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Crop Diversity and Trend Patterns in Chikkaballapur : A Comparative Study of Major Crops

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Abstract

This study examines crop diversification and trends in the area, production and productivity of major crops in Chikkaballapur district, Karnataka, over the period from 2015-16 to 2022-23. Using the Simpson Index, Compound Annual Growth Rates (CAGR) and instability indices, the analysis explores shifts in land use patterns and agricultural dynamics. Results reveal a significant transition from traditional cereal and pulse crops to high-value horticultural crops like Tomato and Potato. While cereals such as Maize and Ragi showed relative stability, Paddy faced declining productivity despite an increase in cultivated area. On the other hand, among the Pulses like Horse Gram demonstrated improved yields but reduced area, whereas Red Gram and Field Bean experienced overall declines in cultivation and production. Further, in case of Oilseed crops like Groundnut showed moderate growth, albeit with notable instability. However, in case of Vegetables like Tomato and Potato witnessed substantial expansion in cultivation and production, driven by market demand, although Tomato showed declining productivity. The findings highlight a gradual transformation in the district's agricultural landscape, driven by climatic conditions, market trends and evolving farmer preferences. This diversification underscores the need for targeted policies to enhance productivity, manage risks and support sustainable agricultural growth.

Keywords : Compound annual growth rate, Crop diversification, Simpson index, Instability analysis

India is a predominant agriculture-based country which held fifth position in the world economies with $3732 trillion US and agriculture contribution to it is 18.40 per cent, respectively. The climatic and soil conditions of India have suitability to cultivate wide variety of crops within the country. But the cropping pattern changes across the country in accordance with the climatic situations and soil availability. The cropping patterns also change with the time period as nature itself will have critical movement. In this context, the present study has been undertaken to study the crop diversity and trends in area, production and productivity of major crops in Chikkaballapur district of Karnataka. Agriculture in Chikkaballapur, a district known for its diverse agro-climatic conditions, plays a critical role in shaping the livelihoods of its rural population. Over the years, changes in climate, market demand, technological advancements and government policies have significantly influenced cropping patterns in the region. As a result, farmers have adopted diverse cropping systems to ensure economic sustainability and resilience against risks such as price volatility and environmental stress.

Literature Review

Crop diversification itself acts as a instrument to mitigate the risks associated with the climate change and helps in the optimization of land allocation (Birthal *et al.,* 2007). Bellundgi *et al.* (2016) revealed that are under ragi was seen declining trend over the study period. Kumar *et al.* (2017) indicated area under vegetables has revealed positive significant growth in southern dry zone and crop diversification indicated cropping pattern shift. The growth rate results of food crops were seen positive trend in Chikkaballapur district over the period from 1997-98 to 2017-18 (Ashwini *et al.,* 2021).

Data and Methodology

The Chikkaballapur district has been selected for the study due to its diversity in climatic conditions, proximity to various markets and farmers innovativeness and their adoption supremacy. The information needs existing in the region (cropping pattern, decadal change in land use pattern, growth pattern and crop diversification) were analyzed. The recent study by Ashwini *et al*., has studied the trend till 2017-18 and indicated the positive growth in major crops of the districts. Hence, for this study the data from Anonymous (2015-16 to 2022-23) FRE reports, DES has been considered to check the latest trend. The data with respect to area, production and productivity was collected from Directorate of Economics and Statistics (DES), Karnataka. The Simpson Index has employed to check the crop diversification in region and compound annual growth rate to verify the trend of major crops over the area. The decadal trend, growth rate and crop diversification has enabled the author for the crop selection (activities) to the crop optimization models.

Simpson Index : The crop diversification or concentration offer crop activities over time and space. Simpson's Index (SI) is used in this study to find the diversification in the region for different taluks in the district. The formula for the SI is as follows,

$$SI = 1 - \sum_{i=1}^{n} Si\text{^}2$$

Where,

$Si = Ci/\sum Ci$ is the ratio of Ci = proportion of ith crop to the particular crop in a specified geographical land.

If SI = 0, Single crop and SI = 1, fully diversified.

