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Changing Pattern of Urbanization in Hisar and Its Environmental Impact

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Abstract
Hisar, the administrative headquarters of Hisar district in western Haryana, has emerged over the past five decades as one of the state's fastest-growing urban centres, driven by its industrial base, educational institutions, and status as a designated counter-magnet city for the National Capital Region. This paper examines the changing pattern of urbanization in Hisar and its associated environmental consequences through a geographical lens. Census data show that Hisar district's population grew from about 15.4 lakh in 2001 to over 17.4 lakh in 2011, while satellite-based studies indicate that the built-up area within the city's rural-urban fringe expanded from roughly 18.6 square kilometres (6 per cent of the study area) in 2003 to 88.3 square kilometres (26 per cent) in 2023, accompanied by a fourfold rise in the land consumption rate between 1972 and 2017. This rapid, largely unplanned spatial expansion, concentrated along the Delhi road in the south-eastern direction, has been linked to a measurable intensification of the urban heat island effect, with minimum land surface temperature rising from about 17°C in 1991 to over 37°C in 2022, as well as to deteriorating air quality, with mean particulate matter (PM2.5) concentrations far exceeding World Health Organization guidelines, particularly during the post-monsoon and winter months. The paper concludes that Hisar's urban growth trajectory, while economically significant, requires urgent planning interventions in land-use regulation, green cover restoration, and air-quality management to ensure environmentally sustainable urban development.

Keywords: *Hisar, urbanization, land use/land cover change, urban heat island, air quality, environmental impact, Haryana*

1. Introduction

Urbanization, defined as the progressive concentration of population and economic activity in towns and cities, is one of the most transformative processes shaping the geography of contemporary India. Hisar, founded by Firuz Shah Tughlaq in 1354 AD and now the administrative headquarters of Hisar district in western Haryana, exemplifies this transformation. Located about 164 kilometres west of New Delhi, the city has been designated a 'counter-magnet' city for the National Capital Region, intended to absorb migratory pressure that would otherwise be directed towards Delhi. Its diversified economic base, including a large steel and galvanized-iron industry, textile and automobile units, and the presence of Chaudhary Charan Singh Haryana Agricultural University, has made it one of the principal urban growth centres of the state.

Over the past five decades, Hisar has undergone marked demographic and spatial change. Rural-to-urban migration, driven by employment opportunities, educational infrastructure, and

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comparatively better civic amenities, has fuelled a rapid increase in population and a corresponding outward expansion of the built-up area, mainly along the transport corridor towards Delhi and, more recently, towards the south-west and north-east. Such unplanned or loosely regulated urban sprawl carries significant environmental consequences, including loss of prime agricultural and vegetated land, increased impervious surface cover, and altered local climate through the urban heat island effect, in addition to deteriorating air quality linked to vehicular emissions, industrial activity, and seasonal crop-residue burning in the surrounding countryside.

This paper undertakes a geographical study of the changing pattern of urbanization in Hisar and evaluates its environmental impact. Specifically, it examines (i) the demographic trajectory of population growth in Hisar, (ii) the pattern and pace of land use/land cover change and urban sprawl based on published satellite-based studies, and (iii) the resultant environmental impacts, particularly the intensification of the urban heat island effect and the deterioration of ambient air quality. The analysis draws on Census of India data, peer-reviewed remote-sensing studies of Hisar's land use dynamics, and real-time air quality monitoring records.

2. Population Growth and Urban Expansion in Hisar

Hisar's urban growth has been closely tied to the broader demographic expansion of its district. According to the Census of India, the population of Hisar district increased from about 15.37 lakh in 2001 to 17.44 lakh in 2011, registering a decadal growth rate of roughly 13.4 per cent, while the city itself, as a municipal corporation, recorded a decadal growth rate exceeding 20 per cent over the same period, reflecting a pace of urban growth considerably faster than the district as a whole. By the 2011 Census, Hisar city had a population of about 3.01 lakh confined within a municipal area of 49.43 square kilometres, giving it a population density of roughly 6,211 persons per square kilometre — a figure far higher than the district's overall density of about 438 persons per square kilometre.

The annual exponential growth rate of the district's population has fluctuated across census decades, peaking at 4.37 per cent during 1971–81 before moderating to 1.55 per cent during 2001–11, a pattern that nonetheless conceals the sharper and more concentrated growth experienced within the urban core itself. This demographic build-up has translated directly into spatial expansion, as documented in the land use/land cover analysis presented in the following section.

