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Impact of regional development on land use pattern in eastern Uttar Pradesh: An inter-district analysis

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Abstract

Eastern Uttar Pradesh, a relatively underdeveloped region of India, lacks significant investment in industries such as manufacturing and technology. This study tries to measure land use changes over a 20-year period (2001–2021) and to assess inter-district variations in development levels. Using a comprehensive methodological framework, the study draws on secondary data from the Census of India, the Directorate of Economics and Statistics, and NITI Aayog. District-level variations in land use and development have been analyzed with the help of composite indices constructed from thirteen key socio-economic and infrastructure indicators. These composite indices allow for a robust assessment of development disparities across 27 districts. The findings reveal substantial changes in land use and considerable variation in development levels in eastern Uttar Pradesh, with Varanasi and Allahabad emerging as the most developed districts, benefiting from strong economic and infrastructure index. This research highlights the relationship between land utilization and regional development. The results suggest that targeted regional development policies can mitigate development disparities.

Keywords: *Land use patterns, development, Eastern Uttar Pradesh, composite index, regional development, socioeconomic factor.*

Introduction

The land is a critical natural resource, and its judicious utilization is vital for sustainable development. Over the past two decades, largely driven by urbanization, Eastern Uttar Pradesh has experienced notable shifts in land use patterns, population growth, and industrial development. Development is a multifaceted concept crucial for understanding the complex relationships between socio-economic factors and land use patterns. Traditional economic theories, such as those by Chisholm (1982), define development as an economic structural transformation characterized by increased output, aligning with Rostow's (1971) stages of growth model. Schumpeter (1984, 1985, and 1989) highlighted innovation as a key driver of economic development, influencing land use decisions. Early works on land use and development, like Bhalla and Alagh (1979), analyzed regional disparities and agrarian structures in India, proposing policies for inclusive growth but without a specific focus on inter-district variations or connections to socio-economic indicators like literacy and infrastructure. Mishra (1985) studied rural development schemes in Uttar Pradesh but primarily focused on program evaluations rather than land use changes. Sen

(1999) introduced the concept of capabilities and freedoms in understanding human development. Although this framework is widely applicable, it was not explicitly linked to land use changes in the context of regional disparities. These foundational studies laid the groundwork for understanding development but lacked an explicit focus on how socio-economic factors influence land use dynamics.

Recent studies, such as that of Sinha (2017), emphasized the intersection of land use, agriculture, and urbanization, advocating for sustainable land use practices but focusing more on environmental rather than socio-economic impacts. Kushwaha *et al.* (2020) explored spatial patterns of land use in Eastern Uttar Pradesh, identifying challenges like fragmented agricultural landholdings and inadequate reforms. However, their analysis remained descriptive, with limited integration of socio-economic factors such as income and literacy. Gupta *et al.* (2023) focused on sectoral dynamics and policy interventions but did not develop an inter-district comparative framework or address temporal changes in land use patterns.

This study aims to bridge these gaps by providing a comprehensive inter-district analysis of land use patterns in Eastern Uttar Pradesh. It integrates socio-economic indicators like literacy, income, and infrastructure development, offering insights into their role in shaping land use dynamics over time. By adopting this approach, the research contributes new perspectives to the discourse on sustainable land management and development in the region.

The present study aims to investigate the relationship between regional development and land use patterns in Eastern Uttar Pradesh. The major objectives of this research are a) to measure inter-district levels of development and analyze land use patterns in Eastern Uttar Pradesh; b) to correlate changes in land use and levels of development across various districts within Eastern Uttar Pradesh and c) to evaluate socio-economic and infrastructural factors that influence regional development.

Database

The study compares inter-district variations in levels of development with changes in land use patterns in Eastern Uttar Pradesh over the two decades from 2001 to 2021. Data sources include the Census of India for 2001 and 2011 which provide essential demographic and socio-economic profiles critical for understanding population dynamics and economic activities across the districts. Additionally, data from the Directorate of Economics and Statistics, Uttar Pradesh, and the Ministry of Agriculture, Government of India, regarding agricultural productivity, infrastructure development, and economic indicators have been utilized for analysis and index building. The comprehensive datas*et a*llows for an in-depth understanding of demographic changes, economic activities, and land use patterns during this period. The study employs both quantitative and qualitative approaches to provide a holistic analysis of development and land use dynamics in Eastern Uttar Pradesh. The quantitative approach uses statistical techniques to analyze relationships between land use patterns and socio-economic indicators. Correlation analysis determines the strength and direction of associations between land use changes and relevant variables. Furthermore, a composite index is constructed to measure development levels across districts, enabling a comparative analysis of socio-economic

disparities in Eastern Uttar Pradesh. The qualitative approach relies on secondary data sources, including government reports, socio-economic surveys, and existing literature, to gain contextual insights into land use patterns and development disparities in the region.

