

**IMPACT OF URBAN SPRAWL ON ENVIRONMENTAL SUSTAINABILITY IN DELHI.
(ANALYZING THE EFFECTS OF RAPID URBANISATION ON AIR QUALITY, WATER
RESOURCES, GREEN SPACES AND BIODIVERSITY)**

Reena¹

Prof. Sunita Yadav²

Abstract

The rise of the economic, social, and technological sectors is made possible by urbanisation, which also helps society by creating job opportunities and better living and healthcare conditions. However, environmental deterioration and congestion are two primary drawbacks of urbanisation. Urban green spaces (UGS) such as parks, gardens, roadside vegetation, etc. must be created and maintained with careful thought in urban settlements through comprehensive land use planning in order to achieve sustainable and ecologically friendly urbanisation. The term "urban sprawl" describes the unchecked growth of cities and towns, which frequently leads to the encroachment of urban areas onto neighbouring rural or undeveloped terrain. This tendency has been noted in numerous Indian cities.

In India, increasing urbanisation and population increase have resulted in the spread of cities and towns, raising serious concerns about urban sprawl. In-depth analysis of urban sprawl's causes and varied effects on the environment, society, and economy are provided in this research paper's analysis of urban sprawl in India. Based on extant literature and empirical research that is particular to India, this study investigates the ramifications of urban sprawl and proposes approaches and policy directives aimed at mitigating its adverse impacts and advancing sustainable urban development within the nation. With an emphasis on its causes and effects on the environment, society, and economy, this research paper offers a thorough overview of urban sprawl in Delhi.

Keywords: Urbanization, Social, Environment, Society, Economy, Urban sprawl.

Introduction

India is not an exception to the widespread trend of urbanisation in the world today. The last few decades have seen a major expansion of Indian cities due to a rapidly growing population and rising urban migration. Urban sprawl is a complicated, multifaceted phenomenon that has emerged as a result of this expansion and has significant effects on the environment, society, and economy.

¹Research Scholar, Department of Geography, Baba Masthnath University, Rohtak.

² Professor, Department of Geography, Baba Masthnath University, Rohtak .

Within the Indian context, urban sprawl is defined as the unplanned and unregulated growth of cities that result in the encroachment of natural resources, the haphazard development of urban infrastructure, and the encroachment of agricultural land. Numerous causes contribute to it, such as migration from rural to urban areas, population expansion, insufficient land-use laws, and ineffective urban planning.

In India, urban sprawl has several negative effects and presents many difficulties. From an environmental standpoint, the loss of green spaces and agricultural land poses a challenge to food security, and hazards to public health are enhanced by increased pollution of the air and water. Furthermore, urban sprawl increases the effects of climate change and generates urban heat islands, making cities more susceptible to extreme weather events. The objective of this research study is to present a thorough analysis of urban sprawl and its consequences within the Indian setting. It aims to investigate the origins and complex effects of urban expansion on the environment, society, and economy by looking at case studies from Indian cities and the literature that has already been published. In addition, the paper will offer tactics and policy suggestions for controlling and reducing the adverse consequences of urban sprawl in India, promoting sustainable urban growth, and building future-proof cities.

Current scenario of urban sprawl in India

The main cause of India's urban sprawl problem is unplanned and chaotic urban growth, which affects all of the country's major cities to differing degrees. For instance, over the past three decades, Delhi, the nation's capital, has experienced tremendous urban expansion, especially in the east-southeast region. There are frequently insufficient facilities and infrastructure in the new construction located on the fringes of the cities. In the end, it puts strain on the city's services and transit networks. For example, Hyderabad has seen an increase in IT parks and housing colonies in locations like Madhapur and Kukatpally, but public transport has not kept up with this boom.

