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Changing Patterns of Land Use and Level of Agricultural Development in Munger District, Bihar

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Abstract

Agriculture continues to play a pivotal role in the socio-economic development of Bihar, particularly at the district and sub-district levels where spatial variations are pronounced. The present study examines the changing patterns of land use and the level of agricultural development in Munger district, Bihar. The study is based on secondary data. Land use changes were examined for 2000–01 to 2010–11, and block-wise agricultural development was assessed for 2011. Standardized Z-scores of multiple indicators were used to construct a composite index of agricultural development across blocks. MS Office software was used for tabular presentation, while QGIS was employed for map preparation and spatial analysis. The results reveal a gradual expansion of net sown area accompanied by a decline in fallow and wasteland categories, indicating increasing pressure on land resources. The composite index highlights marked inter-block disparities in agricultural development, with blocks such as Tarapur and Sangrampur exhibiting higher development levels, while Bariarpur, Jamalpur, and Dharhara remain relatively backward. The study underscores the need for block-specific agricultural planning, focusing on irrigation development, institutional credit, and infrastructural support to reduce intra-district disparities.

Keywords: Agricultural Development, Land Use Change, Z-score, Spatial Disparities, Munger District

Introduction

Agriculture forms the backbone of the Indian economy and continues to play a decisive role in ensuring food security, employment generation, and rural livelihood sustainability. Despite rapid industrialization and urban expansion, a substantial proportion of India's population remains directly or indirectly dependent on agriculture. In this context, the study of land use patterns and agricultural development assumes critical importance, particularly at the district and sub-district levels where spatial variations are more pronounced. Land use reflects the interaction between human activities and the natural environment and is influenced by physical, socio-economic, and institutional factors. Changes in land use patterns, such as the expansion of cultivated land, reduction of fallow land, and conversion of agricultural land to non-agricultural uses, significantly affect agricultural productivity and sustainability. In developing regions like Bihar, rising population pressure, fragmentation of agricultural holdings, and inadequate infrastructure have further intensified the need for efficient land resource management. Munger district, located in southern Bihar, presents a unique geographical setting comprising fertile alluvial plains and hill ranges. Although agriculture remains the principal occupation, the district exhibits considerable inter-block variation in land use efficiency, irrigation coverage, cropping intensity, and access to institutional facilities. These variations have resulted in uneven agricultural development across blocks. The present study seeks to analyze the changing patterns of land use and assess the level of agricultural development in Munger district. By employing standardized indicators and a composite index approach, the study aims to identify spatial disparities and provide a scientific basis for region-specific agricultural planning and policy intervention.

Review of Literature

A number of scholars have examined land use dynamics and agricultural development at various spatial scales, providing important theoretical and methodological foundations for regional agricultural studies. One of the earliest contributions was made by **Weaver (1954)** [19], who emphasized crop-combination analysis as an effective technique for understanding agricultural land use patterns. Building on this methodological base, **Bhatia (1965)** [1] examined patterns of agricultural efficiency in India and demonstrated the existence of significant regional inequalities in agricultural performance. Subsequently, **Trewartha (1969)** [17] highlighted the role of the working population in agricultural and economic development, stressing how demographic factors contribute to regional disparities. With a broader regional perspective, **Singh and Dhillon (1984)** [15] analyzed agricultural regionalization in India, emphasizing the combined influence of physical conditions and socio-economic factors. During the same period, **Shafi (1984)** [12] focused on agricultural productivity and underscored the critical importance of irrigation and technological advancement in enhancing agricultural output. Extending this line of inquiry, **Husain (1996)** [6] emphasized the relevance of land use studies for sustainable agricultural planning, particularly in developing regions.