Methodology

To achieve the objective of studying the relationship between land use patterns and the level of development in Eastern Uttar Pradesh, this study includes a systematic approach that integrates quantitative techniques and district-level analysis. The first objective involves measuring changes in land use patterns between 2001 and 2021. This is achieved through spatial analysis using bar graphs to map and quantify the extent and distribution of different land use categories across the region. This enables precise measurement of land cover changes and facilitates the identification of significant shifts in agricultural, urban, and other land uses over the two decades under study. The second objective focuses on examining the association between land use patterns and levels of development in Eastern Uttar Pradesh. To accomplish this, statistical methods correlation analysis is employed to determine the extent to which variations in land use correspond with socio-economic development indicators such as GDP per capita, literacy rates, and infrastructure access. This quantitative approach helps establish empirical relationships between land use dynamics and developmental outcomes. This study conducts a composite index for development, on the basis of 13 socio-economic indicators. This methodological approach aggregates all variables (Table 1) into a single metric, offering a holistic view of development disparities among districts in Eastern Uttar Pradesh over the study period. The third objective seeks to identify the key factors influencing development and assess their impact on regional disparities in Eastern Uttar Pradesh. To achieve this, qualitative methods are employed, which include the analysis based on the result of quantitative techniques that also include reviewing existing literature and policy documents to identify gaps in understanding the factors influencing development. Observational Methods uses contextual data that enriches the quantitative findings and provides contextual insights into the factors influencing land use decisions and development trajectories, including policy frameworks, infrastructure investments, and socio-cultural dynamics.

To assess the level of development at the district level, 13 indicators have been selected to measure development across the 27 districts of Eastern Uttar Pradesh. The explanations and justifications for these indicators are discussed in Table 1. The indicators to evaluate socio-economic advancements in Eastern Uttar Pradesh's districts; a range of factors has been identified. Economic indicators reflect urbanization and growth, while health metrics, such as life expectancy and access to medical facilities, are crucial for public health. Infrastructure measures, including road density and electrification rates, assess service quality. Educational indicators, like literacy rates and institutional density, gauge learning opportunities. Demographic metrics provide insights into development trajectories, creating a comprehensive framework for informed policies and targeted actions to enhance regional development.

The present study is conducted using the Human Development Index (HDI)

Table 1: Selected development indicators

Development indicators	Explanation and Justification
percent Urban population	Reflects the rate of urbanization, indicating demographic shifts and urban infrastructure needs essential for development planning.
percent of Irrigated area to total net sown area	Measures agricultural productivity and water resource management, critical for sustainable agriculture and rural development.
Literacy Rate	Indicates improvements in educational access and quality, crucial for human capital development and socio-economic progress.
Per capita food grain production (kgs)	Measures agricultural productivity per capita, reflecting food security levels and economic contributions from the agricultural sector.
No. of registered working factories per lakh population	Reflects industrial presence and economic diversification, providing employment opportunities and contributing to economic growth.
percent of electrified villages to total inhabited villages	Indicates access to electricity, influencing living standards, healthcare, education, and economic activities.
Per capita electricity consumption	Measures energy usage patterns, reflecting development levels, infrastructure availability, and energy access disparities.
percent of main workers to the total population	Assesses labor force participation, indicating employment opportunities and economic activity levels within districts.
Per capita income	Key measure of economic well-being, reflecting average income levels and disparities across districts, essential for assessing standards of living and economic inequality.
Change in surface road per km^2	Measures infrastructure development, particularly road networks, enhancing connectivity, accessibility, and economic integration, supporting regional development.
No. of IITs per lakh population	Indicates investments in higher education and research, fostering human capital development, innovation, and technological advancement.
No. of hospitals per lakh population	Reflects healthcare infrastructure availability, influencing health outcomes, quality of life, and human development indicators.
No. of scheduled commercial banks per lakh population	Financial inclusion indicator, indicating access to banking services and financial resources critical for economic activities, development, and inclusive growth.

methodology. The HDI is a composite statistic that incorporates indicators of life expectancy, education, and per capita income, which are utilized to rank countries into four tiers of human development.

