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Spatial and Temporal Dynamics of Population and Agriculture in Ambedkar Nagar District: A Geographical Analysis

ORIGINAL ARTICLE

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Abstract

Agriculture has long been the backbone of the global economy, with over half India's population relying on it for their livelihood and employment. Uttar Pradesh stands out in food grain production because of its fertile Gangetic plains, extensive canal irrigation, and Government and private tube wells. Social, economic, political, and technological factors influence crop production in the state. This study examines the Spatial and temporal trends of significant crops, including concentration and diversification in Ambedkar Nagar district for 2001, 2011, and 2021, to understand the changing relationship between land, humans, and the environment. Jasbir Singh's method is used to calculate crop concentration, and the Gibbs and Martin method is used to assess crop diversification. The findings indicate increased rice, wheat, and pulses concentration while sugarcane cultivation has declined. Between 2001 and 2021, crop concentration and diversification in Ambedkar Nagar district show noticeable shifts. The district's high crop concentration and diversification indices reflect that agriculture remains the main occupation and income source.

Key Words

Population, Agriculture, Economy, Environment.

Introduction

Agriculture and its related activities continue to be a fundamental source of livelihood for a large portion of India's population(Kumar&Kushwaha, 2023). Despite the swift expansion of secondary and tertiary sectors, the dependence on agriculture has remained steadfast since independence (Pandey& Dwivedi, 2017). Initially, agriculture contributed over 50% to India's GDP. By 2019–20, however, this contribution had declined to 17.80% of GDP/GVA (Subramanian, 2023). Historically, India has been recognised as an agricultural stronghold, with farming as the backbone of the nation's economy. Rice, a key cereal, is the staple food for hundreds of millions worldwide (Pathak, 2021).Around 54.6% of India's workforce is still engaged in agriculture and related activities (Perianayagam, 2012). Indian agriculture is marked by a high concentration of specific crops and significant crop diversification(Sharma et al., 2023). Population growth, diminishing landholdings, and farm fragmentation drive these trends. These conditions necessitate practices that maximise agricultural

yield while addressing the needs of farmers. Both high crop concentration and diversification are essential for the efficient utilisation of agricultural land (Khan, 2009).

Agriculture is a critical role in shaping the socioeconomic fabric of rural India. Ambedkar Nagar, a district in eastern Uttar Pradesh, exemplifies the spatial and temporal dynamics of agricultural practices. With fertile alluvial soils and a subtropical climate, the district has historically contributed to the state's agrarian economy (Singh & Sharma, 2020). Over time, technological advancements have introduced modern farming techniques, boosting efficiency and productivity, while population growth and increasing food demand have significantly influenced land use patterns. Government initiatives, including subsidies, crop insurance, and financial support, have also shaped agricultural development (Kumar et al., 2018). Spatial variations in cropping patterns, irrigation systems, and land use reflect the interaction between natural resources and socioeconomic conditions, with farmers adopting diverse strategies to maximise yields and ensure food security. Temporally, shifts in productivity and crop diversification indicate the district's ability to adapt to market demands and environmental challenges, with high-value crops supplementing staple cereals to enhance resilience and stabilise incomes (Dheeraj, 2022). Despite these advancements, small and marginal farmers, who comprise a significant workforce, face persistent challenges, including limited access to modern technologies, credit, and markets. Addressing these issues is essential for improving agricultural productivity and livelihoods. Efforts by Government programs and NGOs aim to support these farmers, fostering sustainable practices and enhancing their socioeconomic well-being (Singh & Sharma, 2020).

The agriculture in the district is confronted with significant obstacles, such as the effects of climate change, water scarcity, and soil degradation. A thorough geographical analysis is required to find patterns and trends in agricultural development to address these concerns (Baghel, 2024). Insights into the resilience and sustainability of Ambedkar Nagar's agrarian systems can be gained by combining spatial and temporal dimensions (Rao, 2019). In this study, the regional distribution of agricultural practices, variations in cropping patterns throughout time, and the socioeconomic effects of these dynamics will all be examined. Its objective is to contribute to the broader discussion on rural development and sustainable agriculture in India (Chauhan, 2022). While maintaining the area's ecological integrity, the results can help stakeholders and policymakers develop measures that increase agricultural productivity (Verma, 2021).

This research aims to investigate the temporal trends of the main crops grown in the Ambedkar Nagar district, looking at how farming practices have evolved over time. To highlight regional differences in agricultural methods, it also looks at the distribution and trends of essential crops among the district's various blocks. An additional principal aim is to examine crop concentration and diversification patterns, emphasising how these practices have changed in reaction to technological, economic, and environmental factors. By looking at these factors, the study hopes to provide a comprehensive picture of the agricultural dynamics in the area.

