

Sprawling Metropolis: A Case Study of Indore with Sustainable Solutions

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ABSTRACT

Urbanization can take many different shapes around the world: it can take the form of low-density residential neighborhoods, business districts, or industrial estates that surrounds undeveloped areas. In developing nations, urbanization rates are rising, and India's urbanization trend demonstrates growth that exceeds national borders. The limited supply and high cost of land inside city limits encourage urban growth outside of established metropolitan boundaries.

Urban sprawl, or the outward growth of cities into surrounding rural areas, is a major aspect of contemporary urbanization around the world. The phenomena provides both possibilities and challenges for sustainable urban development as it is closely related to rapid population increase, economic growth, and changing patterns of land use.

Major geographical changes are happening in Indian cities because of the country's rapidly urbanization, which has been accelerated by growing populations, migration from the countryside to the cities, and economic growth. By 2031, it is projected that there will be more than 600 million people residing in cities in India, which emphasizes the urgent requirement to solve the issues caused by urban sprawl.

The city of Indore, India, which makes a good example of the complexities of urban growth in India. Indore, one of the most rapidly expanding cities in the nation, has grown quickly in the past few years, particularly within the northeast region.

This study explores the causes behind this in Indore, the challenges it raises, and how cities can be more sustainably designed to avoid these problems.

Keywords-Urban sprawl, Urbanization, Sustainability, Sustainable Solutions

I. INTRODUCTION

Urbanization is a defining feature of contemporary development across the globe, with cities expanding rapidly into surrounding rural areas—a phenomenon commonly referred to as urban sprawl. This outward

growth of cities brings about a multitude of socio-economic and environmental changes, presenting both opportunities and challenges for sustainable urban development.

In India, this trend is particularly evident, where rapid population growth, economic advancement, and shifting land-use patterns have contributed to the sprawling expansion of urban areas.

Among the cities, experiencing this rapid expansion is Indore, located in the central Indian state of Madhya Pradesh. Indore, once a small town, has transformed into one of the fastest-growing urban centers in the country, attracting migrants in search of better opportunities and contributing to its burgeoning population. This growth, however, has not been without consequences, as the city grapples with issues of land-use conflicts, infrastructure strain, and environmental degradation, green area, agriculture area, and many more.

Some studies claims that the northeast region of Indore, in particular, has witnessed significant urban sprawl in recent years, characterized by the invasion of residential, commercial, and industrial developments into formerly rural landscapes. This expansion has implications for the city's socio-economic fabric, natural environment, and overall livability, necessitating a deeper understanding of the drivers and dynamics of urban sprawl in this area.

Against this backdrop, this study seeks to research into the complexities of urban sprawl in Indore region. Through an interdisciplinary approach, the study endeavors to provide valuable insights into the challenges posed by urban sprawl in Indore an propose sustainable solutions for mitigating its adverse effects. In developing countries, where rapid urbanization coincides with a critical juncture in environmental impact, sustainable development is paramount. This entails achieving economic growth that enhances people's lives without depleting the environment or other resources. Given the extraordinary growth rates observed, cities in the developing world emerge as the epicenter of the endeavor for sustainable growth.

Understanding the dynamics of urban sprawl in Indore region is not only crucial for the city's sustainable development but also holds broader implications for urbanization trends in India. Furthermore, this study adds to the larger conversation on sustainable urban development and sustainable solutions that create livable, environmentally friendly cities in India and around the world.

II. URBAN SPRAWL IN INDIA

Urban sprawl is the result of cities growing carelessly into surrounding areas. It is characterized by uncontrolled growth of organizations, infrastructure, and housing. This pattern creates low-density, scattered development, an increased dependence on motor vehicles, challenges controlling resources, and problems with sustainability. People migrate in large numbers to adjacent rural or underdeveloped areas in search of affordable housing as populations in cities expand and living costs increase. But the uncontrolled expansion that characterizes urban sprawl has an adverse impact on the environment, society, and economy.

India's urban population has been escalating by over two percent annually since 2018, prompting cities to extend their reach into adjacent rural and impoverished areas. These locales, due to their proximity to urban centers, become increasingly sought-after for their affordable housing options and lower cost of living. Nevertheless, this migration exerts immense pressure on urban infrastructure, natural ecosystems, and agricultural lands.

