Land-use dynamics and built-up expansion in India: An analysis of the drivers and consequences of urban sprawl

Amit Kumar[1*], Dr. Vipin Kumar[2] and Sushmita[1]

[1] Research Scholar, Department of Geography, Indira Gandhi University, Meerpur, Haryana, India

[2] Associate Professor, Department of Geography, Indira Gandhi University, Meerpur, Haryana, India

Corresponding author: Amit Kumar

Received 18 Aug 2026; Accepted 24 Sep 2026; Published 7 Oct 2026

DOI: https://doi.org/10.64171/JSRD.5.4.34-41

Abstract

Urban sprawl is the low-density, automobile-dependent, and other unplanned outward expansion of urban areas into surrounding rural and peri-urban land, and has become one of the most persistent features of contemporary urbanisation. This paper reviews the principal drivers and multidimensional consequences of urban sprawl in India, with a particular focus on land-use and land-cover change. The findings indicate a substantial increase in India's built-up area from 81.45 lakh hectares to 117.92 lakh hectares in 2024 -2025, representing an overall increase of 44.78%. The study further shows that sprawl is produced by an interacting set of demographics, economic, social, cultural, technological, political, institutional, and policy forces rather than by any single cause. And then the consequences extend across environmental, economic, social, and health domains. The paper concludes by discussing the policy implications of this evidence, including compact growth and smart growth strategies.

Keywords: Built-up land, Urban sprawl, Land use dynamics, Sustainable urban planning, Smart growth

1. Introduction

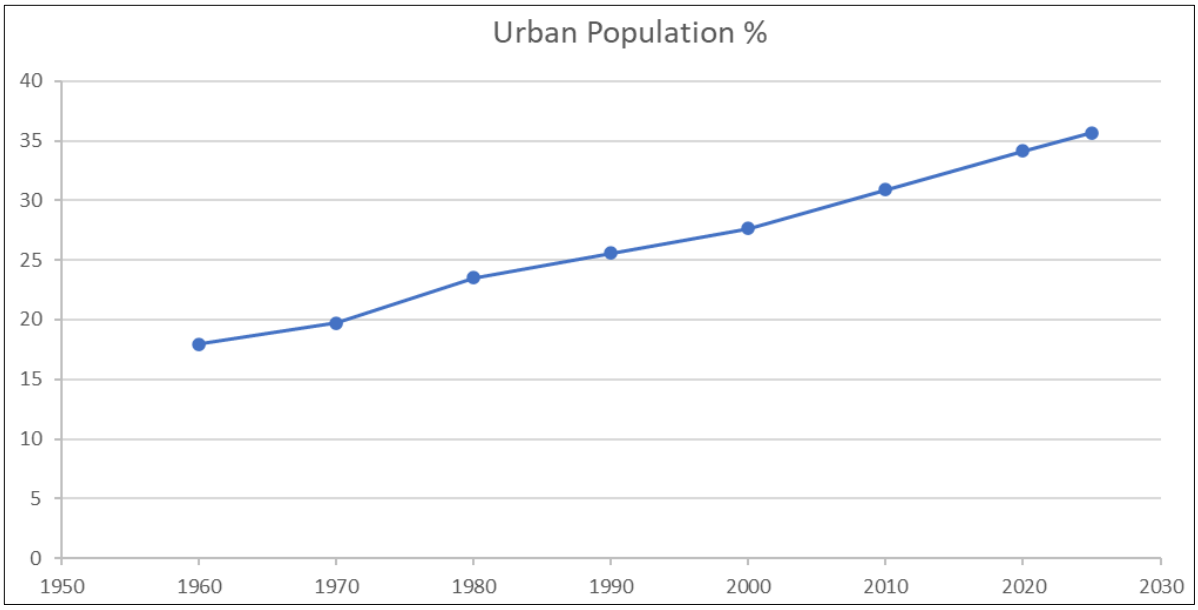
Globally, urban expansion is accelerating, yet much of this growth is occurring in inefficient and unsustainable forms. Many cities expand outward, spreading into surrounding farmland, forests, and open spaces, rather than into already existing urban areas. This unplanned, outward and often uncontrolled expansion is called urban sprawl. Urban sprawl has become a universal phenomenon in developed and developing nations, as evidenced by the rapid outward expansion of cities into rural and peri-urban areas. This random growth is often associated with low-density settlements, reliance on transport facilities, and the rapid conversion of natural and agricultural lands into built-up areas (Bhatta, 2010; Hamidi et al., 2015) [1, 10]. Although Urbanization can bring economic growth, better infrastructure and opportunities, unregulated growth leads to land-use inefficiency, environmental degradation, and socio-economic irregularities.