In the late 1990s, attention increasingly shifted towards land use change and its implications. **Singh (1998)** [14] analyzed land use change in India and noted the growing pressure on cultivable land resulting from population growth and economic transformation. At the regional level, **Yadav (2003)** [21] examined spatial patterns of agricultural development in eastern India and identified infrastructural constraints as a major limiting factor. Further highlighting institutional dimensions, **Reddy (2006)** [11] emphasized the role of irrigation and institutional credit in reducing regional disparities in agriculture. More recent studies have focused on diversification, policy influence, and composite measurement approaches. **Chand and Chauhan (2009)** [2] examined agricultural diversification and its impact on land use efficiency, while **Kumar (2011)** [8] analyzed district-level agricultural development in Bihar and reported wide inter-district disparities. Using census-based data, **Singh and Singh (2012)** [16] highlighted policy-driven transformations in land use patterns. Methodologically, **Jat and Singh (2015)** [7] assessed agricultural development using composite indices and revealed significant block-level variations. Subsequently, **Verma (2017)** [18] emphasized the role of rural infrastructure in promoting agricultural growth, and **Sharma and Kumar (2020)** [13] examined recent trends in land use change, stressing the need for sustainable agricultural planning. The reviewed literature clearly indicates that land use change and agricultural development are closely interlinked and spatially uneven. However, despite extensive research at national and regional levels, micro-level studies at the block level particularly for Munger district remain limited, thereby justifying the present research.

Study Area

Munger district possesses a long and rich historical legacy. In ancient times, it was known as Maudgalyagiri, a name believed to be derived from the Buddhist monk Maudgalya, and later as Modagiri, associated with Sage Mudgala Muni. The district was formally constituted on 15 July 1812. Geographically, Munger district occupies a strategically significant location in southern Bihar, with the River Ganga flowing from west to east along its northern boundary. It extends between latitudes 24°56′46″ N and 25°29′55″ N and longitudes 86°18′ E and 86°44′24″ E, covering a total area of 1,419.70 sq. km, which constitutes approximately 3.30% of Bihar's total geographical area. According to the Census of India, 2011, the district has a population of 1,367,765, representing about 1.31% of the state's population, with an average population density of 964 persons per sq. km. Physiographically, the southern part of the district is characterized by the Jamalpur–Kharagpur hill ranges, while the remaining area comprises extensive and fertile alluvial plains. Administratively, Munger district is divided into three subdivisions and nine development blocks (Fig 1).
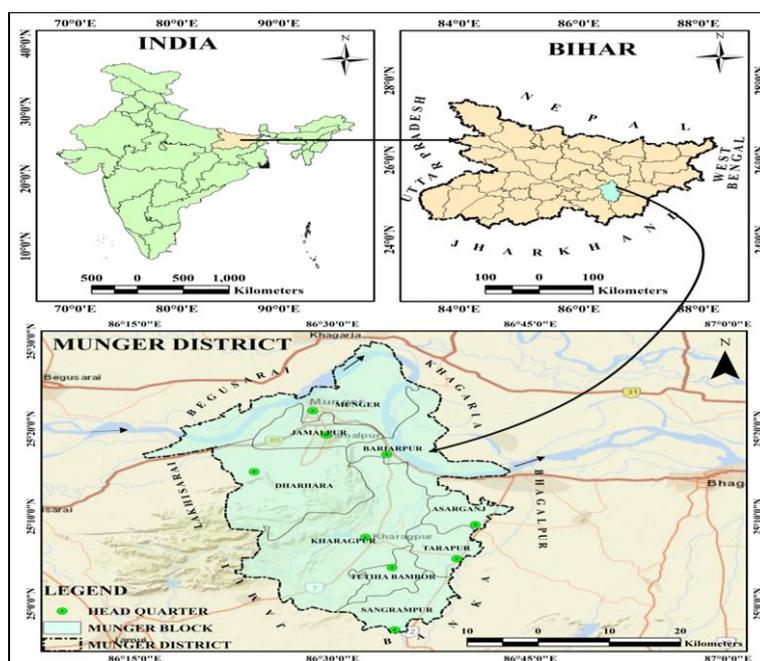

Fig 1: Location Map of the Study Area

Objectives

The present study has been undertaken with the following objectives:

- To examine the changing patterns of land use in Munger district between 2000–01 and 2010–11.
- To analyze block-wise variations in agricultural land use in Munger district for the year 2011.
- To assess the level of agricultural development across blocks using standardized indicators and a composite index.
- To identify inter-block disparities in agricultural development.