Table 1: Decadal Population Growth of Hisar District, 1971–2011

Census Year	Total Population	Decadal Growth Rate (%)	Annual Growth Rate (%)
1981	—	—	2.72

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1991	—	—	2.72 (avg. 1981–91)
2001	15,37,117	27.11	3.80
2011	17,43,931	13.38–13.45	1.55
Mean (1971–2011)	**—**	**—**	***3.11***

Note: The mean annual growth rate of 3.11% is computed by the author as the average of the reported annual growth rates for the four census decades (1971–81: 4.37%; 1981–91: 2.72%; 1991–2001: 3.80%; 2001–11: 1.55%). Source: Census of India (1971–2011); rsisinternational.org, Growth of Population of Hisar (Haryana) during Time Series (2015); Wikipedia, Hisar district.

3. Land Use / Land Cover Change and Urban Sprawl

Remote-sensing based studies using multi-temporal Landsat imagery provide the most reliable evidence of Hisar's changing urban form. A land use/land cover (LULC) study of Hisar city's rural-urban fringe, comparing satellite imagery from 2003, 2013, and 2023, found that the built-up area expanded dramatically from about 18.6 square kilometres (6 per cent of the study area) in 2003 to 88.3 square kilometres (26 per cent) in 2023 — nearly a fivefold increase in two decades. Over the same period, barren land declined from 97.4 square kilometres (29 per cent) to 69.2 square kilometres (21 per cent), while vegetation cover showed a modest increase from 122.6 square kilometres (37 per cent) to 137.7 square kilometres (41 per cent), suggesting that urban expansion has occurred partly at the expense of barren and fallow land as well as agricultural tracts, even as localised afforestation or green-belt efforts have partially offset vegetation loss.

A separate study covering the period 1972 to 2017 found that Hisar's land consumption rate — a measure of the rate at which land is converted to urban use relative to population growth — increased roughly fourfold, from 0.007 in 1972 to 0.028 in 2017, confirming that urban expansion in recent decades has substantially outpaced earlier phases of growth. Other LULC studies covering the urban core report that the built-up area approximately doubled between 2011 and 2021 alone, with projections suggesting a further 47 per cent increase between 2021 and 2035 if current trends continue unchecked. Spatially, this expansion has been concentrated in the south-eastern direction along the Delhi road, and more recently towards the south-west and north-east, driven by liberal industrial policy, transport connectivity, and the proliferation of unauthorised colonies on the urban fringe.

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Table 2: Land Use / Land Cover Change in the Rural-Urban Fringe of Hisar City, 2003–2023

LULC Category	Area in 2003 (sq. km / %)	Area in 2023 (sq. km / %)	Mean Annual Rate of Change (sq. km/yr)
Built-up area	18.6 (6%)	88.3 (26%)	+3.49
Vegetation cover	122.6 (37%)	137.7 (41%)	+0.76
Barren / bare land	97.4 (29%)	69.2 (21%)	−1.41
Mean absolute annual change (all categories)	—	—	***1.89***

Note: Mean annual rate of change computed by the author as (2023 value − 2003 value) ÷ 20 years for each category; the overall mean is the average of the absolute annual rates across the three categories. Source: Assessment of Land Use and Land Cover Dynamics in the Rural-Urban Fringe of Hisar City, SEEJPH (2025).

4. Environmental Impact of Urbanization

The rapid and spatially concentrated expansion of Hisar's built environment has produced two clearly documented environmental consequences: an intensifying urban heat island (UHI) effect and a marked deterioration in ambient air quality. A geospatial study of land surface temperature (LST) in Hisar found that the minimum LST rose from about 17.02°C in 1991 to 37.40°C in 2022, while the maximum LST increased from 30.00°C to 47.24°C over the same period, with the most densely built-up zones showing the highest temperatures. The study also reported a negative correlation between vegetation cover (NDVI) and LST, and a positive correlation between built-up density (NDBI) and LST, confirming that the loss of vegetated and open land to construction is a principal driver of urban warming in the city.

- Land surface temperature in densely built-up zones has risen sharply, reducing outdoor thermal comfort for residents, particularly during summer months.
- Ambient air quality has deteriorated, with real-time monitoring placing Hisar's Air Quality Index frequently in the 'poor' to 'severe' range, especially during the post-monsoon and winter months when crop-residue burning in the surrounding agricultural belt compounds vehicular and industrial emissions.
- Mean annual PM2.5 concentration in Hisar was recorded at about 81.1 micrograms per cubic metre in one assessment year, more than five times the World Health Organization's annual guideline value.
- Loss of vegetated and open land on the urban fringe has reduced the city's natural capacity to moderate temperature and filter air pollutants, compounding the heat island effect.

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- Groundwater and surface drainage patterns have been altered by the spread of impervious surfaces, increasing the risk of localised waterlogging during monsoon rainfall events.
- Unregulated peripheral growth, including unauthorised colonies, has outpaced the provision of sewerage, drainage, and solid-waste management infrastructure, adding further environmental stress.