In North America, cities like Atlanta and Los Angeles are noted for the sprawling of urban development. These cities have witnessed a significant increase in land consumption that far outpaces population growth, leading to fragmented development (Fulton William et al., 2001). Similarly, in Europe, urban expansion around metropolitan regions such as Madrid and Rome has highlighted issues such as habitat loss and strain on public services (EEA, 2006) [6].

The problems associated with urban sprawl are most pronounced in developing countries, where rapid population growth and inadequate urban planning accelerate them. In China, cities such as Beijing and Shenzhen have experienced major changes in land use driven by economic reforms and industrialisation, leading to the loss of fertile farmland and ecological habitats (Deng et al., 2015; Godara et al., n.d.) [5, 9]. Due to poor infrastructure, informal sprawl in African cities like Nairobi and Lagos exacerbates the spread of slums (UN-Habitat, 2020) [23]. With 600 million people expected to live in cities by 2031, India is experiencing one of the quickest urban transformations in the world (MOHUAP, 2015) [16].

India is experiencing rapid urban transformation the increasing urban population from 17.93% in 1960 to 35.69% in 2025 (World Bank, 2025) [25] and has been accompanied by considerable changes in land use and expansion of built-up areas the available LULC data indicate that built-up area increase from 81.45 lakh ha in 2005-06 to 117.92 lakh ha in 2024- 2025, a 44.8% growth (National Remote Sensing Centre, 2025) [18]. This expansion reflects the growing pressure of urbanisation on land resources and highlights the importance of understanding the spatial pattern and consequences of urban growth. With a large proportion of the population increasingly concentrated in urban areas, rapid urban expansion can create significant pressure on agricultural land, natural resources, infrastructure and the environment. These changes are particularly visible in rapidly developing urban and peri-urban regions of India (Sudhira et al., 2004) [22]. Large cities like Bengaluru and Delhi are growing quickly, intruding on farmland and seriously degrading the environment (Jat et al., 2008; Sudhira et al., 2004) [12, 22]. Between 1989 and 2020, urban sprawl in the Haryana city of Rewari increased the built-up area by 704%, primarily at the expense of agricultural land (Kanav et al., 2024) [13].

This study seeks to examine the growth of built-up area expansion in India, identify the main causes and evaluate its environmental, societal, and health impacts. The findings may inform the relevant authorities and policymakers in creating plans for sustainable Urban growth while conserving land use and promoting healthy human development in growing urban areas.



Source: (World Bank, 2025)

Fig 1: Trend of Urban Population in India, 1960-2025

2. Literature Review

The phenomenon of urban sprawl has attracted increasing attention as a primary challenge of rapid urbanisation, especially in developing countries such as India. Urban sprawl is considered as the most important factor by several researchers on the basis of rapid urbanization. Kanav et al. (2024) [13] argued that population growth, industrial development, and migration have contributed to the expansion of urban areas, particularly in emerging towns such as Revathi Behar, where the planning mechanism has failed to keep up with the growth. Sharma et al. (2024) [13] also stressed that population growth, migration, and inadequate planning have made it the main driver of land use and land cover change. Festus et al. (2020) [7] further added that migration from congested city centres to peri-urban areas in search of better living has become a significant contributor to outward urban expansion, which is prevalent when land-use regulations are ineffective.

The literature highlights that urban sprawl has led to the conversion of agricultural land, forest, and water bodies into built-up areas and has degraded the environment. Das et al. (2023) [4] linked it with urban heat islands, groundwater depletion, and poor air quality. Sharma & Kumar (2023) [21] stress the loss of vegetation and natural resources. Ren et al. (2022) [20] also demonstrated that pollution outside cities causes fragmentation, another way urban growth has a detrimental impact on biodiversity. Similarly, Chen et al. (2019) [3] highlighted that urban sprawl has led to increased pollution, energy use, and loss of green space, and suggested using the pressure-state-response framework to evaluate its ecological effects.

To conclude, the literature highlights that although rapid urbanisation and poor planning are the main causes of urban sprawl, advanced geospatial technology and sustainable land use policies can monitor and mitigate its adverse environmental effects.

3. Research Methodology

3.1 Research design

This study employs a descriptive and analytical research design and relies on secondary data sources to examine the pattern, drivers and consequences of urban sprawl. Data were collected from published reports by the World Bank (2025) [25], ISRO Bhuvan, NSRC LULC Statistics India, government publications, and other relevant sources. LULC data are used to examine changes in built- up areas over different periods. Absolute change is calculated as the difference in built-up area between successive observations. Data on urban population and urbanisation trends are used to understand the broader context of urban growth in India. Previous empirical studies are also reviewed to identify the major drivers and consequences associated with urban sprawl.

