

**RESEARCH ARTICLE :**

Growth performance of cereals in Karnataka : A district wise analysis

■ M.G. SAVITHA AND L.B. KUNNAL**ARTICLE CHRONICLE :****Received :**

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SUMMARY : The study examined the trend in growth rates of major cereals viz., maize, paddy, sorghum and wheat in Karnataka by using the compound growth rate function. For an in-depth analysis of trend and growth rates in area, productivity and production of cereals, major 5 districts for each crop based on the highest area were selected for the study. The necessary secondary data were collected for a period of 15 years from 1998-99 to 2012-13. The growth of area of total cereals showed a substantial annual decrement. Further, the production and productivity of the total cereals were recorded a positive annual increment. The area under paddy, maize and wheat has recorded a mild annual increment where as jowar registered a significant negative growth in the state as a whole.

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Compound growth rate, Cereals, Area, Production, productivity

BACKGROUND AND OBJECTIVES

In the world of today, cereal grains have been considered as the principal component of human diet for thousands of years and have played a major role in shaping human civilization. Around the world rice, wheat and maize and to a lesser extent, jowar and millets are important staples critical to daily survival of billions of people. Today, cereal grains are the single most important source of calories to a majority of the world population.

Agriculture is the backbone of Indian economy as more than 65 per cent of the population is directly or indirectly depends on agricultural activities and contributes nearly 32 per cent of the national income. The agriculture and other allied activities contribute

significantly to the gross domestic Product (GDP), accounting for nearly 16 per cent of the total GDP. It provides employment to around 69 per cent of the total work force while contributing 18 per cent of the total export. India, with only 2.3 per cent of world's total land area supports 18 per cent of human and 15 per cent of livestock population in the world. The country has made an impressive progress on the food front, which has resulted in increased production of food grains.

Karnataka is endowed with varied agro-ecology, agro-climate, biodiversity, soils and climate conditions across the state. Its economy, particularly agricultural economy is experiencing significant changes for the past three decades. Agriculture sector in the state registered a growth of 4.5 per cent during the

Author for correspondence :**M.G. SAVITHA**

Department of
Agricultural Economics,
College of Agriculture,
University of
Agricultural Sciences,
DHARWAD (KARNATAKA)
INDIA
Email: mgsavithaecon@gmail.com

See end of the article for
authors' affiliations

period 2012-13 (Anonymous, 2012). Despite declines in its contribution to GDP, it still continues to be the major sector in terms of its contribution to employment creation, export earnings and supply of raw materials to various industries in the state.

A large proportion of the cultivated area in the state is devoted to the production of principal crops. They are paddy, maize, redgram, groundnut, cotton, etc. Of the total cultivated area of the state, about 33 per cent is covered by cereals, 42 per cent by pulses, 19 per cent by oil seeds and 6 per cent by commercial crops. Among all the food grains, cereals occupy important place both with respect to domestic and international trade. Among cereals rice, maize, jowar and wheat are considered to

be important, as these crops cover major portion of cereals with respect to area and production in the state.

The total food grain production in the state has increased from 99.97 tons during 1998-99 to 117.37 lakh tones during 2011-12. The state has large arable area under different crops having potential to increase further. It has paddy area of 12.78 lakh hectares, ragi area of 6.45 lakh hectares, jowar area of 12.63 lakh hectares, bajra area of 2.74 lakh hectares, maize area of 13.21 lakh hectares, wheat area of 2.25 lakh hectares, minor millets area of 0.21 lakh hectares making a total cereal area of 50.27 lakh hectares. In view of the importance of cereals, an attempt has been made in this study to analyse the growth in area, production and productivity