The formula defining the HDI is promulgated by the United Nations Development Programme (UNDP). x, into a unit-free index between 0 and 1 (which allows different indices to be added together), the following formula is used:

$$\text{HDI index}=(b-a)/(x-a)$$

Where:

x = actual value of the indicator

a = lowest value of the indicator

b = highest value of the indicator

This exercise has been done in the following steps:

All data are computed according to the selected parameters of development and grouped into major categories i.e. Social, Economic, Infrastructural Health and Demography. A composite index is formed by

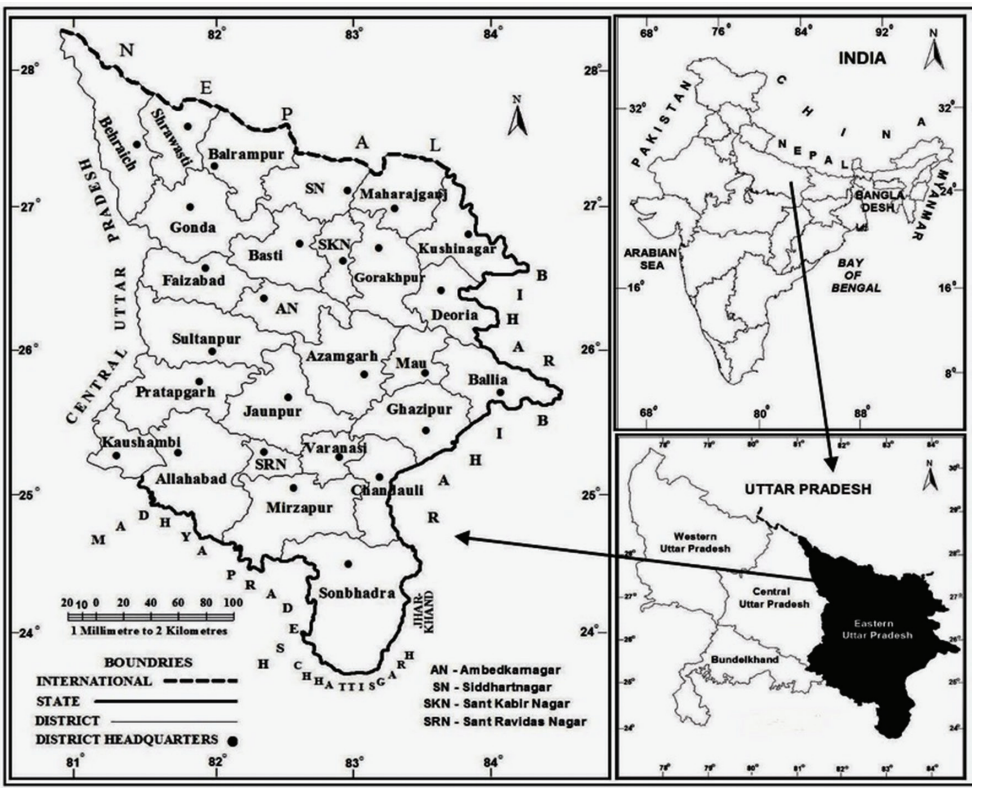

Fig. 1: Study area: Eastern Uttar Pradesh

Source: Prepared by the author

aggregating all indicators data, category-wise for each district. That helps to understand the diversity in levels of development across the districts. To determine the standard score range, data from the composite index is standardized using the Z-score method, which categorizes the districts according to their level of development under the three categories (High, Medium and Low). The Z-score formula is as follows:

$$z = \sigma (x - \mu)$$

Where:

- x = value of each factor
- μ= mean of the factor values
- σ = standard deviation of the factor values

This structured approach ensures a rigorous analysis of development disparities across the districts in Eastern Uttar Pradesh, enabling informed policy decisions based on the HDI framework.