Compound Annual Growth Rate (CAGR) : To analyze the trend of the major crops in the study area, Compound Annual Growth Rate has been computed. The exponential growth function has been used to calculate the growth rates. Symbolically the function can be written as,

$$Y = ab^t \text{ - - - - - - - - - - - - (1)}$$

$$\log Y = \log a + t \log b \text{ - - - - - - - - - (2)}$$

Y = Area (ha) /Production (tonnes) / Productivity (kg/ha)

a = Intercept

b = Regression coefficient

t = Time period (years)

CAGR in percentage can be arrived as

$$CAGR = (\text{Antilog (b)-1}) \times 100 \text{ - - - - - - (3)}$$

Instability analysis : The coefficient of variation was used as a measure to study the variability in area, production, productivity. The Coefficient of Variation (CV) was computed using the following formula given by Kent (1924),

$$CAGR = \frac{Standard\ Deviation}{Mean} \times 100$$

Whenever the trend of series was found to be significant, the variation around the trend rather than the variation around mean was used as an index of instability. The formula suggested by Cuddy and Della (1978) was used to compute the degree of variation around the trend

$$Instability\ Index = CV * \sqrt{(1 - R2)}$$

Where,

R^2 = Coefficient of determination from a time-trend regression adjusted by the number of degrees of freedom.

Results and Discussion

Land use Pattern Analysis : The section explains the decadal change in both land use pattern and cropping pattern in the Chikkaballapur district.

For this current study it is very much necessary to understand the existing cropping pattern of the region, as it helps to select the major crops grown in the region to be incorporated to the crop optimization models. In this view, the cropping pattern of the region was analyzed and presented in the Table 1. The results indicated that among the crops, maize (28.07%) and ragi (17.23%) were found to be the major crops in the area with total share of almost 35 per cent to total cropping area. In pulses, almost all the crops had less than one per cent area each in the total area. Among horticultural crops, Tomato is leading crop with area share of 6.33 per cent, followed by Mango (4.96%), Potato (2.19%) and Grapes (1.24%) respectively. In oilseeds groundnut was the only with greater area share of 9.12 per cent and rest has less than one per cent share each. Considering area as the parameter, maize, ragi, groundnut, paddy, tur, horse gram, avare (*Lablab purpureus*), tomato and potato crops has been selected for the development of the crop optimization models. For the same crops, the instability and growth rate were analyzed for further crop performance over the past decade.

Table 1

Cropping pattern of Chikkaballapur district

Principal Crops	Area (Ha.)	Percentage
Cereals		
Paddy	2939	1.47
Ragi	34338	17.23
Bajra	116	0.06
Maize	55956	28.07
Other Cereals and Millets	1852	0.93
Pulses		
Bengal gram	54	0.03
Tur	1357	0.68
Horse gram	715	0.36
Avare	1740	0.87
Cowpea	148	0.07
Horticultural Crops		
Tomato	12626	6.33
Potato	4369	2.19
Grapes	2472	1.24
Mango	9881	4.96
Oilseeds		
Groundnut	18177	9.12
Sunflower	1502	0.75
Castor	48	0.02
Other Oilseeds	24	0.01
Commercial crops		
Cotton	508	0.25
Sugarcane	85	0.04
Gross Cropped Area	199317	100.00

Source : Directorate of Economics and Statistics, Government of Karnataka, 2022-23

The decade-long transformation in land use pattern in Chikkaballapur district, comparing the periods of 2012-13 and 2022-23 has been presented in the Table 2. The total geographical area has remained constant at 404,501 hectares. However, notable shifts are observed in other land use categories. The area categorized as not available for cultivation saw a significant increase from 6,635 hectares in 2012-13 to 67,045 hectares in 2022-23, reflecting a marked rise of 14.93 per cent over the decade. This shift could be attributed to increased infrastructure development due to rapid growth of the Chikkaballapur leading to conversion of agricultural to non-agricultural lands. In contrast, areas designated as other uncultivable land have shown only a minimal change, increasing by 0.06 per cent. The area under fallow land has increased by 2.9 per cent, suggesting either increased periods of land rest or challenges in sustaining agricultural productivity. A significant decline in gross sown area and net sown area by of 4.75 per cent and 3.16 per

TABLE 2

Decadal change in land use pattern in Chikkaballapur district

Particulars	2012-13	Per cent	2022-23	Per cent	Decadal Change (%)
Geographical area	404501	100.00	404501	100.00	
Forest area	49704	12.29	49704	12.29	0.00
Areas not available for cultivation	6635	1.64	67045	16.57	14.93
Other uncultivable land	66775	16.51	67012	16.57	0.06
Fallow land	24113	5.96	35857	8.86	2.90
Gross sown area	212946	52.64	193749	47.90	-4.75
Net sown area	197674	48.87	184883	45.71	-3.16
Irrigated area	54787	13.54	48823	12.07	-1.47

Source : District at a glance, ZillaPanchayath, Chikkaballapur 2012-13 and 2022-23

cent, respectively was witnessed and indicates the decrease in land area under cultivation. This trend could reflect issues such as water scarcity or shifts in economic activity. Additionally, the irrigated area dropped by 1.47 per cent, pointing to potential challenges in water resource management or a decrease in irrigation infrastructure investment.

