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Research Article

Land Use and Land Utilization Changes in Karnataka: A Geo-Spatial Analysis

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Abstract

Land is a finite and fundamental natural resource whose utilization reflects the interaction between physical conditions, population growth, agricultural development, urbanization, industrialization and environmental processes. Karnataka has experienced considerable changes in land-use patterns during the last decade as a result of agricultural intensification, expansion of settlements and infrastructure, changes in fallow land, forest conservation and increasing pressure on natural resources. The study focuses particularly on changes in forest area, land under non-agricultural uses, barren and uncultivable land, permanent pastures, culturable wasteland, fallow land and net area sown. The findings indicate that Karnataka's land-use structure has undergone gradual but spatially differentiated transformation. In 2015–16, the state had a geographical area of approximately 190.5 lakh ha, with about 100.06 lakh ha under net area sown and 120.09 lakh ha under total cropped area. By 2021–22, the net area sown was reported at about 111.66 lakh ha in the national land-use classification. The study examines land-use changes in Karnataka during 2016–17 to 2023–24 using statistical and trend analysis. The results show a clear shift towards agricultural intensification, with net area sown increasing by 8.58%, total cropped area by 14.31%, and area sown more than once by 43.66%, raising cropping intensity from 119.52% to 125.82%. In contrast, other fallow land declined by 69.57%, cultivable waste by 21.25%, and miscellaneous tree crops by 35.64%, while non-agricultural land increased by 5.22%. Trend analysis found significant changes in 10 of 12 categories, with total cropped area showing the strongest positive trend (3.649 lakh ha/year) and other fallow land the strongest negative trend (–1.786 lakh ha/year). Overall, Karnataka experienced increased agricultural utilisation, reduced fallow and wasteland, and growing non-agricultural land use, highlighting the need for sustainable land-use planning.

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INTRODUCTION

Land is one of the most important natural resources supporting agriculture, forestry, human settlements, industries, infrastructure, and ecological systems. The pattern of land use and land utilization reflects the interaction between physical conditions, population growth, economic activities, and technological development and government policies. Changes in land use are therefore an important indicator of regional development and environmental transformation. In a rapidly developing state such as Karnataka, increasing urbanization, expansion of infrastructure, agricultural intensification, industrial development and changing climatic conditions have contributed to significant changes in the utilization of land resources.

Karnataka has considerable geographical diversity, ranging from the Western Ghats and forested areas to the semi-arid Deccan Plateau and coastal regions. This diversity has resulted in variations in agricultural land, forest area, cultivable wasteland, fallow land, land under non-agricultural uses and other land-use categories across the state. Agriculture continues to be an important component of the state's economy and rural livelihood system, while urban and industrial expansion has increasingly created pressure on agricultural and other land resources. Consequently, understanding the temporal changes in land utilization is essential for effective land-resource management and sustainable regional development.

Research Objectives

1. To examine the growth and pattern of land use and land utilization in Karnataka.
2. To identify the geo-spatial distribution of major areas of land-use and land utilisation in the state.

Hypothesis

1. There is a significant temporal change in the major land-use categories of Karnataka over the past few periods.

DATA SOURCES AND METHODOLOGY

The study uses secondary data obtained from the Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Land Use Statistics at a Glance, Forest Survey of India, Open Government Data Platform of India, Land Use Statistics Information System (LUS), Government of India, Karnataka Economic Survey (2023), Karnataka Department of Agriculture, department official documents, research journals, scholarly articles, newspapers, magazines, and websites.

Statistical Techniques for Data Analysis: The study applies percentage analysis, absolute change, annual growth rate, Compound Annual Growth Rate (CAGR), linear trend analysis, spatial interpretation, and coefficient of determination (R^2) to examine the changing pattern of land utilization categories in Karnataka from 2016–17 to 2022–23. The data were interpreted, processed, and analysed using Microsoft Excel, SPSS 21 software, EViews, and Gretl.

Percentage Share: Percentage Share = (Area under a particular land-use category / Total geographical area) $\times$ 100
The total geographical area of Karnataka is 190.50 lakh hectares.