Study Area

Ambedkar Nagar district, situated in the eastern part of Uttar Pradesh, is positioned between latitudes 26° 09' and 26° 40' North and longitudes 82° 12' and 83° 09' East (Fig. 1). Covering an area of 2350 square kilometres, it lies within the middle Gangetic Plain (Kapoor, 2004). Akbarpur serves as both the district's administrative headquarters and its main town. According to the 2011 Census, Ambedkar Nagar has a population of 2,397,888, comprising 1,212,410 males and 1,185,478 females, with a population density of 1020 persons per square kilometre (Census, 2011). The district's northern boundary is marked by the Ghaghara River, which separates it from the districts of Basti, Santkabirnagar, and Gorakhpur (Kale, 1993). To the west, it is bordered by Faizabad, to the south by Sultanpur, and the east by Azamgarh (Nag, 1992). Ambedkar Nagar is divided into nine development blocks: Tanda, Baskhari, Ramnagar, Jahangirganj, Jalalpur, Bhiyav, Bhiti, Katehari, and Akbarpur.

Data and Methodology

This study relies solely on secondary data. The necessary data were sourced from the district statistical handbook of Ambedkarnagar, covering the nine development blocks. The analysis focuses on five major crops: wheat, paddy, sugarcane, oilseeds, and pulses. Various sources, including Government websites, the District Census Handbook, the Central Ground Water Board, district survey reports, and the Sankhiki Patrika of the district, provided the secondary data used in this paper. The collected data were then thoroughly analysed using software like Stata, Microsoft Excel, and QGIS.This study calculates crop diversification using the Gibbs and Martin method according to Gibbs and Martin Method 1962.

Crop Diversification Index = $1 - Óx^2 / (Óx)^2$.In Gibbs and Martin's method, the crop diversification index value ranges from 0 to 1. '1' shows the higher index value means higher crop diversity and '0' shows less diversity.

Results and Discussion

1. Demographic Characteristics of Ambedkar Aagar: Temporal and Spatial Analysis

Ambedkar Nagar district, positioned in the eastern region of Uttar Pradesh, boasts a diverse population with unique demographic traits influenced by its geographic location, cultural heritage, and economic circumstances. Demographic characteristics include population Distribution, Growth, Density, Literacy and Sex ratio. Table 1 describes all the characteristics and their temporal and spatial distribution according to development blocks:

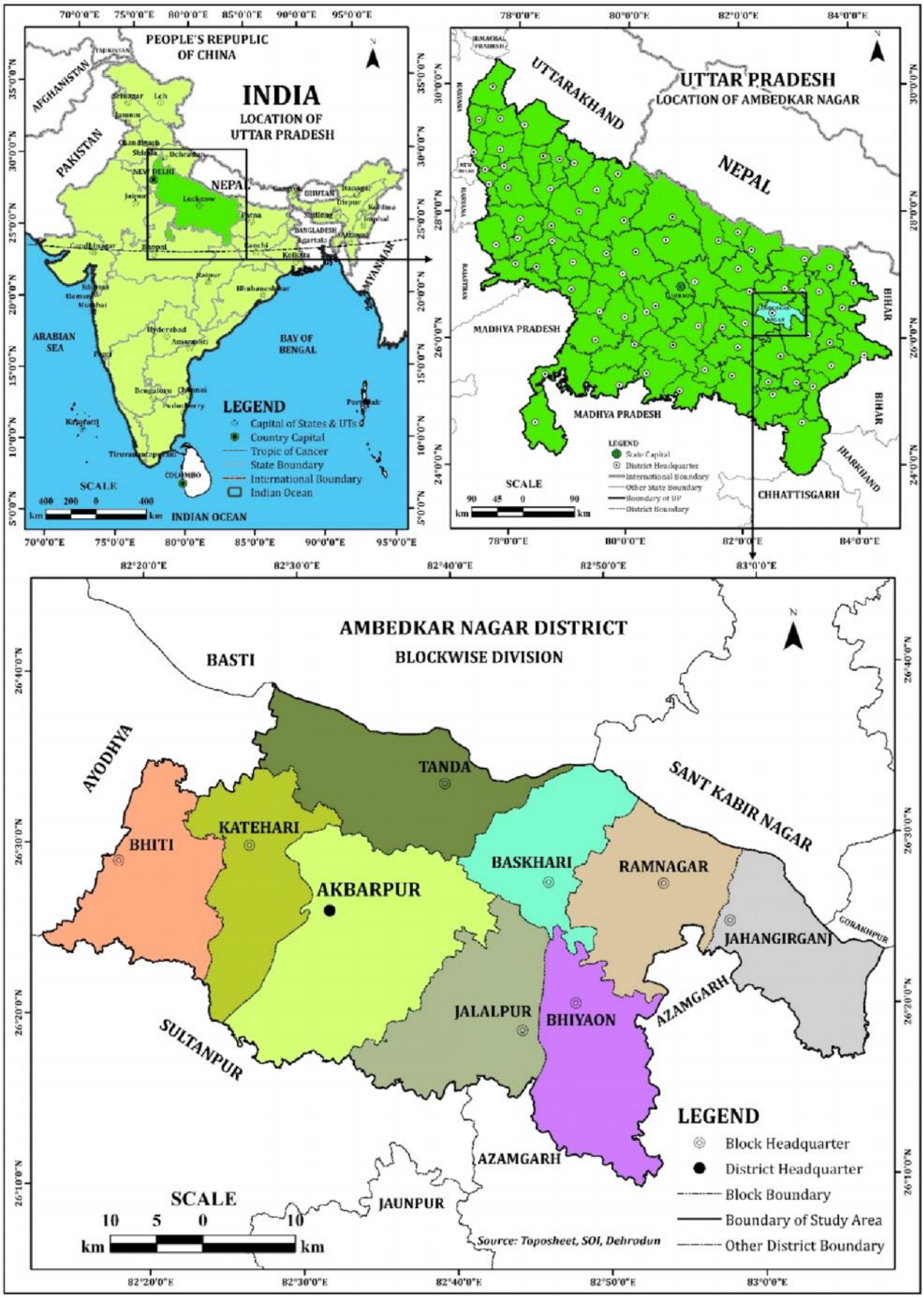
Table 1: Blockwise Demographic Characteristics, 2001 -2011

