JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Urban Sprawl and Sustainable Urbanisation: A Case Study of Jodhpur City

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ABSTRACT:- This paper examines the patterns of urban sprawl and the challenges of sustainable urbanisation in Jodhpur City, Rajasthan. Drawing upon land use/land cover (LULC) change analysis (1990–2020), spatial landscape metrics, and the Jodhpur Master Development Plan (MDP) 2031, the study highlights the dynamics of urban expansion, its socio-economic and environmental impacts, and the policy framework for managing growth. The findings reveal significant conversion of agricultural and forest land into built-up areas, fragmented and haphazard urban growth, and increasing pressure on infrastructure and natural resources. The study underscores the urgent need for compact, planned, and sustainable urban development strategies.

KEYWORDS:- Urban sprawl; Sustainable urbanisation; Land use/land cover (LULC); Remote sensing; GIS; Jodhpur City; Rajasthan; Master Development Plan (MDP) 2031; Landscape metrics; Urban planning

OBJECTIVES:

- To analyse LULC changes in Jodhpur (1990–2020).
- To evaluate urban sprawl patterns using spatial metrics.
- To assess the role of MDP 2031 in sustainable urbanisation.

METHODOLOGY:

The study is based on satellite imagery (1990–2020), GIS-based LULC classification, and spatial metrics analysis. Insights from the Jodhpur Master Development Plan 2031 were used to link observed changes with planning interventions.

INTRODUCTION: - Urbanisation is one of the most transformative processes shaping modern India, influencing economic growth, demographic shifts, and spatial structures of cities. In recent decades, Indian cities have experienced accelerated growth due to industrialisation, migration, and improvements in connectivity. Jodhpur, the second-largest city of Rajasthan, provides a compelling case study of these dynamics. Located in the arid Thar Desert, Jodhpur has seen rapid expansion of its built-up area alongside a decline in agriculture and open land. While this expansion has spurred economic opportunities, infrastructure development, and cultural prominence, it has also created challenges such as haphazard sprawl, inadequate service delivery, ecological degradation, and social inequalities. Understanding how Jodhpur has urbanised over time, and assessing the effectiveness of its planning frameworks like the Master Development Plan 2031, provides important insights into the broader debate on sustainable urbanisation in India.

STUDY AREA: -

Jodhpur, often referred to as the "Blue City" and the second-largest urban centre of Rajasthan, is located at 26°18′N latitude and 73°10′E longitude, at an elevation of 241 metres above sea level. The city lies on the eastern edge of the Thar Desert, about 340 km southwest of Jaipur and 250 km from the Indo-Pak border. Its strategic location historically made it a hub for trade, defence, and cultural exchange. The topography of Jodhpur is diverse, marked by scattered hills in the north and northwest, natural drainage slopes towards the Jojari River, and extensive stone quarries. The climate is arid, characterised by extreme temperatures, scanty rainfall, and high evaporation rates, making water management a critical issue for urban development. Jodhpur is not only an administrative and educational centre but also a major tourist destination, with the Mehrangarh Fort, Umaid Bhawan Palace, and old walled city contributing to its global prominence. The growing population, rapid industrialisation, and expansion of institutions have increased land pressure, making Jodhpur a significant case study in understanding urban sprawl and sustainable urbanisation.

