of CBUA expanded beyond their limits into adjoining census towns and villages. Built-up area shares outside the 2011 ST boundaries of CBUAs increased from 29 percent to 32 percent between 2010 and 2020, though this estimate is subject to the data limitations of the analysis.

Peri-urban areas of the Global South have increasingly taken the form of dispersed, low-density development, placing significant stress on natural resources and landscapes that are inherently vulnerable (Salem and Tsurusaki 2024). Rapidly urbanising peri-urban areas in India are highly vulnerable to environmental degradation, causing threats to water security, biodiversity, and climate resilience. Unregulated urban growth with weaker enforcement of land development and environmental regulations is resulting in an encroachment on natural infrastructure such as lake beds, wetlands, and agricultural land in the peripheries of Indian cities (Kannan et al. 2021; Shekhar 2025). Speculative real estate projects in the city peripheries displace traditional farming communities and landless labourers, deepening socio-economic inequalities. Village settlements too are often absorbed into city jurisdictions without comprehensive transition plans to upgrade their access to urban services. Several of these get notified as slums after their amalgamation with the city limits because of their unplanned, unserviced development patterns (Expert Committee—BBMP Restructuring 2016). Such urban expansion patterns have locked investment into unsustainable infrastructure development and maladaptive urban forms requiring expensive retrofits. With more than 50 percent of the new infrastructure, buildings and urban services required by 2050 yet to be built, there are ample opportunities to plan for resilient and sustainable urban development (World Bank Group 2025).

Peri-urban land management strategies are, therefore, necessary to avoid the negative impact of urban sprawl on agricultural lands, terrestrial ecosystems, natural reserves, and protected areas. Managing natural resources through transition plans is critical for better environmental health, and economic outcomes and the long-term resilience of the agglomeration. There is a need to balance inner city revitalization and peripheral development to ensure urban expansion aligns with equitable access to urban amenities and infrastructure (Mathews et al. 2023; Wei and Ewing 2018). Spatial planning should be undertaken at the scale of the entire urban agglomeration, with planning boundaries aligned to functional urban areas rather than to built-up extent alone, and supported by coordinated governance across municipal,

rural, and parastatal institutions. This requires a paradigm shift towards integrated regional planning, ecologically informed land-use policies, the provision of basic services and amenities, and inclusive governance mechanisms that recognise the interconnectedness of urban and peri-urban systems.

Many very large CBUAs and several hill cities dominate in verticality

Among very large CBUAs, Delhi is the most spread out in terms of horizontal built-up area, with pockets of peripheral verticality, while Mumbai dominates in verticality with the highest mean building height. Among the very large CBUAs, Bengaluru had the fastest horizontal growth rate between 2010 and 2020, while Kolkata had the slowest. Many hill city CBUAs have a higher mean building height than other CBUAs but limited horizontal built-up spread due to topographical constraints. However, the hill cities of Gangtok, Shimla, and Dalhousie witnessed relatively higher horizontal expansion growth rates. Kochi and Thiruvananthapuram in Kerala do not follow the very large CBUA pattern of verticality, owing to their unique rural-urban continuum type of urbanisation. Most small-sized CBUAs are predominantly two-storeyed (6 m) or lower, except for several hill cities which exhibit greater verticality. Inequitable access to basic services is a daunting hurdle for different size classes of CBUAs in India. Several infrastructure networks stop at the administrative boundaries of the city, often resulting in the self-provisioning of services in the peri-urban areas. This results in increasing inequities as the affluent can access privatised services such as bore wells and tankers for water supply while the poor wait for the government-installed services (Expert Committee—BBMP Restructuring 2016; Shekhar 2025).

In very large CBUAs, high-rise development often coincides with wealth concentration and socio-economic segregation, with wealthier communities able to pay for private water supply, recreational zones, and other amenities, while surrounding peripheries face poorer public service quality. In India, the quality of water, sanitation, and electricity is much worse in the urban peripheries than in the core of the seven largest metropolitan cities[3] (World Bank 2013). The areas in the immediate proximity of STs, irrespective of size class, are witnessing unmanaged urban expansion. Hill city CBUAs also face rising hazard risks, particularly landslides resulting from over-construction that disregards fragile terrain or sensitive ecosystems. Population density, settlement patterns, and geographies differ across CBUAs; hence, a one-size-fits-all approach will not work and a context-specific approach to infrastructure development is required.

Infrastructure needs to be appropriately sized to accommodate needs of different population levels as areas transition from rural to urban status. Context-specific service delivery models tailored to the local geography, population density, settlement patterns, and land availability would enable equity-based approaches to development suitable for expanding peripheries.

Tall building clusters are located near knowledge-intensive sectors such as IT and ITes, reinforcing agglomeration economies and contributing to higher levels of economic productivity and innovation. Newer, taller buildings attract establishments and are, therefore, relevant in understanding the urban structure (Curci 2015). These higher-order urban sub-centres place substantial demands on energy, water, and other infrastructure. The functional integration between the urban core, emerging peripheral sub-centres, and the wider regional economy becomes critical for sustainable metropolitan development through interconnected energy, water, and land systems. This necessitates a regional approach to planning, which guides expanding cities on how to direct large investments that preserve ecological resources while continuing to enhance their economic competitiveness (Li et al. 2009; Mao et al. 2024).

Contiguous multi-entity administrative configurations dominate in CBUAs

Some CBUAs are encompassed within single large municipal boundaries, while many others are spread across multiple municipal, district, and state boundaries. Single municipal entities also face staffing and resource availability constraints. Many multi-jurisdictional CBUAs comprising urban local bodies, rurally administered villages, and CTs often operate under fragmented administrative arrangements even though they function as a single urban agglomeration. Different standards and service-level benchmarks between the different grades of urban and rural local bodies weakens planning and service delivery, further exacerbating the challenges of integrating service delivery following municipal expansion. It also creates additional challenges in the implementation of connective infrastructure services, such as roads, railways, metro networks, airports, and telecommunication lines, that transcend multiple jurisdictions and require inter-administrative boundary collaboration.

While CBUAs exist as one contiguous area with strong socio-economic linkages and spatial interactions, the reality of how their economies function is not well understood and, hence, an integrated approach to planning, governing, and managing these areas is absent (Coleman and Sharma 2018). Although CBUAs span multiple administrative jurisdictions, many function as integrated urban regions because of daily commuting for work, business, and other services, movement of goods, and supply chains that operate across the agglomeration (Mathews et al. 2023).

Governance frameworks for CBUAs that form a single agglomeration but face multiple disjuncts should be reimagined. Reformed governance frameworks are needed to coordinate the functioning of different parastatal and local bodies that have overlapping functional roles and responsibilities. Coordinated and collaborative functioning within multi-jurisdictional agglomerations can ensure resource sharing and improvements in economic productivity.

