

Research Article

URBANIZATION IMPACTS ON FOREST ECOSYSTEMS: A GEOGRAPHICAL STUDY ON BANDA DISTRICT

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ABSTRACT

This study investigates the impacts of land use change on forest ecosystems in Banda District due to urbanisation, employing a geographical approach. Banda District, located in Bundelkhand region of Uttar Pradesh possess a unique geographical position due to its decreasing forest cover on the account of increasing built-up and agricultural land. Through a combination of remote sensing analysis, GIS mapping, and field surveys, the research assesses the extent and spatial patterns of forest loss and conversion to built-up and agricultural areas over a time period of 2011-2021. Furthermore, this paper aims to inform policy and management strategies for sustainable forest conservation in Banda District.

Keywords: land use change, Forest Ecosystem, Urbanisation, Remote Sensing, GIS Mapping, Spatial Pattern, Built-up Area.

INTRODUCTION

Urbanization is a global phenomenon that alters landscapes and ecosystems, with far-reaching consequences for biodiversity, natural resource management, and human well-being. Rapid urban expansion frequently results in the conversion of natural ecosystems, particularly forests, into built-up regions to support growing people and economic activity. As a result, forest ecosystems suffer considerable stresses and alterations, compromising their ecological integrity and the benefits they offer to humans and the environment. Banda District, located in Uttar Pradesh's Bundelkhand area, is an interesting case study for investigating the complex interaction between urbanization and forest ecosystems. Banda District, located within the marginal region of Uttar Pradesh and Madhya Pradesh, features a unique mix of extensive forest cover and rising urban growth. Banda District, with its broad range of forest types and ecosystems, including dry deciduous mixed forests and other vegetation types unique to the region, is a good environment for studying the dynamics of urbanization-induced forest change. The study aims to fill current knowledge gaps in the literature on the urbanization-forest nexus in Banda District. While earlier study has looked at the effects of urbanization on forests on a global and regional scale, there have been few studies that focus on individual regions like Banda District. By addressing this vacuum, the research aims to give a detailed knowledge of the complex interactions between urbanization dynamics and forest ecosystems at the local scale, taking into account socioeconomic, ecological, and institutional factors that influence land use patterns and environmental effects.

LITERATURE REVIEW

Md. Tufail in 2014, conducted a state level analysis on trends and patterns of urbanization in India and found that rural migration plays very important role in the process of urbanization. The population growth due to urban agglomeration takes place at very rapid rate on

the account of natural ecosystem. Urbanization is the prominent factor for urbanization where demographic shift is closely interlinked to labour shift which is informal in nature. It is also because of unequal distribution of agricultural resources in the rural areas as compared to urban areas tends to an 'urban bias'. Singh, Gupta and Jha (2013), in their study of Urbanization and Economic Development in Madhya Pradesh: Policy Implications for Sustainable Forest Management have examined the link between land use patterns, population, urbanization, and net state domestic products (NSDPs) in Madhya Pradesh (MP) from 1990-91 to 2000-01. The goal is to develop effective policies for sustainable forest management.

The study conducted by Pankaj Kumar and Shankar Mishra (2017), in the detailed analysis of the use and management of forest resources in Pratapgarh district, Uttar Pradesh area has been done. The study focuses on key aspects of forest resource utilization using useful data collection, statistical analysis and socio-economic parameters. The methods, data sources, and supplies used in this study are also provided.

Aggarwal (2001 and 2002) and Kaimowitz and Angelson (1998), have highlighted the impact of human activities through agriculture, forestry, and climate change in forestry research. Forestry research examines the sustainability of forest resources, biological diversity, forest organization, and the effects of human interactions. The study covers forest organization, forest management, impacts of climate change, and demographic and economic aspects in relation to natural resources. The main objective of this research was to improve the organization, use, and management of forest resources so as to preserve the strategic importance, forest organization, and biological diversity.