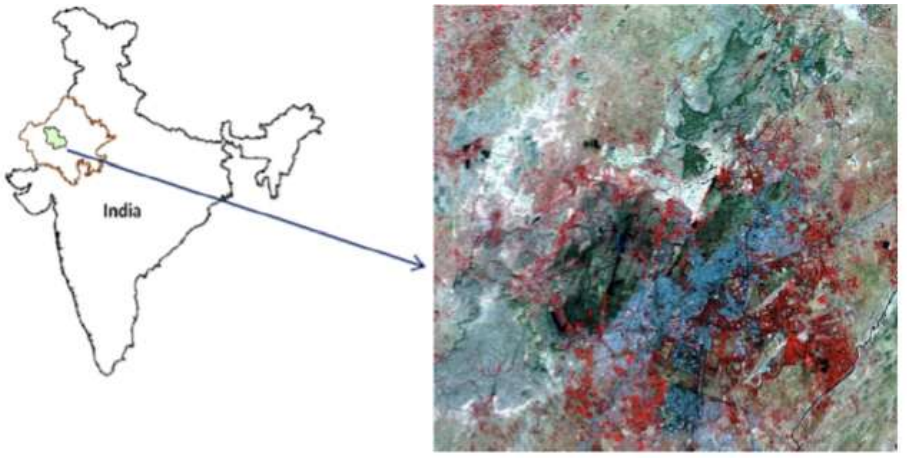

Figure 1: Study Area Map of Jodhpur City

RESULTS AND SPATIAL ANALYSIS OF URBAN SPRAWL:

Between 1990 and 2020, Jodhpur experienced dramatic land use change. Built-up land expanded from 7,665.77 hectares (32.9% of the urbanised area) in 1990 to 11,607.52 hectares (49.8%) in 2020, reflecting a gain of nearly 17%. This growth occurred primarily at the expense of agricultural land, which declined from 7,515.18 hectares (32.7%) to 3,760.99 hectares (16.1%) over the same period. Forest land decreased slightly from 20.7% to 19.6%, while wastelands and mining areas expanded marginally. These transitions point to strong urban encroachment on productive agricultural land and peripheral ecosystems.

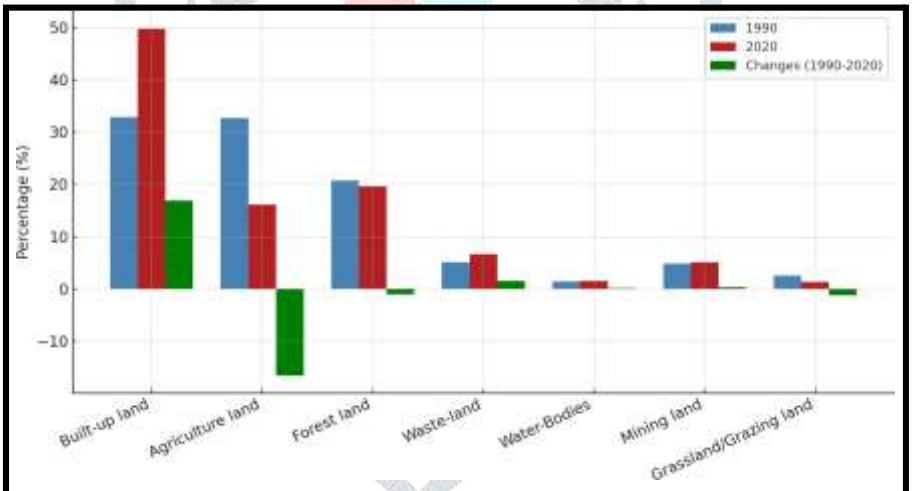

Figure 2: Bar Graph of Land Use & Land Cover Changes in Jodhpur City, 1990–2020 (Hectare area in Percentage)