Causes of urban sprawl

- **Poor urban planning:** One of the primary causes of urban sprawl is poor urban planning. India has seen the uncontrolled growth of many cities without thought to the long-term effects. Urban areas have grown into forested and agricultural areas as a result of this.
- **Population growth:** India's population is expanding quickly, placing strain on the country's already-existing metropolitan centres. Cities expand as a result of rising housing and infrastructural demands brought on by population growth.

- **Infrastructure development:** Urban sprawl is frequently caused by the construction of infrastructure, such as highways and motorways. Urban regions grow as a result of the real estate development brought about by these infrastructure improvements.
- **Migration from rural regions:** Another important factor contributing to urban sprawl is migration from rural areas to cities. People relocate to cities in quest of greater living standards and better employment prospects. The increase in population causes metropolitan areas to grow.
- **Government policies:** Urban sprawl is also a result of government policies that support industrialization and urbanisation. These policies frequently give economic growth precedence over sustainable development, which encourages city growth.

Problems of urban sprawl

Congestion in the streets: One of the main issues with urban sprawl is the rise in traffic congestion. Longer commutes from an increasing number of people living in larger cities cause extra traffic on already congested highways. This adds to air pollution in addition to wasting time and energy.

Infrastructure strain: The current infrastructure is strained by urban sprawl. Utilities including power, water, and sewage systems are in greater demand as cities grow. The expanding population may put a strain on the infrastructure, resulting in poor services and upkeep problems.

Loss of agricultural land: As cities grow, they frequently turn once-agricultural land into urban areas. This results in a loss of arable land, which has an impact on food production and raises the need for imported items. It also uproots farmers from their livelihoods and disturbs the rural economy.

Impact on the environment: The environment is greatly impacted by urban sprawl. It causes more pollution, deforestation, and biodiversity loss. Not only does the loss of green areas and natural ecosystems impact the ecosystem, but it also plays a role in climate change.

Social inequality: The spread of urban areas can make inequality worse. Lower-class citizens are driven out of the urban core when cities grow because of rising living expenses. Communities are resultingly divided and have restricted access to basic facilities and services.

Solutions to Mitigate Urban Sprawl

While urban sprawl remains a problem, there are a number of proactive ways to support sustainable growth and guide cities towards a more equitable and effective future.

- **Compact City Planning:** One of the most important ways to stop urban sprawl is to promote compact city development. Using this approach, communities are planned to accommodate

mixed land use, where adjacent commercial, residential, and recreational spaces coexist. Traffic congestion can be lessened and an environmentally friendly urban lifestyle can be promoted by reducing reliance on automobiles through the development of walkable neighbourhoods and an efficient public transportation system.

- **Policies for Smart Growth:** Implementing smart growth plans is crucial to effectively controlling urban growth. Instead than encouraging growth to move into undeveloped areas, these plans focus it on already-existing urban centres. Sustainable urban expansion is supported by infill construction and the revitalization of older areas, which make the most use of pre-existing resources.

- **Green Infrastructure:** By establishing green infrastructure, urban sprawl's detrimental effects, like declining air quality, can be mitigated. Incorporating parks, green spaces, and urban forests enhances air quality, promotes biodiversity, and provides residents with recreational opportunities that enhance their overall well-being.

- **Mixed-Income Housing:** Offering options for mixed-income housing is one of the most crucial strategies for creating inclusive and varied communities. Locals are discouraged from searching for homes outside of the city when there are reasonably priced housing options close to places of employment in city centres. This encourages social cohesion and a more diversified metropolitan population in addition to providing housing needs.

- **Regional Planning:** A comprehensive approach to controlling sustainable urban growth requires coordinated regional planning. This entails coordinating transportation and land use planning to protect important green spaces and agricultural land that abut metropolitan areas. Cities can achieve a balance between development and environmental protection through the strategic coordination of regional planning.