3.2 Indicators and calculation procedures

Let A_0 denote the built-up area at the start of a reporting interval, A_t the corresponding area at its end, and n the elapsed number of years. All calculations use the reported area values without interpolating annual observations. The following indicators were used:

Increase/ Change in built-up area (lakh ha) = $A_t - A_0$

Percentage Change = $(A_t - A_0 / A_0) * 100$

Average annual addition = $(A_t - A_0)/ n$

Compound annual growth rate (CAGR) = $[(A_t/A_0) \wedge (1/n) - 1] \times 100)$
Built-up share = (Built-up land area / geographical area) *100

4. Temporal dynamics of built-up area expansion in India

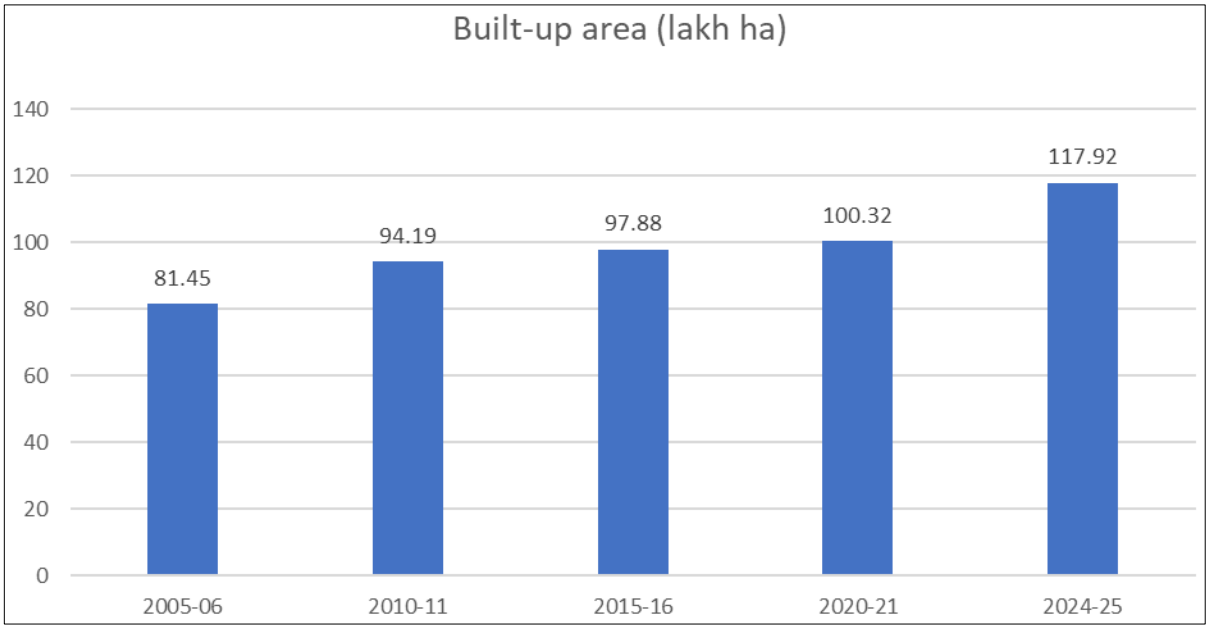
Demographic urbanisation is accompanied by changes in the physical extent of developed land. The built-up area provides a useful indicator of this physical dimension because it captures the land occupied by buildings and associated developed surfaces.

4.1 Changes in the national built-up area

According to Table 2, the built-up area increased from 81.45 lakh hectare in 2005-2006 to 117.92 lakh hectare in 2024-25. This difference amounts to an increase of 36.47 lakh ha, or approximately 44.78%, between 2005-2006 and 2024-2025. Its share of India's geographical area increases from 2.48% to 3.59%, a gain of 1.11 % points.

