

Geo-Spatial Analysis of Area and Production of Foodgrain Sector in Karnataka: A Trend Analysis

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Abstract—Food-grain production constitutes an important component of Karnataka's agricultural economy and plays a significant role in rural employment, food security, household income stability, poverty reduction, agricultural farmers' improvement, and regional development. They cover a large portion of the state's farmland, providing daily food and nutrition to millions of people. Crops like ragi in the south and jowar in the north are perfectly suited for dry weather. This makes them highly reliable for poor farmers who depend on rainfall. Cultivating foodgrains creates steady jobs for rural families and keeps local markets stable. The present study examines the temporal trend and spatial dimensions of area and production of food grains in Karnataka during 2015–16 to 2024–25. The study also adopts a geo-spatial perspective to understand regional variations associated with Karnataka's diverse agro-climatic conditions.

The findings indicate that the area under foodgrains increased from 73.38 lakh hectares in 2015–16 to 85.71 lakh hectares in 2024–25, representing a CAGR of about 1.74 percent. Food-grain production increased from 96.44 lakh tonnes to 151.57 lakh tonnes during the same period, registering a CAGR of about 5.15 percent. Productivity increased from approximately 1,314 kg per hectare to 1,768 kg per hectare, with a CAGR of about 3.35 percent. However, the series shows considerable year-to-year fluctuations, particularly during years affected by rainfall variability and agricultural stress. The study concludes that the long-term improvement in food-grain production has been driven not only by expansion of cultivated area but also by improvements in productivity. Spatially differentiated agricultural planning, irrigation development, climate-resilient technologies, improved seed varieties and region-specific crop planning are essential for sustaining food-grain production in Karnataka.

Index Terms—Foodgrains, Karnataka, Area, Production, Productivity, CAGR, Trend Analysis, Geo-Spatial Analysis, Spatial Variation and Correlation Analysis

I. Introduction

Agriculture continues to occupy a central position in Karnataka's rural economy despite the increasing importance of industry and services. The sector provides livelihood opportunities to a large section of the rural population and contributes significantly to food security and rural development. Karnataka possesses considerable diversity in rainfall, soil characteristics, topography and irrigation availability. Consequently, agricultural production varies considerably across regions. Foodgrains, comprising cereals and pulses, are particularly important because they constitute the foundation of household food security. Major food-grain crops cultivated in Karnataka include rice, jowar, ragi, maize, bajra, wheat and minor millets among cereals, and tur and other pulses among leguminous crops. The state has also experienced substantial changes in cropping patterns, irrigation, agricultural technology and market conditions.

According to the Agriculture Department report (2025), food-grain cultivation has experienced considerable fluctuations over the past decade. The area under food grains increased during the latter part of the study period, while production fluctuated sharply due to variations in rainfall, crop productivity and climatic conditions. The final estimates show that the total food-grain production of 143.43 lakh tonnes in 2022–23, 128.31 lakh tonnes in 2023–24 and 151.57 lakh tonnes in 2024–25. The geo-spatial dimension of agricultural production is particularly relevant in Karnataka because the state contains ten agro-climatic zones, with considerable differences in rainfall, soil quality, elevation and irrigation. The Karnataka Economic Survey notes that cereals, pulses, oilseeds and commercial crops are distributed differently across these agro-climatic regions.

II. Objectives of the Study

1. To study the performance and growth in trends of area, production and yield of foodgrains in Karnataka.
2. To analyse the geo-spatial dimensions of food-grain cultivation in relation to Karnataka's agro-climatic regions.

III. Materials and Method

The study uses secondary data sources collected mainly from the Directorate of Economics and Statistics (2025), Government of Karnataka, Karnataka Economic Survey (2025), Department of Agriculture and Farmers Welfare, Government of India, and related official agricultural publications. Additional information was sourced from other government publications, research journals, scholarly articles, newspapers, magazines, and reliable websites. Statistical Techniques for Data Analysis: Statistical techniques including percentage change, annual growth rate, Compound Annual Growth Rate (CAGR), productivity analysis, linear trend analysis and coefficient of determination (R^2) are employed. The data were processed and analysed using Microsoft Excel, SPSS 21, EVIEWS, and Gretl.