Urban sprawl has a broad impact on society when uncontrolled growth expands on areas that are both rural and urban. Caused by a demand for jobs, the increasing numbers of people, and rising housing prices, cities continue to expand, getting huge areas of undeveloped or rural land and having a major effect on the natural environment.

India's persistent growth in population is the primary cause of urban sprawl.

Already overpopulated cities are increasingly overloaded by an invasion of newcomers seeking better work consumers, a greater standard of living, and improved living conditions. This demographic expansion has caused cities to consistently expand into neighboring rural areas. Compared with busy urban centers, rural or underdeveloped regions provide cheaper housing and a more cheap lifestyle, which is

how families and individuals consider these newly urbanized areas very appealing.

III. CAUSES OF URBAN SPRAWL

Urban sprawl in India is a multifaceted problem driven by various interconnected factors, all significantly affecting the development of cities and towns. It is vital to grasp these contributing elements to formulate effective strategies for addressing the challenges posed by uncontrolled urban growth.

- i. **Improper Urban Planning:** A lack of comprehensive urban planning is a key driver of urban sprawl in India. Many cities are growing in a haphazard manner, ignoring the long-term consequences. This unplanned development has led to uncontrolled expansion, encroaching on rural and forested areas.
- ii. **Population Growth:** India's rapid population increase is putting pressure on existing cities, forcing them to expand beyond their current boundaries to accommodate the growing need for housing and infrastructure. Urban sprawl is fueled by the rising demand for resources and amenities driven by population growth.
- iii. **Infrastructure Development:** The construction of transportation hubs, such as roads and highways, often initiates urban sprawl by creating new areas for development. These projects attract real estate expansion, leading to the spread of urban areas.
- iv. **Migration from Countryside Regions:** Rural-to-urban migration is a significant contributor to urban sprawl. As cities expand, migrants from rural areas flock in search of improved living standards and job opportunities, further fueling population growth and pushing cities beyond their current limits.
- v. **Government Initiatives:** Government policies favoring industrialization and urbanization unintentionally promote urban sprawl. By prioritizing economic growth over sustainable development, these policies encourage city expansion, exacerbating resource scarcity and pollution.

In summary, urban sprawl in India is influenced by a complex interplay of factors. Recognizing the relationships among these factors is crucial for developing comprehensive plans that balance growth imperatives with sustainability goals. Addressing these underlying issues is essential for guiding urban development towards a more sustainable and balanced path.

IV. CASE STUDY: INDORE CITY

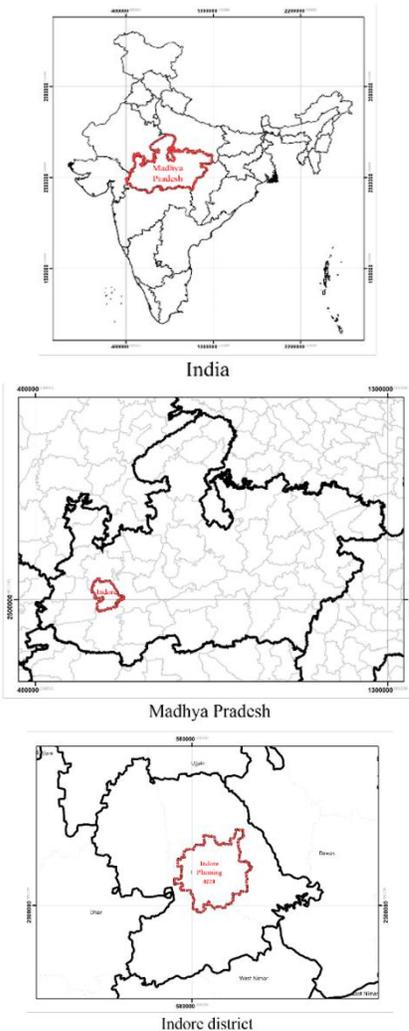


Fig. 1. Indore Location Map

As the commercial center of Madhya Pradesh, Indore is classified as a tier II metropolitan city and was selected because of its large population, lack of geographic restrictions on growth, and accessibility to secondary data.