Study area: Eastern Uttar Pradesh

Eastern Uttar Pradesh, spanning 85,298.79 km² and encompassing 27 districts, has been chosen as the study area for understanding regional development dynamics and land use patterns (Fig. 1). Positioned between 23°51' N to 28°0'31' N latitudes and 81°30' E to 84°0' E longitudes, this region lies within the northern sub-continental interior, characterized by a subtropical climate heavily influenced by the monsoon. This climatic context directly

impacts agricultural practices, water resource availability, and socio-economic activities, making it an ideal setting for investigating the intricate relationships between land use and development. Eastern Uttar Pradesh was selected for this study due to its unique blend of physical and socio-economic characteristics, making it a compelling case for analyzing land use and development dynamics. Its vast hydrological network of major rivers supports agriculture, the primary economic activity, while the region also faces significant challenges such as fragmented landholdings, inadequate reforms, and socio-economic disparities. These issues, combined with ongoing shifts in urbanization, industrialization, and agricultural practices, provide a dynamic backdrop to explore the complex interplay between development and sustainable land use. Additionally, the area's demographic complexity, and intra-regional socio-economic conditions with 117 *tehsil*s and 341 community development blocks, provide a detailed perspective on land management and development across various administrative units.

Result and discussion

This section presents the results and discussion of a comprehensive assessment aimed at understanding the development levels across 27 districts in Eastern Uttar Pradesh. The study employs 13 carefully selected indicators, each essential for evaluating various socio-economic dimensions within the region. The findings are in detail, highlighting key observations and implications derived from the analysis of these indicators across the districts. Here values obtained from the HDI method discussed in methodology that fall between 0-1 and further ranking has been given on the basis of hierarchal value in each category.

The regional-level analysis of Eastern Uttar Pradesh's development landscape reveals significant spatial disparities in socio-economic progress. By assessing 13 key development indicators, a composite index highlights overarching trends in economic, infrastructural, health, educational, and demographic dimensions across the region. This broader perspective allows for the identification of regional patterns, helping to address systemic challenges and propose policy interventions that target the root causes of uneven development (Table 2).

Regional Economic Trends

Eastern Uttar Pradesh displays a wide range of economic conditions, with districts such as Varanasi and Allahabad driving regional economic growth due to their diversified economic base like industrial activity and,little-developed services sector. However, much of the region remains agrarian, with districts in the least-developed category, such as Shrawasti, Baharaich, and Maharajgunj, heavily dependent on agriculture with limited economic diversification. These districts demonstrate the need for targeted economic interventions, including investment in small-scale industries, agro-based enterprises, and capacity building for sustainable livelihoods.

Infrastructure and industrial development: Infrastructure plays a critical role in the development of the region, with industrial hubs such as Sonbhadra benefiting from robust infrastructure tied to energy and mineral resources. Despite these localized successes, much of Eastern Uttar Pradesh struggles with infrastructure deficits, especially in transportation, electricity, and digital connectivity. The least developed districts are particularly disadvantaged by inadequate infrastructure, which hampers their capacity

Table 2: Composite Index Analysis of Development Parameters in Eastern Uttar Pradesh Districts

District	Economic	Rank	Health	Rank	Infrastructure	Rank	Education	Rank	Demography	Rank
Allahabad	0.74	1	0.47	15	0.36	8	0.67	5	0.48	6
Ambedkar Nagar	0.32	19	0.31	26	0.26	13	0.6	9	0.49	5
Aazamgarh	0.34	16	0.45	18	0.15	22	0.55	13	0.51	4
Baharaich	0.66	2	0.33	23	0.07	24	0.14	26	0.13	26
Balarampur	0.55	6	0.48	12	0.18	20	0.33	24	0.2	25
Ballia	0.23	24	0.55	4	0.17	21	0.68	3	0.37	16
Basti	0.4	14	0.52	6	0.23	14	0.5	18	0.35	17
Chandauli	0.3	20	0.5	9	0.23	15	0.52	15	0.46	7
Deoria	0.27	21	0.44	19	0.37	7	0.51	16	0.33	22
Faizabad	0.57	5	0.57	2	0.12	23	0.56	12	0.58	2
Gazipur	0.42	12	0.48	11	0.38	6	0.65	7	0.41	10
Gonda	0.4	13	0.4	21	0.32	11	0.77	1	0.34	20
Gorakhpur	0.53	8	0.31	25	0.2	17	0.59	10	0.39	13
Jaunpur	0.52	9	0.47	16	0.42	5	0.51	17	0.42	9
Kaushambi	0.64	3	0.53	5	0.31	12	0.43	21	0.44	8
Kushinagar	0.33	17	0.48	10	0.5	3	0.67	4	0.22	24
Maharajgunj	0.21	25	0.48	13	0.06	25	0.37	22	0.35	18
Mau	0.33	18	0.43	20	0.04	27	0.45	20	0.31	23
Mirzapur	0.48	11	0.51	7	0.18	19	0.7	2	0.57	3
Pratapgarh	0.25	22	0.56	3	0.32	10	0.58	11	0.35	19
Sant Kabir Nagar	0.14	26	0.33	24	0.43	4	0.66	6	0.39	15
Sant Ravidas Nagar (Bhadohi)	0.23	23	0.5	8	0.21	16	0.53	14	0.41	12
Shrawasti	0.08	27	1	1	0.2	18	0.09	27	0	27
Sidharth nagar	0.37	15	0.48	14	0.05	26	0.19	25	0.41	11
Sonbhadra	0.52	10	0.45	17	0.71	1	0.35	23	0.39	14
Sultanpur	0.61	4	0	27	0.33	9	0.49	19	0.34	21
Varanasi	0.55	2	0.36	22	0.5	2	0.64	8	0.74	1