Population Increase and Urban Growth in Delhi

Delhi's urban area has grown from 326.54 square kilometres in 1961 to 591.90 square kilometres in 1981, 700.23 square kilometres in 1991, and 924.68 square kilometres in 2001, which shows the tendency of urbanisation in the city. As a percentage of the overall area, this urban area was 22% in 1961, 40% in 1981, 47% in 1991, and 62% in 2001. Comparably, from 14.37 lakhs in 1951 to 23.59 lakhs in 1961, 84.71 lakhs in 1991, and 129.05 lakhs in 2001, Delhi's urban population grew. As a percentage of Delhi's overall population, the urban population was 88.72% in 1961, 92.73% in 1981, 89.94% in 1991, and 93.18% in 2001.

Delhi's population density has sharply increased as a result of the city's increasing urbanisation. The population density was 274 inhabitants per square kilometre in 1901; it rose to 1176 in 1951 and 9294 in 2001. Delhi's urban population density grew from 7225 people per square

kilometre in 1961 to 9745 in 1981, 12361 in 1991, and 13957 in 2001. Delhi's primary sector's share of the state income has been impacted by the rate of urbanisation. At current rates, the primary sector's share of Delhi's State Income has decreased from 1.40% in 1999–2000 to 0.74% in 2007–08.

Land Use and Environmental Changes in Delhi

The built-up area of Delhi changed by +30.61% between 1977 and 2014, whereas the agricultural area decreased by –22.75 %, the dense forest decreased by –5.31%, the wasteland decreased by –2.76%, and the road/rail network increased by +2.41%. In open forests, scrubs/degraded forests, plantations, and rivers/waterbodies, there was no discernible net percent change.

Moreover, the national capital's population has been growing at an exponential rate. Delhi is one of the world's fastest-growing cities, with a population that grew from a pitiful 405,800 in 1901 to an astounding 16,753,200 in 2011 (Census of India 2011). According to statistics, 2.22 million immigrants arrived in Delhi between 1991 and 2001—a significant increase over the 1.64 million who arrived between 1981 and 1991 (Delhi Human Development Report 2006). Unlike many other cities, Delhi serves a remarkably high number of foreign visitors in addition to its own citizens. Like many other expanding cities, the city sees a high influx of immigrants from all across India, particularly from Uttar Pradesh, Bihar, Haryana, and Rajasthan. A noteworthy and atypical aspect of Delhi is its substantial migrant population, which welcomes millions of tourists annually. These transient guests come to the city for a range of purposes, such as business and employment, studying, sightseeing, and healthcare access. With such drastic shifts in economic policy, as well as in the development of the national capital and the influx and increase of population.

Water Resource in Delhi

Delhi's uncontrolled growth since the 1960s has made it one of India's most water-stressed cities. The population has grown over the last 62 years, from 842,000 in 1981 to 32,066,000 in 2021. Since then, Delhi's rapid economic expansion has resulted in significant changes to the city's land use patterns. It is anticipated that land usage would rise significantly, and adjustments will follow. The city's sustainable growth and ecology are being impacted by these developments. This study uses cross-tabulation metrics-based approaches, remote sensing technologies, and geographical information systems for 1991, 2011, and 2021 Landsat images to demonstrate land use change and its implications in terms of trends, status, and patterns in Delhi during a 30-year period. Based on the gathered data, the analysis is finished, and the quantifiable results show how a built-up area affects different land uses, particularly surface

water resources, whose land use is severely uneven. Surface water resources can be safeguarded by the usage of this kind of research investigation.

Urbanisation on Air quality in Delhi

Mankind has produced the demon known as air pollution, which can have effects that range from hours to decades. It is now a significant and developing issue in India's quickly rising cities, where one of the main causes of the worsening air quality is the country's unparalleled and unplanned urbanisation combined with its quickly increasing car population. Ensuring clean air for its residents is a challenging undertaking for India's capital city, Delhi. The terrible air pollution crisis afflicting India's cities is starkly illustrated by the fact that Delhi, the country's capital, saw just one day of "good" air quality in 2023. Outside of Delhi, the situation is different and provides information about the intricate nature of urban air quality.