The changes in crop-wise area over the decade was highlighted in the Table 3, indicating substantial fluctuations in crop cultivation patterns. A significant reduction is observed in the area under cereals and small millets, including paddy, maize, and ragi, with declines of 7.96 per cent, 12.06 per cent and 27.94 per cent, respectively. Minor millets experienced the

TABLE 3

Decadal change in area under major crops in Chikkaballapur district

Particulars	2012-13	Per cent	2022-23	Per cent	Decadal Change (%)
Paddy	3215	1.63	2959	1.48	-7.96
Maize	63630	32.19	55956	28.07	-12.06
Ragi	47654	24.11	34338	17.23	-27.94
Minor millets	297	0.15	53	0.03	-82.15
Total Cereals and small millets	115001	58.18	95201	47.76	-17.22
Tur	5802	2.94	1357	0.68	-76.61
Horse gram	987	0.50	1404	0.70	42.25
Field Bean	5535	2.80	1740	0.87	-68.56
Cowpea	1596	0.81	148	0.07	-90.73
total pulses	13978	7.07	5030	2.52	-64.01
Groundnut	22190	11.23	18177	9.12	-18.08
Sunflower	945	0.48	1502	0.75	58.94
Rape and Mustard	396	0.20	15	0.01	-96.21
Total Oilseeds	23755	12.02	19774	9.92	-16.76
Tomato	2358	1.19	12626	6.33	435.45
Potato	2740	1.39	4369	2.19	59.45
Net Sown Area	197674	100.00	199317	100.00	

Source : Directorate of Economics and Statistics, Govt. of Karnataka, 2022-23

steepest decline at 82.16 per cent, indicating a shift away from traditional or less profitable cereal crops. The total area under cereals and small millets is decreased by 17.22 per cent, reflecting a possible preference shift towards more profitable or resilient crops.

Pulses also saw a significant drop, with the total area under pulses decreasing by 64.02 per cent. Notably, tur (*Cajanus cajan*) and cowpea areas reduced sharply by 76.61 per cent and 90.73 per cent, respectively, likely indicating declining interest or profitability in these crops. However, horse gram showed a 42.25 per cent increase, possibly due to growing demand or favourable climatic conditions for its cultivation (Table 3). Oilseeds, like groundnut, declined by 18.09 per cent and total oilseeds area dropped by 16.76 per cent. Interestingly, sunflower recorded a remarkable increase of 58.94 per cent, potentially due to its adaptability or increasing market demand. The most striking increase was seen in tomato cultivation, with a 435.45 per cent rise, signifying a shift towards high-value horticultural crops. Potato also saw a significant increase of 59.45 per cent, suggesting a diversification trend in crop production within the district. The analysis reveals a trend towards reduced cultivation of traditional cereals, pulses and oilseeds, with an increase in high-value crops like tomato and potato. This shift might be attributed to changing market demands, profitability concerns or adaptive responses to climatic conditions, underlining a gradual transformation in the district's agricultural landscape over the last decade.

Crop Diversification in Chikkaballapur

The level of diversification in the district was attained by finding the Simpson index (SI) value for each taluk in the district and overall district (Table 4). The values of SI indicate the extent of crop diversification, higher the SI values indicates greater diversification, whereas lower the value suggests less diversity. Among the taluks of Chikkaballapur district, the SI value of Chikkaballapur taluk with 0.72 indicates higher diversification

Table 4
Crop diversification in Chikkaballapur

Regions	Simpson Index (SI) Values
Chikkaballapur	0.72
Chintamani	0.68
Bagepalli	0.67
Gauribidanur	0.43
Gudibande	0.49
Sidlaghatta	0.56
Chikkaballapur District	0.63

(varied cropping pattern) and Gauribidanur has scored lowest SI index (0.43) which implies of less varied cropping pattern or mono cropping is followed in the taluk. The Chintamani and Bagepalli taluk SI values were almost similar to the Chikkaballapur with values 0.68 and 0.67, respectively suggesting moderately high cropping pattern or crop diversification. The SI value for Chikkaballapur was 0.63, indicating the diversity in cropping pattern, though the taluks SI values has greater variation. This data highlights that while some regions in the district embrace diversified farming, others are more focused on fewer crops, potentially impacting their economic resilience and adaptability to changing conditions. The results of the papers were also found similar with Thejaswi *et al.* (2022) of moderate to higher crop diversity in the region.