Table 2: Temporal expansion of built-up area in India

LULC Year	Built-up area (lakh ha)	Built-up share (%)
2005-06	81.45	2.48
2010-11	94.19	2.87
2015-16	97.88	2.98
2020-21	100.32	3.05
2024-25	117.92	3.59



Source: (National Remote Sensing Centre, 2025)

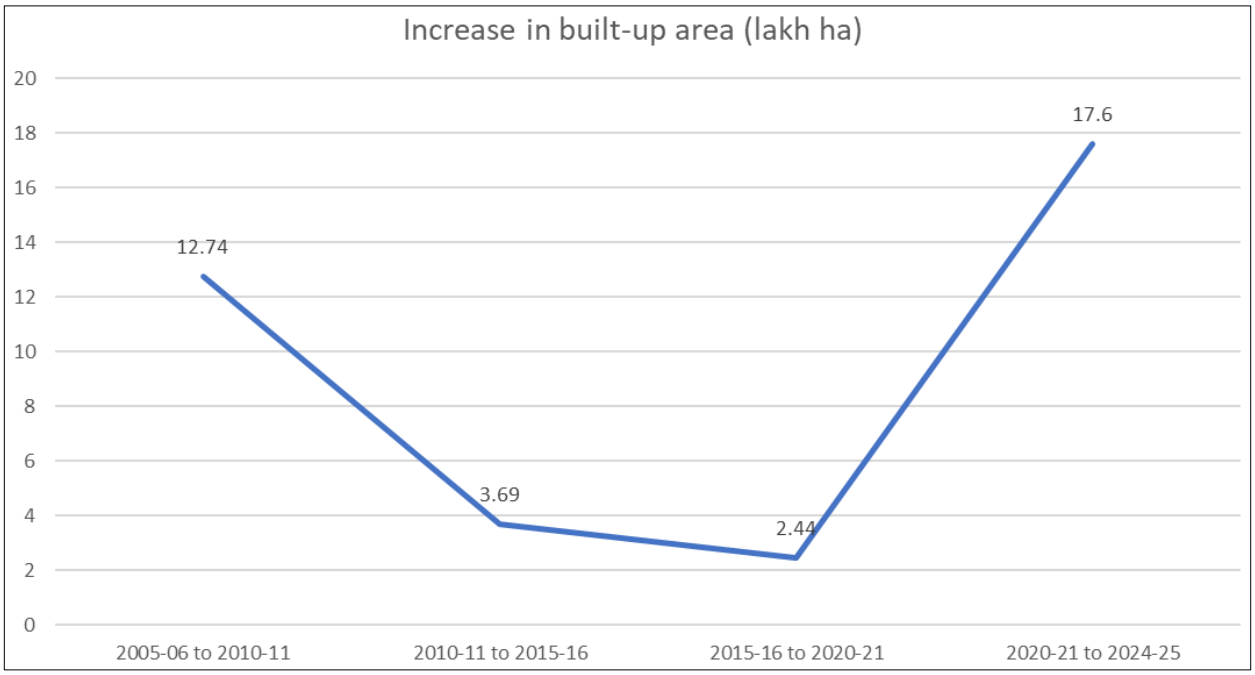
Fig 2

4.2 Variation across reporting periods

The growth of built-up area is one of the key parameters that describes the dynamics of the urbanization process in India. Table 3 below provides an insight into the trends and peculiarities of the development during the chosen period. It can be seen that the overall built-up area in India has increased from 81.4 lakh hectare in 2005-06 to 117.92 lakh hectare in 2024-2025, Which reflects the growth of 36.47 lakh hectare (44.78%) over the period. However, the growth was not consistent throughout the periods. The most notable increase occurred between 2005-06 and 2010-11, when built-up land expanded by 12.74 lakh hectares (15.64%). This was followed by a relatively slower expansion during 2010-11 to 2015-16, with an increase of 3.69 lakh hectares (3.92%), and during 2015-16 to 2020-21, with an increase of only 2.44 lakh hectares (2.49%). In contrast, the period 2020-2021 to 2024-25 witnessed a renewed and substantial expansion, with built-up land increasing by 17.60 lakh hectares (17.54%). Thus, the trend clearly suggests that the growth of the built-up area is not consistent throughout the intervals. Moreover, the last edition of 17.54 % should be regarded as much more substantial, even though the period was shorter than previous ones, as it reflects the average annual growth rate.