Absolute Change: Absolute Change = Area in 2022–23 – Area in 2016–17

Percentage Change: Percentage Change = [(Area in 2022–23 – Area in 2016–17) / Area in 2016–17] $\times$ 100

Compound Annual Growth Rate

$$\text{CAGR} = [(V_2/V_1)^{(1/n)} - 1] \times 100$$

Where,

V_1 is represents the value in 2016–17,

V_2 is represents the value in 2022–23

$n = 8$ years.

Linear Trend Analysis: The linear trend equation is:

$$Y = a + bt$$

Where,

Y = the represents the land-use area,

a = the intercept,

b = the annual trend coefficient and

t = represents time.

Coefficient of Determination: R^2 measures the explanatory power of the fitted linear trend. A value closer to 1 indicates a stronger linear trend. A positive value of b indicates an increasing trend, whereas a negative value indicates a declining trend.

An Overview of Land Use and Land Utilisation in Karnataka

This section details the pattern and growth of land use and land utilisation in Karnataka from 2016 to 2023. Land use and land utilisation changes in Karnataka play a critical role in shaping the state's economy, environment, and urban growth. Karnataka's total reporting area remains constant at 19.05 million ha, but how that land is used has shifted drastically. Geo-spatial analysis provides an effective framework for understanding the spatial and temporal dimensions of land-use change. The integration of geographical information, statistical analysis, and spatial interpretation enables researchers to identify variations between regions and examine the changing distribution of different land-use categories such an approach is particularly useful for Karnataka because of the considerable regional differences in physical geography, agricultural conditions, urban development and economic activities.

Forests are the second-largest land use in Karnataka, covering 20.47% of the state's geographical area, with an additional 4.05% under tree cover of 24.52%. Karnataka has a total forest area of 40,678.23 sq. km, encompassing reserved forests, protected forests, village forests, private forests, section-4 notified forests, unclassified forests, and statutory forests.

Table1: Pattern and Growth of Land Utilisation in Karnataka (2016 to 2023) (In Lakh ha)

Classification	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24
Total Geographical Area	190.50	190.50	190.50	190.50	190.50	190.50	190.50	190.50
1. Forest	30.73	30.73	30.73	30.73	30.73	30.74	30.73	30.73
2(a). Land put to non-agricultural uses	14.95	15.01	15.05	15.11	15.16	15.24	15.53	15.73
2(b). Barren and uncultivable land	7.93	7.93	7.69	7.51	7.43	7.42	7.40	7.40
3. Cultivable waste	4.00	4.00	4.03	3.89	3.93	3.94	3.08	3.15
4(a). Permanent pastures & other grazing land	9.05	9.05	8.72	8.71	8.72	8.74	8.72	8.72
4(b). Miscellaneous tree crops & groves	2.75	2.74	2.51	2.37	2.12	2.11	1.78	1.77
5(a). Current fallow	6.92	6.86	5.71	9.27	4.76	6.78	7.55	11.26
5(b). Other fallow	15.61	15.21	9.40	4.85	3.11	3.86	4.09	4.75
6. Net area sown	98.55	98.95	106.64	108.02	114.53	111.66	111.61	107.01
7. Total cropped area	117.79	119.94	135.27	138.29	149.09	147.48	148.16	134.64
8. Area sown more than once	19.24	20.98	28.63	30.26	34.56	35.82	36.55	27.64
Cropping Intensity (%)	119.52	121.21	126.84	128.02	130.00	132.05	132.75	125.82

Source: 1) Government of Karnataka (2023), Directorate of Economics and Statistics – 2016 to 2023.

2) Government of India, Directorate of Economics & Statistics, Land Use Statistics at a Glance – 2016 to 2023.

The table presents the changing pattern of land utilisation in Karnataka from 2016–17 to 2023–24. The total geographical area remained constant at 190.50 lakh hectares throughout the study period. However, several land-use categories experienced noticeable changes, indicating shifts in agricultural intensity, fallow land, and non-agricultural uses. The area under forest remained almost unchanged at around 30.73 lakh hectares throughout the period. It increased marginally to 30.74 lakh hectares in 2021–22, before returning to 30.73 lakh hectares. This indicates considerable stability in the recorded forest area. Land under non-agricultural uses showed a continuous increasing trend, rising from 14.95 lakh hectares in 2016–17 to 15.73 lakh hectares in 2023–24, an increase of about 5.22%. This suggests increasing pressure from urbanisation, infrastructure development, settlements and other non-agricultural activities. Barren and uncultivable land declined consistently from 7.93 lakh hectares to 7.40 lakh hectares, representing a decline of approximately 6.68%. The downward trend may indicate conversion or utilisation of previously unproductive land for agricultural or other purposes.