Singh, Vinay and Verma, Aditya (2019), helpful and useful information can be obtained in understanding the impact of the use of forest resources. With this, necessary steps can be taken from time to time for the protection and prosperity of forest resources. This study explores the possibilities of conservation and prosperity in the management of forest resources and serves as a temple for new

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research. This study reveals the need for new guidelines and studies in the field of scheduling and analysis of forest resources. This will lead to better understanding and coherent policies can be developed for the conservation and management of forest resources in the future.

Research Objectives

Research objectives provides direction to any research. These are the two major research objectives:

1. Evaluating the degree and geographical distribution of changes in forest cover brought by urbanization in Banda District over the decade.
2. Measuring the quantity of forest lost and the area converted to built-up or urban land under various land use categories in order to provide quantitative statistics on the change's magnitude.

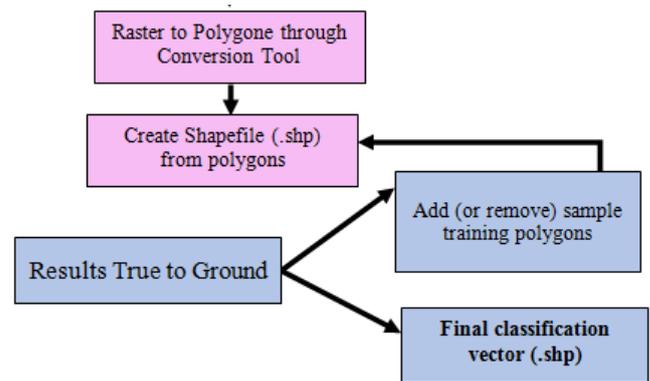
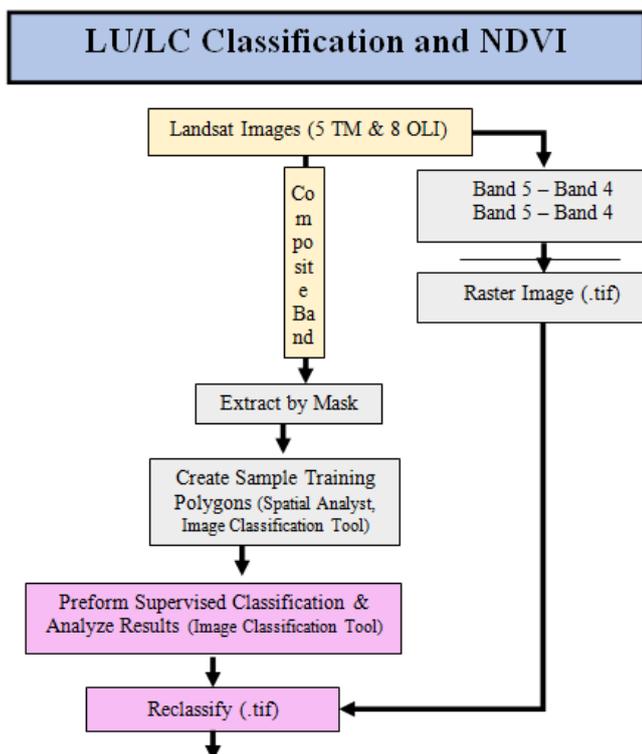
Research Questions

Research questions are a list of questions asked by a researcher or researchers on the topic of their research. These questions help the researcher in achieving the main objective of research, organized knowledge creation, validation of ideas, or solution to problems. Research questions help evaluate the usefulness and importance of research results through planning, data collection, analysis, and answering questions. The research questions are as follows:

1. What is the Extent and Types of Forest resources in Banda District?
2. How Built-up area have increased on the account of Forest and Agricultural Land?