Sr. No.	Districts	Maize	Paddy	Jowar	Wheat	Total cereals
1.	Bagalkote	79594	93	112423	23763	257703
2.	Bengaluru - Urban	852	1620	255	0	26980
3.	Bengaluru - Rural	11800	1425	0	5	56598
4.	Belagavi	146226	66824	140615	48515	453842
5.	Bellary	102087	118665	43253	749	290868
6.	Bidar	1867	5452	73023	7221	99690
7.	Vijayapura	76711	85	196801	53999	386734
8.	Chamarajanagar	35462	15649	19941	0	90805
9.	Chickballapur	53667	6168	1687	0	95795
10.	Chikmagalur	19348	42474	7992	1	117728
11.	Chitradurga	102876	7830	21402	760	182039
12.	Dakshina Kannada	9	54668	0	0	54907
13.	Davanagere	180612	134908	17757	691	357812
14.	Dharwad	40243	27163	46254	41678	158886
15.	Gadag	51042	1876	67863	31054	151362
16.	Kalaburgi	6904	4356	207081	15163	327918
17.	Hassan	66267	49969	2898	0	192421
18.	Haveri	149465	50432	34541	937	220785
19.	Kodagu	3627	33672	0	0	38634
20.	Kolar	743	6252	0	0	64231
21.	Koppal	52404	77029	50091	6707	244955
22.	Mandya	4773	68250	295	0	147790
23.	Mysore	34568	111711	9992	0	220585
24.	Raichur	783	156388	102956	2399	323793
25.	Ramanagar	2499	7641	0	0	83932
26.	Shivamogga	65426	128228	385	1	198745
27.	Tumkur	24301	25967	1321	0	229398
28.	Udupi	22	54427	0	0	56415
29.	Uttara Kannada	4403	76350	11	0	82762
30.	Yadgir	570	75800	55091	1526	159704
	State Total	1319151	1411372	1213931	235167	5373816

Source: Directorate of Economics and Statistics

of major cereals crops viz., paddy, maize, jowar and wheat in Karnataka.

RESOURCES AND METHODS

Karnataka state which is one of the major cereals growing state in the country was purposively selected for the study. The cereal crops grown in Karnataka are paddy, jowar, bajra, maize, ragi and wheat. Among cereals the highest area is under maize followed by paddy jowar, and wheat with an area of 20.37 lakh ha, 14.11 lakh ha, 12.11 lakh ha and 2.35 lakh ha, respectively (Triennium average - 2010-2012). Hence, these cereals were selected for the present study. For an in-depth analysis of trend and growth rates in area, yield and production of cereals, major 5 districts for each crop based on the highest area were selected for the study (Table A).

– Paddy : Raichur, Shivamogga, Mysore, Bellary and Davangere.

– Jowar : Kalaburagi, Vijayapura, Belagavi, Bagalkot and Raichur.

– Maize : Davangere, Belagavi, Haveri, Bellary and Chitradurga.

– Wheat : Vijayapura, Belagavi, Dharwad, Gadag and Bagalkot.

The analysis covers the time series secondary data with respect to area, production and productivity of major cereals crops like maize, paddy, jowar, and wheat in major districts of the crops and Karnataka state as a whole. The study period for the objective was confined to a total duration of 15 years viz., 1998-2012. Data used for the study were collected from various published sources from the Directorate of Economics and Statistics (DES), Bangalore, Karnataka.

The growth in the area, production and productivity under different crops was estimated using the compound growth function of the form:

$$Y_t = ab^t e^{u_t}$$

where,

Y_t = Dependent variable in period t (Area/Productivity/Production)

a = Intercept

b = Regression co-efficient = (1+g)

t = Years which takes values, 1, 2, ..., n

u_t = Disturbance term for the year t

The equation was transformed into log linear form for estimation purpose. The compound growth rate (g) in percentage was then computed using the relationship $g = (10^b - 1) * 100$. The standard error of the growth rate was estimated and tested for its significance with 't' statistic.

OBSERVATIONS AND ANALYSIS

The compound growth rates of area, production and productivity of major cereals crop viz., maize, paddy, jowar and wheat during the period from 1998-99 to 2012-13 for major crop districts and the Karnataka state as whole were computed and presented crop wise as follows:

Maize:

Growth in area, production and productivity of maize crop during the last 15 years (1998-99 to 2012-13) is presented in Table 1. The average area under maize in the state as a whole was 9.17 lakh ha and average production was 25.49 lakh tons with an average productivity of 2.89 tons/ha. It could be observed that growth rate of maize area in Davangere (3.89%), Haveri (6.49%), Belagavi (3.37%) and Chitradurga (8.14%) was positive and significant. The state as a whole registered a significant increase in maize area (7.60% per annum) during the study period. The rapid expansion in area under this crop was mainly due to its important features like short duration, adaption to a wide range of