Materials and Methods

The study is based entirely on secondary data obtained from the District Census Handbook, Munger (2011), District Statistical Handbook, Directorate of Economics and Statistics, Government of Bihar, and related official publications. Land use data were analyzed for the period 2000–01 to 2010–11, while block-wise agricultural development was assessed for the year 2011. Changes in land use were examined through percentage analysis and decadal variation. To assess block-wise agricultural development, selected indicators of agricultural land use and supporting facilities were standardized using the Z-score technique. A composite index was then constructed by aggregating standardized scores to classify blocks into high, medium, and low levels of agricultural development. This

methodology facilitates inter-block comparison and highlights spatial disparities within Munger district. Tabular data were prepared using MS Office software, and QGIS was used for map preparation and spatial analysis.

Results and Discussion

Table 1 illustrates the land use pattern of Munger district for the years 2000–01 and 2010–11 and the corresponding decadal changes. Forest land remained unchanged at 24,276.06 ha, accounting for 17.82% of the total reporting area in both periods, indicating a stable forest cover over the decade. Land not available for cultivation increased from 35,193.44 ha (25.84%) in 2000–01 to 36,310.30 ha (26.72%) in 2010–11, recording a positive decadal change of 0.88%. Within this category, area under non-agricultural uses showed a marginal increase from 28,577.24 ha (20.98%) to 28,557.10 ha (21.02%), while barren and un-culturable land increased from 6,616.20 ha (4.86%) to 7,753.20 ha (5.71%). Other uncultivated land excluding fallow land declined from 6,244.32 ha (4.58%) to 5,576.10 ha (4.10%), reflecting a negative decadal change of 0.48%. Permanent pastures and grazing lands decreased considerably from 877.80 ha (0.64%) to 602.70 ha (0.44%). In contrast, land under miscellaneous tree crops and groves increased from 1,673.80 ha (1.23%) to 2,146.00 ha (1.58%), while cultivable wasteland declined from 3,692.72 ha (2.71%) to 2,827.40 ha (2.08%).

Table 1: Land Use Pattern in Munger District, 2001–2011

| S. No | Land Use Class | Land Use Pattern in Munger District | | | | Decadal Change, 2001-2011 |
| | | 2000-01 | | 2010-11 | | |
		Total Reporting Area (ha)	In Percent	Total Reporting Area (ha)	In Percent	
1	**Forest**	24276.06	17.82	24207.2	17.82	0.00
2	**Not available for cultivation**	35193.44	25.84	36310.3	26.72	0.88
	i) Area under non-agricultural uses	28577.24	20.98	28557.1	21.02	0.04
	ii) Barren and un-culturable land	6616.2	4.86	7753.2	5.71	0.85
3	**Other uncultivated land excluding fallow land**	6244.32	4.58	5576.1	4.10	-0.48
	i) Permanent pastures & other grazing lands	877.8	0.64	602.7	0.44	-0.20
	ii) Land under miscellaneous tree crops & groves	1673.8	1.23	2146	1.58	0.35
	iii) Culturable waste land	3692.72	2.71	2827.4	2.08	-0.63
4	**Fallow Lands**	10177.14	7.47	7568.4	5.57	-1.90
	i) Fallow lands other than current fallows	3194.9	2.35	941.7	0.69	-1.65
	ii) Current fallows	6982.24	5.13	6626.7	4.88	-0.25
5	**Net area Sown**	60308.04	44.28	62209.4	45.79	1.51
	Total	136199	100	135871.4	100	-

Sources: Calculated by authors from District Census Handbook, Munger, 2001 & 2011

A significant reduction was observed in *fallow lands*, which decreased from 10,177.14 ha (7.47%) in 2000–01 to 7,568.40 ha (5.57%) in 2010–11, registering a decadal decline of 1.90%. Fallow lands other than current fallows declined sharply from 3,194.90 ha (2.35%) to 941.70 ha (0.69%), while current fallows reduced moderately from 6,982.24 ha (5.13%) to 6,626.70 ha (4.88%). Correspondingly, the *net area sown* increased from