BLOCK WISE POPULATION DISTRIBUTION AND GROWTH									
Blocks	**Total Population**		**Growth Rate (Percentage)**	**Population Density**		**Literacy Rate (Percentage)**		**Sex Ratio**	
	2001	**2011**	**2001-2011**	**2001**	**2011**	**2001**	**2011**	**2001**	**2011**
Tanda	324702	381203	17	723	858	57.06	71.4	947	954
Baskhari	188354	2,22,893	18	714	807	60.07	72.9	982	964
Ramnagar	184344	2,29,839	25	903	869	58.36	72.6	1011	1003
Jahangirganj	1,62,292	2,10,657	30	860	1003	59.98	72.4	1018	1004
Jalalpur	2,85,811	3,38,735	19	610	737	58.46	72.6	975	969
Bhiyanv	1,74,434	2,08,260	19	827	971	54.95	70.6	1013	998
bheeti	1,49,681	1,73,742	16	829	981	55.66	69.7	973	993
Katehari	1,79,709	2,15,372	20	823	973	55.41	70.9	984	986
Akbarpur	3,45,955	4,17,187	21	710	854	54.28	70.6	965	988
Total	**19,95,282**	**23,97,888**	**100**	**778**	**895**	**57**	**72**	**986**	**984**

(Source: District Handbook, 2001 and 2011)

The table provides a comprehensive overview of the demographic characteristics of Ambedkar Nagar district between 2001 and 2011, highlighting the population distribution, growth rate, population density, literacy rate, and sex ratio across various development blocks. Over this decade, there was a significant increase in the population across all blocks, with Tanda growing from 324,702 to 381,203, Baskhari from 188,354 to 222,893, and Ramnagar from 184,344 to 229,839. Jahangirganj recorded the highest growth rate at 30%, with its population rising from 162,292 to 210,657. Jalalpur's population increased from 285,811 to 338,735, while Bhiyanv and Katehari saw their populations grow from 174,434 to 208,260 and from 179,709 to 215,372, respectively. Bheeti had the lowest growth rate at 16%, with its population increasing from 149,681 to 173,742, and Akbarpur's population grew from 345,955 to 417,187. The district's total population rose from 1,995,282 in 2001 to 2,397,888 in 2011 (Figure 2).

Figure 1: Location Map of the Study Area


PEOPLE'S REPUPLIC OF CHINA
INDIA
LOCATION OF UTTAR PRADESH
PAKISTAN
AFGHANISTAN
NEPAL
BHUTAN
BANGLADESH
MYANMAR
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
SRI LANKA
LEGEND
Capital of States & UTs
Country Capital
Tropic of Cancer
State Boundary
International Boundary
Indian Ocean
SCALE
UTTAR PRADESH
LOCATION OF AMBEDKAR NAGAR
UTTARAKHAND
NEPAL
MADHYA PRADESH
BIHAR
JHARKHAND
CHHATTISGARH
AMBEDKAR NAGAR DISTRICT
BLOCKWISE DIVISION
BASTI
AYODHYA
SANT KABIR NAGAR
GORAKHPUR
AZAMGARH
SULTANPUR
JAUNPUR
TANDA
KATEHARI
BHITI
AKBARPUR
BASKHARI
RAMNAGAR
JAHANGIRGANJ
JALALPUR
BHIYAON
Block Headquarter
District Headquarter
Block Boundary
Boundary of Study Area
Other District Boundary
Source: Toposheet, SOI, Dehradun