Cultivable waste remained around 4 lakh hectares during the initial years but declined substantially after 2021–22. It decreased from 4.00 lakh hectares in 2016–17 to 3.15 lakh hectares in 2023–24. The decline indicates that a portion of cultivable waste may have been brought into productive use. Permanent pastures and other grazing lands declined from 9.05 lakh hectares to 8.72 lakh hectares, with a relatively stable trend after 2019–20. The reduction suggests a gradual pressure on common grazing resources. This category recorded a clear declining trend, falling from 2.75 lakh hectares in 2016–17 to 1.77 lakh hectares in 2023–24, a decline of about 35.64%. This is one of the largest proportional declines among the land-use

categories. Current fallow land exhibited substantial year-to-year fluctuations. It declined from 6.92 lakh hectares in 2016–17 to 4.76 lakh hectares in 2020–21, but subsequently increased sharply to 11.26 lakh hectares in 2023–24. Thus, the category does not follow a uniform trend and appears to be strongly influenced by annual agricultural and climatic conditions. Other fallow land recorded a marked decline from 15.61 lakh hectares in 2016–17 to 3.11 lakh hectares in 2020–21, followed by a modest recovery to 4.75 lakh hectares in 2023–24. Overall, it declined by approximately 69.57% during the study period.

Net area sown increased substantially from 98.55 lakh hectares in 2016–17 to 114.53 lakh hectares in 2020–21. However, it subsequently declined to 107.01 lakh hectares in 2023–24. Despite the recent decline, the area remained about 8.58% higher than its 2016–17 level. The trend line therefore indicates an overall positive long-term direction, although with considerable fluctuations. Total cropped area increased from 117.79 lakh hectares in 2016–17 to 149.09 lakh hectares in 2020–21, the highest value during the study period. It remained relatively high during 2021–22 and 2022–23 but declined sharply to 134.64 lakh hectares in 2023–24. Overall, it increased by approximately 14.31% between 2016–17 and 2023–24. Area sowed more than once increased strongly from 19.24 lakh hectares to 36.55 lakh hectares in 2022–23, demonstrating increased cropping intensity and multiple-cropping practices. However, it declined to 27.64 lakh hectares in 2023–24. Despite this decline, the 2023–24 level was approximately 43.66% higher than in 2016–17. Cropping intensity increased from 119.52% in 2016–17 to 132.75% in 2022–23, reflecting greater utilisation of agricultural land through multiple cropping. It subsequently declined to 125.82% in 2023–24. Nevertheless, it remained 6.30 percentage points higher than the 2016–17 level.

Table-2: Percentage Share of Major Land-Use Categories in Karnataka (2016 to 2023)

Land-use Classification	2016–17 Area (Lakh ha)	Share 2016–17 (%)	2023–24 Area (Lakh ha)	Share 2023–24 (%)
Forest	30.73	16.13	30.73	16.13
Land put to non-agricultural uses	14.95	7.85	15.73	8.26
Barren and uncultivable land	7.93	4.16	7.40	3.89
Cultivable waste	4.00	2.10	3.15	1.65
Permanent pastures & other grazing land	9.05	4.75	8.72	4.58
Miscellaneous tree crops & groves	2.75	1.44	1.77	0.93
Current fallow	6.92	3.63	11.26	5.91
Other fallow	15.61	8.19	4.75	2.49
Net area sown	98.55	51.73	107.01	56.17
Total cropped area	117.79	61.83	134.64	70.68
Area sown more than once	19.24	10.10	27.64	14.51

Source: Compiled from Economic Survey of Karnataka (2016 to 2024).