Table 3: Interval- wise growth in reported built -up area

Period	Change in built-up area (lakh ha)	Percentage increase	Avg Annual Addition (AAC)	Compound Annual Growth Rate (CAGR)
2005-06 to 2010-11	12.74	15.64	2.55	2.95
2010-11 to 2015-16	3.69	3.92	0.74	0.77
2015-16 to 2020-21	2.44	2.49	0.49	0.49
2020-21 to 2024-25	17.60	17.54	4.40	0.12
2005-06 to 2024-2025	36.47	44.78	1.92	1.97



Source: (National Remote Sensing Centre, 2025)

Fig 3

Possible explanation for the variation between periods

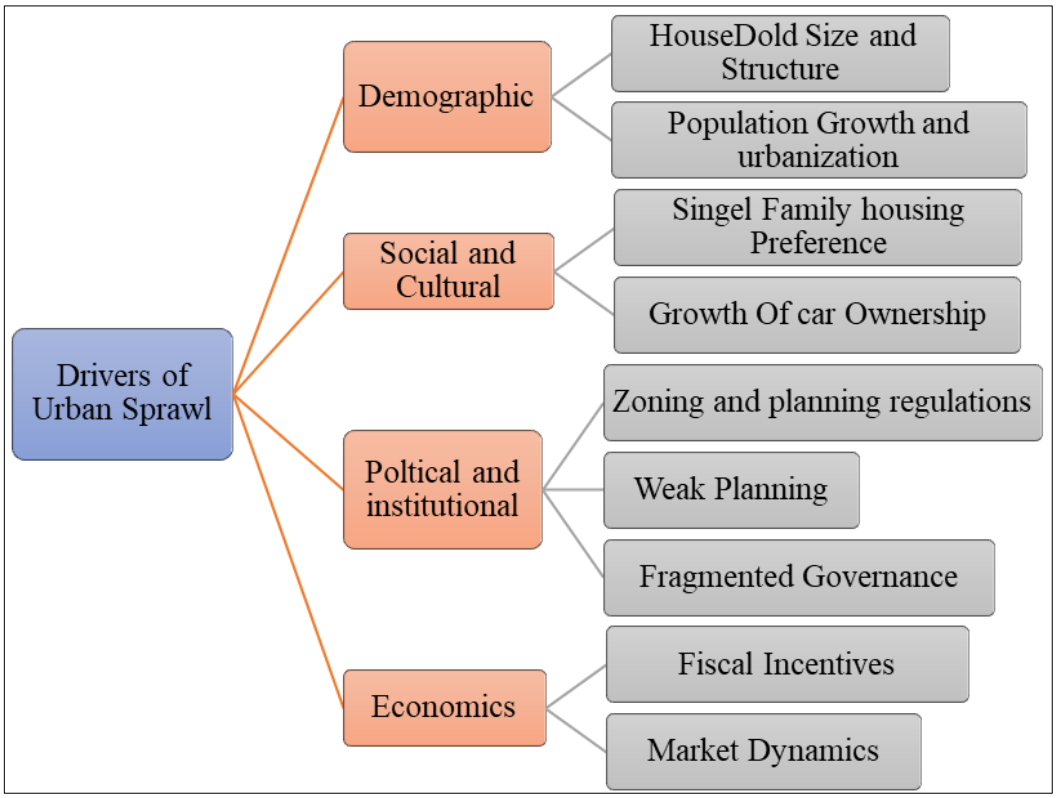
The irregular pattern in Table 3 reflects different processes of land development, rather than a single national trend. Demand from housing, industry and commerce does not rise steadily over time. New transport infrastructure and road building may improve accessibility and make the edges of cities more attractive for development, while variation in land prices and costs shifts the timing of development from one area to another. Changes in household formation in migrant and urban populations could increase demand for developed land, but the effect would be seen in variation in densities and housing markets.

Institutional conditions provide a second possible explanation. The timing of development approvals, infrastructure investment, and the harmonisation of planning authorities can increase land conversion in some periods and slow it down in others. When different agencies have responsibilities over metropolitan fringes, the order of road construction, land-use approvals, and service provision can be extremely uneven. Such mechanisms are relevant to interpreting the national trend, but the present study has no period-specific evidence construction, investment or planning decisions that would elucidate their role in the changes observed.

A third consideration is the comparability of land-cover observations. The relatively small additions recorded in 2010-11 and 2020-21 should not be taken as evidence of slowing urban development, any more than the larger increase recorded from 2020-21 to 2024-25 can demonstrate an acceleration of urban sprawl.

5. Driving forces and consequences

Urban Sprawl does not evolve spontaneously; it is the result of a complex interaction among drivers operating at multiple scales. The drivers of urban sprawl are rarely mutually exclusive. Understanding these drivers is crucial for developing effective solutions that will help steer the urban growth in a different, more sustainable direction. This study divides the drivers into several interrelated categories, including social and cultural, economic, demographic, political and institutional.