Source: Calculated by the author

Table 3: Category-wise Composite Development Index

Level of Development	Z Score value	Districts
Very High	≥ 0.50	Varanasi, Allahabad
High	0.30 - 0.49	Sonbhadra, Gazipur, Jaunpur, Kaushambi, Mirzapur, Gonda, Faizabad
Moderate	0.20 - 0.30	Balarampur, Sant Kabir Nagar, Sant Ravidas Nagar, Deoria, Sultanpur, Ballia, Pratapgarh, Basti, Ambedkar Nagar, Chandauli, Aazamgarh, Kushinagar, Gorakhpur
Least	< 0.20	shrawasti, Baharaich, Maharajgunj, Mau, Sidharth Nagar

Source: Calculated by the author

to attract investment, improve market access, and foster industrial development. Regional planning should prioritize infrastructure development as a key enabler of economic growth and employment generation.

Health and educational services: Healthcare and education are pivotal to human capital development, yet stark disparities exist across the region. While Varanasi and Allahabad offer better healthcare facilities and educational opportunities due to urbanization and institutional presence, districts in the least developed category experience poor access to both sectors. The need for regional healthcare improvement and educational reform is evident, with a focus on enhancing the quality of services in rural areas, improving healthcare infrastructure, and addressing the shortage of trained medical personnel and teachers.

Demographic dynamics and urbanization: Eastern Uttar Pradesh's demographic profile indicates that urbanized districts like Varanasi benefit from a favorable population structure, which supports socio-economic development. However, districts with high population densities but low urbanization rates face significant pressure on land and resources, which exacerbates development challenges. The regional analysis suggests that promoting planned urbanization and improving urban-rural linkages can alleviate the strain on rural economies and create more balanced development outcomes.

Regional policy implications: The regional disparities in development levels require differentiated policy approaches. Strengthening infrastructure in underdeveloped districts is essential to improve connectivity and access to markets. Promoting economic diversification by encouraging small-scale industries and non-farm employment, particularly in agriculture-dependent districts is necessary. Addressing healthcare and education gaps through targeted investments in human capital development, with a particular focus on rural and underserved areas requires attention. Implementing region-specific development plans that take into account local strengths and weaknesses, and leveraging regional assets such as industrial clusters, natural resources, and cultural heritage too is important.

By adopting a region-specific perspective, Eastern Uttar Pradesh can move towards more balanced development, ensuring that no district is left behind while capitalizing on the strengths of leading districts. This approach not only addresses immediate development needs but also creates long-term sustainability for the region's socio-economic growth.

The development landscape of Eastern Uttar Pradesh, shaped by both its geographical features and socio-economic conditions, reveals distinct regional patterns. Districts with very high and high development, such as Varanasi, and Allahabad, benefit from their advantageous physical settings and resource availability (Table 3). Varanasi and Allahabad, located along the Ganga River, have leveraged their fertile soils, historical significance, and better connectivity to become regional economic hubs. Sonbhadra, on the other hand, stands out for its industrialization, driven by mineral resources in its hilly terrain. These areas enjoy diversified economies, stronger infrastructure, and access to educational and healthcare services, contributing to their sustained growth. Their urbanized environments also foster service-sector expansion and tourism, enabling further socio-economic development. However, even in these districts, challenges persist, such as the need for sustainable management of resources and addressing regional inequalities (Fig. 2).