The Census definition of urban agglomeration should be revisited to capture all settlements with urban characteristics that extend across jurisdictional boundaries. As the nation is undertaking Census 2027, incorporating ways to better capture the on-ground urban expansion patterns will provide a better understanding of India's urbanisation trajectory. While the surveys and data collection can be continued based on the established wards, municipal/village, and state boundaries, data could be aggregated to recognise the true extent of urban agglomerations. Using remote sensing techniques and satellite imagery to gather built-up area data can help in understanding the built density (horizontal and vertical) and contiguous extent of STs, enabling informed decision-making for future regional development plans and strategies.

Population-based approaches tailored to different CBUA size classes, such as municipal expansion or subdivision into multi-municipal structures, should be explored. Larger cities with greater financial and institutional capacity can support neighbouring smaller cities through institutional arrangements, such as sharing financial and technical expertise, to enable improved and integrated functioning of the whole agglomeration.

Built-up areas in villages and CTs, which are the peri-urban areas outside the municipal boundaries, are undergoing rapid transitions in built form, demography, and economic characteristics. In many cases, contiguous built-up areas outside the municipal boundaries of CBUAs are larger than the built-up areas within the STs, highlighting municipal boundary and urban footprint mismatches. States must adopt targeted policies for peri-urban areas, as recommended by the Central Finance Commission, to ensure that urban expansion is sustainable, well planned, and managed with improved access to urban amenities and integrated development of connective infrastructure networks. Differentiated urban expansion across size classes can provide a foundation for targeted policies, guide financial allocations, and inform decision-making for urban agglomerations. Such targeted policies will facilitate integrated infrastructure development, environmental protection, and economic growth, along with directing appropriate schemes and fund allocation towards planned urban expansion across size classes.

Conclusion

India's urban growth is increasingly occurring in peri-urban areas that remain underestimated, necessitating a methodological advancement to capture its true extent and dynamics. The findings of this paper reveal that peri-urban growth across city sizes is significant. India's current patterns of built-up area growth are characterised by horizontal expansion, while variations in verticality across CBUAs shape different urbanisation patterns, increasing the demand for infrastructure and placing more pressure on natural resources and land. This results in environmental degradation, unserviced expansion, loss of ecological resources, and inequities in access to amenities and services, locking urbanisation into unsustainable urban forms that are expensive to retrofit at a later stage.

The one-size-fits-all approach will not work; instead, limited resources must be strategically directed, given the differences in scale and growth patterns across CBUAs and the admixture of urban and rural administrative entities that govern them. While multi-jurisdictional coordination and cooperation is required in the case of very large CBUAs, small and medium-sized ones require tailored investments to provide infrastructure that is appropriately sized and attuned to local needs. Similarly, hill city CBUAs, along with many others, require an urgent focus on preserving and conserving ecological resources, as well as assessing land suitability and carrying capacity for different types of development, in order to manage vertical and horizontal growth.

As CBUAs increasingly accommodate most of the nation's urban population and jobs, the Census of India 2027 must capture the spatial growth and economic dynamism of each agglomeration in its entirety, beyond the separate tabulation of its constituent STs, CTs, and contiguous villages across districts and states. This will further prompt a much-needed reimagination of urban governance for such complex agglomerations, as well as related reforms in planning, municipalisation, and financing.

CBUAs and their significant peri-urban growth make the case for stronger metropolitan and regional thinking beyond statutory boundaries. Land management policies must, therefore, address not only inner-city revitalisation but also the inevitable rapid growth of peripheral areas. While it has limitations, the CBUA methodology provides a morphological foundation of urban areas that can act as a starting point to understand and complement the analysis of shared labour markets using commuting patterns and functional urban areas.

Appendix A1: Data sources and limitations

Data sources

This paper relied on the best and latest data available across multiple time periods from a variety of sources for analysis. These are as follows:

- Lists of statutory towns, census towns, and villages and their census codes were collated from the Directorate of Census Operation, Office of the Registrar General and Census Commissioner, India.
- Administrative boundaries and major road networks of all the statutory towns, census towns, and villages were extracted from open city maps and the SHRUG database for the year 2011.
- Number of establishments by employment size and by sectors and employment numbers by industrial sectors were collated from the Economic Census 2013–14 published by the Central Statistics Office, Ministry of Statistics & Programme Implementation (CSO MoSPI).
- Horizontal built-up areas were extracted for the years from 1990 to 2020 for the administrative boundaries of urban and rural local bodies from the World Settlement Footprint Evolution (1985–2015) of the German Aerospace Agency and Global Human Settlement Layers - EU JRC (European Union Joint Research Centre), and the Built-up Surface Grid 1975–2030 (P2023A). GHSL provides the best open-source temporal data (100 m); however, Google Dynamic World V1 2020 provides a better tool for CBUA delineation. This does not alter the metrics of built-up area increase derived from GHSL.
- Building height data for the CBUAs were extracted for the years 2020–2023 from Open Buildings 2.5D Temporal Dataset (2020–2023) from Google, produced using low-resolution imagery from the Sentinel-2 satellite mission.

Data limitations and disclaimers

- **Non-availability of data for 264 statutory towns**
  This working paper is confined to analysing the growth trends of 3,777 statutory towns listed in the census records of 2011. Out of a total of 4,041 statutory towns in the 2011 census, 264 were not included in the analysis due to data limitations such as boundary misalignment and missing data (these STs represent < 0.02 percent of the total urban population, 2011).
- **Non-availability of latest municipal boundaries across all statutory towns, limitations and implications**
  Considering the non-availability of the latest boundary information for all statutory towns and the time required to update for the ones that are available, the nationally digitised town boundary data of 2011 from the SHRUG database have been used in this study. While the census data publication year is 2011, the census enumerations were conducted in 2010, and hence the ST boundaries correspond closely with the GHSL reference year of 2010.

  For estimating the built-up area outside CBUA statutory town boundaries for 2020, 2011 statutory town boundaries are used, as updated municipal boundaries are not available for all statutory towns at the national scale. As a result, municipal boundary expansions or the reclassification of rural areas as statutory towns after 2011 are not reflected in this analysis. Some built-up areas identified as lying outside CBUA statutory town boundaries may now fall within municipal limits in statutory towns that expanded their boundaries after 2011. As a result, the estimated extent of built-up area beyond statutory town boundaries may be slightly overestimated for such statutory towns. Newly created statutory towns, including census towns that may have been reclassified as statutory towns after 2011, are also not captured in this analysis. This may lead to an underestimating of built-up area within statutory towns.
- **Non-availability of data from Economic Census 2013–14 and under-representation**
  Due to the absence of economic census data for two cities (Palghar in Maharashtra and Longding in Arunachal Pradesh), these cities were removed from the analysis. Further, an underestimation of employment/establishment numbers was observed for towns and villages in Andhra Pradesh.
- **Improvements in and limitations of the GHSL data**
  Due to the improvement in the quality of sensors and the availability of satellite imagery after 2010, building footprints in the GHSL dataset are recorded more accurately, whereas data prior to this period may be comparatively less precise. However, this is the most widely utilised and accurate temporal dataset, used by scientists, policymakers, and practitioners to support international policy frameworks and agreements, including the New Urban Agenda, the Sendai Framework for Disaster Risk Reduction, the Paris Agreement, and the Sustainable Development Goals.