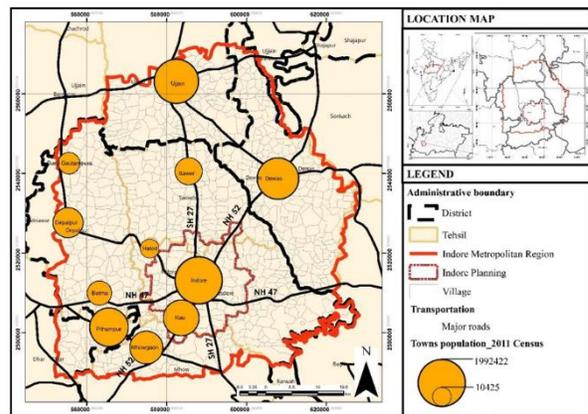
The region surrounding Indore has a major impact on

the development of suburban areas. The Indore Development Plan - 2021 designates the city of Indore and its nearby surroundings as the Indore Metropolitan area.

To the south and southwest are industrial centers like Pithampur, Mhow, and Dhar; to the north are places of worship such as Dewas and Ujjain. In addition, projected industrial areas like Transport Nagar and the Super Corridor are located just beyond the municipal limit, thereby augmenting the city's financial influence over its outer limits.

The expanding metropolis area's economy is boosted by the region's productivity. Indore, a city with significant commercial and industrial importance, has experienced fast economic growth at the same time as its surrounding areas are becoming more and more populated. In western Madhya Pradesh, it also acts as a center for trade, industry, healthcare, and education.

The extensive road network that connects Indore to other towns is an important factor in the rise of suburban regions around the city. Major national and state highways that pass through Indore, such as the NH-52 that links Delhi to Mumbai, the NH-47 that links Ahmedabad, and the SH-27 that takes you to Bhopal, serve the city as one of the nation's rapidly growing logistics and transportation centers.



Compiled from Census of India, 2011

Fig. 2. Population Distribution in Urban Areas- Indore Metropolitan Region, 2011

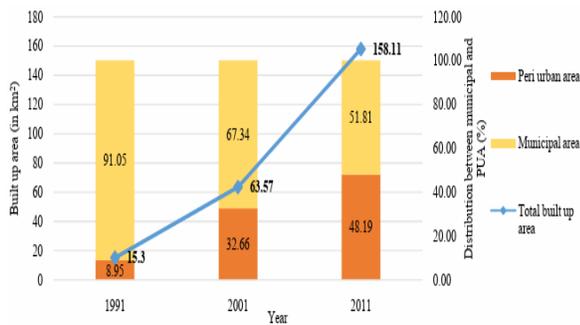
i. DATA ANALYSIS

Spatial changes, reflected in the transformation of land cover to built-up areas, illustrate the growth pattern of the region. Analysis of land use and land cover indicates that the built-up area in Indore expanded significantly from 15.3 km² in 1991 to 158.11 km² in

2011. Notably, the proportion of this built-up area in the sub-urban zone surged from 8.95 percent to 48.19 percent.

This spatial expansion exhibits a linear and compact form, attributed to the radial and ring road transport networks respectively. The rate of urban expansion in sub-urban areas during the two decades shows an annual spatial growth of 1.94 km² from 1991 to 2011, escalating to 5.54 km² from 2001 to 2011. Consequently, it can be deduced that the growth of sub-urban areas surrounding the Indore Municipal Corporation accelerated notably from 2001 to 2011.

ii. URBAN EXPANSION INTENSITY INDEX



Graph 1. Built up area growth and its percentage distribution across municipal and sub urban areas, Indore, 1991-2011

According to the results, the northeast experienced the most rapid development between the years 2001 and 2011, then came the north and southeast (refer to Table 1). On the other hand, the northwest and west regions experienced the lowest rate of suburban development. Conversely, the period from 2001 to 2011 witnessed a faster pace of urban expansion in suburban areas than the period between 1991 to 2001, which was defined by mild and medium-speed growth.

The development of industrial operations to the borders in the villages of Mhow and Rau has been responsible for the growth observed in the southern direction. The Super Corridor's growth in the north and the AB ring road's link to NH-3's north and south additionally had an important effect on the spatial development of the region around it.

Urban areas are growing toward the outermost part and outskirts of Indore as an outcome of depopulation and commercial area conversion in the center of the

city. This development pattern's primary growth axis are north (toward Ujjain) and southwest (toward Mhow).

A study carried out in Indore by Kumar et al. (2007) discovered that there is a minimal built-up development of land, which results in disorganized urban growth, particularly in peripheral and rural-urban zones. An airport is the main barriers to spatial development in the west, and the environmentally sensitive zone in the southeast offers additional problems.