In contrast, districts with moderate and least development, such as Shrawasti, Baharaich, and Sultanpur, are geographically disadvantaged, with many located in the flood-prone plains or isolated regions near the Nepal border. These areas remain heavily reliant on agriculture, often facing environmental challenges such as frequent floods and water-logging which hinder consistent growth. Limited access to infrastructure, particularly transportation and irrigation, exacerbates their economic struggles, restricting market access and opportunities for diversification. The least developed districts, characterized by poor healthcare and education facilities, remain trapped in a cycle of low productivity and slow growth. To bridge these regional disparities, it is essential to focus on enhancing infrastructure, promoting economic diversification, and addressing the environmental vulnerabilities that have stunted development in these districts. By tailoring policies to leverage local strengths and address geographical challenges, Eastern Uttar Pradesh can strive for more balanced and inclusive regional development.

Inter-district variation in land utilization in eastern U.P.

The analysis of land use patterns in Eastern Uttar Pradesh reveals several significant trends over the period. Overall, there is a noticeable decrease in forest cover across most districts, indicating ongoing deforestation and land conversion for agricultural and other uses.

The land use changes between 2001 and 2021 in eastern Uttar Pradesh reveal significant shifts in the region, driven by both geographical factors and human intervention (Fig. 3 and 4). Sonbhadra stands out with a remarkable increase in forest cover, rising from 8.8 percent in 2001-02 to 53.3 percent by 2010-11 and continuing to show improvements in 2021 due to concerted afforestation efforts and stricter environmental regulations. This increase is closely tied to its geographical setting in the Vindhyan hills, where rugged terrain limits agricultural expansion, making the area more conducive to forest conservation. In contrast, districts located in the fertile plains, such as Allahabad, experienced a slight decrease in forest cover, from 17.5 percent in 2001-02 to 16.4 percent by 2010-11, and this trend persisted through 2021, driven by the demand for agricultural land. The flat, arable landscape of these districts has made them prime candidates for agricultural expansion, pushing back forested areas.

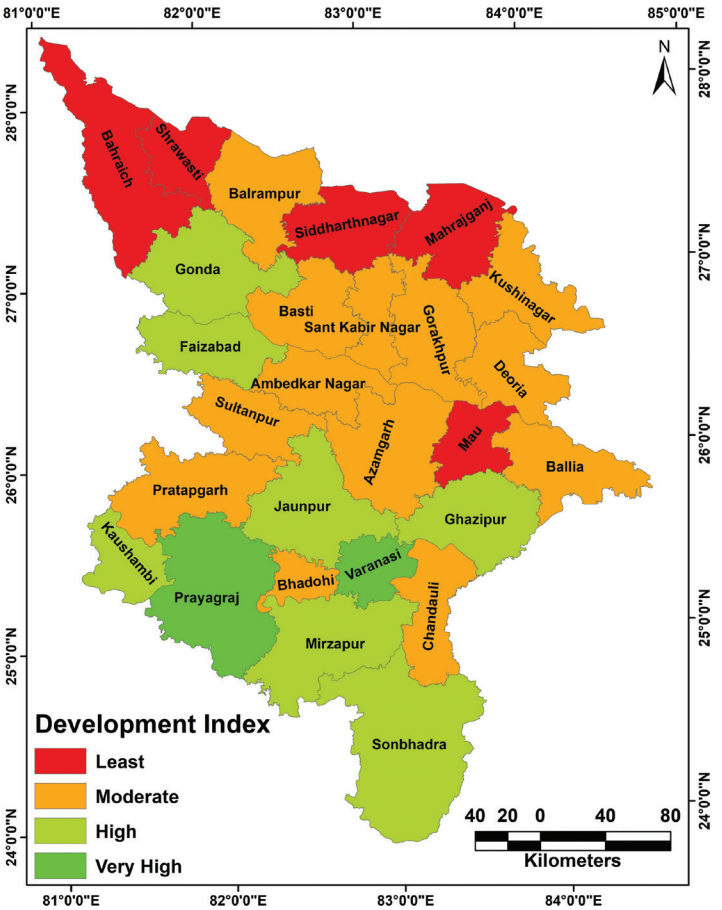

Fig. 2: District wise Development index in Eastern Uttar Pradesh

Source: Based on Composite Development Index

Additionally, the percentage of non-agricultural land used for cultivation increased in several districts between 2001 and 2021, reflecting growing agricultural pressure (Fig. 3 and 4). In Kaushambi, non-agricultural land under cultivation rose sharply from 5.6 percent in 2001-02 to 16.7 percent by 2010-11, and this trend likely extended into 2021 due to its location in the fertile Yamuna plains, where flat, nutrient-rich soils encourage farming. This contrasts with Sonbhadra, which, despite the rise in forest cover, still retained 13.2 percent of its land as uncultivated in 2010-11 and slightly decreased by 2021, a reflection of its challenging terrain. Conversely, the net sown area has expanded across the region, as seen in districts like Jaunpur and Pratapgarh, where fallow land increased slightly, signaling potential land degradation or shifts in agricultural practices. These geographic variations between the plains and hilly regions underscore how land use is intricately tied to local environmental conditions, influencing development trajectories and resource management strategies.