Source: Author's creation

Fig 4

5.1 Economic Drivers

a) Land Market Dynamics

The most basic economic driver of sprawl is the difference between land prices at the edge of the city and those in the developed urban core. The price of the land on the periphery is lower than the price of the land in the central city, reflecting the agricultural or underdeveloped nature of the site rather than its potential for Urban Development (Yu et al., 2024) [30]. Lower land costs at the urban fringe attract developers and investors, enabling them to achieve higher profit margins by purchasing at low prices, subdividing, and selling developed lots at urban prices. This leads to the rapid conversion of rural land into urban use.

b) Fiscal Incentives

Fiscal incentives drivers play an important role in shaping urban expansion patterns, frequently supporting low-density, outward growth. In fiscal zoning, municipalities often favour industrial and commercial development while resisting residential development because it generates more land-based revenue, such as land conversion fees, property taxes, and development charges, etc. Through tax breaks and housing and land subsidies, governments encourage suburban development, which lowers the cost of homeownership and promotes urban expansion (Yan et al., 2022) [28].

5.2 Demographic Drivers

a) Household Size and Structure

In many rapidly expanding urban areas, the average household size is decreasing, even as the total population and number of households grow. This trend accelerates the land consumption pressure as more residential units are needed to house the same number of people (Hosseini & Hajilou, 2019) [11]. Thus, creating low-density, leapfrog development characteristics of urban sprawl.

b) Population Growth and Urbanisation

Between 1950 and 2020, the global urban population increased from 751 million to 4.2 billion, currently 55% of the world's population lives in urban areas, by 2050 the number is predicted to rise 68% (United Nations, 2019) [24]. Global population growth and the ongoing urbanisation transition create continuous demand for new housing, which is the dominant driver of peri-urban expansion (Hosseini & Hajilou, 2019) [11].

5.3 Social and Cultural Drivers

a) Single Family Housing Preference

This preference is driven by a combination of cultural ideals, economic factors, lifestyle choices, and policy incentives that make spacious detached homes (Tagnan et al., 2022) more desirable and attainable than urban living, which is typically unavailable in high-density city centres.

b) Growth of Car Ownership

Automobile ownership has increased the rate of suburbanization by creating more opportunities for individuals to live farther from the city. From their workplace, increased car ownership facilitates people's lives since they can decide where to live and how to get there. These characteristics have

significantly impacted the growth of sprawl because people can live in places considered cheap and undervalued. Moreover, the tendency encourages more people to work from home, thereby promoting more sprawl (Booth et al., 2024) [2].

5.4 Political and Institutional Driver

- ***Zoning and Planning regulations***

Zoning laws that require low-density, single-family housing across large areas or that prohibit mixing, legally mandate sprawl. Where planning regulations require large minimum plot sizes, wide road setbacks, and abundant car parking for every development, the resulting built form is inevitably sprawling, regardless of individual preferences. Weak or absent planning systems, common in many rapidly growing cities in the developing world default to unregulated outward expansion by default.

- ***Weak planning system***

In this, inadequate urban planning institutions, outdated regulations, limited enforcement capacity, and poor implementation of land-use policies undermine orderly urban development. Such weaknesses often lead to unregulated land conversion, inefficient infrastructure provision, and uncontrolled peripheral growth (Wu et al., 2017) [26], making a weak planning system a major institutional driver of urban sprawl.

- ***Fragmented governance***

In this, the division of planning and regulatory authority among multiple powers and agencies with weak management leads to inconsistent land-use decisions, inter-jurisdictional competition, and gaps in metropolitan planning (Moore-Cherry et al., 2022) [17]. This institutional and political disintegration often promotes low-density peripheral development, inefficient infrastructure provision, and uncontrolled urban expansion, making it a key structural driver of urban sprawl.

5.5 Consequences of Urban Sprawl

The consequences of urban sprawl extend across environmental, social, and economic dimensions, interacting with and amplifying one another in ways that create general urban problems. Understanding these cascading effects is essential for making the case for sprawl mitigation.

Fiscal impacts on central cities

As households, businesses, and investments move to the periphery, central cities often experience decreasing tax bases, ageing infrastructure, and intense poverty. This creates a cycle of decline that can be hard to reverse, as disinvestment reduces the quality of public services, further incentivising out-migration (Yan et al., 2022) [29].

Urban heat island effect

Mostly urban areas experience higher temperatures than surrounding rural areas; this phenomenon strengthens the urban heat island effect of sprawling development. The urban heat island effect increases energy demand for cooling, degrades air quality by increasing ozone formation and creates heat-related health risks, particularly during extreme heat events (Das et al., 2023) [4].

Public health impacts

The built environment of sprawl has significant public health consequences, such as diabetes, sleep disruption, and stress, etc. The car-dependent lifestyle features of sprawl diminish the opportunity for physical activity. Long commuting times, a symbol of sprawl, are related to multiple adverse health outcomes and diminished family interaction (Yan et al., 2021) [27].