The land-use pattern of Karnataka during 2016–17 to 2023–24 shows a clear shift towards greater agricultural utilisation and intensification. Net area sown increased from 98.55 to 107.01 lakh ha, while total cropped area rose from 117.79 to 134.64 lakh ha. The area sown more than once also increased substantially from 19.24 to 27.64 lakh ha, indicating increased cropping intensity. In contrast, other fallow land, cultivable waste, barren

and uncultivable land, grazing land, and miscellaneous tree crops declined. Land under non-agricultural uses increased moderately from 14.95 to 15.73 lakh ha, suggesting growing pressure from non-agricultural activities. Forest area remained unchanged at 30.73 lakh ha. Overall, the results indicate agricultural expansion and intensification accompanied by a reduction in several categories of unused or less-utilised land.

Table-3: Absolute and Percentage Changes in Land Use and Land Utilization in Karnataka (2016 to 2023)

Classification	2016–17	2023–24	Absolute Change	Percentage Change (%)
Forest	30.73	30.73	0.00	0.00
Land put to non-agricultural uses	14.95	15.73	+0.78	+5.22
Barren and uncultivable land	7.93	7.40	-0.53	-6.68
Cultivable waste	4.00	3.15	-0.85	-21.25
Permanent pastures & other grazing land	9.05	8.72	-0.33	-3.65
Miscellaneous tree crops & groves	2.75	1.77	-0.98	-35.64
Current fallow	6.92	11.26	+4.34	+62.72
Other fallow	15.61	4.75	-10.86	-69.57
Net area sown	98.55	107.01	+8.46	+8.58
Total cropped area	117.79	134.64	+16.85	+14.31
Area sown more than once	19.24	27.64	+8.40	+43.66
Cropping Intensity	119.52	125.82	+6.30	+5.27

Source: Compiled from Economic Survey of Karnataka (2016 to 2023).

Note: Area is expressed in lakh hectares. Cropping intensity is expressed as a percentage; therefore, its absolute change is presented in percentage points.

The results reveal considerable changes in Karnataka's land-use structure. Other fallow land registered the largest decline, falling by 10.86 lakh hectares or 69.57%. Miscellaneous tree crops and groves declined by 35.64%, while cultivable waste declined by 21.25%. In contrast, current fallow land increased substantially

by 62.72%. The net area sown increased by 8.46 lakh hectares (8.58%), while total cropped area increased by 16.85 lakh hectares (14.31%). Particularly notable was the 43.66% increase in area sown more than once, indicating greater reliance on multiple-cropping practices.

Table-4: Trend Analysis of Land Use and Land Utilization in Karnataka (2016 to 2023)

S. No	Classification	CAGR (%)	Direction
1	Forest	0.00	Stable
2	Land put to non-agricultural uses	0.73	Increasing
3	Barren and uncultivable land	-0.98	Declining
4	Cultivable waste	-3.36	Declining
5	Permanent pastures & other grazing land	-0.53	Declining
6	Miscellaneous tree crops & groves	-6.10	Declining
7	Current fallow	7.20	Increasing
8	Other fallow	-15.63	Declining
9	Net area sown	1.18	Increasing
10	Total cropped area	1.93	Increasing
11	Area sown more than once	5.31	Increasing
12	Cropping Intensity	0.74	Increasing

Source: Compiled from Economic Survey of Karnataka (2016 to 2023).

The CAGR results show that other fallow land experienced the fastest decline, with a CAGR of -15.63% , followed by miscellaneous tree crops and groves at -6.10% . Conversely, current fallow recorded the highest positive CAGR of 7.20% . Among agricultural indicators, area sowed more than once recorded a strong CAGR of 5.31% , indicating an increasing tendency towards multiple cropping. Total cropped area grew at 1.93% annually, while net area sown increased at 1.18% annually.

Geo-Spatial Distribution of Major Areas of Land Utilisation in Karnataka

The geo-spatial distribution of land utilisation in Karnataka exhibits considerable regional variation due to differences in physiography, rainfall, soil characteristics, irrigation availability, population density, urbanisation and economic development. For the research paper, the spatial analysis can be organised around the major land-utilisation categories: forest, net area sown, land put to non-agricultural uses, barren and uncultivable land, permanent pastures, cultivable wasteland and fallow land.