Table 1 : Compound growth rates of area, production and productivity of maize in selected districts of Karnataka

Sr. No.	Major districts	Area			Production			Productivity		
		Mean area (lakh ha)	C.V. (%)	CGR (%pa)	Mean production (lakh tons)	C.V. (%)	CGR (%pa)	Mean productivity (kg/ha)	C.V. (%)	CGR (%pa)
1.	Davangere	1.52	18.33	3.886**	4.29	33.7	4.21	2924	31.53	0.641
2.	Haveri	1.26	20.46	6.492**	3.53	36.79	6.841**	2952	19.16	0.342
3.	Belagavi	1.17	28.39	3.379**	2.96	36.96	6.667**	2685	28.91	1.758
4.	Chitradurga	0.73	33.91	8.145**	2.08	28.04	8.726*	3002	24.62	-2.594
5.	Bellary	0.63	39.66	8.195	1.32	52.84	2.558	2364	37.78	-3.382**
	Karnataka	9.17	32.65	7.609	25.49	37.87	7.863**	2896	14.84	0.236

Note : ** and * indicate significance of value at P=0.01 and 0.05, respectively

soils and climatic conditions and high yield per hectare as compared to other cereal crops. Maize yield has been increasing at the rate of 0.23 per cent per annum. But in the major maize growing districts like Chitradurga (-2.59 %) and Bellary (-3.38 %), the growth in yield exhibited declining trend. However, Chitradurga district showed highest and significant annual growth rate (8.72 %) in production followed by Haveri (6.80 %) and Belagavi district (6.60 %). In the state as a whole maize production showed a significant positive growth rate of 7.86 per cent per annum. Similar trend was reported by Sinha and Thakur (1993) who observed an increasing trend in yield level in their study.

Paddy :

The compound growth rates of area, production and productivity of paddy are computed for the selected districts and for Karnataka State as a whole. Rice is one of the important staple food crops grown in the state. It is cultivated under irrigated conditions and assured rainfall situation. From the Table 2, it could be seen that the average area under rice in the state is 13.90 lakh ha. The area under rice has witnessed a marginal annual increment of 0.32 per cent per annum. Among the major crop districts, positive and significant growth rate of area

was observed in Bellary district (4.82 %) and no significant growth of area was observed in Raichur, Davangere, and Mysore districts which saw the growth at the rate of 2.78, 1.95 and 0.73 per cent per annum, respectively. But a negative and significant growth rate of area was observed in Shivamogga district (-1.54 %). The average annual production of rice in the state is around fifty lakh tones. The growth in rice production in the state is meager around 0.93 per cent per annum and for the selected major crop districts it was found to be positive. The rice productivity in the state is hovering around 4.01 tonnes per ha. The rice productivity in the state witnessed an annual growth of 0.09 per cent per annum. However, growth rate of productivity was found to be positive for Shivamogga district (1.22 %) but it was negative and non significant for remaining other districts. Thus, the growth in the production of rice in these districts has come mainly from the growth in the rice area than from the growth in productivity (Narala and Zala, 2010).

Jowar :

From the Table 3 it could be seen that the average area under jowar in the state is 15.54 lakh ha. The area under jowar in the selected districts viz., Kalaburagi,

Table 2 : Compound growth rates of area, production and productivity of paddy in selected districts of Karnataka

Sr. No.	Major districts	Area			Production			Productivity		
		Mean area (lakh ha)	C.V. (%)	CGR (%pa)	Mean production (lakh tons)	C.V. (%)	CGR (%pa)	Mean productivity (kg/ha)	C.V. (%)	CGR (%pa)
1.	Raichur	1.39	22.31	2.778	5.83	31.90	2.011	4599	11.72	-1.246
2.	Davangere	1.14	22.11	1.948	5.45	36.76	2.126	5306	11.54	-0.446
3.	Shivamogga	1.37	9.39	-1.543**	4.51	28.18	0.119	3642	17.44	1.218
4.	Bellary	0.95	26.17	4.828**	4.38	46.95	8.197	5284	11.08	-0.23
5.	Mysore	1.11	13.30	0.729	4.65	28.82	0.769	4670	9.88	-0.535
	Karnataka	13.90	9.53	0.32	50.57	28.43	0.93	4019	12.47	0.09