When farmers burn the straw that remains after harvesting rice to make place for new crops in the autumn, India's already poor air quality tends to get worse. Although this fall's pattern was the same, the most recent air quality measurements have been particularly alarming.

This seasonal environmental concern begins with the habit of burning rice stubble by farmers in adjacent states. Beyond agricultural methods, though, the issue also includes industrial and urban pollutants like car emissions and emissions from coal-fired power plants.

The environment now faces a major threat from air pollution, which also poses a major risk to public health. Approximately 80% of urban dwellers are subjected to air pollution levels higher than the World Health Organization's (WHO) recommended threshold. Six major Indian cities were identified as having poor air quality globally in the World Air Quality (IQAir) (WORLD AIR QUALITY study 2019) study. According to Sikarwar and Rani (2020), Delhi is among the developing world's most polluted cities on a regular basis. According to Bherwani et al. 2020 and Venter et al. 2020, the burning of biomass, industry, traffic, household activities, and pavement dust are the main causes of air pollution in Delhi.

According to a 2020 study, air pollution is expected to shorten the life expectancy of around 40% of Indians by more than nine years. Delhi, with its dense population and rapid growth, is frequently at the top of these frightening rankings. The NCR's industries, burning of crop residue and biomass, sewage and municipal garbage, and vehicles all considerably worsen Delhi's air pollution. Delhi placed fourth on a list of 50 of the most polluted cities in the world in terms of PM_{2.5} levels in 2022, while India is the eighth most polluted nation overall, according to the World Air Quality Report published by IQAIR.

In the fight against air pollution, Delhi has a significant challenge from the rapid increase of anthropogenic activity. Maintaining clean and safe air is vital for the existence of all living

organisms. However, bad air quality is still a common occurrence in Delhi. Ecosystems, human health, and the climate all suffer from air pollution. In order to ensure a sustainable future for everybody, air pollution must be addressed. Since severe air pollution contributes to global warming, controlling air pollution is just as crucial as reducing climate change. Thus, cities also have a significant role in contributing to climate change. Cities generate more than 60% of greenhouse gas emissions and are predicted to require 78% of the world's energy. This information comes from UN Habitat.

Urban Biodiversity and Green Spaces in Delhi

The National Capital Territory of Delhi, with a population of 25 million, is the second largest urban region in the world when taking into account the size of urban agglomerations (United Nations, 2014). Large amounts of vegetation are being replaced by concrete buildings and low albedo surfaces as a result of increased urbanisation (Singh and Grover 2015). Since this trend is unavoidable, the challenge is to adapt to the changing urban environment. As more people become aware of the value of urban trees, ecologists and urban planners worldwide are pursuing the idea of eco-cities. Nevertheless, the idea of urban forestry has not gained much traction in India; as a result, a thorough knowledge of urban trees is necessary before incorporating them into the process of urban development.

Urban green spaces play a huge role and offer numerous benefits. According to Hillary et al. (2002), urban green spaces are crucial for biodiversity protection. Aside from recreational and cultural benefits, other essential ecosystem services offered by urban trees include air filtering, microclimate regulation, noise reduction, rainwater drainage, and sewage treatment (Bolund and Hunhammar 1999). In both large cities and small villages, tree shade serves as a store and shelter for street vendors and underprivileged store owners (Bhattacharya and Nigam 2010).

Creating a livable community starts with the planning of green areas. Still, in already-existing cities like Delhi, their numbers are currently declining. Urban Green Spaces (UGS) are susceptible to shrinkage, distortion, and depletion for a variety of causes as cities develop. This has some immediate repercussions; a decrease in green space is directly linked to an increase in the frequency of natural disasters. So, one of the criteria to evaluate Sustainable Development Goals (SDGs) 11, particularly objective 11 (Sustainable Cities and Communities), might be the amount of green space and open space in a city. The IPCC states that drastic changes in land use, energy consumption, urban and infrastructure systems, and industrial systems would be necessary to keep global warming to 1.5 degrees Celsius. Protecting urban green spaces should be a top priority in this regard.