Growth Rate Analysis

The instability and growth of the key agricultural metrics (area, production and productivity) for three cereal crops namely Paddy, Ragi and Maize, over the period from 2015-16 to 2022-23 was analyzed and presented in the Table 5. These metrics are analyzed for their compound annual growth rates (CAGR), mean values, coefficients of variation (CV) and cuddy della valle indices (CDVI), shedding light on the performance, variability and stability of each crop over time.

For Paddy, the results show that while the area under cultivation has expanded significantly at a CAGR of 26.61 per cent, productivity has sharply declined, with a negative growth rate of -18.56 per cent per year. Despite this increase in land use, production has only seen modest growth at 3.10 per cent annually. This suggests in efficiencies in the system, as more land is being cultivated but with declining yields. The CV values for area (99.87%) and production (119.15%) reinforce this instability. The relatively lower CV was observed in the productivity (38.8%) suggests that although yields have declined, they have been more consistent compared to the area and production. The CDVI for production (128.38%) points to high instability, indicating significant year-on-year variations in output (Table 5).

In the case of Ragi data in presented Table 5 indicated that the area under cultivation has decreased slightly, with a negative CAGR of -2.37 per cent. However, both production and productivity have shown positive growth, with productivity increasing by 8.19 per cent annually. This indicates that despite a decrease in land area, farmers have achieved better yields, possibly due to improved agricultural practices or favourable conditions. The low CV for area (13.93%) indicating stable land use over time. However, production has been more volatile, reflected in a higher CV of 48.74 per cent. The CDVI values for area (13.83%) and productivity (42.53%) indicate lower instability, while the CDVI for production (51.38%) suggests higher variability in output, perhaps due to external factors such as market dynamics or climate conditions.

For Maize the trends reveal stagnation (Table 5), with minimal change in the area under cultivation (-0.31% CAGR) and slight growth in production (0.16% CAGR) and productivity (0.46% CAGR). These figures suggest that maize cultivation has remained relatively unchanged, with little improvement in either land use or yields. The CV for productivity (34.42%) points to moderate instability in yields. Maize's CDVI for area (19.38%) reflects low instability in land use, while the CDVI values for production (48.41%) and productivity (37.16%) highlight greater instability, implying that

TABLE 5

Compound annual growth rate for area, production and productivity of major cereal crops in Chikkaballapur district

Crop Year	Paddy			Ragi			Maize		
	Area (Ha.)	Production (MT)	Productivity (Kg/Ha)	Area (Ha.)	Production (MT)	Productivity (Kg/Ha)	Area (Ha.)	Production (MT)	Productivity (Kg/Ha)
2015-16	1333	5194	3896	46946	70952	1511	59377	197230	3322
2016-17	1406	5572	3963	43118	21874	507	53001	77883	1469
2017-18	431	2291	5316	48698	102406	2103	59501	262428	4410
2018-19	584	2781	4762	32348	23875	738	32799	56052	1709
2019-20	506	2430	4802	45808	89838	1961	42731	135360	3168
2020-21	3711	15769	4249	44201	103941	2352	56281	191054	3395
2021-22	6853	28228	4119	44109	62868	1425	53642	133631	2491
2022-23	2959	1049	355	34338	52889	1540	55956	138054	2467
CAGR	0.266 **	0.031 **	-0.186 **	-0.024 *	0.056 *	0.082 *	-0.003 *	0.002 **	0.005 *
Mean	2222.88	7914.25	392.78	42445.75	66080.38	1517.23	51661	148961.5	2803.91
CV (%)	99.87	119.15	38.8	13.93	48.74	42.22	17.95	44.82	34.42
CDVI	88.7	128.38	34.72	13.83	51.38	42.53	19.38	48.41	37.16