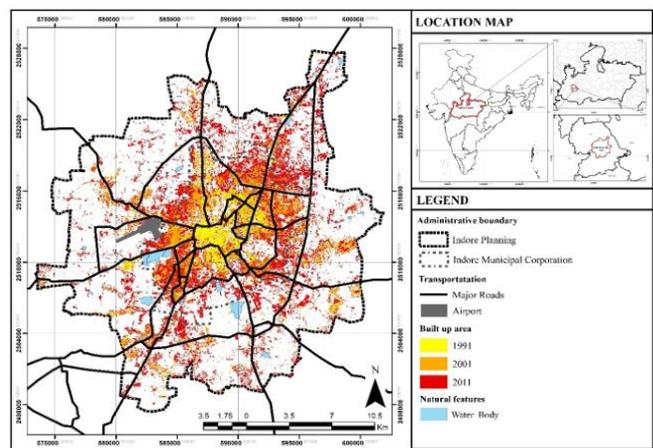


Fig. 3. Built up area growth, Indore, 1991-2011

The Northeast area of Indore is more vulnerable to urban sprawl than other areas because of a number of causes.

These include a surge in the demand for housing, a fast-paced population rise, brisk economic development, improved transportation infrastructure, flexible land use regulations, and possibly less effective urban planning strategies.

These factors work together to create an atmosphere that encourages the unplanned and unregulated growth of urban districts into adjacent rural or undeveloped territories, which exacerbates urban sprawl in Indore's Northeast.

Table 1. Urban Expansion Intensity Index – Indore sub urban region, 1991-2011

Directions	Urban Expansion Intensity Index				
	1991 - 2001	2001 - 2011			
SE	0.57	1.46			
SW	0.64	1.42			
NE	0.44	2.74			
N	0.33	1.48			
S	0.47	1.34			
NW	0.36	1.14			
W	0.55	1.01			
E	0.74	1.25			
Legend	High speed	Fast	Medium speed	Low speed	Slow

V. CASE STUDIES: CITIES DEALING WITH URBAN SPRAWL

India's urban sprawl needs to be addressed with a comprehensive and multifunctional plan. In order to effectively prevent sprawl and promote lively, living communities, legal changes, cash rewards for eco-friendly behavior, and public participation are required.

India offers a unique chance to learn from the past and move toward sustainable urban development as it continues to urbanize. This will ensure that future cities flourish in harmony with the environment and the people who live there.

A number of case studies provide valuable information about strategies to address urban sprawl in India:

- i. Delhi:** Stronger laws and more extensive green efforts are of critical importance as seen by the capital city's serious air pollution problem and the slums' rapid growth. To minimize the negative consequences of uncontrolled sprawl, policies to reduce pollution and support sustainable urban growth must be put into place.
- ii. Mumbai:** Mumbai's enormous metro project acts as an example of how effective public transportation systems may reduce sprawl by lowering the need for private vehicles and enhancing the overall standard of living for locals. Infrastructure spending for mass transit is essential for controlling urban expansion and reducing pollution and traffic congestion.

- iii. Pune:** Known for emphasizing green areas and mixed-use development, Pune is an outstanding instance of sustainable growth in cities. Pune is an example of how cities can accept growth while preserving ecological balance, thanks to its dedication to ecologically sensitive planning methods and the incorporation of nature into the built environment.

These case studies illustrate the wide range of techniques that cities may use to deal with urban sprawl. Even if every city will have different problems that need special solutions, India may use the information it has learned to map out a course toward a time when cities will be great centers of prosperity and well-being.

India can lead the way in sustainable and inclusive urban development across the country by comprehending the fundamental causes and effects of urban sprawl and utilizing the knowledge gained from other cities.

VI. SOLUTIONS TO MITIGATE URBAN SPRAWL FOR SUSTAINABLE DEVELOPMENT

Addressing uncontrolled urban sprawl in Indore requires a multifaceted approach that prioritizes sustainability and balances economic growth with environmental conservation and social equity. Here are some sustainable solutions for mitigating urban sprawl in Indore:

- i. Comprehensive Urban Planning:** Implementing comprehensive urban planning strategies that prioritize compact, mixed-use development, and efficient land use can help contain urban sprawl. Zoning regulations should promote higher-density development within existing urban areas while protecting green spaces and agricultural land on the city's periphery.
- ii. Investment in Public Transportation:** Expanding and improving public transportation infrastructure, including bus rapid transit systems (BRTS) and metro rail networks, can reduce reliance on private vehicles and mitigate sprawl-inducing congestion. Integrated transit-oriented development (TOD) around transit hubs can

encourage compact, walkable neighborhoods with access to amenities and services.