A UN assessment estimates that by 2050, an additional 2.5 billion people will live in urban areas, with almost 90% of them concentrated in cities in Asia and Africa. Both actively and passively, urban green spaces provide a multitude of benefits for human well-being. Green space in urban areas can lower PM2.5 concentrations through processes of absorption and deposition. Cities with green spaces can lessen the impact of pollution and the urban heat island effect, which is the term for heat trapped in populated regions. Because of human activity, the urban heat island effect manifests itself in towns and cities. Urban heat islands have been shown to be lessened by green roof construction and the addition of a layer of flora on rooftops.

Green spaces are beneficial to people's mental, emotional, and physical health, according to a World Health Organisation study on urban green space interventions and health. In order to preserve public health, we need to start realising the importance of urban green spaces and start making investments in them now for the future. Urban green space management, planning, and assessment are rarely systematic and grounded on data. It is imperative to monitor and cultivate the various advantages that urban green spaces can provide, as this is a lost chance. More study is needed to determine the best tactics to use in order to close this gap.

Conclusion

India's urban sprawl has a big effect on the economy, society, and environment. It causes economic inequality, the loss of agricultural land, greater transportation costs, infrastructural costs, and environmental damage. Nonetheless, these detrimental effects can be lessened with the use of efficient sprawl control techniques and sustainable urban development methods. But there is hope with the introduction of sustainable urban planning methods. If we take thoughtful and intentional approaches to urban development, we may lessen the negative consequences of sprawl and build livable communities that will last and leave a sustainable legacy for future generations. Our commitment to creating large, resilient, inclusive, and peaceful cities through a careful balance between growth and environmental management is the key to our success.

In India's cities, government agencies typically place greater emphasis on maintaining the current vegetation than on planting new trees. Extraordinary efforts have been made in New Delhi to preserve, care for, and nurture trees. Public engagement and tree care are promoted by government-backed programmes like Tree Ambulance and Green Leap Delhi. Even though Chennai has lately started tree planting initiatives, saplings still need to be maintained and cared for to ensure their survival and well-being.

Cities are enhanced by their urban green spaces. Promoting health in early and later life is hampered by unsafe infrastructure and poorly maintained UGSs. In order to improve quality of life, engineered infrastructure can be supplemented or replaced by urban green spaces. The urgent demand for numerous resilience measures is established by unprecedented urbanisation, population increase, climate change, and urban environmental hazards like heat and water stress. In order to research and maximise urban green spaces, it is imperative that remote sensing, public policy, and landscape management be applied in concert. Urban planners must start thinking creatively and designing cities with an emphasis on the urban ecology of the city since sustainability is a design issue.

References

1. Ramaiah, M., & Avtar, R. (2019). Urban green spaces and their need in cities of rapidly urbanizing India: A review. *Urban science*, 3(3), 94.
2. Sharma, R., & Joshi, P. K. (2015). The changing urban landscape and its impact on local environment in an Indian megacity: The case of Delhi. *Urban development challenges, risks and resilience in Asian mega cities*, 61-81.
3. Jana, C., Mandal, D., Shrimali, S. S., Alam, N. M., Kumar, R., Sena, D. R., & Kaushal, R. (2020). Assessment of urban growth effects on green space and surface temperature in Doon Valley, Uttarakhand, India. *Environmental monitoring and assessment*, 192, 1-17.
4. Rahaman, S., Jahangir, S., Haque, M. S., Chen, R., & Kumar, P. (2021). Spatio-temporal changes of green spaces and their impact on urban environment of Mumbai, India. *Environment, development and sustainability*, 23, 6481-6501.
5. Upreti, M., & Kumar, A. (2023). Landscape modeling for urban growth characterization and its impact on ecological infrastructure in Delhi-NCR: An approach to achieve SDGs. *Physics and Chemistry of the Earth, Parts A/B/C*, 131, 103444.
6. Singh, B., Venkatramanan, V., & Deshmukh, B. (2022). Monitoring of land use land cover dynamics and prediction of urban growth using Land Change Modeler in Delhi and its environs, India. *Environmental Science and Pollution Research*, 29(47), 71534-71554.
7. Basu, T., & Das, A. (2021). Systematic review of how eco-environmental transformation due to urbanization can be investigated in the sustainable development of Indian cities. *Environmental Challenges*, 4, 100099.