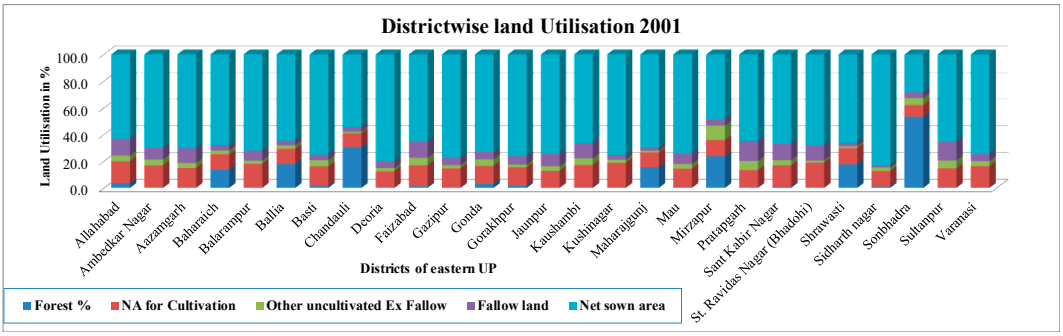

Fig. 3: District-wise land utilization in eastern U.P., 2001

Source: Based on land use pattern (2001), Niti Aayog, Govt. of India

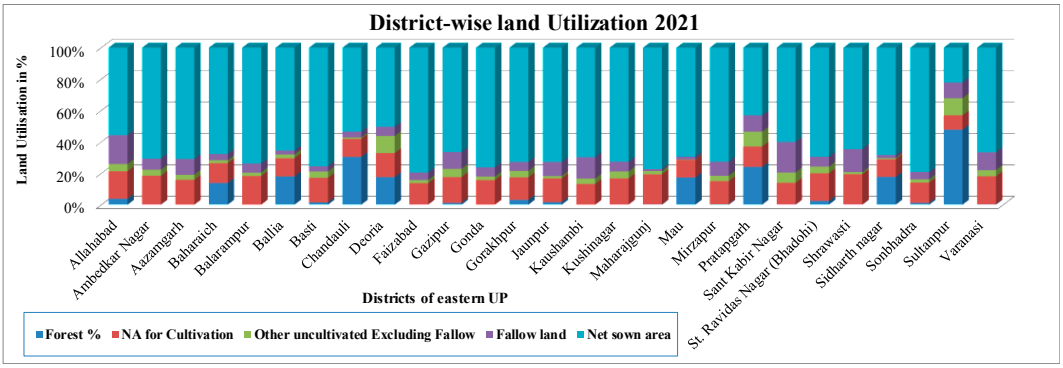

Fig. 4: District-wise land utilization in eastern U.P. 2021

Source: Based on land use pattern (2021), Niti Aayog, Govt. of India.

Overall, the changes in land use patterns in these districts suggest that there has been an increase in agricultural activity, with a corresponding decrease in forest cover and fallow land. This may have both positive and negative impacts on the environment and local communities, highlighting the need for careful monitoring and management of land use.

The analysis of land use patterns in Uttar Pradesh highlights the interconnectedness of environmental, agricultural, social, and economic factors. Addressing these challenges requires concerted efforts toward sustainable land management practices, equitable development strategies, and resilient agricultural systems to ensure long-term prosperity and environmental stewardship in the region.

Development and land use changes

The analysis of land use patterns across districts in Uttar Pradesh indicates complex relationships between development indicators and land utilization dynamics. For instance, regions with strong agricultural traditions often prioritize land for cultivation, reflecting a historical reliance on agriculture rather than focusing solely on literacy or income levels. In these areas, land utilization is shaped by factors such as soil fertility,

Table 4: Correlation between development composite index and land use categories

	Forest Cover	Land under Cultivation	Other Uncultivated Land	Fallow Land	Net Sown Area
Development Composite Index	-0.437	0.597	-0.422	0.483	-0.481

Source: Calculated by the author

irrigation availability, and local agricultural practices, rather than educational attainment or economic prosperity.