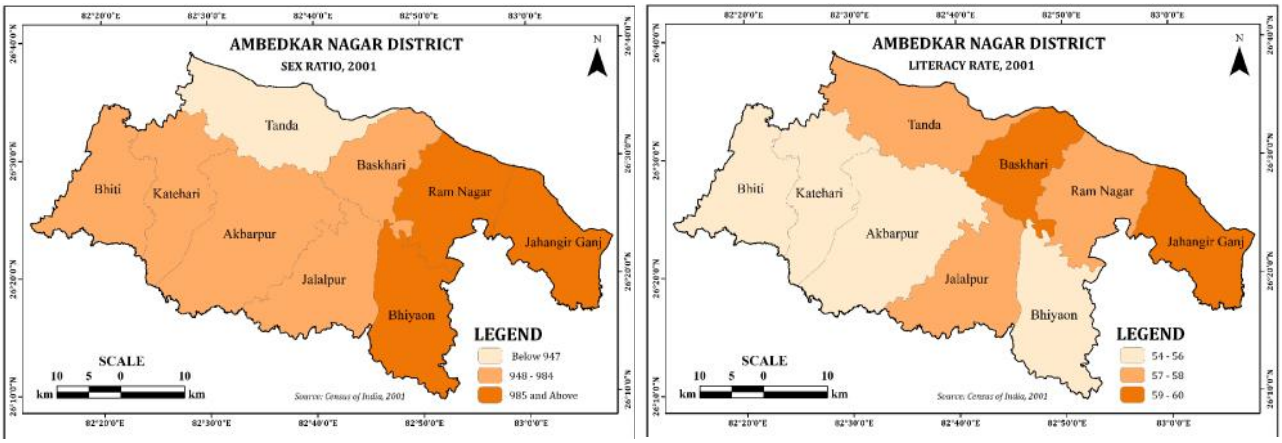
The population density also saw an upward trend across all blocks, reflecting the increasing pressure on resources and infrastructure. Tanda's density increased from 723 to 858 persons per square kilometre, while Baskhari's grew from 714 to 807. Ramnagar experienced a slight decrease in density from 903 to 869, whereas Jahangirganj's density rose significantly from 860 to 1003. Jalalpur's density increased from 610 to 737, and Bhiyanv's from 827 to 971. Bheeti's density grew from 829 to 981, and Katehari's from 823 to 973. Akbarpur's density rose from 710 to 854, with the overall district density increasing from 778 to 895 persons per square kilometre (Figure 3).

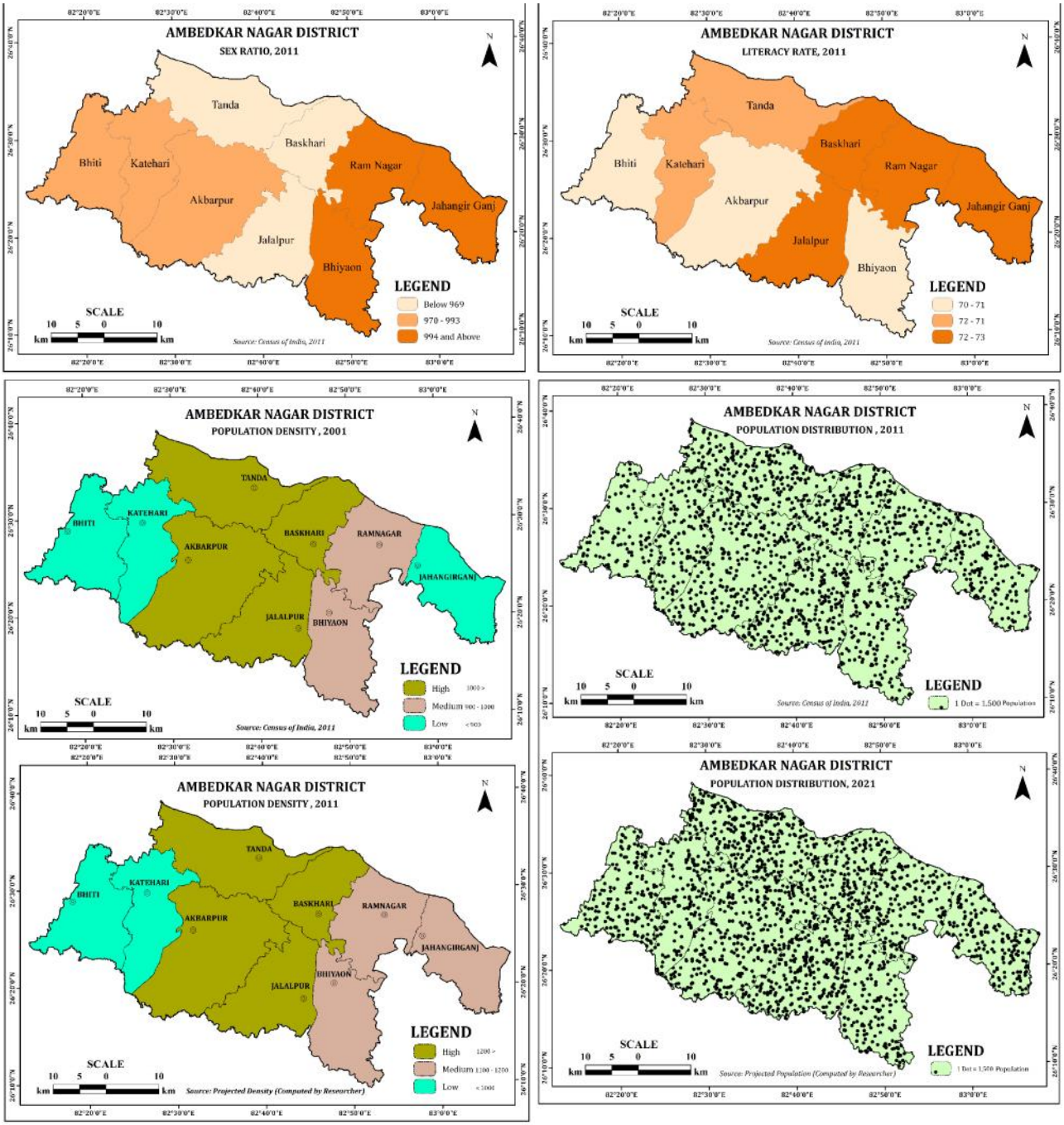
Literacy rates improved markedly across the district, reflecting the impact of educational initiatives. Tanda's literacy rate rose from 57.06% to 71.4%, while Baskhari saw an increase from 60.07% to 72.9%. Ramnagar's literacy rate improved from 58.36% to 72.6%, and Jahangirganj from 59.98% to 72.4%. Jalalpur's literacy rate rose from 58.46% to 72.6%, Bhiyanv from 54.95% to 70.6%, and Bheeti from 55.66% to 69.7%. Katehari's literacy rate increased from 55.41% to 70.9%, and Akbarpur from 54.28% to 70.6%. The district literacy rate rose from 57% to 72%, indicating significant educational strides (Figure 2).