Table 3: Environmental Impact Indicators of Urbanization in Hisar (Mean Values)

Indicator	Earlier Period	Recent Period	Mean Value (Recent Period)
Minimum Land Surface Temperature (°C)	17.02 (1991)	37.40 (2022)	37.40
Maximum Land Surface Temperature (°C)	30.00 (1991)	47.24 (2022)	47.24
Land Consumption Rate (index)	0.007 (1972)	0.028 (2017)	0.028
Mean Annual PM2.5 Concentration (µg/m³)	—	81.1 (assessment year)	81.1
Mean Post-Monsoon PM2.5, Oct–Dec (µg/m³)	—	134.0 / 133.2 / 114.7	127.3

Note: Mean post-monsoon PM2.5 (127.3 µg/m³) computed by the author as the average of the reported October, November, and December readings. Source: Geospatial approach to analyse the impact of urban development on the urban heat island in Hisar city (research study); IQAir Hisar Air Quality Report; Movable of Urban Growth in Hisar City (land consumption rate).

Taken together, these indicators show that Hisar's urbanization has followed a broadly unplanned, sprawl-led trajectory in which built-up expansion has consistently outpaced the growth of green cover and environmental infrastructure, resulting in compounding heat and air-quality stresses that disproportionately affect the city's most densely populated and industrially active zones.

5. Towards Sustainable Urban Growth: Planning Implications

Addressing these environmental consequences requires coordinated planning interventions rather than piecemeal responses. Priorities include strengthening master-plan enforcement to curb unauthorised peripheral development, mandating green cover and open-space ratios in new residential and industrial layouts, expanding urban forestry and green-belt programmes to counteract the urban heat island effect, and strengthening air-quality monitoring and management, including regulation of crop-residue burning in the district's agricultural

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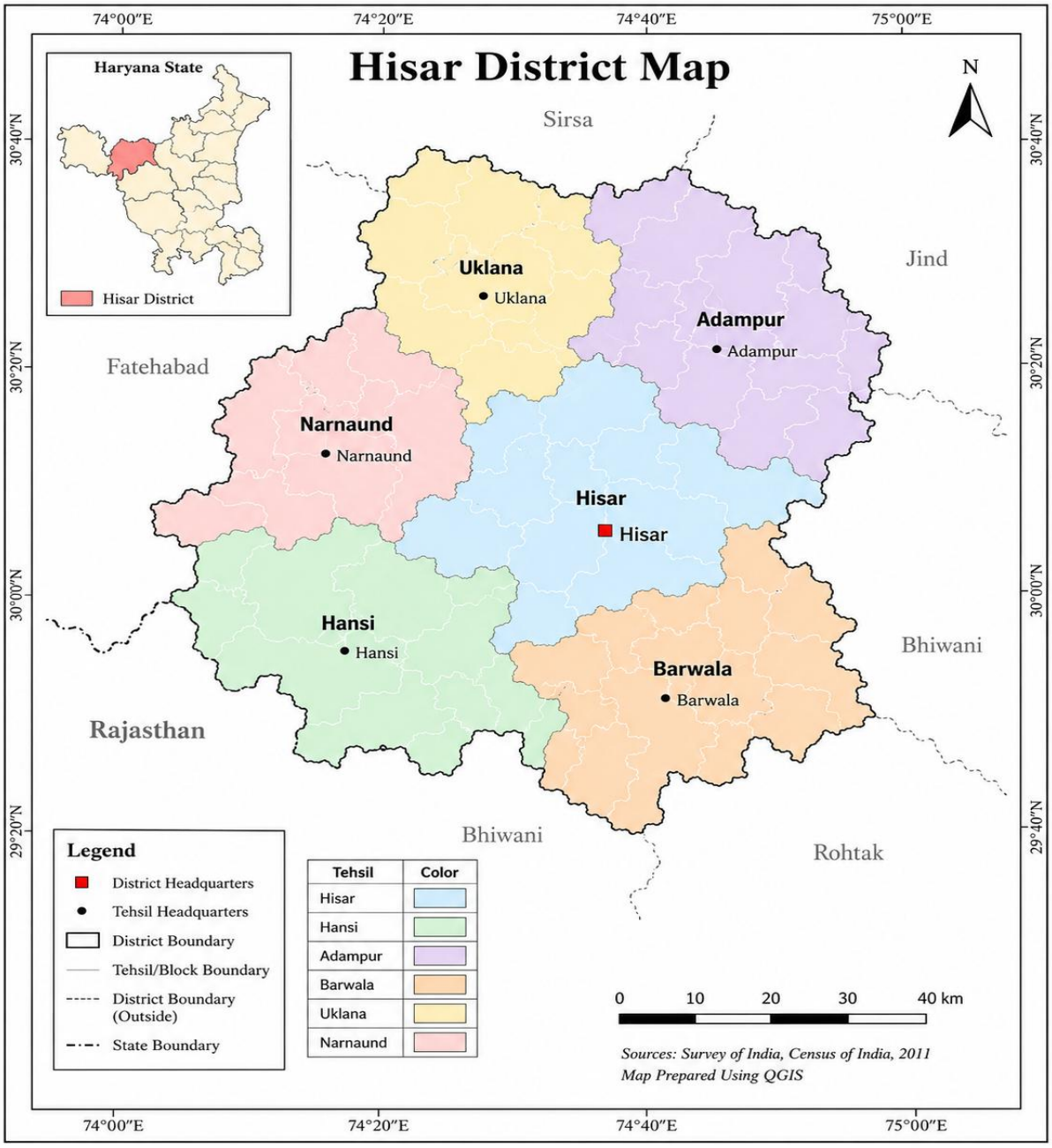
hinterland during the post-monsoon season. Given that Hisar's built-up expansion has been concentrated along specific transport corridors, corridor-focused planning — combining transit-oriented development with mandatory green buffers — offers a more targeted approach than uniform city-wide regulation.