IV. Hypothesis

1. There is a significant relationship between area and production of foodgrains in Karnataka during the study period.

V. Performance of Foodgrains Sector in Karnataka: Present Scenario

Karnataka's foodgrain sector shows a mix of record-breaking milestones and climate challenges. They cover a large portion of the state's farmland, providing daily food and nutrition to millions of people. Crops like ragi in the south and jowar in the north are perfectly suited for dry weather. This makes them highly reliable for poor farmers who depend on rainfall. Cultivating foodgrains creates steady jobs for rural families and keeps local markets stable. Furthermore, government programs actively support these crops to

protect farmers' incomes. Ultimately, foodgrains are vital for preventing hunger, supporting rural livelihoods, and driving the state's rural economy forward. According to the Economic Survey 2025–26, Karnataka ranks 10th in India for total foodgrain production, contributing over 10% to the country's total output. The state is a national leader in maize production and ranks second in coarse cereals like ragi and jowar. The state recently achieved an impressive yield of 153 lakh tonnes. Following this success, the government set a target of 148.48 lakh tonnes for the subsequent crop year. However, maintaining these numbers remains a battle against nature. Extreme weather and severe rainfall shortages during the southwest monsoon have hit sowing targets hard. Experts estimate that this lack of rain could cause a loss of up to 50 lakh tonnes in production. To build long-term stability, Karnataka is actively pushing for structural changes. The state is promoting millet farming through financial incentives and expanding micro-irrigation systems. These steps aim to help farmers cope with unpredictable rains, reduce crop loss, and secure the state's food supply.

VI. Results and Discussion

Growth in Trends of Area, Production and Productivity of Foodgrain Sector in Karnataka

This section discusses the growth in trends of area, production and productivity of foodgrain sector in the state. Karnataka's foodgrain sector has seen strong growth, driven by better farming methods, government support, and changing crop trends. Total foodgrain production in the state climbed past expectations to reach 153.00 lakh tonnes during the 2024–25 cycles (Economic Survey of Karnataka (2025)). Karnataka has a total cultivated area of roughly 9.85 million ha. The major crops like maize, rice (paddy), ragi (finger millet), and jowar cover the largest shares of the cereal-cultivated land. Also, shifting traditional coarse cereal areas have faced adjustments, pulse cultivation and high-yield commercial cereals like maize have expanded due to better irrigation and market support.

Table: Area, Production, Productivity and Annual Production Growth of Foodgrains in Karnataka, 2015–16 to 2024–25

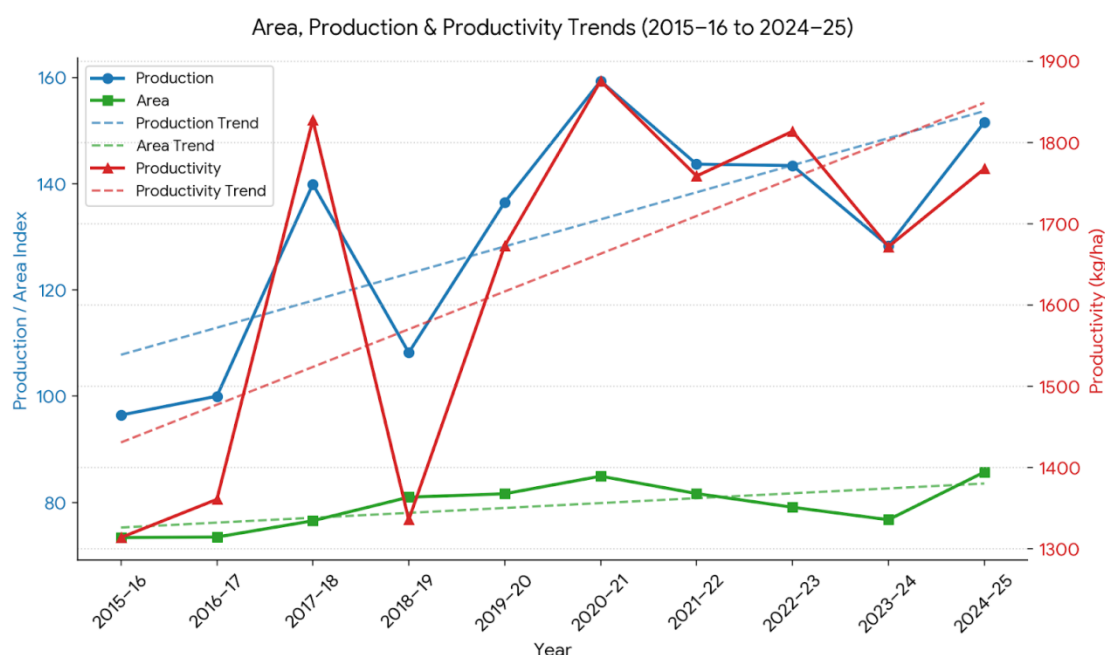
(Area in Lakh ha, Production in Lakh Tonnes, Productivity in Kg/ha)				
Year	Area	Production	Productivity	Annual Production Growth (%)
2015–16	73.38	96.44	1,314	-
2016–17	73.47	99.99	1,361	3.68
2017–18	76.53	139.91	1,828	39.92
2018–19	80.98	108.20	1,336	-22.66
2019–20	81.62	136.51	1,673	26.16
2020–21	84.93	159.35	1,876	16.73