Note : * and ** indicate significance level at 1 and 5 per cent respectively

production outcomes are more influenced by external factors. Overall, the analysis reveals that while paddy has seen a significant increase in the area under cultivation, its declining productivity and high instability in production are concerning. Ragi shows a more positive trend, with improvements in yield despite a slight reduction in area and relatively lower instability. Maize has remained largely unchanged, with some instability in production but fairly stable land use. The instability indices (CDVI) highlight that paddy and maize have experienced greater variability in production, whereas ragi has shown more consistent performance over the years. This suggests a need for focused interventions to stabilize production, particularly for paddy and maize and further enhance the productivity of ragi. The growth rate obtained for the crops were in line with works of Ashwini *et al.,* 2021.

The analysis of red gram over the years (2015-16 to 2022-23) reveals a declining trend in both the area under cultivation and production, with negative Compound Annual Growth Rates (CAGR) of -23.29 per cent for area and -26.09 per cent for production. This sharp reduction reflects a significant decrease in the crop's cultivation over time. Productivity, though also showing a decline, has decreased at a slower rate of -3.65 per cent per year, indicating that while less area is cultivated, the yields are slightly more resilient. The coefficients of variation (CV) for area (65.63%) and production (90.54%) further emphasize this instability, suggesting that external factors like climate or market forces may have had a strong impact on red gram cultivation. The Cuddy Della Valle Instability Index (CDVI) for production (62.94%) and productivity (47.82%) corroborates this observation, marking Red Gram as a crop with significant vulnerability and volatility in production patterns, which may make it a risky crop for farmers (Table 6).

For Horse gram, the data form Table 6 reveals a more positive trend compared to Red Gram. Although the area under cultivation has seen a slight decline with a CAGR of -5.54 per cent, production has grown at a CAGR of 4.29 per cent and productivity has increased

TABLE 6

Compound Annual Growth Rate for area, production and productivity of major Pulse crops in Chikkaballapur district

Crop Year	Red gram			Horse gram			Field bean (Avare)		
	Area (Ha.)	Production (MT)	Productivity (Kg/Ha)	Area (Ha.)	Production (MT)	Productivity (Kg/Ha)	Area (Ha.)	Production (MT)	Productivity (Kg/Ha)
2015-16	7682	4094	533	3150	1303	414	4922	4540	922
2016-17	13168	4941	375	849	245	289	5089	3805	748
2017-18	10720	10490	979	3787	3120	824	5668	6311	1113
2018-19	4417	1246	282	5325	1509	283	1360	783	576
2019-20	5149	3654	710	3076	2664	866	2582	2305	893
2020-21	3548	2441	688	1985	1627	820	2314	1559	674
2021-22	3266	1015	311	1662	993	597	2409	1262	524
2022-23	1357	540	398	1404	968	689	1740	915	526
CAGR	-0.233 *	-0.261 *	-0.037 *	-0.055 NS	0.043 **	0.104 NS	-0.144 ***	-0.210 ***	-0.078 **
Mean	6163.38	3552.62	534.39	2654.75	1553.62	597.76	3260.5	2685	746.93
CV (%)	65.63	90.54	45.24	55.31	60.22	40.44	51.72	74.53	28.61
CDVI	32.21	62.94	47.82	58.1	64.47	37.31	38.96	53.33	21.97

Note : *, **, *** and NS indicate significance level at 1, 5, 10 per cent and non-significant respectively

at an impressive rate of 10.41 per cent per year. This indicates that despite a reduction in the area being used for Horse Gram, farmers have been able to achieve much higher yields and output, likely due to improved agricultural practices or better environmental conditions. The CVs for area (55.31%) and production (60.22%) are lower than those for Red Gram, indicating more stability in cultivation and output. Notably, the productivity CV (40.44%) and CDVI (37.31%) suggest that yield performance has been relatively stable, making Horse Gram a more consistent and potentially more reliable crop in terms of productivity. However, the CDVI for production (64.47%) still shows some instability, which could be linked to the fluctuations in cultivation area.