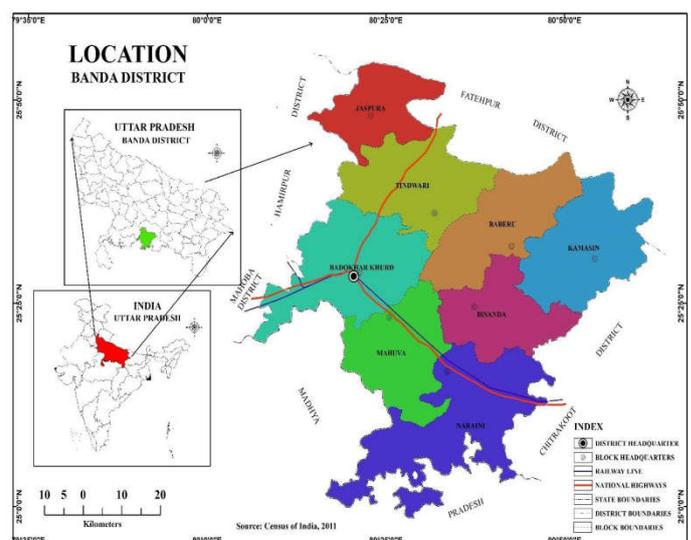
METHODOLOGY

Banda district is geographically positioned between 25°25'55.21" N and 24°58'36.85" N latitude and 80°06'12.56" E and 81°02'20.93" E longitude.



Study Area

Banda district is geographically positioned between 25°25'55.21" N and 24°58'36.85" N latitude and 80°06'12.56" E and 81°02'20.93" E longitude. The district's total geographic area is 4408 km² (Forest Survey of India, 2021) Administratively Banda district is subdivided into 4 Tehsils and 8 Blocks (Figure1). The region's geology includes Precambrian Bundelkhand granites that are unconfirmably overlain by quaternary alluvium from Vindhyan. Yamuna, Ken, and Baghain, which are a part of the Yamuna River system, are the main and important drainage of the district. Three physiographic units the Alluvial Plain, Marginal Alluvial, and High Land (Hard Rock) Area can be distinguished within the region. The district's primary economic driver is agriculture. For irrigation, surface and ground water are both utilised. The area that is net irrigated is 153804 Ha, while the area that is net seeded is 336000 Ha, indicating that 45.77% of the land is irrigated by ground water and surface water and the remaining 93% is dependent on rainfall. The district's canal network spans 1193 kilometres, and there are 460 public tube wells. Both loose sediments and black cotton soil may be found in the Banda district. The predominant soil colour in the centre is black cotton soil. In the district, four primary types of soil predominate: Rakar, Mar, Kabar, and Padua. Hard rock terrain, marginal alluvium, and alluvium are features that define the district. Sand and gravel have a secondary role in the secondary porosity of cracks and joints, where ground water occurs.



Source: District Census Handbook, Part-A, 2011

Figure 1: Location of the Study Area

Forest Resources of Banda District

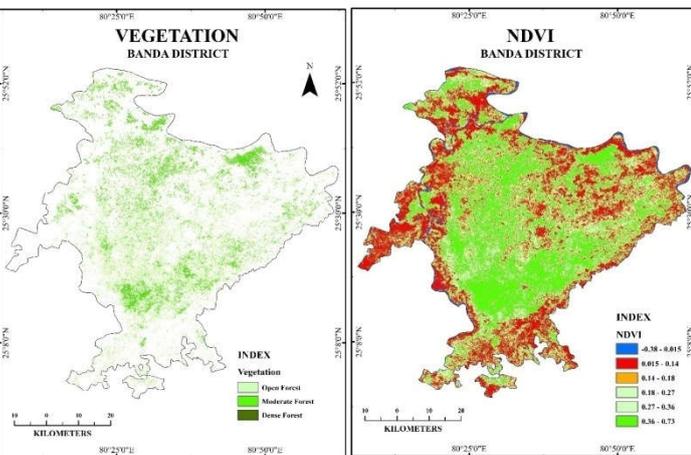
Banda district's forest is predominantly dry deciduous mixed forests located in the foothills of Vindhyan hill range. As per the state forest survey report, 2021 the total area under the vegetation is 101.91 Km² which is only 2.31% of district's total geographical area (Figure 2). The forest department manages the vast majority of the district's forests. Teak, Kardhai, Dhou, Tendu, Khair, Palash, Babul, baraunda, karil, mahua, sajhana, shisham, and bamboo is particularly valuable for the industrial sector. In this forest there are many medicinal shrubs, herbs, and trees including Amla, Bahera, Bel, Arjun, Mahua, Seja, and Chironji. In addition, scrub, reed, kans, and other grasses are abundant in nature. They offer useful livestock grazing. This forest fulfils majority of the people's needs, including grazing and fodder for cattle, building materials for houses, wood for agricultural equipment, fuel, grass for thatching, and rope production. In addition to tendu leaves for the bidi business and khair for catechu (katha) production, nearby woodlands provide a variety of therapeutic plants and shrubs.