Appendix A2: Method of CBUA delineation, horizontal growth trends, verticality, and its limitations

Method of CBUA delineation

Built-up extent was delineated from the near real-time 10-m landcover dataset Dynamic World V1, jointly produced by Google in partnership with the National Geographic Society and the World Resources Institute.

The dataset contains near real-time (NRT) land-use land cover (LULC) predictions created from Sentinel-2 imagery for nine land-use land cover (LULC) classes. "Built-up area" is one of the nine classes and is used to demarcate the CBUA polygons for each of the statutory towns analysed in this study. Each image has different pixel-wise probabilities. Thresholding class probabilities was implemented to retain only high-confidence pixels.

Built-up pixels within the Dynamic World dataset were initially identified using a high-probability threshold of greater than 70 percent. Subsequently, a 500-m focal mean filter was applied to the resulting data to smooth isolated patches and emphasis regions of spatial concentration. Finally, a secondary threshold of 0.15 was applied to smoothen the output and keep it spatially unified. All the built clusters falling within a single contiguous area formed by the statutory town boundaries and the built clusters were identified and demarcated to be part of one Contiguously Built Urban Agglomeration (CBUA).

To delineate the built urban agglomeration, contiguity of both built-up area and administrative boundaries of statutory towns are considered. For each of the statutory towns, all built-up areas that are physically contiguous with each other, including those transcending multiple rural and urban body jurisdictions, are identified and demarcated as a Contiguously Built Urban Agglomeration (CBUA). In a CBUA, all built-up area clusters of adjoining statutory towns are captured, irrespective of discontinuities in their built-up area. However, in the case of villages within the CBUA, only built-up area patches that are contiguous with the built-up area of the statutory towns are captured. In most cases, the built-up area extends over several statutory towns and villages and, in a few cases, it remains within a single statutory town. When two CBUAs merge, they are considered as one agglomeration and the largest city amongst them in terms of population remains the primate. To avoid the complexities of apportioning the economic data from the economic census at this large scale, the economic data for the entire administrative boundaries of villages and census towns are considered for the analysis even though they may only fall partially within the CBUA.

Formulae for calculating horizontal built-up area trends

- CBUA Built-up area = Built-up area within CBUA boundary containing both ST and villages (inclusive of rurally governed CTs)
- Share of built-up area in ST = Built-up area in ST/Total Built-up area of CBUA
- Share of built-up area in villages = Built-up area in villages/ Built-up area of CBUA
- Built-up area outside STs in 2010 have been computed, and their growth up to 2020 has also been presented at CBUA level.
- Annual Exponential Growth Rate (AEGR)=(LN (Horizontal built-up area (final year)/Horizontal built-up area (initial year))/ number of years)* 100 – Step 5 of the methodology

Determination of verticality

Mean heights and built volume for all CBUAs are computed using Open Buildings 2.5D temporal data (2020–2023) from Google by averaging the heights of buildings for these years.

Built-up area share of buildings classified, based on their heights, are computed as built-up pixels within a building height-class/Total built-up pixels within the CBUA.

Limitations and disclaimers

The application of a uniform method to delineate the urban extent of cities that are heterogenous in the spatial form and pattern raises some concerns.

- Using the CBUA method, the paper measures the physical extent and growth of cities as contiguous built-up areas. This is a morphological definition of an urban agglomeration and does not directly measure a functional urban area or a single labour market. A functional urban area and a labour market definition rely on commuting flows, travel-time thresholds, and evidence of economic integration across settlements (Dijkstra, Poelman, and Veneri 2019). As this analysis involves over 3,777 statutory towns, the immense time and labour that would be required to assess travel-time thresholds represents a significant constraint. Further, data on commuting patterns and economic activities are not consistently available across these statutory towns. Hence, CBUAs are used here as a practical and feasible approximation of the urban extent of statutory towns. This means the analysis captures places that are physically connected through built form, but it may exclude non-contiguous settlements whose inhabitants commute to the city and may include contiguous areas that are not equally integrated through daily labour market interactions. The results should, therefore, be read as evidence on the geography of urban expansion and built-form integration and not as a complete measure of functional economic integration.

- Contiguous built-up spread results in the formation of geographically large CBUAs, such as the case of Kerala state where the cities and rural hamlets of similar built density blend into each other, blurring the distinction between urban and rural. For instance, the built-up areas of Kottayam and Thiruvananthapuram, which are about 150 km apart, form a continuous urban corridor, making it difficult to delineate the limits of each urban agglomeration. In the CBUA methodology, the contiguous built-up extent that is beyond the statutory town boundaries is assigned to the statutory town that has the largest population. As the largest city, Thiruvananthapuram is designated the primate town, and Kottayam forms a secondary town within the agglomeration. Using population as the only criteria for designating a primate town involves a trade-off. In certain CBUAs, secondary statutory towns may have greater economic relevance because of their industrial specialisation, employment concentration, or role as sector-specific growth centres. Assigning primacy based on population alone may mask the economic importance of such towns in the analysis, although it does not affect the delineation of the CBUA itself.
- In certain cases, discontinuities in the built-up area in villages that are physically and functionally urban have restricted them from getting captured within the agglomeration extent of the statutory towns. For example, areas around Bengaluru International Airport remain outside the Bengaluru CBUA due to discontinuity in the built-up area. The accuracy of the representation of urban extent could be enhanced through in-depth field enquiries (Ramachandran 1989), but this would be cumbersome, given the vast number of settlements analysed in this study.
- As contiguity is the primary criterion employed in capturing the built urban agglomeration extent of statutory towns, the assumption is that all villages that have accommodated the built-up area spread from the statutory towns are undergoing urban transformation. Establishing the causality for the built-up area transformation in the villages of the CBUAs is beyond the scope of this study.
- The objective of this paper is not to define "urban" or identify what is missing in the current approach to defining "urban" in India, but to understand how statutory towns, as defined by the state statutes and recorded in the 2011 census, have grown morphologically. How urban India is and an analysis of what is missing and underrepresented in India's methodology of measuring "urban" will be the task of subsequent research.

Appendix A3: Method of selection of cases for illustration

Method of selecting six CBUAs for illustrating horizontal growth trends and verticality

To examine horizontal built-up area growth trends and verticality across the four CBUA classes, six CBUAs were selected based on an evaluation of key parameters: CBUA spatial extent, horizontal built-up area growth rate (2010–2020), and mean building height. From the very large CBUA category, Delhi was selected for its largest spatial extent, Mumbai for its highest mean building height, and Bengaluru for its most rapid horizontal expansion during the 2010–2020 period. From the large, medium, and small CBUA categories, Greater Visakhapatnam, Gangtok, and Bawal were selected, respectively, as each accommodates a substantive built-up area and exhibits high mean building height within its corresponding class.