60,308.04 ha (44.28%) to 62,209.40 ha (45.79%), reflecting a positive decadal change of 1.51%. Overall, the table reveals a gradual expansion of cultivated land and reduction in fallow and wasteland categories, alongside a marginal increase in non-agricultural and barren land, highlighting growing pressure on land resources in Munger district during the study period.
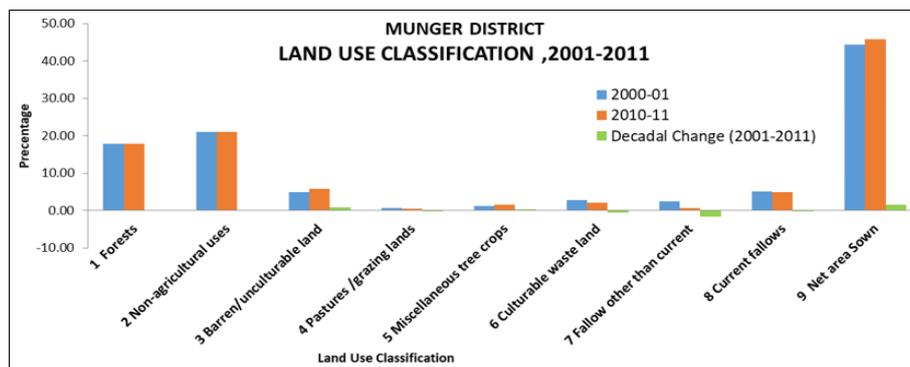
Fig 2: Land use classification of munger District, 2001-2011

Table 2 (A): Block-wise Agricultural Land Use and Availability of Miscellaneous Facilities in Munger District, 2011

Blocks	Agricultural Land Use and Availability of Miscellaneous Facilities, Munger District, 2011						
	X1 (Z-Score)	X2 (Z-Score)	X3 (Z-Score)	X4 (Z-Score)	X5 (Z-Score)	X6 (Z-Score)	X7 (Z-Score)
Munger	24.31	32.43	143.34	56.46	25.85	14	31
	-1.42	-0.16	0.36	-0.23	1.67	2.66	-0.23
Bariarpur	38.73	23.95	125.98	51.51	24.27	1	12
	-0.82	-0.81	-1.06	-0.44	0.64	-0.97	-1.58
Jamalpur	67.50	27.52	131.23	26.81	21.62	2	28
	0.38	-0.54	-0.63	-1.53	-1.08	-0.39	-0.44
Dharhara	26.34	18.93	128.04	23.47	24.23	11	34
	-1.33	-1.20	-0.89	-1.68	0.62	-0.53	-0.02
Kharagpur	41.13	21.92	126.19	83.34	22.22	7	65
	-0.72	-0.97	-1.04	0.96	-0.69	-0.10	2.19
Asarganj	82.49	52.75	156.82	73.16	24.16	4	26
	1.00	1.41	1.46	0.51	0.57	-0.24	-0.59
Tarapur	87.07	57.92	159.73	91.93	24.17	6	29
	1.19	1.81	1.70	1.34	0.58	0.19	-0.37
Tetiha Bambor	79.57	32.30	133.71	70.35	22.19	5	35
	0.88	-0.17	-0.43	0.39	-0.71	-0.68	0.06
Sangrampur	78.49	42.57	145.30	77.10	20.78	8	48
	0.84	0.62	0.52	0.68	-1.62	0.05	0.98
Mean	58.40	34.48	138.93	61.57	23.28	7.67	34.22
SD	24.06	12.98	12.24	22.69	1.54	6.90	14.05

Note: X1- Net Area Sown (%), X2- Area Sown More Then Ones (%), X3- Cropping Intensity (%), X4- Irrigated Area (%), X5- Average Productivity of All Crops (q/ha), X6- Commercial & Co-operative Banks, and X7- Agricultural Credit Societies.
Sources: Calculated by authors from District Census Handbook, Munger, 2011

Table 2 (B): Block-wise Agricultural Land Use and Availability of Miscellaneous Facilities in Munger District, 2011