The sex ratio is the number of females per 1,000 males, showed slight variations across the blocks. Tanda's sex ratio increased from 947 to 954, while Baskhari decreased from 982 to 964. Ramnagar's sex ratio slightly reduced from 1011 to 1003, and Jahangirganj from 1018 to 1004. Jalalpur experienced a minor decrease in sex ratio from 975 to 969 and Bhiyanv from 1013 to 998. Bheeti's sex ratio improved from 973 to 993, while Katehari slightly increased from 984 to 986. Akbarpur's sex ratio rose from 965 to 988. Overall, the district's sex ratio slightly decreased from 986 to 984 (Figure 2).

Between 2001 and 2011, Ambedkar Nagar district experienced significant demographic changes across its development blocks. The highest growth rate was 30%, while Bheeti had the lowest at 16%. Population density rose from 778 to 895 persons per square kilometre, reflecting growing pressure on resources and infrastructure. Blocks such as Jahangirganj and Bhiyanv reached the highest density levels during this period.Meanwhile, the district's sex ratio declined slightly from 986 to 984 females per 1,000 males, with blocks like Bheeti and Katehari showing minor gains, while others like Baskhari and Jahangirganj saw slight reductions.

Figure 2: Population Distribution, Density, Sex ratio and Literacy Rate Map of Ambedkar Nagar District, 2001 – 2011





2. Agricultural aspect: Crop Diversification in Ambedkar Aagar

This study primarily focuses on the agricultural aspects, specifically cropping patterns, irrigation, and fertiliser use. A blockwise analysis of the Ambedkar Nagar district shows variations, including land use and productivity across blocks. Agriculture remains the main source of livelihood for district's population, with blocks such as Tanda, Baskhari, and Katehari being major contributors to agricultural production. Detailed statistical data is provided in Table 2 for further explanation.

Crop diversification in Ambedkar Nagar District, Uttar Pradesh, is emerging as a crucial approach for promoting agricultural sustainability, boosting farmer incomes, and managing environmental resources.Crop diversification is essential to sustainable agricultural development, offering economic, social, and ecological benefits. It involves introducing a variety of crops in a specific area to improve farm efficiency and minimise risks (Chand and Kumar, 2001). In India, crop diversification is traditionally seen as transitioning from growing

less profitable crops to more lucrative ones. This shift is driven by Government initiatives, market demands, and farmers' decisions based on the physical conditions of the area. Indian agriculture is currently experiencing significant resource reallocation, influenced by crop diversification and land conversion for industrialisation. The period from 1970-71 to 2006-07 is crucial in Indian agricultural history. Following the Green Revolution's success in the 1960s and 1970s, significant changes occurred in the 1980s. During the globalisation-influenced 1990s, localised crop diversification gained momentum (Lieve, 2011). Government policies have shifted focus from staple grains to high-value non-food commercial crops, such as vegetables, fruits, and flowers (Bhalla and Singh, 2009).

Additionally, crop diversification is a potential solution to rural poverty, not just a means to strengthen the national economy (Vyas, 1984). Crop diversity reduces pest and disease pressure while enhancing nutrient cycling. This can decrease input requirements, increase productivity, and mitigate environmental risks from excessive fertiliser and pesticide use.