Method of selecting 6 CBUAs for illustrating administrative composition and limitations in analysis

To study administrative composition and its diversity by CBUA category, six CBUAs were selected, considering key parameters that included CBUA spatial extent, mean height, and diversities/uniqueness in terms of number of statutory towns, census towns, and villages. One of the main reasons for selecting these physical parameters was to examine the administrative characteristics of cities with the largest built-up extent and those with the highest mean building heights. Diversity in terms of number of statutory towns, census towns, and villages indicates the administrative fragmentation and range of jurisdictions that must coordinate to manage urban growth. From the very large CBUA category, Delhi was selected for its largest spatial extent and its transcending multiple state boundaries, involving different administrative entities across states and the union territory of Delhi. Mumbai CBUA, having the highest mean building height, was chosen to explore how its administrative structure resembles or differs from Delhi, whose CBUA has expanded more horizontally than Mumbai's. Kolkata was selected as one of three multi-district agglomerations captured by the Census of India 2011 that have several statutory towns, census towns, and villages. Coimbatore (large spatial extent), Aizawl (single municipal CBUA), and Mansa (large spatial extent) were selected from the large, medium, and small CBUA categories, respectively. While analysing the administrative composition of CBUAs, the role of larger regional institutions, such as the National Capital Region Planning Board, and the provisions for metropolitan-level governance envisaged under the 74th Constitutional Amendment Act and the weakness of their implementation are not examined. These dimensions remain beyond the scope of the present paper.

Appendix A4: Establishment and employment by sector across CBUAs

Table A4.1 | **Number and (share) of establishments and employment by sector and employee size across all CBUA, 2013–14**

TYPE/ SIZE		ESTABLISHMENT/ EMPLOYMENT	VERY LARGE CBUAs (11)	LARGE CBUAs (55)	MEDIUM CBUAs (710)	SMALL CBUAs (2,274)	TOTAL
SERVICE ESTABLISHMENTS	< 10 employees	Establishments	51,75,610	34,61,816	53,94,044	31,96,570	31,96,570
			30%	20%	31%	19%	100%
		Employment	1,07,93,282	67,64,879	1,01,71,969	57,74,526	3,35,04,656
			32%	20%	30%	17%	100%
	(10-100) employees	Establishments	96,689	48,687	72,758	40,551	2,58,685
			37%	19%	28%	16%	100%
		Employment	23,83,301	12,37,821	17,20,513	9,39,776	62,81,411
			38%	20%	27%	15%	100%
	(100-500) employees	Establishments	6,375	2,377	2,568	958	12,278
			52%	19%	21%	8%	100%
		Employment	12,70,848	4,43,224	4,67,667	1,82,605	23,64,344
			54%	19%	20%	8%	100%
	> 500 employees	Establishments	882	266	239	58	1,445
			61%	18%	17%	4%	100%
		Employment	14,02,762	3,24,994	2,72,917	63,274	20,63,947
			68%	16%	13%	3%	100%
MANUFACTURING ESTABLISHMENTS	< 10 employees	Establishments	13,12,385	10,19,001	15,70,608	8,73,456	47,75,450
			28%	21%	33%	18%	100%
		Employment	36,66,127	23,81,110	33,10,063	16,86,284	1,10,43,584
			33%	22%	30%	15%	100%
	(10-100) employees	Establishments	50,727	21,857	27,716	9,876	1,10,176
			46%	20%	25%	9%	100%
		Employment	14,04,547	5,79,891	7,33,131	2,48,403	29,65,972
			47%	20%	25%	8%	100%
	(100-500) employees	Establishments	3,957	1,574	2,523	801	8,855
			45%	18%	29%	9%	100%
		Employment	7,87,062	3,09,939	4,99,740	1,63,514	17,60,255
			45%	18%	28%	9%	100%
	> 500 employees	Establishments	644	210	408	151	1,413
			46%	15%	29%	11%	100%
		Employment	9,56,004	2,56,842	5,20,424	1,74,455	19,07,725
			50%	14%	27%	9%	100%

Source: Authors' tabulation using data from the Sixth Economic Census 2013–14.

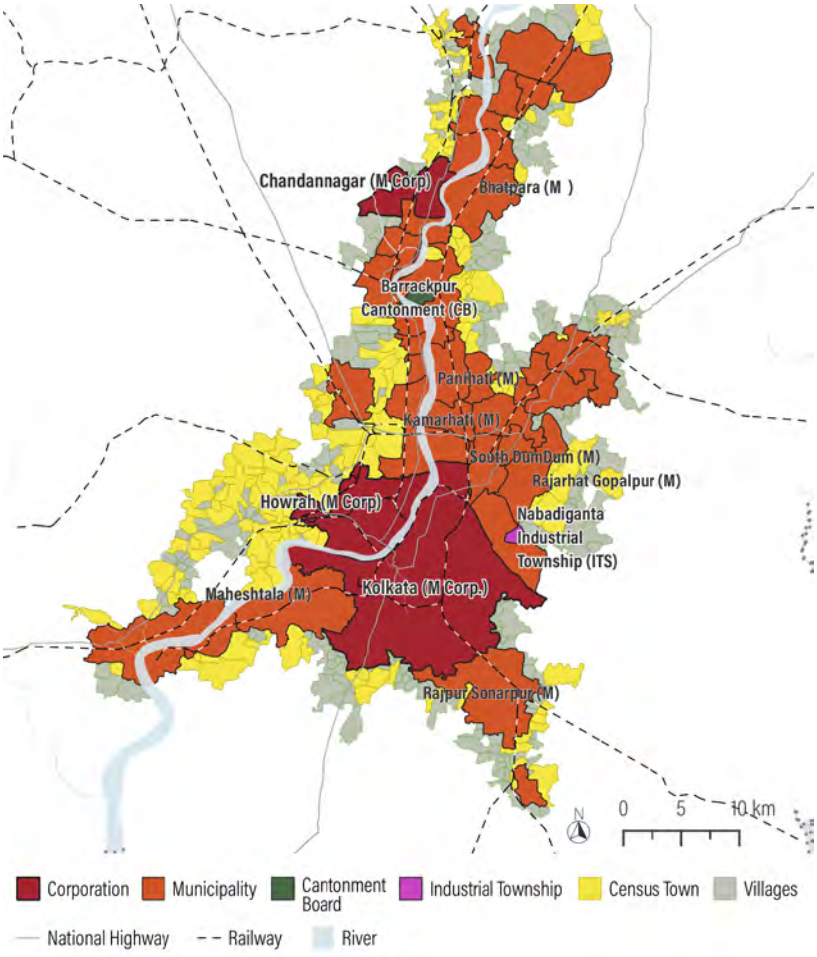
Table A4.1 | **Number and (share) of establishments and employment by sector and employee size across all CBUA, 2013-14 (contd.)**