total area) in 2011 to 101.91 square kilometers (2.31% of the total area) in 2021.

Urbanisation and LULC change

District Banda is the 53rd most populous district of Uttar Pradesh. As compared to the 22.3% of people living in urban areas throughout the state, the district has a 15.3% percentage of its inhabitants living in urban areas. The population density of the Banda district is 408 people/km², which is lower than the state average of 829 people/km² (District Census Handbook, Part-A, 2011). With 863 females for every 1000 men, Banda district has a lower sex ratio than the state average of 912 females per 1000 males, ranking it 67th. With 66.7% literacy, the Banda district is in 46th place, behind the state average of 67.7%. Out of the 694 settlements in the area, only 37 are deserted. The district's 19.8% decadal growth rate is less than the state average of 20.2%. In terms of inhabited settlements, Banda tahsil has the most (198), while Atarra tahsil has the fewest (102). There are eight towns in the district. Following the 2001 census, no statutory town was added, combined, or reclassified. 319,963 households, or 1% of all households in the state, are located in the district. In the area, households typically house 5.6 people. The process of urbanization in Banda District is complex and is defined by the quick growth of urban areas along with dynamic shifts in socioeconomic dynamics and land use patterns. The urbanization of Banda District, is fueled by a number of variables including population increase, migration, economic development, and infrastructural initiatives. Urban centres put pressure on the rural landscapes around them as they expand, which causes natural ecosystems like woods and agricultural land to be converted into built-up areas. The district's socio-cultural dynamics, land tenure systems, and local government structures shapes urbanization in Banda District and affects how infrastructure, services, and economic opportunities are distributed throughout the area. Urbanization presents a number of issues, including environmental degradation, habitat fragmentation, and socioeconomic inequality, even as it also offers chances for employment, better access to services, and increased connection.

Land use and land cover (LU/LC) patterns in Banda District have changed significantly over the last ten years, indicating the dynamic interaction of institutional, environmental, and socioeconomic variables.



Source: Landsat 5 (TMS), WRS Row- 342 & 43, WRS Path- 144 Acquired on 07-01-2011, USGS Earth Explorer

Figure 2: Forest in Banda District

Table 1: Study Area: Types of Forests

S. No.	Types of Forest	Area (Km ²) 2021	Area (Km ²) 2011	Change (Km ²) 2011-21
1	Open Forest	46.00	77.00	-31
2	Moderate Forest	55.91	26.00	+29.91
3	Dense Forest	0.00	0.00	0.00
4	Scrub	4.00	29.00	-25.00
Total Area (Km ² /%)		101.91 / 2.31%	103.00 / 2.33%	1.09 / -0.26%