Scholars, including Gibbs and Martin, Bhatia, and Singh, have proposed formulas to calculate the Crop Diversification Index (CDI). Bhatia's method involves assessing crop diversification by dividing the sum of percentages of areas under various crops by the total number of crops (1965). However, this method is optimal only when considering crops with an area exceeding 10% of the gross sown area. Singh's method calculates the Index by dividing the area under crops occupying more than 5% of the gross sown area by the total cropped area. The Gibbs and Martin method does not rely on area and spatial extent data for any specific crop. Therefore, for the study area in Ambedkar Nagar District, the Gibbs and Martin method has been used to assess the Crop Diversification Index.

Figure 3: Population Growth Rate Map of Ambedkar Nagar District, 2001 – 2011

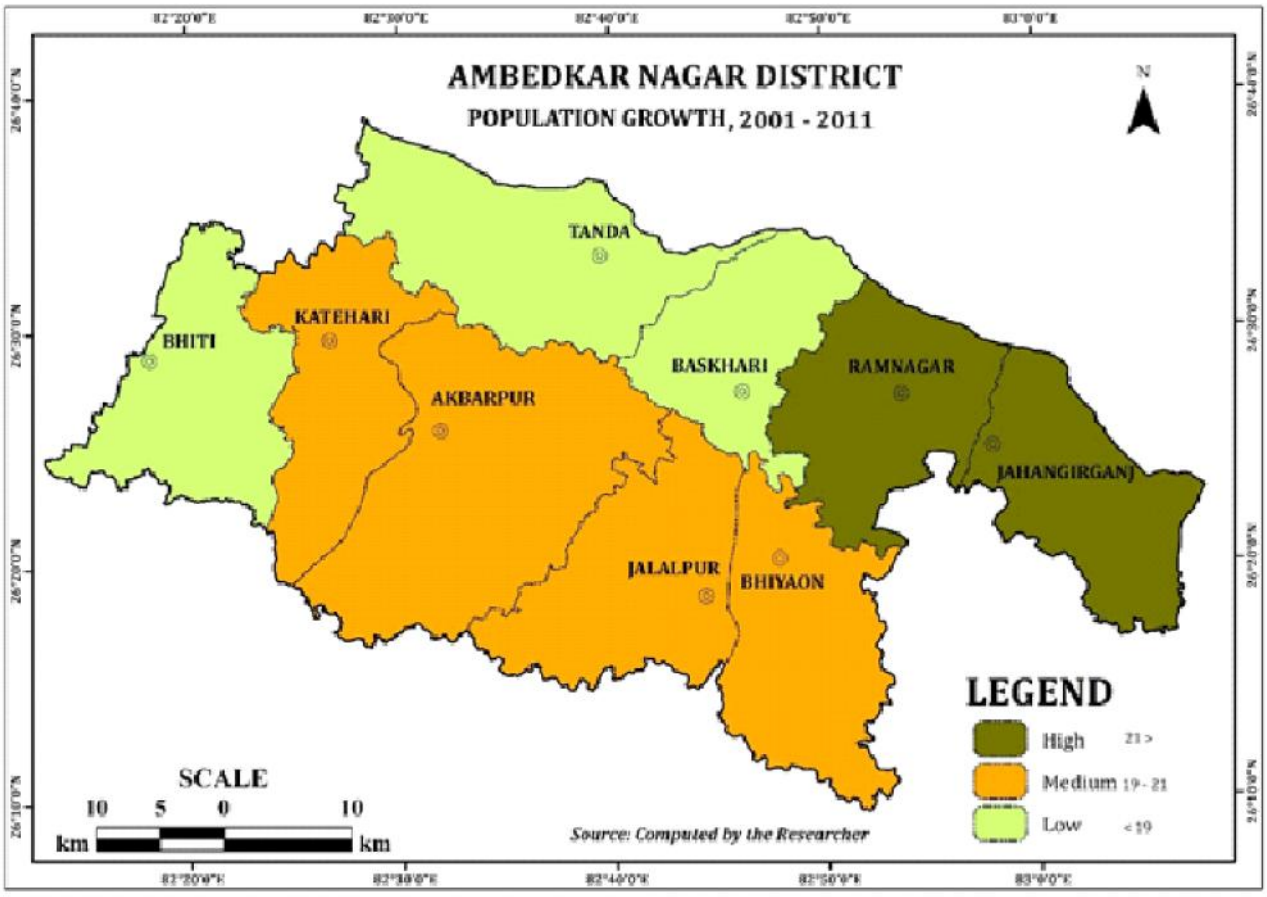
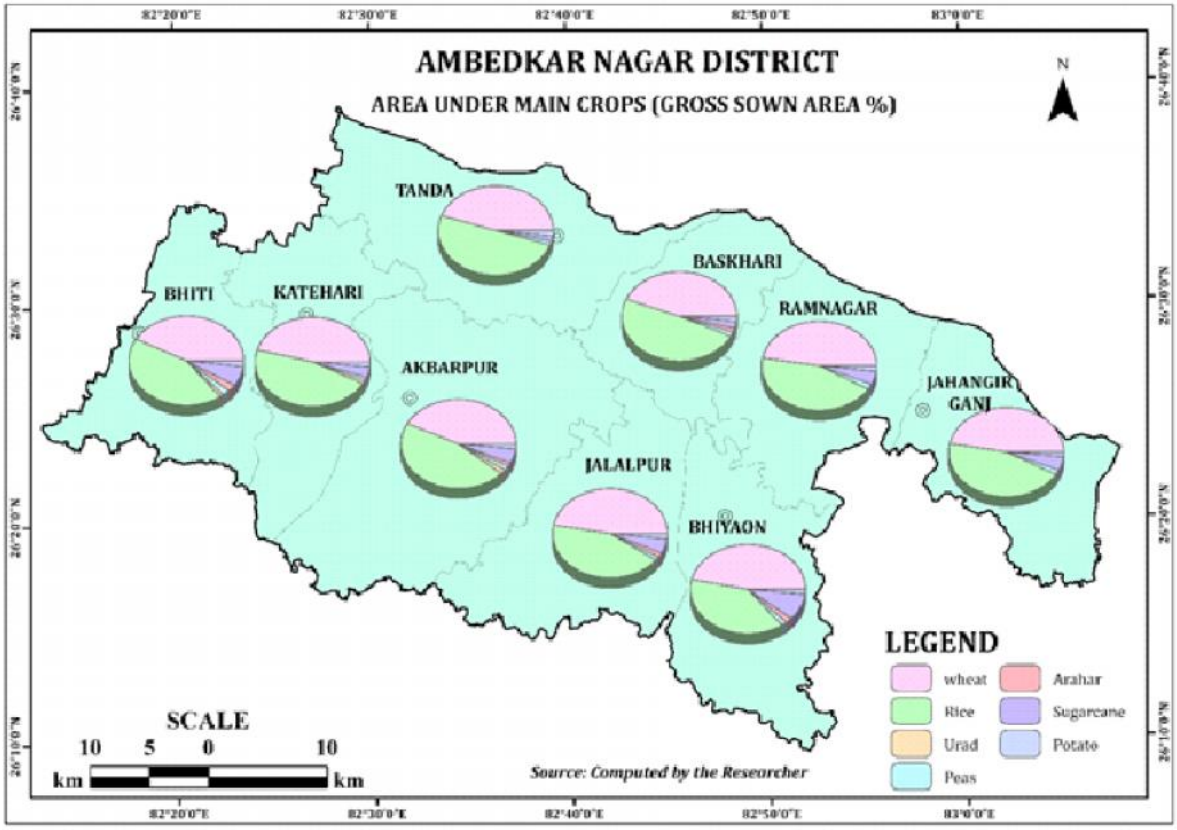