TYPE/ SIZE		ESTABLISHMENT/ EMPLOYMENT	VERY LARGE CBUAs (11)	LARGE CBUAs (55)	MEDIUM CBUAs (710)	SMALL CBUAs (2,274)	TOTAL
PRIMARY ESTABLISHMENTS	< 10 employees	Establishments	3,59,560	3,12,033	5,60,361	5,04,239	17,36,193
			21%	18%	32%	29%	100%
		Employment	5,39,435	5,07,740	9,46,294	8,63,271	28,56,740
			19%	18%	33%	30%	100%
	(10-100) employees	Establishments	949	2,148	3,232	3,331	9,660
			10%	22%	34%	35%	100%
		Employment	25,142	53,125	73,992	74,782	2,27,041
			11%	23%	33%	33%	100%
	(100-500) employees	Establishments	26	28	71	59	184
			14%	15%	39%	32%	100%
		Employment	5,189	6,121	13,950	11,479	36,739
			14%	17%	38%	31%	100%
	> 500 employees	Establishments	7	4	23	22	56
			13%	7%	41%	39%	100%
		Employment	11,173	4,204	28,326	31,041	74,744
			15%	6%	38%	42%	100%
	Total	Establishments	**70,07,811**	**48,70,001**	**76,34,551**	**46,30,072**	**2,41,42,435**
			29%	**20%**	**32%**	**19%**	**100%**
		Employment	**2,32,44,872**	**1,28,69,890**	**1,87,58,986**	**1,02,13,410**	**6,50,87,158**
			36%	**20%**	**29%**	**16%**	**100%**

Source: Authors' tabulation using data from the Sixth Economic Census 2013–14.

Appendix A5: Illustrative examples of multi-jurisdictional governance structure in CBUAs

Figure A5.1 | **Constituent bodies in Kolkata CBUA**



Source: Authors' analysis based on the Shrug (DDL) Database and Census of India 2011.

Kolkata CBUA: Largest multi-municipal agglomeration with different legislative provisions for rural and urban administration

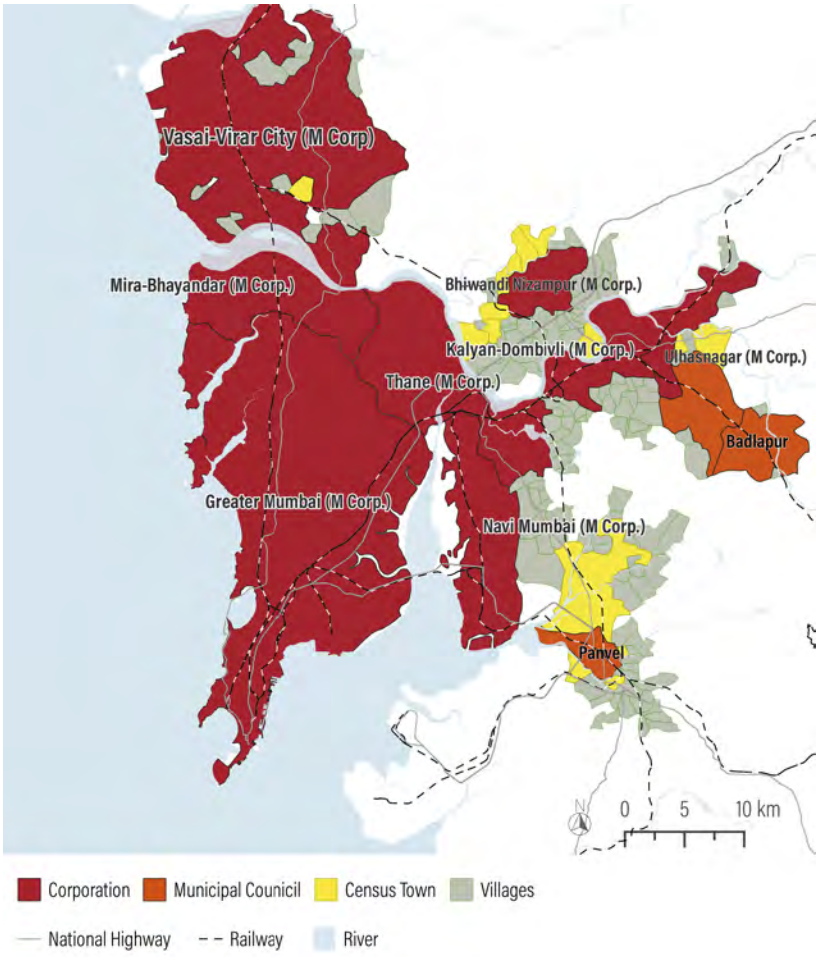
Kolkata CBUA, spread across the districts of Haora, Hoogly, North and South 24 Parganas, and Nadia of West Bengal, is one of the largest multi-district urban agglomerations recognised by the Census of India (figure A5.1). It comprises Kolkata Municipal Corporation (KMC) at its core and 423 other urban and rural local bodies (table A5.1). Kolkata and Haora cities are administered as per the provisions of separate corporation acts, whereas areas under other STs are administered as per the West Bengal Municipal Act 1993. CTs and rural panchayats function as per the provisions of the West Bengal Gram Panchayat Act 1973. The financial and staff allocation, roles, and responsibilities prescribed under these Acts vary for each of the local bodies, implying fragmented governance in the CBUA.

Table A5.1 | **Constituent bodies and the built-up area distribution in Kolkata CBUA**

SL.NO	TYPE OF LOCAL BODY	NUMBER OF ENTITIES (AS PER CENSUS 2011)	BUILT-UP AREA 2010 (KM^2)	SHARE OF BUILT-UP AREA 2010 (%)	BUILT-UP AREA 2020 (KM^2)	SHARE OF BUILT-UP AREA 2020 (%)
1	Municipal Corporation (M.Corp)	3	94.4	35.0	96.5	34.0
2	Municipality	39	129.3	47.9	136.1	47.9
3	Cantonment	1	0.5	0.2	0.5	0.2
4	Industrial Township	1	0.2	0.1	0.2	0.1
5	Census towns	153	32.6	12.1	36	12.7
6	Villages	227	13.0	4.8	14.7	5.2
	Total	**424**	**270**	**100.0**	**284**	**100.0**

Source: Authors' computation based on GHSL 1990-2020, The Shrug (DDL) database and Census of India 2011

Figure A5.2 | **Constituent bodies in Mumbai CBUA**



Source: Authors' analysis based on the Shrug (DDL) Database and Census of India 2011.

Mumbai CBUA: Multi-municipal multi-village CBUA

Mumbai CBUA is spread across multiple districts, with the primate city of Greater Mumbai itself spread across two districts of Maharashtra, each under the jurisdiction of a separate District Collector (figure A5.2).