2021–22	81.66	143.68	1,759	-9.83
2022–23	79.08	143.43	1,814	-0.17
2023–24	76.73	128.31	1,672	-10.54
2024–25	85.71	151.57	1,768	18.13
CAGR (%)	1.74	5.15	3.35	

Source: Compiled from the Directorate of Economics and Statistics, Government of Karnataka, *Karnataka Economic Survey*, and related official agricultural statistics. The latest 2024–25 figures are final estimates: Foodgrain area 85.71 lakh ha and production 151.57 lakh tonnes.

The above table presents the trend in area, production, productivity and annual production growth of foodgrains in Karnataka during 2015–16 to 2024–25. The data indicate an overall improvement in foodgrain production, although considerable year-to-year fluctuations were observed. The area under foodgrain cultivation increased from 73.38 lakh hectares in 2015–16 to 85.71 lakh hectares in 2024–25, registering a CAGR of 1.74 per cent. The cultivated area reached its highest level of 85.71 lakh ha in 2024–25, while the lowest area was recorded in 2015–16. The expansion in area was particularly noticeable during 2019–20 and 2020–21, followed by a decline during 2021–22 to 2023–24 and a sharp recovery in 2024–25.

Foodgrain production increased substantially from 96.44 lakh tonnes in 2015–16 to 151.57 lakh tonnes in 2024–25, recording a relatively higher CAGR of 5.15 per cent. Production reached its highest level of 159.35 lakh tonnes in 2020–21, after which it declined to 128.31 lakh tonnes in 2023–24 before recovering to 151.57 lakh tonnes in 2024–25. This indicates that changes in production were influenced not only by cultivated area but also by variations in productivity and agricultural conditions. The productivity of foodgrains improved from 1,314 kg/ha in 2015–16 to 1,768 kg/ha in 2024–25, registering a CAGR of 3.35%. The highest productivity of 1,876 kg/ha was recorded in 2020–21, while the lowest was observed in 2015–16. The rise in productivity suggests improvements in crop performance, agricultural practices, input use and other production-related factors over the study period.



The annual production growth rate shows substantial fluctuations. Production growth was modest at 3.68% in 2016–17, but increased sharply to 39.92% in 2017–18. It subsequently declined by 22.66% in 2018–19. Strong recovery was observed in 2019–20 and 2020–21, with growth rates of 26.16% and 16.73%, respectively. Production again declined during 2021–22, 2022–23 and 2023–24, before registering a significant recovery of 18.13% in 2024–25. The above table reveals that foodgrain production in Karnataka grew faster than both cultivated area and productivity, as reflected in the respective CAGRs of 5.15%, 1.74% and 3.35%. Thus, the long-term increase in foodgrain production can be attributed to a combination of expansion in cultivated area and improvement in productivity.

Table 4: Growth Indicators of Food Grains in Karnataka (2015–16 to 2024–25)

Indicator	2015–16	2024–25	Absolute Change	Percentage Change	CAGR (%)
Area (lakh ha)	73.38	85.71	+12.33	+16.81	1.74
Production (lakh tonnes)	96.44	151.57	+55.13	+57.17	5.15
Productivity (kg/ha)	1,314	1,768	+454	+34.55	3.35

Source: Compiled Data by the Researcher

The above table results clearly show that production increased faster than area. While the food-grain area increased by about 16.81%, production increased by approximately 57.17%. Productivity increased by about 34.55%. Therefore, productivity improvement was an important contributor to the long-term growth of food-grain production in Karnataka.