Table 2: Block wise area under main crops

Block	Block wise area under main crops (gross sown area %)							? X^2	(? $X)^2$	C.D.I.
	Wheat	Rice	Urad	Peas	Arahar	Sugarcane	Potato			
Tanda	35.58	39.09	0.71	0.91	0.66	1.21	1.35	2799.02	6321.84	0.55
Baskhari	40.36	44.2	0.41	1.17	1.14	1.91	1.39	3590.99	8204.74	0.56
Ramnagar	40.72	38.32	0.24	1.45	0.16	3.53	1.42	3143.2	7368.51	0.57
Jahangirganj	42.33	40.5	0.66	1.35	0.16	3.86	1.16	3450.61	8103.6	0.57
Jalalpur	47.33	43.35	0.13	1.21	1.45	4.55	1.61	4146.23	9926.14	0.58
Bhiyanv	43.03	35.96	0.51	1.51	1.71	7.67	1.41	3210.98	8427.24	0.62
bheeti	39.44	39.53	1.05	1.97	2.06	5.76	1.51	3162.82	8339.34	0.62
Katehari	41.79	42.11	0.95	0.95	0.56	2.93	1.33	3532.13	8211.98	0.57
Akbarpur	38.46	40.84	1.32	1.26	1.03	3.92	1.34	3168.63	7773.95	0.59

(Source: District Handbook, 2011)