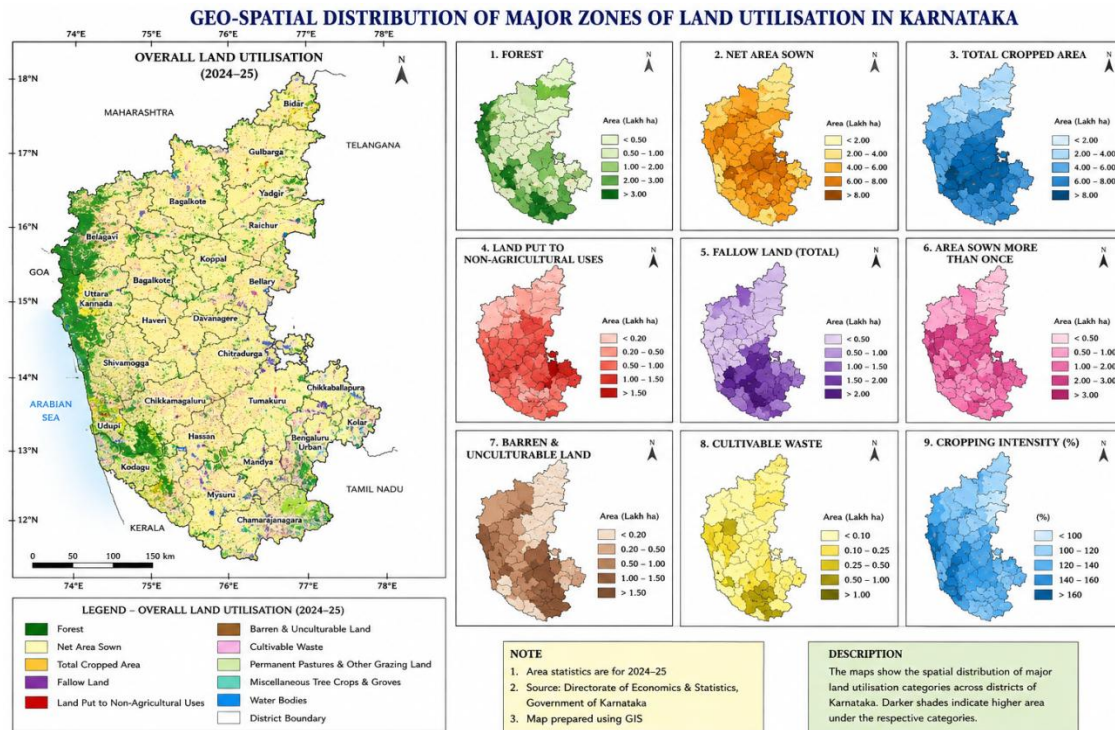


Fig: Geo-Spatial Distribution of Major Zones of Land Utilisation in Karnataka

Forest land is mainly concentrated in the Western Ghats and Malnad regions of Karnataka. Uttara Kannada, Shivamogga, Chikkamagaluru, Kodagu and parts of Hassan and Dakshina Kannada have relatively high forest resources. The high rainfall, rugged terrain and favourable ecological conditions support dense natural vegetation. In contrast, the northern interior districts generally have lower forest concentration. Agricultural land constitutes the dominant land-use category in Karnataka. Higher concentrations of net area sown occur across the northern and southern agricultural regions, particularly in districts such as Vijayapura, Bagalkot, Gadag, Koppal, Raichur, Ballari, Tumakuru, Mandya, Mysuru and parts of Hassan and Davanagere. The spatial pattern is strongly influenced by irrigation facilities, soil fertility and rainfall. Irrigated areas associated with the Krishna, Tungabhadra and Cauvery river systems generally support more intensive agricultural land use. Land under non-agricultural uses is strongly concentrated around Bengaluru and other major urban centres. Bengaluru Urban

represents the most prominent area of non-agricultural land use because of rapid urbanisation, residential expansion, industrial development, transport infrastructure and commercial activities. Other important urbanisation centres include Mysuru, Mangaluru, Hubballi-Dharwad, Belagavi, Kalaburagi and Ballari. Barren and uncultivable land is more prominent in the dry and semi-arid northern and north-eastern parts of Karnataka. Vijayapura, Bagalkot, Kalaburagi, Yadgir, Raichur, Koppal and parts of Ballari experience relatively greater constraints associated with aridity, shallow soils, rocky terrain and water availability.