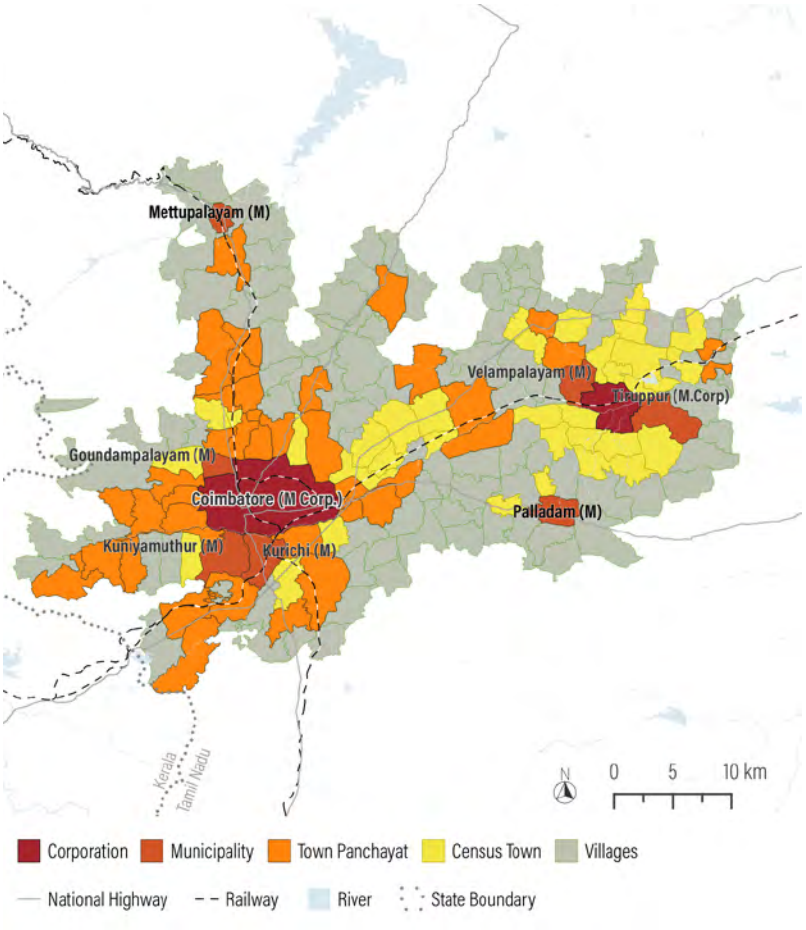
Apart from Greater Mumbai, the CBUA has seven other municipal corporations, three municipal councils, and several CTs and villages under rural administration (table A5.2). This co-existence of multiple urban and rural administrative bodies highlights the complexities of infrastructure planning, municipal boundary expansion, and the need for ensuring effective interdepartmental coordination across the agglomeration.

Table A5.2 | **Constituent bodies and the built-up area distribution in Mumbai CBUA**

SL.NO	TYPE OF LOCAL BODY	NUMBER OF ENTITIES (AS PER CENSUS 2011)	BUILT-UP AREA 2010 (KM^2)	SHARE OF BUILT-UP AREA 2010 (%)	BUILT-UP AREA 2020 (KM^2)	SHARE OF BUILT-UP AREA 2020 (%)
1	Municipal Corporation (M.Corp)	8	152.8	81.3	161.5	80.5
2	Municipal Council (M Cl)	3	10.7	5.7	11.8	5.9
3	Census towns	16	10.8	5.7	11.6	5.8
4	Villages	127	13.6	7.2	15.8	7.9
	Total	**154**	**187.9**	**100.0**	**200.7**	**100.0**

Source: Authors' computation based on GHSL 1990–2020, the Shrug (DDL) Database, and Census of India 2011.

Figure A5.3 | **Constituent bodies in Coimbatore CBUA**



Coimbatore CBUA: A dual growth node agglomeration

Coimbatore CBUA is a large CBUA spread across two districts of Tamil Nadu. In this CBUA, Coimbatore and Tiruppur cities function as dual growth nodes located along a major transport corridor, along with several other small municipalities and villages (figure A5.3). This CBUA has municipal corporations, municipalities, town panchayats, and village panchayats entrusted with the administrative and governance functions (table A5.3). As the two cities in the agglomeration function as industrial growth nodes, their industrial development, infrastructure investment, environmental management and service delivery decisions require coordination across multiple local body governments and district departments.

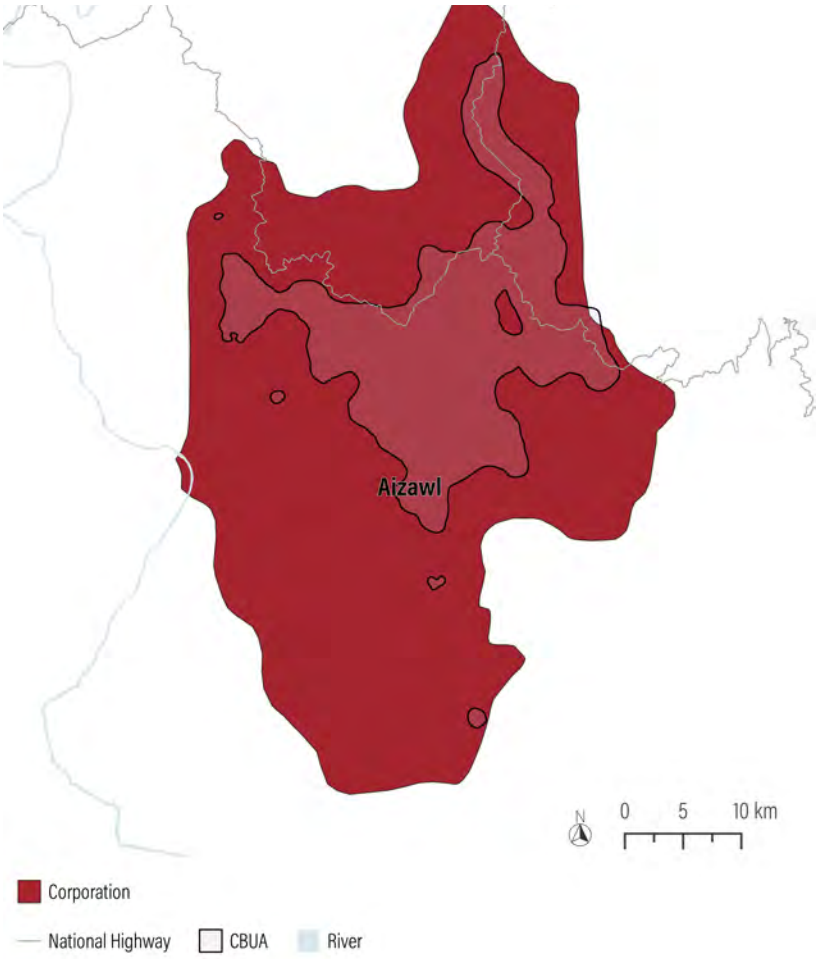
Source: Authors' analysis based on the Shrug (DDL) Database and Census of India 2011.