Map 1: Location of the Study Area



Study Area

The present study is based on Hisar city and its surrounding rural-urban fringe, located in the western part of Haryana. Hisar is the administrative headquarters of Hisar district and is one of

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the important urban centres of the state. The city was founded by Firuz Shah Tughlaq in 1354 AD and is situated about 164 kilometres west of New Delhi. Due to its location, economic activities and urban growth, Hisar has emerged as an important centre for the study of urbanization and environmental change. Hisar has been designated as a counter-magnet city for the National Capital Region, which means that it is expected to absorb population and economic pressure that would otherwise move towards Delhi. The city has a diversified economic base, including steel and galvanized-iron industries, textile units, automobile-related activities, trade, education and service-sector development. The presence of Chaudhary Charan Singh Haryana Agricultural University has also strengthened the city's educational and institutional importance. These factors have played a major role in accelerating population growth and spatial expansion in Hisar. The study area is significant because Hisar has experienced rapid demographic and spatial growth during the last five decades. According to the 2011 Census, Hisar city had a population of about 3.01 lakh within a municipal area of 49.43 square kilometres, with a high population density of about 6,211 persons per square kilometre. The population growth of the city has been faster than the district as a whole, showing the increasing concentration of people, employment and urban services in the urban core.

Spatially, the urban expansion of Hisar has taken place mainly towards the south-eastern direction along the Delhi road, and in recent years also towards the south-western and north-eastern parts of the city. Remote-sensing studies show that the built-up area in the rural-urban fringe increased from about 18.6 square kilometres in 2003 to 88.3 square kilometres in 2023, indicating nearly fivefold expansion within two decades. This expansion has resulted in the conversion of open land, barren land and agricultural land into residential, commercial and industrial built-up areas. Hisar has been selected as the study area because it clearly reflects the changing pattern of urbanization in a medium-sized Indian city. Rapid population growth, industrial development, transport connectivity, expansion of unauthorized colonies and outward growth of the built-up area have created several environmental problems. These include the decline of open and vegetated land, increase in impervious surfaces, urban heat island effect, poor air quality, pressure on drainage and stress on basic urban infrastructure. Therefore, Hisar provides a suitable geographical setting for examining the relationship between urban growth and environmental impact. Thus, the study area represents a rapidly expanding urban centre of western Haryana where demographic growth, land use change and environmental stress are closely connected. The geographical analysis of Hisar helps in understanding how urbanization affects land, temperature, air quality and overall urban environmental sustainability.

6. Conclusion

The geography of urbanization in Hisar over the past five decades reveals a city whose spatial growth has consistently outpaced the capacity of its natural and infrastructural systems to absorb it. Population growth, concentrated disproportionately within the municipal core, has

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driven a near-fivefold expansion of built-up area within the city's rural-urban fringe since the early 2000s, while a fourfold rise in the land consumption rate between 1972 and 2017 confirms an accelerating pace of land conversion. These changes have not been environmentally neutral: land surface temperatures in the city's built-up zones have more than doubled in some seasons since 1991, and mean particulate matter concentrations regularly exceed international health guidelines by a wide margin, particularly during the crop-burning season.

As a designated counter-magnet city expected to absorb future migratory pressure from the National Capital Region, Hisar's experience carries lessons for other mid-sized Indian cities undergoing similarly rapid urbanization. A geographical approach that maps the precise spatial pattern of built-up expansion, vegetation loss, and environmental stress can help planners target interventions — green cover restoration, corridor-specific land-use regulation, and air-quality management — where they are most needed, ensuring that Hisar's continued economic and demographic growth does not come at the cost of its environmental sustainability and residents' quality of life.

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