Field Bean (Avare), on the other hand, has shown a more mixed performance, with notable declines across all three parameters: area, production and productivity (Table 6). The area under cultivation has decreased significantly with a negative CAGR of -14.4 per cent, while production has dropped at an even faster rate of -21.04 per cent. Productivity, though declining at a slower pace (-7.76% CAGR), still points to a downward trend in yield. The coefficients of variation for area (51.72%) and production (74.53%) further highlight this instability, suggesting a high degree of unpredictability in the crop's performance. The Cuddy Della Valle Instability Index (CDVI) for production (53.33%) reinforces this, showing substantial year-on-year volatility. However, the CDVI for productivity (21.97%) is comparatively lower, suggesting that while overall cultivation and output are unstable, yields per hectare have shown more consistency. This indicates that while the crop may be cultivated less frequently or in smaller areas, the productivity per unit of area remains relatively stable.

The analysis of Groundnut over the years (2015-16 to 2022-23) reveals a moderate growth in both area under cultivation and production, with Compound Annual Growth Rates (CAGR) of 3.05 per cent for area and 7.34 per cent for production. These results from Table 7 indicated that the cultivation of

TABLE 7

Compound annual growth rate for area, production and productivity of major oilseed and vegetable crops in Chikkaballapur district

Crop Year	Groundnut			Potato			Tomato		
	Area (Ha.)	Production (MT)	Productivity (Kg/Ha)	Area (Ha.)	Production (MT)	Productivity (Kg/Ha)	Area (Ha.)	Production (MT)	Productivity (Kg/Ha)
2015-16	19535	19418	994	2298	31208	13581	3449	41446	12017
2016-17	25565	8765	343	2650	43421	16385	2416	73948	30608
2017-18	17441	21364	1225	2610	52730	20203	2504	44575	17802
2018-19	24982	13083	524	3043	56641	18614	5404	71489	13229
2019-20	25600	27852	1088	1843	31852	17283	6453	89306	13839
2020-21	36388	36235	996	4324	87395	20212	10508	154073	14662
2021-22	29982	28354	946	2645	35773	13525	11134	122239	10979
2022-23	18177	14052	773	4369	81694	18699	12626	127132	10069
CAGR	0.031 *	0.073 **	0.042 **	0.068 *	0.083 *	0.015 *	0.287 **	0.186 **	-0.079 **
Mean	24708.75	21140.38	861	2972.75	52589.25	17312.5	6811.75	90526	15400.59
CV (%)	25.96	43.66	34.48	30.77	41.47	15.36	60.13	44.86	42.8
CDVI	26.85	43.87	36.23	27.95	39.1	16.19	24.94	24.22	37.81

Note : * and ** indicate significance level at 1 and 5 per cent respectively

Groundnut has expanded over time and production has increased at an even faster rate, likely due to favourable market conditions or improvements in agricultural practices. Productivity has also improved modestly at a rate of 4.16 per cent annually. The standard deviation values for area (6415 Ha) and production (9229.32 MT) suggest moderate fluctuations in these variables, while the coefficients of variation (CV) for area (25.96%) and production (43.66%) highlight a degree of instability in the cultivation and output of Groundnut. The Cuddy Della Valle Instability Index (CDVI) for production (43.87%) and productivity (36.23%) indicates that while there is growth, the crop still faces instability, which may pose challenges for sustained increases in production. Despite the overall positive growth, the instability warrants caution for farmers relying heavily on Groundnut as a stable income source.

For Potato, there has been more consistent growth across all parameters, with the area under cultivation increasing at a CAGR of 6.77 per cent, production rising by 8.31 per cent annually and productivity improving slightly by 1.45 per cent. This trend values from Table 7 suggests that Potato has become a more favourable crop in the region over the years, with farmers likely expanding cultivation due to good market demand or favourable climatic conditions. The standard deviation values for area (914.57 Ha) and production (21807.59 MT) show that there are notable variations from year to year. However, the coefficient of variation for productivity (15.36%) and its corresponding CDVI (16.19%) indicate a much more stable yield performance relative to other crops. The moderate CDVI for production (39.10%) shows some instability, but this does not seem to significantly affect the crop's overall performance. Overall, Potato appears to be a relatively stable crop with consistent growth and lower volatility in yield, making it a potentially reliable crop for farmers.