- iii. **Promotion of Green Spaces:** Preserving and expanding green spaces within the city, such as parks, urban forests, and green corridors, not only enhances the quality of life for residents but also helps mitigate the environmental impacts of urbanization. Green infrastructure initiatives, such as green roofs and permeable pavements, can also help manage stormwater runoff and improve air quality.
- iv. **Incentives for Sustainable Development:** Offering financial incentives, such as tax breaks or subsidies, for developers who adhere to sustainable building practices, such as green building certifications and energy-efficient design, can encourage responsible urban development. Additionally, providing incentives for adaptive reuse of existing buildings and brownfield redevelopment can help revitalize urban areas without further encroaching on undeveloped land.
- v. **Community Engagement and Participation:** Engaging local communities in the planning and decision-making processes through participatory approaches, such as citizen workshops and community charrettes, ensures that development projects are responsive to the needs and aspirations of residents. Empowering community-based organizations and grassroots initiatives can also foster bottom-up solutions to urban sprawl.
- vi. **Smart Growth Policies:** Adopting smart growth principles, such as compact development, mixed land uses, and preservation of open space, can guide sustainable urban growth in Indore. Smart growth strategies emphasize infill development and redevelopment in existing urban areas, promoting efficient land use and minimizing sprawl.
- vii. **Regional Collaboration:** Collaborating with neighboring municipalities and regional planning agencies to coordinate land use and transportation planning efforts can help manage growth beyond city limits and prevent sprawl from spreading into surrounding rural areas. Regional planning

initiatives should prioritize sustainable development goals and incorporate principles of equity and social inclusion.

By adopting these sustainable solutions and integrating them into urban planning and development policies, Indore can effectively manage urban sprawl while promoting a livable, resilient and sustainable urban environment for its residents.

Sustainable Urban Planning as a Solution to Urban Sprawl

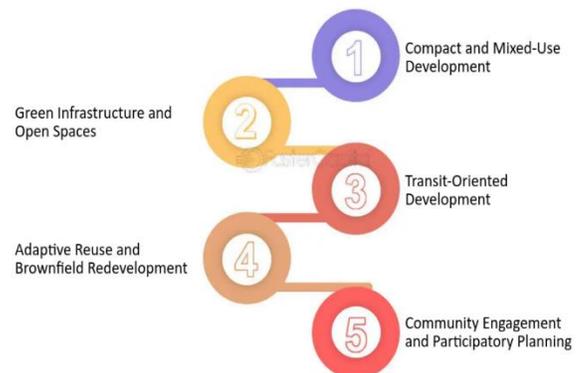


Fig. 4. Sustainable Urban Planning as a Solution to Urban Sprawl

VII. CONCLUSION

In conclusion, immediate attention and integrated efforts are needed to solve the problem of urban sprawl in India, especially in cities like Indore. However, there is a little hope with these challenges because to advancement of sustainable urban planning strategies. By adopting thoughtful and systematic methods for urban development, we can both mitigate the negative effects of sprawl and foster inclusive, resilient communities that will last for many generations.

There are several obstacles in Indore because of the city's fast urbanization and growth. Prioritizing sustainability and responsibility for the environment in urban planning initiatives is crucial as the population increases and development expands. Indore could reduce the adverse effects of sprawl while maintaining an excellent standard of life for its citizens by adopting sustainable practices including compact and mixed-use development, preserving green spaces, and supporting efficient public transportation.

In addition, community involvement and participation are crucial in determining where Indore's urban development will proceed in the future. It is achievable for the city to make sure that development is inclusive and sensitive to the many interests of its residents by including local stakeholders in decision-making procedures and incorporating their points of view and demands into planning projects.

In final analysis, it all comes down to finding a balance between the need for growth and protecting the environment. With adaptability, inclusion, and ecological responsibility as the top goals, Indore can create a city environment that will be a source of wealth and happiness for all of its citizens in the future. Indore has the chance to leave behind a sustainable legacy that's beneficial to present and future generations through smart and purposeful development of cities.

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