Air and water pollution

The automobile dependence of sprawling development creates substantial air pollution. Water quality is similarly degraded by sprawl; the extensive impervious surfaces of roads, parking lots, and rooftops in sprawling development prevent rainwater infiltration, increasing stormwater runoff that carries pollutants into waterways (Kanav et al., 2024) [13]. Sprawling development also increases demand for water and energy, further straining natural resources (Prieto-Curiel et al., 2025) [19].

Greenhouse gas emissions and climate change

Urban sprawl is a significant contributor to greenhouse gas (GHG) emissions through two primary ways: transportation emissions and building energy consumption (Luqman et al., 2023) [15]. Recent studies consistently demonstrate that dispersed urban expansion is associated with higher CO_2 emissions, whereas compact urban forms are more conducive to climate change mitigation (Liu et al., 2024) [14].

6. Conclusions

Urban sprawl is a multidimensional and globally widespread pattern of metropolitan growth, driven by an interplay of demographic pressure, rising incomes, automobile-enabling transportation technologies, and fragmented land-use governance. The findings of the present study indicate that the expansion of built- up land is an important manifestation of this process in India. The built-up area increases from 81.45 lakh hectare in 2005-2006 to 117.92 lakh hectare in 2024-25, representing an overall increase of 36.47 lakh hectare (44.78%). Although the pace of expansion varied across the study periods, a marked acceleration was observed during 2020-21 to 2024-25, when the built-up area increased by 17.16 lakh hectare (17.54%). This is a substantial increase that indicates growing pressure on land resources and highlights the increasing intensity of urban expansion. The consequences of such expansion extend beyond changes in land use and encompass environmental degradation, elevated infrastructure, weakened social cohesion, and measurable public-health burdens, particularly related to obesity, physical inactivity, and traffic injury. Because Sprawl is produced by deeply rooted market and institutional incentives, addressing it requires

coordinated policy responses that span regional growth management, pricing reforms, and compact, mixed-use design, rather than any single intervention. Understanding and controlling the causes and effects of urban sprawl will remain a major challenge for sustainable Urban Development as urbanisation continues to grow globally.

Overall, sustainable Urban Development requires a detailed planning framework that minimises the socio-economic and environmental effects of urban sprawl while addressing its root causes. Policymakers should prioritise compact urban growth, protect environmentally and agriculturally vulnerable areas, build green infrastructure, and implement smart land use. Strengthening the integration of geospatial technology into urban planning and decision-making will be necessary to promote resilient, inclusive, and environmentally sustainable cities amid ongoing urban expansion.