Table A5.3 | **Constituent bodies and the built-up area distribution in Coimbatore CBUA**

SL.NO	TYPE OF LOCAL BODY	NUMBER OF ENTITIES (AS PER CENSUS 2011)	BUILT-UP AREA 2010 (KM^2)	SHARE OF BUILT-UP AREA 2010 (%)	BUILT-UP AREA 2020 (KM^2)	SHARE OF BUILT-UP AREA 2020 (%)
1	Municipal Corporation (M.Corp)	2	35.4	21.5	45.2	22.9
2	Municipality (M)	7	20.8	12.6	23.6	12.0
3	Town Panchayat	38	40.8	24.7	42.6	21.6
4	Census towns	34	42.3	25.7	50.6	25.7
5	Villages	102	25.6	15.5	35	17.8
	Total	**183**	**164.9**	**100.0**	**197.0**	**100.0**

Source: Authors' computation based on GHSL 1990-2020, the Shrug (DDL) database and Census of India 2011.

Figure A5.4 | **Aizawl CBUA**

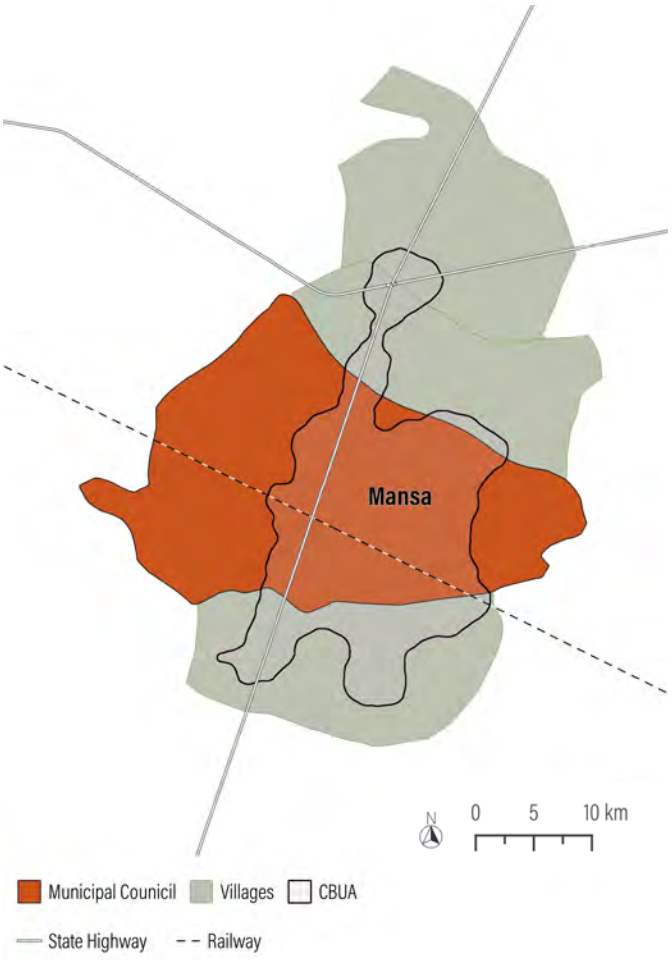


Source: Authors' analysis based on the Shrug (DDL) Database and Census of India 2011.

Aizawl CBUA: CBUA with built-up area bound within single municipal limit

Aizawl, Mizoram's capital city, is an example of a CBUA bound within a single ST boundary. Its built-up area constitutes less than four percent of total area within the city's administrative boundary (figure A5.4). Aizawl is a medium-sized CBUA with a population of 3,58,000 and a total contiguous built-up area of 4 km^2 as of 2020. The challenges of governing this CBUA will be similar to those faced by any small statutory town with limited access to finance and staff for its administration.

Figure A5.5 | **Constituent bodies in Mansa CBUA**



Mansa CBUA: Single municipal multi-village, small CBUA

Mansa is a small CBUA, and the administrative headquarters of Mansa district in Punjab. This CBUA comprises Mansa municipal council and three villages as shown in table A5.4 and figure A5.5.

Source: Authors' analysis based on the Shrug (DDL) Database and Census of India 2011.

Table A5.4 | **Constituent bodies and the built-up area distribution in Mansa CBUA**

SL.NO	TYPE OF LOCAL BODY	NUMBER OF ENTITIES (AS PER CENSUS 2011)	BUILT-UP AREA 2010 (KM^2)	SHARE OF BUILT-UP AREA 2010 (%)	BUILT-UP AREA 2020 (KM^2)	SHARE OF BUILT-UP AREA 2020 (%)
1	Municipal Council	1	3.29	79.7	3.57	74.4
2	Villages	3	0.84	20.3	1.2	25.0
	Total	**5**	**4.13**	**100.0**	**4.8**	**100.0**

Source: Authors' computation based on GHSL 1990–2020, the Shrug (DDL) Database, and Census of India 2011.

Appendix A6: Descriptive statistics for CBUA growth rates

ALL CBUAs	AEGR BUILT-UP AREA _CBUA 1990-2000	AEGR BUILT-UP AREA _CBUA 2000-2010	AEGR BUILT-UP AREA _CBUA 2010-2020
Mean	4.06	2.27	1.54
Median	3.60	2.02	1.31
Maximum	39.81	17.23	72.47
Minimum	0.00	0.00	0.01
Range	39.81	17.23	72.47
Standard Deviation	2.60	1.40	1.86
Skewness	2.17	2.26	21.28
Kurtosis	15.85	12.15	726.18

Notes: AEGR = Annual Exponential Growth Rate. AEGR for 2000–10 and 2010–20 for Badrinathpuri and Baghmara, belonging to small CBUAs, was considered as 0.00 due to an insignificant built-up area in 2010 and 2020 and lack of data for 1990 and 2000.
This considers the average of AEGR values determined across each CBUA considered in the distribution and is different from the overall AEGR calculated for each size class category. This is purely done to analyse and understand the descriptive statistics.

As the dataset contains the complete population of CBUAs in India (as opposed to sample), basic descriptive statistics across size classes, including mean, median, standard deviation, range, minimum, maximum, skewness, and kurtosis is tabulated here. The range is clearly the greatest across medium and smaller CBUAs. However, because of the large number of observations, the average alone does not reflect the extent of variation in AEGR across the individual CBUAs. The "mean" metric indicates similarity across size classes, but the other measures of standard deviation, number of observations, and range indicate the scale and variability of the underlying data.

Appendix A6: Descriptive statistics for CBUA growth rates (contd.)