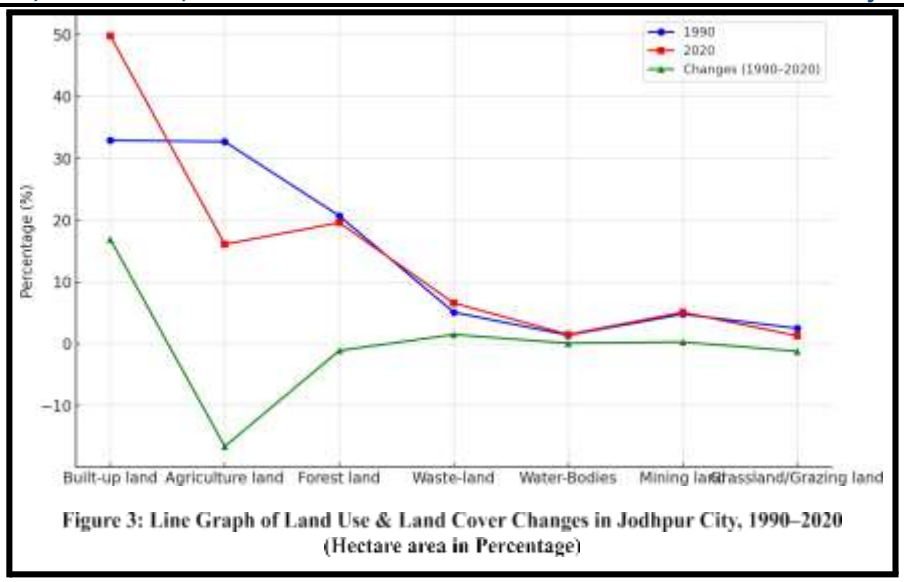

Figure 3: Line Graph of Land Use & Land Cover Changes in Jodhpur City, 1990–2020 (Hectare area in Percentage)

The spatial pattern of growth was further clarified by landscape metrics. FRAC_MN values consistently greater than 1 suggest increasingly irregular patch shapes, an indication of dispersed and unplanned expansion. AWMPFD values reveal that Jodhpur's built-up form was more compact in 1990 but became more fragmented by 2015. Similarly, ENN_MN values dropped from 113.6 in 1990 to 98.4 in 2015, showing that built-up patches became closer over time, while CPLAND values increased from 4.2% to 21.3%, reflecting the consolidation of larger core built-up areas. Together, these metrics highlight how Jodhpur's urbanisation was both outwardly expansive and internally consolidating, leading to sprawl that is irregular yet increasingly dominant in the urban landscape.

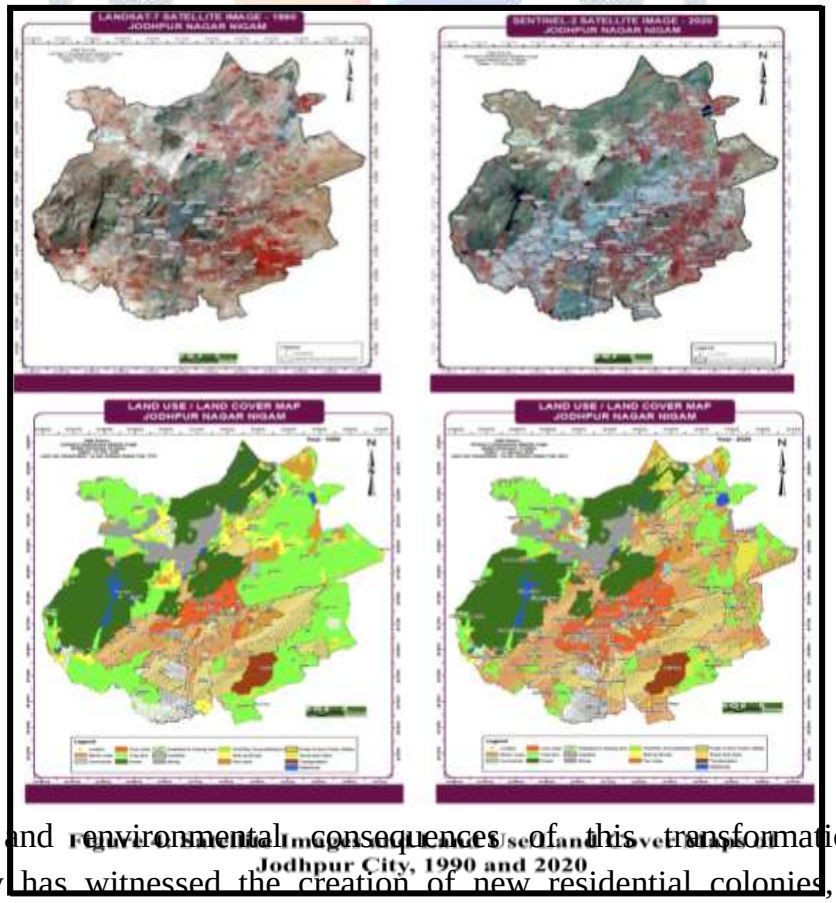

Figure 4: Satellite Images and Land Use and Land Cover Maps of Jodhpur City, 1990 and 2020