Permanent pastures and grazing land are spatially associated with dryland agricultural regions, where livestock production forms an important component of the rural economy. These areas are particularly relevant in northern and central Karnataka. However, conversion of common grazing areas into agricultural, residential and infrastructure uses represents an important land-use management issue. Cultivable wasteland occurs mainly in

regions where agricultural development is constrained by soil degradation, inadequate moisture, erosion, salinity, rocky terrain or inadequate irrigation. Its distribution overlaps substantially with dryland and semi-arid regions. Fallow land shows considerable spatial and temporal variation. Higher concentrations are generally associated with rain-fed agricultural

areas, particularly in the northern dry zone. The extent of fallow land varies according to rainfall, drought conditions, irrigation availability, crop prices and farmers' decisions.

Major Spatial Zones of Land Utilisation: For your GIS analysis, Karnataka can broadly be interpreted through the following spatial zones:

Table-5 Major Spatial Zones of Land Utilisation in Karnataka

S. No	Spatial Zone	Major Land-Utilisation Characteristics
1	Western Ghats & Malnad	Forest, plantations, horticulture and relatively limited cultivated land
2	Coastal Karnataka	Forest, plantations, paddy, horticulture and settlements
3	Northern Dry Zone	Extensive agriculture, fallows, pastures and barren/uncultivable land
4	Central Karnataka	Agriculture, horticulture, grazing land and mixed land use
5	Southern Karnataka	Agriculture, irrigated cultivation, horticulture and plantations
6	Bengaluru Metropolitan Region	gh non-agricultural use, built-up expansion and declining agricultural pressure zd

Hypothesis Testing

H₀: There is no significant temporal change in the major land-use categories of Karnataka over the past few periods.

H₁: There is a significant temporal change in the major land-use categories of Karnataka over the past few periods.

Table-5: Hypothesis Testing of Temporal Trends in Major Land-Use Categories of Karnataka (2016 to 2023)

S. No	Land-use category	Trend coefficient (b)	R ²	p-value	Trend
1	Forest	0.0004	0.061	0.555	Increasing
2	Land put to non-agricultural uses	0.1033	0.866	0.001	Increasing
3	Barren and uncultivable land	-0.0863	0.836	0.002	Decreasing
4	Cultivable waste	-0.1283	0.629	0.019	Decreasing
5	Permanent pastures & other grazing land	-0.0463	0.555	0.034	Decreasing
6	Miscellaneous tree crops & groves	-0.1561	0.968	<0.001	Decreasing
7	Current fallow	0.3873	0.216	0.246	Increasing
8	Other fallow	-1.7855	0.714	0.008	Decreasing
9	Net area sown	1.7154	0.522	0.043	Increasing
10	Total cropped area	3.6486	0.534	0.040	Increasing
11	Area sown more than once	1.9348	0.529	0.041	Increasing
12	Cropping intensity	1.4215	0.532	0.040	Increasing

Source: Computed from the given land-utilisation data, 2016–17 to 2023–24.

Note: A p-value < 0.05 indicates a statistically significant temporal trend.

The hypothesis testing results demonstrate that most of the major land-use categories in Karnataka experienced statistically significant temporal changes during 2016–17 to 2023–24. The area under land put to non-agricultural uses recorded a statistically significant increasing trend, with a trend coefficient of 0.1033 lakh hectares per year, $R^2 = 0.866$, and $p = 0.001$. Since the p-value is less than 0.05, the null hypothesis is rejected for this category. This indicates a strong and statistically significant expansion of land under non-agricultural uses. Barren and uncultivable land showed a significant declining trend of 0.0863 lakh hectares per year, with $R^2 = 0.836$ and $p = 0.002$. Similarly, cultivable waste declined significantly at 0.1283 lakh hectares per year ($p = 0.019$). These results indicate that potentially usable land categories have undergone significant changes during the study period.

The trend in permanent pastures and other grazing land was also statistically significant, declining by approximately 0.0463 lakh hectares per year ($p = 0.034$). Miscellaneous tree crops and groves showed one of the strongest declining trends, with a coefficient of -0.1561 lakh hectares per year, $R^2 = 0.968$, and p

< 0.001. The very high R^2 indicates that the temporal decline in this category is strongly explained by the linear trend. Other fallow land also experienced a statistically significant decline, with a trend coefficient of -1.7855 lakh hectares per year, $R^2 = 0.714$, and $p = 0.008$. This is a particularly substantial change in the land-use structure. Among the agricultural indicators, net area sown increased significantly by approximately 1.7154 lakh hectares per year ($p = 0.043$).