PARAMETER	AEGR BUILT-UP (1990-2000)	AEGR BUILT-UP (2000-2010)	AEGR BUILT-UP (2010-2020)
VERY LARGE CBUAs			
Mean	3.67	2.46	1.44
Median	3.22	2.52	1.39
Maximum	6.66	3.95	2.46
Minimum	0.91	0.94	0.49
Range	5.75	3.01	1.96
Standard Deviation	1.63	0.98	0.55
Skewness	0.18	-0.06	-0.05
LARGE CBUAs			
Mean	3.54	2.09	1.43
Median	3.46	1.91	1.41
Maximum	7.63	4.45	2.94
Minimum	0.28	0.39	0.22
Range	7.34	4.06	2.72
Standard Deviation	1.56	0.92	0.56
Skewness	0.34	0.44	0.15
Kurtosis	-0.25	-0.15	0.33
MEDIUM CBUAs			
Mean	4.41	2.36	1.53
Median	4.03	2.19	1.42
Maximum	16.40	9.18	19.66
Minimum	0.04	0.25	0.13
Range	16.36	8.93	19.53
Standard Deviation	2.43	1.18	1.12
Skewness	1.10	1.01	8.64
Kurtosis	2.19	2.08	124.10
SMALL CBUAs			
Mean	3.97	2.25	1.54
Median	3.48	1.96	1.27
Maximum	39.81	17.23	72.47
Minimum	0.00	0.00	0.01
Range	39.81	17.23	72.47
Standard Deviation	2.67	1.47	2.05
Skewness	2.44	2.46	20.60
Kurtosis	18.94	13.12	645.18

Notes: AEGR = Annual Exponential Growth Rate. AEGR for 2000–10 and 2010–20 for Badrinathpuri and Baghmara, belonging to small CBUAs, was considered as 0.00 due to an insignificant built-up area in 2010 and 2020 and lack of data for 1990 and 2000. This considers the average of AEGR values determined across each CBUA considered in the distribution and is different from the overall AEGR calculated for each size class category. This is purely done to analyse and understand the descriptive statistics.

Abbreviations

ADB	Asian Development Bank
AEGR	Annual Exponential Growth Rate
BBMP	Bruhat Bengaluru Mahanagara Palike
BUA	Built-up Area
CAA	Constitutional Amendment Act
CBUA	Contiguously Built Urban Agglomeration
CSO	Central Statistics Office
CT	Census Town
DDL	Development Data Lab
EU JRC	European Union Joint Research Centre
GHSL	Global Human Settlement Layer
IT/ITes	Information Technology/ Information Technology enabled services
LAP	Local Area Plan
LULC	Land Use Land Cover
MCD	Municipal Corporation of Delhi
MoHUA	Ministry of Housing and Urban Affairs
MoSPI	Ministry of Statistics & Programme Implementation
NCR	National Capital Region
NDMC	New Delhi Municipal Council
NOIDA	New Okhla Industrial Development Authority
OECD	Organisation of Economic Co-operation and Development
SHRUG	Socio-economic High-Resolution Rural-Urban Geographic Data Platform for India
ST	Statutory Town
TPS	Town Planning Scheme
UA	Urban Agglomeration
UN	United Nations
URDPFI	Urban and Regional Development Plans Formulation and Implementation
WUP	World Urbanisation Prospects

Glossary

Annual exponential growth rate (AEGR): A measure of the annual rate of change over a specified period, calculated using natural logarithms and the formula AEGR = ((natural logarithm (Final Value/Initial value))/Number of Years) *100.

Built-up: Human-made structures such as buildings, roads, and other concretised surfaces that are observable and measurable using satellite imagery and global remote-sensing data.

Built-up volume: Three-dimensional space occupied by built structures, measured by combining the built-up area and the height of the built structures.

Census Towns: Villages that meet the demographic and economic criteria of urban areas as defined by the Directorate of Census Operations of India but are not recognised as urban by State government.

Contiguously Built Urban Agglomeration (CBUA): A continuous stretch of built-up area as delineated through satellite imagery, spatially connected and forming a single agglomerated settlement, that lies within and around a statutory town and transcends both urban and rural local bodies. The term CBUA was coined by the authors.

Establishments: Units engaged in production and/or distribution of goods and services not solely for consumption.

High-rise buildings: Buildings above four storeys and/or a building exceeding 15 meters in height, above the average level of front road without stilts and above 17.5 meters with stilts, are termed high-rise buildings in the Model Building Byelaws 2016, issued by the Ministry of Housing and Urban Affairs (MoHUA), Government of India.

Horizontal built-up area: The land area occupied by roads, concretised surfaces and buildings irrespective of building height or number of storeys.

Primate city: The statutory town with the largest population share in the CBUA.

Statutory Town: Administrative units recognised as urban by State legislation. Municipal Corporation, Municipality, Cantonment Board, Notified Area Committee, and Town Panchayat are Statutory Towns.

Town Panchayats: Sometimes known as Nagar Panchayats, they are a form of urban local body typically instituted in areas transitioning from rural to urban status.

Verticality: The vertical dimension of built-up areas characterised by taller buildings or multi-storey structures, rather than horizontal single-floor structures, is referred to as verticality.

Endnotes

1. The Sixteenth Finance Commission Report 2025–26 recommended release of urbanisation premium grants of ₹10,000 crore to states as a one-time grant for: (i) merger of peri-urban villages into adjoining urban local body areas and (ii) formulation of a Rural-to-Urban Transition Policy as a precursor to avail the urbanisation premium grant (Sixteenth Finance Commission 2026).
2. UAs are defined as a continuous urban spread consisting of either a town and its adjoining outgrowths or two or more physically contiguous towns with or without outgrowth (Office of the Registrar General 2018). Such areas may possess urban-like features in terms of infrastructure, and amenities get added with the existing statutory towns as their outgrowths and form an urban agglomeration.
3. The seven largest metropolitan cities analysed in the World Bank study are Mumbai, Delhi, Bengaluru, Kolkata, Chennai, Hyderabad, and Ahmadabad.

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About the authors

Tintu Sebastian is Program Manager, Integrated Urban Development, Sustainable Cities & Transport program, at WRI India
Contact: Tintu.Sebastian@wri.org

Rejeet Mathews is Program Director, Integrated Urban Development, Sustainable Cities & Transport program, at WRI India
Contact: Rejeet.Mathews@wri.org

Raj Bhagat Palanichamy is Senior Program Manager, Geo Analytics, Sustainable Cities & Transport program at WRI India
Contact: RajBhagat.P@wri.org

Abhimanyu S. is Senior Program Associate, Geo Analytics, Sustainable Cities & Transport program at WRI India
Contact: Abhimanyu.S@wri.org

Paramjeet Chawla is Senior Program Manager, Integrated Urban Development, Sustainable Cities & Transport program, at WRI India
Contact: Paramjeet.Chawla@wri.org

Authors' contributions

Tintu Sebastian contributed to drafting significant portions of the manuscript and held a significant role in analysing the data and creating supporting graphics for the paper. Rejeet Mathews conceived the research hypothesis, provided substantial intellectual contributions, and drafted portions of the working paper. Raj Bhagat provided substantial intellectual contributions through the conceptual framing and developing analytical framework for the working paper. Abhimanyu performed the data analysis and graphics for core research findings. Paramjeet Chawla provided intellectual inputs into restructuring and revising the content of the manuscript.

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