References

1. Bhatta B. Causes and consequences of urban growth and sprawl. In: Advances in Geographic Information Science. Springer Science and Business Media Deutschland GmbH, 2010, 17–36. doi:10.1007/978-3-642-05299-6_2.
2. Booth L, Karl C, Farrar V, Pettigrew S. Assessing the impacts of autonomous vehicles on urban sprawl. Sustainability (Switzerland), 2024, 16(13). doi:10.3390/su16135551.
3. Chen D, Lu X, Liu X, Wang X. Measurement of the eco-environmental effects of urban sprawl: Theoretical mechanism and spatiotemporal differentiation. Ecological Indicators. 2019;105:6–15. doi:10.1016/j.ecolind.2019.05.059.
4. Das B, Khan F, Mohammad P. Impact of urban sprawl on change of environment and consequences. Environmental Science and Pollution Research. 2023;30(49):106894–106897. doi:10.1007/s11356-023-29192-3.
5. Deng X, Singh RB, Jiang Q, Dong J, Su H. Observations and modeling of the climatic impact of land-use changes 2014. Advances in Meteorology, 2015, 2015. doi:10.1155/2015/592636.
6. EEA. EEA environmental statement 2006. European Environment Agency, 2006. Available from: https://www.eea.europa.eu/en/analysis/publications/report_2006_0707_150910.
7. Festus IA, Omoboye IF, Andrew OB. Urban sprawl: Environmental consequence of rapid urban expansion. Malaysian Journal of Social Sciences and Humanities (MJSSH). 2020;5(6):110–118. doi:10.47405/mjssh.v5i6.411.
8. Fulton W, Pendall R, Nguyen M. The Brookings Institution survey series. Brookings Institution, 2001 July.
9. Godara R, Kumar V, Beniwal A, Jat BC. Assessment and management of urban sprawl through geo-informatics in Panchkula District, Haryana, India. Available from: www.ijcta.com.
10. Hamidi S, Ewing R, Preuss I, Dodds A. Measuring urban sprawl and validating sprawl measures: Draft, 2015. Available from: https://www.researchgate.net/publication/265164422_Measuring_Urban_Sprawl_and_Validating_Sprawl_Measures-Draft.
11. Hosseini SH, Hajilou M. Drivers of urban sprawl in urban areas of Iran. Papers in Regional Science. 2019;98(2):1137–1158. doi:10.1111/pirs.12381.
12. Jat MK, Garg PK, Khare D. Monitoring and modelling of urban sprawl using remote sensing and GIS techniques. International Journal of Applied Earth Observation and Geoinformation. 2008;10(1):26–43. doi:10.1016/j.jag.2007.04.002.
13. Kanav A, Kumar S, Sharma R, Kumar J. Measuring urban expansion and land use/land cover changes using remote sensing and landscape metrics: A case of Rewari City, India. Journal of Landscape Ecology (Czech Republic). 2024;17(1):107–132. doi:10.2478/jlecol-2024-0007.
14. Liu X, Xu H, Zhang M. The effects of urban expansion on carbon emissions: Based on the spatial interaction and transmission mechanism. Journal of Cleaner Production, 2024, 434. doi:10.1016/j.jclepro.2023.140019.
15. Luqman M, Rayner PJ, Gurney KR. On the impact of urbanisation on CO2 emissions. npj Urban Sustainability, 2023, 3(1). doi:10.1038/s42949-023-00084-2.
16. MOHUAP. 3Multi_Attributes_Technology_22_07_2015, 2015.
17. Moore-Cherry N, Kayanan CM, Tomaney J, Pike A. Governing the metropolis: An international review of metropolitanisation, metropolitan governance and the relationship with sustainable land management. Land, 2022, 11(5). doi:10.3390/land11050761.
18. National Remote Sensing Centre. Bhuvan—Indian Geoportal of ISRO, 2025. Available from: https://bhuvan.nrsc.gov.in/ngmaps#3.4/22.91/82.78.
19. Prieto-Curiel R, Luengas-Sierra P, Borja-Vega C. Urban sprawl is associated with reduced access and increased costs of water and sanitation, 2025. Available from: http://arxiv.org/abs/2402.06676.
20. Ren Q, He C, Huang Q, Shi P, Zhang D, Güneralp B. Impacts of urban expansion on natural habitats in global drylands. Nature Sustainability. 2022;5(10):869–878. doi:10.1038/s41893-022-00930-8.
21. Sharma M, Kumar V. Assessment of urban sprawl, land use/land cover changes and land consumption rate in Hisar City, Haryana, India. Human Geographies. 2023;17(1):47–71. doi:10.5719/hgeo.2023.171.3.
22. Sudhira HS, Ramachandra TV, Jagadish KS. Urban sprawl: Metrics, dynamics and modelling using GIS. International Journal of Applied Earth Observation and Geoinformation. 2004;5(1):29–39. doi:10.1016/j.jag.2003.08.002.
23. UN-Habitat. The value of sustainable urbanization, 2020.
24. United Nations. 68% of the world population projected to live in urban areas by 2050, says UN, 2019. Available from: https://www.un.org/uk/desa/68-world-population-projected-live-urban-areas-2050-says-un.

25. World Bank. Urban population (% of total population)—India, 2025. Available from: https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=IN.
26. Wu Y, Fan P, Li B, Ouyang Z, Liu Y, You H. The effectiveness of planning control on urban growth: Evidence from Hangzhou, China. Sustainability (Switzerland), 2017, 9(5). doi:10.3390/su9050855.
27. Yan Y, Liu H, He C. How does urban sprawl affect public health? Evidence from panel survey data in urbanizing China. International Journal of Environmental Research and Public Health, 2021, 18(19). doi:10.3390/ijerph181910181.
28. Yan Y, Liu T, Wang N, Yao S. Urban sprawl and fiscal stress: Evidence from urbanizing China. Cities, 2022a, 126. doi:10.1016/j.cities.2022.103699.
29. Yan Y, Liu T, Wang N, Yao S. Urban sprawl and fiscal stress: Evidence from urbanizing China. Cities, 2022b, 126. doi:10.1016/j.cities.2022.103699.
30. Yu H, Zhu S, Li JV, Wang L. Dynamics of urban sprawl: Deciphering the role of land prices and transportation costs in government-led urbanization. Journal of Urban Management. 2024;13(4):736–754. doi:10.1016/j.jum.2024.08.002.