8. Pawar, M., & Dhote, M. (2023). The City Green Landscapes: Environmental Benefits and Typologies of Green Landscapes in Delhi. In *Urban Commons, Future Smart Cities and Sustainability* (pp. 645-663). Cham: Springer International Publishing.
9. Sharma, S., Nahid, S., Sharma, M., Sannigrahi, S., Anees, M. M., Sharma, R., ...& Joshi, P. K. (2020). A long-term and comprehensive assessment of urbanization-induced impacts on ecosystem services in the capital city of India. *City and Environment Interactions*, 7, 100047.
10. Mukherjee, F. (2022). Environmental Impacts of Urban Sprawl in Surat, Gujarat: An Examination Using Landsat Data. *Journal of the Indian Society of Remote Sensing*, 50(6), 1003-1020.
11. Dinda, S., Chatterjee, N. D., & Ghosh, S. (2021). An integrated simulation approach to the assessment of urban growth pattern and loss in urban green space in Kolkata, India: A GIS-based analysis. *Ecological Indicators*, 121, 107178.
12. Banerjee, S., Banerjee, A., & Palit, D. (2021). Ecosystem services and impact of industrial pollution on urban health: evidence from Durgapur, West Bengal, India. *Environmental Monitoring and Assessment*, 193(11), 744.
13. Das, C., Shukla, J., & Dhyani, S. (2022). Endorsing City Biodiversity Index (CBI): Assessing Ecosystem Health in Urban Sprawls and Eco-DRR-Inclusive Urban Planning. In *Blue-Green Infrastructure Across Asian Countries: Improving Urban Resilience and Sustainability* (pp. 441-463). Singapore: Springer Singapore.
14. Chopra, B., Singh, B., & YSC, K. (2022). Spatio-temporal Analysis of Land Use/Land Cover Changes in Urban Forest Ecosystem A Case Study of Delhi Ridge Forest. *International Review for Spatial Planning and Sustainable Development*, 10(3), 128-147.
15. Humbal, A., Chaudhary, N., & Pathak, B. (2023). Urbanization Trends, Climate Change, and Environmental Sustainability. In *Climate Change and Urban Environment Sustainability* (pp. 151-166). Singapore: Springer Nature Singapore.
16. Gupta, G., Shrivastava, R., Khan, J., & Singh, N. K. (2023). Emerging Approaches for Sustainable Urban Metabolism. *Urban Metabolism and Climate Change: Perspective for Sustainable Cities*, 247-273.
17. Mandal, J., Ghosh, N., & Mukhopadhyay, A. (2019). Urban growth dynamics and changing land-use land-cover of megacity Kolkata and its environs. *Journal of the Indian Society of Remote Sensing*, 47, 1707-1725.

18. Anguluri, R., & Narayanan, P. (2017). Role of green space in urban planning: Outlook towards smart cities. *Urban Forestry & Urban Greening*, 25, 58-65.
19. Verma, P., Singh, R., Bryant, C., & Raghubanshi, A. S. (2020). Green space indicators in a social-ecological system: A case study of Varanasi, India. *Sustainable Cities and Society*, 60, 102261.
20. Ray, S., & Ray, I. A. (2011). Impact of population growth on environmental degradation: Case of India. *Journal of Economics and Sustainable Development*, 2(8), 72-77.
21. Pandit, M. K. (2021). Climate change, urbanization and impact on natural environment: The Indian Scenario. *Urban growth and environmental issues in India*, 173-187.