Table 2 Linear Trend of Food-Grain Area, Production and Productivity in Karnataka (2015–16 to 2024–25)

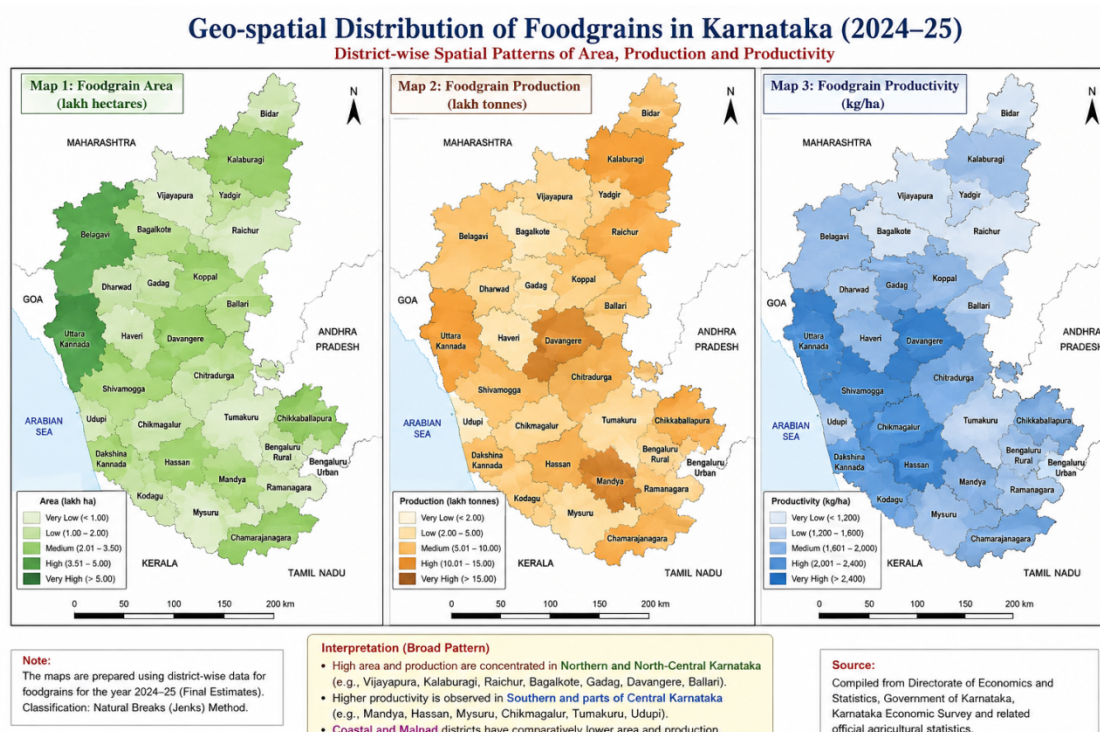
Variable	Linear Slope	R ²	Significance (p-value)	Interpretation
Area	0.921 lakh ha/year	0.412	0.046	Significant positive trend
Production	5.099 lakh tonnes/year	0.495	0.023	Significant positive trend
Productivity	46.472 kg/ha/year	0.414	0.045	Significant positive trend

Source: Compiled Data by the Researcher

The linear trend analysis indicates positive trends for all three variables. The estimated annual increase in food-grain area is approximately 0.92 lakh hectares per year. The production trend indicates an average annual increase of approximately 5.10 lakh tonnes, while productivity increased at an estimated rate of approximately 46.47 kg per hectare per year. Since the p-values for area, production and productivity are below the 5 percent significance level, the null hypotheses of no significant trend are rejected. Therefore, the study provides statistical evidence of an overall increasing trend during the study period, despite considerable annual fluctuations.

Geo-spatial Dimensions of Foodgrain Cultivation in Karnataka: A Geographical Perspective

Karnataka exhibits substantial geographical diversity. The state is divided into ten agro-climatic zones based on rainfall, soil characteristics, elevation and other physical conditions.



This diversity creates significant spatial differences in agricultural production. The spatial distribution of food grains can broadly be interpreted through the following regional characteristics:

Northern Karnataka: Northern Karnataka contains extensive dryland farming areas. Jowar, pulses, maize and other dryland food crops have considerable importance. Rainfall variability is an important factor affecting production in this region.

Central Karnataka: Central districts exhibit a mixture of dryland and irrigated agriculture. Maize, ragi, pulses and other cereals are important components of the agricultural system.

Southern Karnataka: Southern Karnataka has relatively favourable conditions for ragi, maize, rice and pulses in several areas. Irrigation facilities and access to markets have influenced cropping patterns.

Coastal and Malnad Karnataka: The coastal and Malnad regions receive relatively higher rainfall and have agricultural systems dominated by plantation and horticultural crops. Consequently, food grains generally occupy a smaller relative share compared with the dry and semi-arid interior regions. The spatial pattern therefore reflects the interaction between rainfall, soil, irrigation and agricultural specialization.

Spatial and Temporal Interpretation

The results indicate that Karnataka's food-grain economy has undergone both structural and temporal changes.