Source: India State of Forest Report, 2011& 2021

From Table 1, distribution of the various types of forest cover in the research region for the years 2011 and 2021 is shown, together with the related changes over the course of the decade. It divides forests into four categories: scrub, open forest, moderate forest, and dense forest. The area covered by Open Forest lost 31 square kilometers in 2021, falling from 77.00 square kilometers in 2011 to 46.00 square kilometers. On the other hand, there was an increase of 29.91 square kilometers as Moderate Forest grew from 26.00 to 55.91 square kilometers. Dense Forest covered 0.00 square kilometers of land, unaltered. The scrub woodland lost 25 square kilometers, shrinking from 29.00 square kilometers to 4.00 square kilometers. Overall, there was a net loss of 1.09 square kilometers (-0.26%) in the total forest area, which fell from 103.00 square kilometers (2.33% of the

Table 2- Banda District: LU/LC 2011 and 2021

S. No.	LU/LC	LU/LC Area (Km ²)		LU/LC Change (Km ²)
		2011	2021	
1	Forest	60.40	46.87	-13.53
2	Agricultural Land	3597.90	3800.59	202.69
3	Built-up Area	87.35	241.26	153.91
4	Shrubland	74.50	24.04	-50.45
5	Barren Land	358.54	232.20	-126.34
6	Fallow Land	52.43	8.86	-43.57
7	Water bodies	176.89	54.18	-122.71
Total Area of the District (Km ²)		4408.00	4408.00	-

Source: Developed by Researcher

Comparing data from 2011 to 2021, the table2 gives a thorough summary of how land use and land cover (LU/LC) have changed in Banda District during the previous ten years. A separate LU/LC type (forest, agricultural land, built-up area, shrub land, barren land, fallow land, and water bodies) is represented by each row, and the columns

show the corresponding area (in square kilometers) for each year between 2011 and 2021 as well as the area's change throughout that time (Figure 3). From 60.40 Km² in 2011 to 46.87 Km² in 2021, there has been a notable 13.53 Km² drop in the area covered by forests. There might be a drop due to urbanization, deforestation, or conversion of the land to another use. A significant rise of 202.69 Km² has been observed in agricultural land, from 3597.90 Km² in 2011 to 3800.59 Km² in 2021. This increase is a result of land clearance, intensification of agriculture, or conversion of land use from other categories. From 87.35 Km² in 2011 to 241.26 Km² in 2021 a remarkable rise of 153.91 Km² the built-up area has significantly increased. This shows that the area is rapidly becoming more urbanized, developing its infrastructure, and growing its population. There has been 50.45 Km² fall in the area designated as shrubland from 74.50 Km² in 2011 to 24.04 Km² in 2021. Grazing pressures, natural succession processes, or land conversion may be to blame for this decrease. From 358.54 Km² in 2011 to 232.20 Km² in 2021 a drop of 126.34 Km² barren area has significantly decreased. Land reclamation, afforestation initiatives, or increased agricultural production might be the cause of this shift. There has been a drop of 43.57 Km² in fallow land from 52.43 Km² in 2011 to 8.86 Km² in 2021. Changes in farming techniques, reforestation, or land cultivation might be the cause of this drop. Between 2011 and 2021, the area covered by water bodies dropped dramatically, from 176.89 Km² to 54.18 Km², a considerable loss of 122.71 Km². Changes in hydrological patterns, changes in land use, or human activity might be the cause of this drop.