Blocks	Agricultural Land Use and Availability of Miscellaneous Facilities, Munger District, 2011					
	X8 (Z-Score)	X9 (Z-Score)	X10 (Z-Score)	X11 (Z-Score)	Σ Z-Score	Composite Index
Munger	31	14	32	43	-	-
	-0.23	-0.83	-0.39	-0.06	3.27	0.30
Bariarpur	12	11	15	20	-	-
	-1.58	-1.09	-1.43	-1.94	-10.87	-0.99
Jamalpur	28	9	29	37	-	-
	-0.44	-1.27	-0.57	-0.55	-7.72	-0.70
Dharhara	34	46	62	42	-	-
	-0.02	1.93	1.45	-0.14	-0.64	-0.06
Kharagpur	65	37	67	63	-	-
	2.19	1.15	1.76	1.59	4.28	0.39
Asarganj	26	20	34	43	-	-
	-0.59	-0.32	-0.27	-0.06	2.88	0.26
Tarapur	29	21	27	49	-	-
	-0.37	-0.23	-0.70	0.44	5.83	0.53
Tetiha Bambor	35	25	30	36	-	-
	0.06	0.11	-0.51	-0.63	-2.05	-0.19
Sangrampur	48	30	49	60	-	-
	0.98	0.55	0.66	1.34	5.00	0.45
Mean	34.22	23.67	38.33	43.67	-	-
SD	14.05	11.59	16.28	12.18	-	-

Note: X8- Public Distribution System (PDS) Shop, X9- Weekly Haat, X10- Self-Help Group (SHG), X11- Power Supply for Agricultural Use
Sources: Calculated by authors from District Census Handbook, Munger, 2011

Tables 2(A) and 2(B) demonstrate significant inter-block variations in agricultural land-use patterns and the availability of institutional and infrastructural support in Munger district. The indicators together reflect both the production base (X1–X5) and the support system (X6–X11), summarized through Z-scores and a composite index. Blocks such as **Tarapur, Sangrampur,** and **Kharagpur** emerge as relatively advanced. Tarapur records high values for net area sown (87.07%), area sown more than once (57.92%), cropping intensity (159.73%), and irrigated area (91.93%), along with a strong composite index score of **0.53**, the highest in the district. **Sangrampur** also performs well, with high cropping intensity (145.30%), irrigation coverage (77.10%), better access to power supply (60), and a composite index of **0.45**. **Kharagpur** shows balanced performance across land-use variables and facilities, reflected in a positive composite index of **0.39**.

Asarganj and Munger blocks occupy a moderately developed position. **Asarganj** shows high net area sown (82.49%), cropping intensity (156.82%), and irrigation (73.16%), resulting in a positive composite index of **0.26**. **Munger** block, despite relatively moderate land-use indicators, benefits from better institutional facilities such as banks, SHGs, and power supply, yielding a composite index of **0.30**. In contrast, Bariarpur, Jamalpur, Dharhara, and Tetia Bambar display lower levels of agricultural development. **Bariarpur and Jamalpur** record lower Z-scores across most land-use and facility indicators, with composite index values of –**0.99** and –**0.70** respectively, indicating pronounced backwardness. **Tetia Bambar** also shows deficiencies in irrigation, productivity, and institutional support, reflected in a negative composite index of –**0.19**. **Dharhara** remains close to the district average but slightly below in composite terms **(–0.06)**, indicating marginal development. Overall, the district average values-net area sown (58.40%), cropping intensity (138.93%),

irrigated area (61.57%), and average productivity (23.28 q/ha) mask significant spatial disparities. Blocks with better irrigation, higher cropping intensity, and stronger institutional support systems clearly achieve higher composite index values. The tables clearly reveal significant spatial imbalances in agricultural development within Munger district, underscoring the need for targeted interventions in the lagging blocks to improve irrigation facilities, agricultural productivity, and rural support infrastructure.

Table 3: Level of agricultural development in Munger District, 2011

S. No	Levels	Composite Index	No. of Blocks	Name of Blocks
1	Low Level of Agricultural Development	< 0.00	4	Dharhara, Tetiah Bambor, Jamalpur, Bariarpur
2	Medium Level of Agricultural Development	0.00 to 0.38	2	Munger, Asarganj
3	High Level of Agricultural Development	> 0.38	3	Tarapur, Sangrampur, Kharagpur