First, the increase in food-grain area from 73.38 lakh hectares to 85.71 lakh hectares demonstrates that food grains continue to occupy a substantial portion of the state's agricultural land.

Second, the considerably higher CAGR of production compared with area indicates that production growth cannot be explained by area expansion alone. Improvements in productivity have contributed significantly.

Third, the sharp fluctuations in production reveal the vulnerability of Karnataka agriculture to climatic conditions. The decline in production during 2018–19 and 2023–24 illustrates the importance of rainfall and climatic variability.

Fourth, the recovery in 2024–25 is particularly significant. Final estimates show food-grain production increasing to 151.57 lakh tonnes, compared with 128.31 lakh tonnes in 2023–24.

Fifth, the increasing importance of maize and pulses reflects changes in the state's cropping pattern. The Karnataka Economic Survey notes increasing trends in crops such as maize and tur, while several traditional crops have shown declining trends in recent years.

Testing Hypothesis

H_0 : There is no significant relationship between area and production of foodgrains in Karnataka during the study period.

H₁: There is a significant relationship between area and production of foodgrains in Karnataka during the study period.

Table- Pearson Correlation between Foodgrain Area and Production in Karnataka, 2015–16 to 2024–25

Variables	N	Mean	Std. Deviation	Pearson Correlation (r)	Sig. (2-tailed)
Area (lakh ha)	10	79.41	4.30	0.771	0.009
Production (lakh tonnes)	10	130.34	20.53		

Source: Author's calculation based on foodgrain area and production data for Karnataka (2015 to 2024)

The above table shows that Pearson correlation coefficient between foodgrain area and production is 0.771, indicating a strong positive relationship between the two variables. This suggests that, in general, an increase in the area under foodgrain cultivation is associated with an increase in foodgrain production in Karnataka. The significance value is 0.009, which is less than the conventional 5 per cent level of significance ($p < 0.05$). Therefore, the relationship between area and production is statistically significant. Hence, the null hypothesis is rejected, while the alternative hypothesis is accepted. The results confirm that there is a statistically significant and strong positive relationship between foodgrain area and production in Karnataka during 2015–16 to 2024–25.

VII. Conclusion

The study examined the temporal and spatial dimensions of foodgrain area, production, and productivity in Karnataka during 2015–16 to 2024–25. The results reveal an overall positive long-term trend, despite substantial year-to-year fluctuations. The area under foodgrains increased from 73.38 lakh hectares in 2015–16 to 85.71 lakh hectares in 2024–25, while production increased from 96.44 lakh tonnes to 151.57 lakh tonnes. The corresponding CAGRs were 1.74 per cent for area and 5.15 per cent for production. Productivity also increased from 1,314 kg per hectare to 1,768 kg per hectare, registering a CAGR of 3.35 per cent.

The higher rate of production growth compared with area growth demonstrates the increasing contribution of productivity improvements to Karnataka's foodgrain sector. However, the considerable year-to-year fluctuations in production indicate the vulnerability of agriculture to rainfall variability, climatic shocks, and other agro-climatic conditions. The spatial dimension is equally important, as Karnataka's ten agro-climatic zones differ considerably in terms of rainfall, soil characteristics, irrigation availability, topography, and cropping patterns. Therefore, foodgrain development policies need to be region-specific and responsive to local agricultural conditions. GIS-based spatial analysis can further

identify disparities in foodgrain area, production, and productivity and support policymakers in the more effective allocation of agricultural resources.

The linear trend analysis confirms a statistically significant positive trend in foodgrain area, production, and productivity during the study period. Foodgrain production recorded the highest annual growth rate of 39.92 per cent in 2017–18, although substantial fluctuations were observed in subsequent years. These variations reflect the influence of climatic conditions and other agricultural factors on foodgrain production. The correlation analysis revealed a strong positive and statistically significant relationship between foodgrain area and production ($r = 0.771$; $p = 0.009$). Therefore, the null hypothesis stating that there is no significant relationship between area and production was rejected. The findings indicate that an increase in the area under foodgrain cultivation is significantly associated with an increase in production. However, production is also influenced by productivity, rainfall, irrigation, technology, input use, and other agro-economic factors.

From a geo-spatial perspective, foodgrain cultivation is unevenly distributed across Karnataka because of variations in rainfall, soil characteristics, irrigation, topography, and cropping patterns. The northern and central regions, which have extensive dryland areas, play an important role in cereal and pulse cultivation, while the southern, coastal, and Malnad regions exhibit greater agricultural specialization and distinct foodgrain cultivation patterns. This spatial variation highlights the need for differentiated agricultural planning and resource allocation across regions.

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