Total cropped area increased at approximately 3.6486 lakh hectares per year ($p = 0.040$), while area sown more than once increased by 1.9348 lakh hectares per year ($p = 0.041$). These significant positive trends demonstrate increasing agricultural intensification during the study period. Cropping intensity also exhibited a statistically significant positive trend, increasing by approximately 1.42 percentage points per year, with $R^2 = 0.532$ and $p = 0.040$. This confirms that agricultural land was increasingly being utilised through multiple cropping. However, two categories did not exhibit statistically significant temporal trends. Forest area remained virtually stable, with $p = 0.555$, while current fallow land showed substantial annual fluctuations

and an increasing trend coefficient of 0.3873 lakh hectares per year, but the trend was not statistically significant ($p = 0.246$). Therefore, the null hypothesis cannot be rejected for these two categories.

Finally, the results provide strong evidence of significant temporal change in the majority of land-use categories. The null hypothesis is rejected for 10 out of 12 categories, while it is not rejected for forest and current fallow land. Therefore, the study concludes that the null hypothesis (H_0) is rejected for the majority of major land-use categories and the alternative hypothesis (H_1) is accepted. Hence, there has been a statistically significant temporal transformation in the land-use structure of Karnataka during 2016–17 to 2023–24.

CONCLUSION

The present study examined the temporal changes in land utilisation in Karnataka during 2016–17 to 2023–24 using percentage share, absolute change, percentage change, CAGR, and linear trend analysis. The findings reveal substantial changes in the state's land-use structure during the study period. Although the total geographical area remained constant at 190.50 lakh hectares, individual land-use categories experienced significant changes. The analysis indicates a clear expansion of agricultural intensification. Net area sown increased from 98.55 lakh hectares in 2016–17 to 107.01 lakh hectares in 2023–24, while total cropped area increased from 117.79 to 134.64 lakh hectares. The area sown more than once increased considerably from 19.24 to 27.64 lakh hectares, and cropping intensity increased from 119.52% to 125.82%. These changes indicate greater utilisation of available agricultural land through multiple cropping.

At the same time, several non-cultivated land categories experienced substantial reductions. Other fallow land declined by 69.57%, cultivable waste by 21.25%, barren and uncultivable land by 6.68%, and miscellaneous tree crops and groves by 35.64%. The decline in these categories suggests a gradual shift of land towards more productive or alternative uses. However, current fallow land increased by 62.72%, reflecting considerable year-to-year fluctuations in agricultural land utilisation. The study also identifies increasing pressure from non-agricultural activities. Land put to non-agricultural uses increased from 14.95 to 15.73 lakh hectares, with a positive and statistically significant linear trend. This indicates the growing influence of urbanisation, infrastructure development, settlements and other non-agricultural requirements on the state's land resources.

The hypothesis testing further confirms that most major land-use categories underwent statistically significant temporal changes during the study period. Significant trends were observed for land put to non-agricultural uses, barren and uncultivable land, cultivable waste, permanent pastures and grazing land, miscellaneous tree crops and groves, other fallow land, net area sown, total cropped area, area sown more than once and cropping intensity. Forest area remained relatively stable, while current fallow land exhibited fluctuations without a statistically significant linear trend. Finally, the findings demonstrate that

Karnataka's land-use structure is undergoing a process of agricultural intensification, reduction of fallow and wasteland categories, and increasing conversion of land towards non-agricultural uses. The simultaneous growth of cropped area and multiple-cropping practices highlights the increasing pressure to produce more from existing agricultural resources. Therefore, scientific land-use planning, protection of forests and grazing lands, sustainable management of agricultural resources, and appropriate regulation of non-agricultural land conversion are essential for maintaining a balance between agricultural development, environmental sustainability and urban-economic growth.

The study concludes that Karnataka has experienced significant temporal transformation in its land-use pattern during 2016–17 to 2023–24. The dominant trend is towards greater agricultural intensification and increasing non-agricultural utilisation, accompanied by a substantial decline in fallow, wasteland and certain common land categories. These changes highlight the need for integrated and sustainable land-use planning to ensure long-term agricultural productivity, ecological conservation and balanced regional development.

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