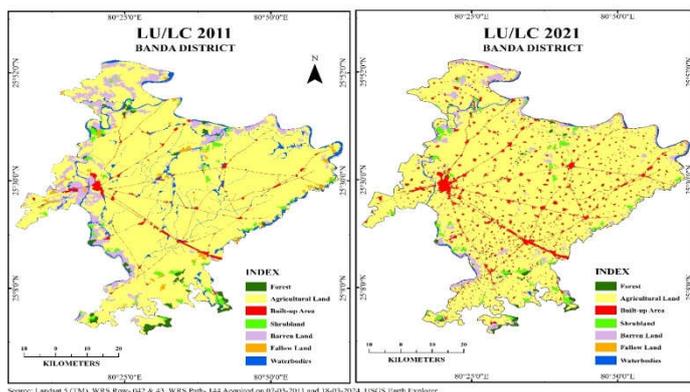


Figure 3: LU/LC of Banda District 2011 and 2021

The district's have seen significant Built-up area changes due to rapid population growth, infrastructural development, expansion in agricultural land and urbanization. Notable changes in LU/LC classes seen in satellite images and remote sensing data, as built-up regions grow at the expense of Barren, Fallow, and other Forest land. There has been a growth in urban centres and semi-urban areas, as seen in figure 3, due to increase in the number of buildings and apartments, retail stores, and industrial facilities. Concurrently, increased economic incentives and expanding food demands, agricultural area have increased, resulting in the conversion of fallow and Barren land into agricultural land.

CONCLUSION

The effects of urbanization on the forest ecosystems in Banda District are especially address these issues, comprehensive strategies that incorporate community involvement, environmental preservation, and land use planning are needed to support sustainable urban growth and forest management in Banda District. Policymakers, planners, and stakeholders can develop strategies to reduce negative effects, improve resilience, and promote inclusive and environmentally

sustainable urbanization processes that benefit both the present and the future generations by having a thorough understanding of the dynamics and implications of urbanization in Banda District. Comprehending the intricacies of land use and land cover change (LU/LC) in Banda District is crucial for making well-informed decisions and devising interventions that seek to encourage sustainable land use practices, preserve biodiversity, and lessen the detrimental effects of land transformation on ecosystems and communities. In order to ensure the long-term resilience and wellbeing of the district's residents and ecosystems, policymakers, researchers, and local stakeholders can monitor and analyse LU/LC dynamics over time in order to spot emerging trends, evaluate the factors driving change, and devise plans to strike a balance between development aspirations and environmental conservation objectives. The dynamic character of the Forest scenario and lucl in Banda District is highlighted by the Forest, NDVI, and lucl study, which shows changes in vegetation, trends in urbanization, and environmental changes during the previous ten years. The district's plans for sustainable development, biodiversity preservation, and ecosystem services are all impacted by these changes.

Fire blackens the earth temporarily, but asphalt blackens it permanently. While this Assessment acknowledges that fire is an important wild land-urban interface issue, it also recognizes the long-term consequence of losing basic ecosystem goods and services to urbanization. Even if all development stopped today, forests would continue to be affected by urban uses through indirect stresses such as air pollution, global climate change, altered disturbance regimes, and introduction of exotic species. We are just beginning to understand the long-term ecological consequences of these indirect effects on forest ecosystems.

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Ethics

The research project on urbanization impacts on forest ecosystems was exempt from ethical approval.

REFERENCES

1. Aggarwal, A. 2014. How sustainable are forestry clean development mechanism projects? A review of the selected projects from India. *Mitigation and adaptation strategies for global change*. 19 :73-91.
2. District Census Handbook, Part-A, Banda District, Census of India, 2011
3. Kaimowitz, D. and Angelsen, A. 1998. *Economic Model for Tropical Deforestation*. Center for International Forestry Research, Bogor
4. Kumar, P. and Mishra, Shankar. (2017). Utilization and management of forest resources in district Pratappgarh: A study. *Botanical Association Newspaper*, 15(2) : 163-174.
5. Singh A. K., Gupta V. B. and Jha R. K. 2013. Urbanization and Economic Development in Madhya Pradesh: Policy Implications for Sustainable Forest Management, *Journal of Energy, Environment & Carbon Credits*. 3(1) : 22-30

6. Singh, V. and Verma, A. 2019. Scheduling and analysis of use of forest resources in Pratapgarh district. *Forestry Studies*, 13(1) : 65-76.
7. Tufail Md. 2014. Trends and Patterns of Urbanization in India: A State Level Analysis, *International Journal of Humanities and Social Science Invention*. 3 (6) : 9-17