The socio-economic and environmental consequences of this transformation are multifaceted. Economically, the city has witnessed the creation of new residential colonies, the establishment of institutions and industries, and a rise in land values, generating employment opportunities and additional

municipal revenues. Socially, however, this growth has exacerbated inequalities, with slum formation, displacement of farmers, and a widening divide between affluent neighbourhoods and informal settlements. Environmentally, the conversion of agricultural and forest land, alongside loss of grasslands and grazing areas, has intensified groundwater depletion, fostered heat island effects, and disrupted local ecosystems.

SUSTAINABLE URBAN FRIENDLY DEVELOPMENT: JODHPUR MDP 2031

The Jodhpur MDP 2031 represents a comprehensive attempt to balance rapid growth with sustainable urban practices. It introduces a zoning framework dividing the city into residential, commercial, industrial, rural, and special-purpose zones, each regulated through Development Control Regulations (DCRs). These DCRs aim to control unregulated land conversion, prevent ribbon development, and promote orderly densification. The plan strongly advocates for mixed land use, enabling residential, commercial, and institutional functions to coexist in compact urban forms, thus reducing commuting distances and promoting energy efficiency.

Infrastructure planning is guided by URDPFI norms, ensuring adequate provision of water, sanitation, housing, waste management, and social services in line with projected population growth. The MDP also incorporates sustainability elements such as biodiversity parks, eco-friendly housing projects, promotion of renewable energy, and discouragement of polluting industries. Furthermore, it seeks to integrate rural and peri-urban areas into the city's growth trajectory by protecting village abadi lands and supporting agro-based industries, thereby strengthening the urban–rural continuum. While the plan is ambitious and forward-looking, its effectiveness will depend on rigorous enforcement, regular monitoring using geospatial tools, and active participation of local communities and stakeholders.

DISCUSSION:

The evidence from Jodhpur underscores the paradox of urbanisation: while it has generated economic growth and cultural prominence, it has also created spatial, social, and ecological stresses. The discussion reveals that urban sprawl in Jodhpur has been both a driver of prosperity and a challenge for sustainability. Key challenges include unplanned conversion of agricultural land, uneven distribution of infrastructure, encroachment on ecologically sensitive areas, and socio-economic disparities reflected in the rise of informal settlements. These patterns highlight weaknesses in enforcement mechanisms and the dominance of market-led land development over planned interventions.

However, the city's Master Development Plan 2031 provides pathways to mitigate these challenges by promoting compact city strategies, mixed land use, and ecological safeguards. For sustainable outcomes, it is critical to strengthen governance capacity, integrate GIS and remote sensing tools into routine urban monitoring, and encourage citizen participation in planning processes. Jodhpur's experience provides lessons not only for Rajasthan but for other rapidly urbanising regions of India facing similar developmental dilemmas.

CONCLUSION:

Over the past three decades, Jodhpur has expanded from a desert town into a sprawling metropolis. While this growth has generated economic opportunities, infrastructure, and social benefits, it has also triggered ecological degradation, groundwater depletion, heat island effects, and rising inequalities. The conversion

of agricultural land and spread of informal settlements reveal an uneven and unsustainable urban trajectory, highlighting the urgent need for better planning and management in this fragile desert environment.

To ensure sustainable urbanisation, strict implementation of the Master Development Plan 2031 is critical, with emphasis on compact city strategies, ecological safeguards, and participatory governance. Key policy measures include: **(1)** enforcing land use regulations to curb sprawl and protect sensitive areas, **(2)** promoting compact and mixed land use development, **(3)** integrating GIS and remote sensing for monitoring growth, **(4)** enhancing water management through recharge protection and rainwater harvesting, **(5)** fostering community participation for inclusive planning, and **(6)** expanding green infrastructure to mitigate environmental stress. Together, these steps provide a practical roadmap for balancing growth with sustainability and positioning Jodhpur as a model of resilient desert urbanism.

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