Sources: Calculated by authors

Table 3 shows that the classification reveals marked inter-block disparities in the level of agricultural development within Munger district. Blocks such as **Tarapur, Sangrampur, and Kharagpur** exhibit a high level of agricultural development, largely attributable to better land-use efficiency and supporting facilities. **Munger and Asarganj** fall under the medium category, indicating moderate development. In contrast, **Bariarpur, Jamalpur, Dharhara, and Tetiah Bambor** are categorized as low-development blocks, reflecting structural constraints in agricultural land use and infrastructural support (Fig 2).
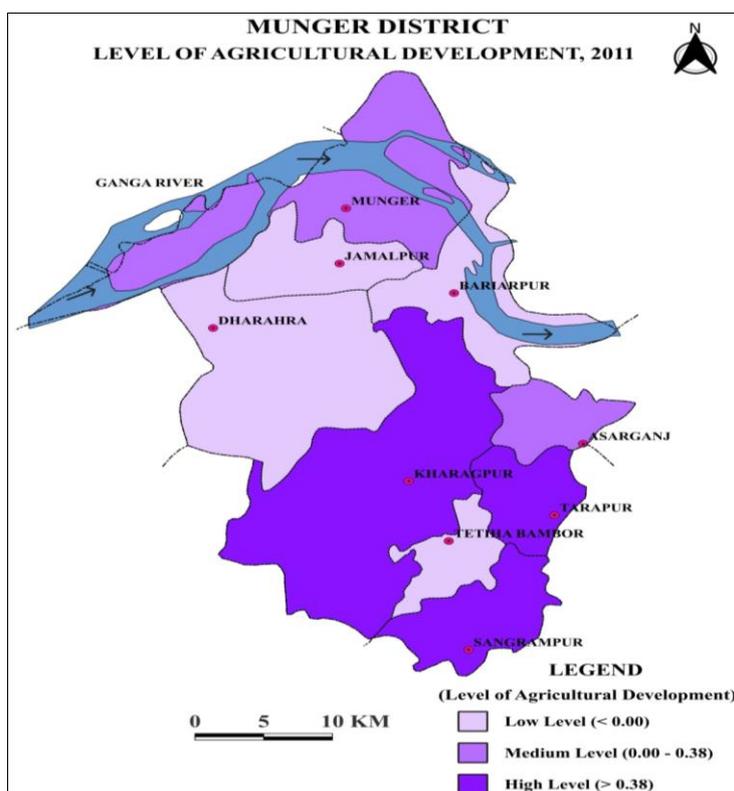

Fig 3: Level of agricultural development in Munger District, 2011

Conclusion

The present study examines the changing patterns of land use and the level of agricultural development in Munger district, Bihar, with particular emphasis on inter-block variations. An analysis of land use change during the period 2000–01 to 2010–11 reveals a gradual increase in net sown area along with a notable decline in fallow and wasteland categories. This trend indicates growing pressure on land resources arising from population growth and increasing demand for agricultural production. Simultaneously, a marginal rise in non-agricultural and barren land reflects the influence of urbanization and infrastructural expansion within the district. The assessment of block-wise agricultural development, based on standardized indicators and a composite index, highlights pronounced spatial disparities across the district. Blocks such as Tarapur, Sangrampur, and Kharagpur exhibit relatively higher levels of agricultural development, supported by better irrigation facilities, higher cropping intensity, and improved access to institutional and infrastructural support. In contrast, Bariarpur, Jamalpur, Dharhara, and Tetiah Bambor remain relatively less developed due to limited irrigation coverage, low land-use efficiency, and inadequate institutional facilities. The findings emphasize the need for region-specific and block-level agricultural planning. Enhancing irrigation infrastructure, strengthening institutional credit, improving power supply, and promoting multiple cropping practices in lagging blocks are essential for reducing intra-district disparities and achieving balanced and sustainable agricultural development in Munger district.

Recommendations

The study recommends the adoption of block-specific agricultural planning in Munger district to address pronounced inter-block disparities in land use and agricultural development. Priority should be given to strengthening irrigation infrastructure, promoting multiple cropping to enhance land-use efficiency, and improving access to institutional credit, power supply, and rural infrastructure in relatively backward blocks such as Bariarpur, Jamalpur, Dharhara, and Tetiah Bambor. Strengthening agricultural extension services and encouraging sustainable land management practices are essential for improving productivity and ensuring long-term resource sustainability. Regular monitoring of agricultural development using composite indices is also suggested to support evidence-based planning and balanced regional development.

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