Figure 4: Gross Sown area (%) under main crops

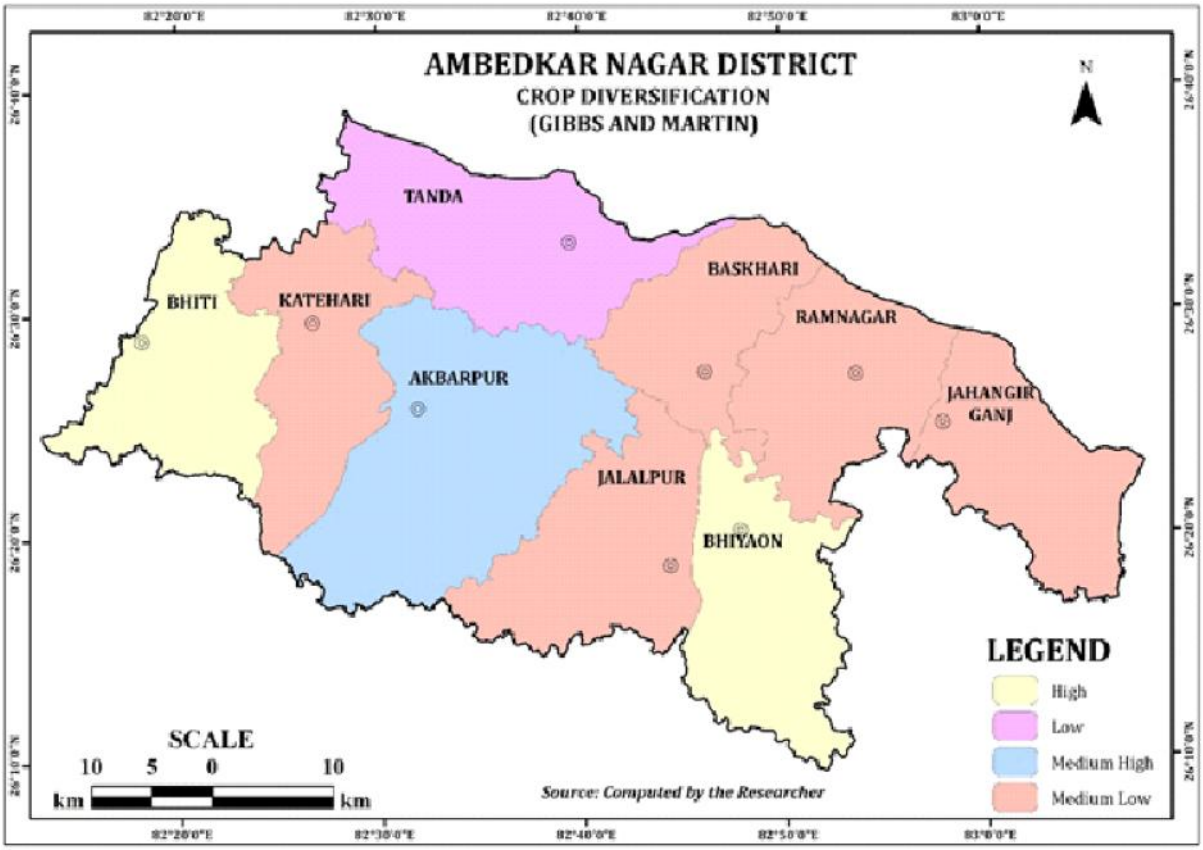


The spatial pattern of crop diversification in Ambedkar Nagar district for 2021 was assessed using the standard deviation method. This analysis classified the district's development blocks into four categories based on Gibbs and Martin's crop diversification index: high, medium-high, medium-low, and low.In this classification, Bhiti and Bhiyanv development blocks are in the high category, while Akbarpur falls under medium-high. The medium-low category includes Jalalpur, Katehari, Ramnagar, Jahangirganj, and Baskhari. Tanda development block is classified as low, indicating the least crop diversification in the district.

Table 3: Division of the district based on the crop diversification index of Gibbs and Martin

Category	Class Interval	No. of Blocks	Name of Blocks
High	more than $\bar{x}+\sigma$ (>0.60)	2	Bheeti (0.62)] Bhiyanv (0.62)
Medium High	$\bar{x}$ to $\bar{x}+\sigma$ (0.58 to 0.60)	1	Akbarpur (0.59)
Medium Low	$\bar{x}-\sigma$ to $\bar{x}$ (0.56 to 0.58)	5	Jalalpur (0.58), Katehari (0.57), Ramnagar (0.57), Jahangirganj (0.57), Baskhari (0.56)
Low	Less than $\bar{x}-\sigma$ (<0.56)	1	Tanda, (0.55)

Figure 5: Crop Diversification Map



Conclusion

The study underscores significant agricultural and demographic trends in Ambedkar Nagar district, focusing on variations in cropping patterns, irrigation practices, and fertiliser use across different development blocks. Agriculture remains the primary source of livelihood, with blocks such as Tanda, Baskhari, and Katehari making significant contributions to production. Crop diversification has emerged as a key strategy for sustainable agricultural development, enhancing income and resource management. The district shows varying levels of diversification: Bhiti and Bhiyanv are highly diversified, Akbarpur is medium-high, and Tanda has the lowest level of diversification. The use of Gibbs and Martin's method to assess crop diversification provides valuable insights into agricultural dynamics.On the demographic front, the district saw a notable population increase from 1.99 million in 2001 to 2.39 million in 2011, with Jahangirganj recording the highest growth rate of 30%. Population density rose from 778 to 895 persons per square kilometer, indicating increased pressure on resources and infrastructure.

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