Moreover, districts experiencing industrial growth or urbanization, regardless of literacy rates or income levels, tend to see land repurposed for non-agricultural uses. This shift is often driven by market demands and infrastructure development rather than direct correlations with literacy or income. Therefore, while socio-economic development influences land use patterns, it is essential to consider a broader range of factors, including geographical conditions, historical land use practices, and local economic activities, to fully understand the dynamics of land utilization in Eastern Uttar Pradesh.

The correlation matrix shows a moderately positive correlation (0.597) between the land under cultivation and the Composite Development Index, suggesting that districts in Eastern Uttar Pradesh with higher development levels cultivate more land or vice versa for certain districts where agriculture is a major economy. Because of improved agricultural infrastructure, a focus on agriculture economically, and support from the government. The Composite Development Index and forest cover, on the other hand, have a somewhat negative association (-0.437), indicating that higher development is associated with decreased forest cover. This is mostly because of developmental activities, changes in population dynamics, and urbanization that have been prominent indicators for composite regional development. Fallow land, net sown area, and other uncultivated land have weak or negative associations, suggesting that these land types have little effect on development levels. These findings highlight the complex interplay between development and land use, underscoring the need for policies that successfully strike a balance between environmental sustainability and economic progress (Table 4).

The changing land use patterns in Uttar Pradesh's districts are significantly influenced by essential infrastructure and socio-economic factors. Factors such as healthcare facilities, educational institutions, per capita food grain consumption, road networks, banking services, and electricity consumption play pivotal roles in shaping these patterns over time. These dynamics reflect a shift from traditional agricultural practices to diversified land uses, including residential and industrial developments, driven by economic growth and evolving community needs.

To effectively address regional disparities, specific measures must be implemented to tailor sustainable land use practices to each district's unique geographical and socio-economic conditions. In districts like Sonbhadra, enhancing forest conservation and promoting forest-based livelihoods can reinforce afforestation efforts while providing

economic benefits. In fertile plains such as Allahabad and Kaushambi, improving agricultural efficiency through crop diversification and water-efficient irrigation is essential. For regions with high fallow land percentages, like Jaunpur and Pratapgarh, targeted soil rehabilitation programs and incentives for sustainable practices can help reintegrate degraded lands into productive use. Integrating these strategies into planning frameworks will ensure that development efforts are sustainable and effective in mitigating regional imbalances.

Conclusion

The research in eastern Uttar Pradesh reveals a complex relationship between land use patterns and development levels, highlighting distinct socioeconomic, environmental, and infrastructural factors across districts. Variations in economic activity, infrastructure quality, and educational attainment underscore significant development disparities. The research on the impact of regional development on land use patterns in Eastern Uttar Pradesh reveals distinct inter-district variations. Districts classified as very high and high development levels, such as Varanasi and Sonbhadra, demonstrate a complex balance between regional development and land use change. Notably, Sonbhadra's forest cover increased from 8.8 percent in 2001-02 to 53.3 percent in 2010-11, attributed to effective afforestation programmes and agro-forestry projects. In contrast, least developed districts like Shrawasti and Baharaich face significant challenges due to limited economic diversification and high fallow land percentages, reflecting outdated agricultural practices.

The study underscores the importance of district-specific strategies tailored to the socio-economic and demographic variations identified through the composite index analysis (Table 2). These interventions are critical for addressing unique regional challenges, By promoting sustainable land use practices and enhancing agricultural productivity, especially in regions with high fallow land, policymakers can foster inclusive growth while addressing environmental degradation. Overall, this research provides Socio-economic disparities across districts further underscoring the relevance of this region for study. Variations in income levels, literacy, and infrastructure availability provide a compelling framework to explore the relationships between development and land use. Unlike regions with more uniform socio-economic conditions, Eastern Uttar Pradesh exhibits pronounced contrasts that make it an ideal case for examining the impact of development policies on land utilization. Urbanization and industrial expansion, juxtaposed with traditional agricultural practices, add to the complexity of the region's land use dynamics that will impact future land use more profoundly. These transitions, coupled with challenges like fragmented landholdings and inadequate land reforms, remain inadequately analyzed in existing research. By focusing on these specific attributes, this study aims to contribute unique insights into the interplay of development into the dynamics between regional development and land use patterns, serving as a foundation for future policy interventions aimed at achieving sustainable and equitable development in Eastern Uttar Pradesh.

Competing interest

The author declares that she has no conflict of interest.

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