Tomato, on the other hand, presents an interesting case of rapid growth in area and production but a decline in productivity (Table 7). The area under cultivation has grown significantly with a CAGR of 28.71 per cent and production has increased at 18.56 per cent annually. This remarkable expansion is indicative of the growing popularity and potential profitability of Tomato farming. However, despite this strong growth in area and production, productivity has seen a decline at a CAGR of -7.89 per cent, suggesting that yield per hectare has decreased over the years. This could be due to various factors such as over exploitation of land, pest issues, or inconsistent farming practices. The standard deviation for area (4096.12 Ha) and production (40607.88 MT) indicates considerable variability, with a high CV for area (60.13%) and production (44.86%) underscoring the instability in these aspects of Tomato farming. The CDVI values for area (24.94%) and production (24.22%) show moderate instability, but the CDVI for productivity (37.81%) highlights concerns over yield variability. In conclusion, while Tomato farming is expanding rapidly, the decline in productivity and variability in yields could pose risks for long-term sustainability, making it essential for farmers to adopt better management practices to enhance yield performance. In summary, Groundnut and Potato show promising growth with increasing production, but Groundnut faces higher instability, while Potato has relatively stable productivity. Tomato, although experiencing rapid expansion, faces challenges in maintaining productivity, making it a high-risk crop despite its profitability. Farmers should consider these dynamics when making cultivation decisions to balance growth potential with production stability. As indicated by the positive trend of vegetables over the decades by Ashwini *et al.* (2021), this study results also reveals positive growth annually.

The study reveals dynamic changes in the cropping patterns of Chikkaballapur district, reflecting farmers' adaptive responses to climatic variability, market opportunities and policy interventions. Traditional cereals such as Paddy, Maize and Ragi continue to play a crucial role, but the declining productivity of Paddy and the stagnation in Maize cultivation warrant strategic interventions. Pulses, particularly Horse Gram, show potential for improvement, whereas crops like Red Gram and Field Bean face significant challenges. The expansion of high-value horticultural

crops like Tomato and Potato highlights the shift towards market-oriented farming, despite challenges such as declining Tomato productivity. Groundnut and Potato emerged as relatively stable crops, offering scope for sustained growth. However, the high instability observed in many crops underscores the importance of enhancing resilience through improved farming practices, technological adoption and effective resource management. This study advocates for a balanced approach that supports crop diversification, ensures food security and promotes sustainable agricultural development in the region. These findings have enabled author to better understand the regional dynamics and develop an efficient crop optimization model.

REFERENCES

ANONYMOUS., 2015, FRE Report (2015-16). Directorate of Economics and Statistics, Government of Karnataka, pp. : 171.

ANONYMOUS, 2016, FRE Report (2016-17). Directorate of Economics and Statistics, Government of Karnataka, pp. : 172.

ANONYMOUS, 2017, FRE Report (2017-18). Directorate of Economics and Statistics, Government of Karnataka, pp. : 172.

ANONYMOUS, 2018, FRE Report (2018-19). Directorate of Economics and Statistics, Government of Karnataka, pp. : 172.

ANONYMOUS, 2019, FRE Report (2019-20). Directorate of Economics and Statistics, Government of Karnataka, pp. : 172.

ANONYMOUS, 2020, FRE Report (2020-21). Directorate of Economics and Statistics, Government of Karnataka, pp. : 172.

ANONYMOUS, 2021, FRE Report (2021-22). Directorate of Economics and Statistics, Government of Karnataka, pp. : 172.

ANONYMOUS, 2022, FRE Report (2022-23). Directorate of Economics and Statistics, Government of Karnataka, pp. : 171.

ASHWINI, M. AND LOKESHA, H., 2021, Growth dynamics of food grains in eastern dry zone of Karnataka - An economic analysis. *Mysore J. Agric. Sci.,* **55** (4) : 20 - 27.

BELLUNDAGI, V. AND UMESH, K. B., 2016, Growth, instability and total factor productivity of ragi finger millet in Karnataka. *Mysore J. Agric. Sci.,* **50** (2) : 213 - 217.

BIRTHAL, P. S., JOSHI, P. K., ROY, D. AND AMIT, T., 2007, Diversification in Indian agriculture towards high-value crops: the role of smallholders. *Land Use Policy*, **91** : 1 - 15.

KUMAR, S. M. AND UMESH, K. B., 2017, Dynamics of cropping pattern and crop diversification in southern dry zone of Karnataka - An economic analysis. *Mysore J. Agric. Sci.,* **51** (2) : 233 - 239.

THEJASWI KUMAR, J., 2022, Spatio-temporal dynamics of crop diversification in Karnataka: An economic analysis. *Ph.D. Thesis* (Pub.), University of Agricultural Sciences, Bangalore.