Note : ** and * indicate significance of value at P=0.01 and 0.05, respectively

Table 3 : Compound growth rates of area, production and productivity of jowar in selected districts of Karnataka

Sr. No.	Major districts	Area			Production			Productivity		
		Mean area (lakh ha)	C.V. (%)	CGR (%pa)	Mean production (lakh tons)	C.V. (%)	CGR (%pa)	Mean productivity (kg/ha)	C.V. (%)	CGR (%pa)
1.	Kalaburgi	1.41	15.91	-4.158**	1.29	33.71	-1.154	982	35.88	3.133**
2.	Vijayapura	1.74	23.02	-4.105**	1.54	27.29	-1.415	989	32.88	2.806
3.	Belagavi	2.53	22.18	-2.83	2	25.65	-0.597	841	25.03	2.297
4.	Bagalkote	2.98	21.53	-3.101**	2.45	19.95	-0.597	882	17.78	4.386
5.	Raichur	1.38	25.94	-5.216	1.25	25.08	-0.961	993	32.74	4.489*
	Karnataka	15.54	16.96	-3.63	12.56	30.15	3.567	939	20.34	2.294

Note : ** and * indicate significance of value at P=0.01 and 0.05, respectively

Vijayapura and Bagalkote showed a negative and significant decrease and state as a whole has registered a negative growth of -3.63 per cent per annum during the study period. The fluctuation in area under jowar was about 16.96 per cent. The production of jowar recorded a negative growth rate in all the selected districts but positive growth rate with respect to state as a whole at the rate of 3.36 per cent per annum. The productivity of jowar in the state recorded a slight positive growth (2.29 %) during the study period. Among the selected districts, positive and significant growth rate of productivity was observed in Kalaburagi (4.82 %) and Raichur district (4.48 %). The wide spread use of high yielding varieties coupled with irrigation and fertilizer application led to increase in productivity. Similar trend was reported by Hiremath and Patil (2003) and Maheshwari (1996) on the growth rate of productivity in their study.

Wheat :

From the Table 4, it is apparent that for state as whole wheat has shown negative annual growth in area of -0.46 per cent. Among the selected districts cultivating wheat, there was a significant decrease in area under Gadag district at the rate of -0.97 per cent per annum

followed by Belagavi (-0.12 %) and Dharwad (-0.19 %) but the decrease was statistically not significant. Despite a fall in area, Gadag district registered a negative growth in production at -2.50 per cent per annum. However, highest growth in production was observed in Dharwad (4.15 %) and Vijayapura (1.78 %). In the state as a whole wheat production showed a positive growth rate of 1.44 per cent per annum with a mean production of 2.17 lakh tons. The fluctuation in growth of production in the state was 23.76 per cent. On the other hand, compound growth rates of wheat productivity were found to be negative for Bagalkote district at the rate of -0.207 per cent per annum. However, growth rate of productivity was found to be higher and positive for Dharwad district (4.35 %), but it was comparatively lower for state as a whole (1.92 %). More or less similar results were reported by Acharya *et al.* (2012) in their study.

Total cereals :

The average area under total cereals in the state during the study period was 53.13 lakh ha (Table 5). The fluctuation in the area under total cereals in the state appeared to be low as the co-efficient of variation was 4.93 per cent. The growth in area under total cereals in the state has recorded a mild annual decrement (-0.35

Table 4 : Compound growth rates of area, production and productivity of wheat in selected districts of Karnataka

Sr. No.	Major districts	Area			Production			Productivity		
		Mean area (lakh ha)	C.V. (%)	CGR (%pa)	Mean production (lakh tons)	C.V. (%)	CGR (%pa)	Mean productivity (kg/ha)	C.V. (%)	CGR (%pa)
1.	Vijayapura	0.23	12.39	0.98	0.33	21.61	1.783	1489	14.38	0.795
2.	Belagavi	0.56	13.53	-0.123	0.6	27.02	0.018	1126	19.22	0.143
3.	Dharwad	0.57	20.08	-0.191	0.48	31.76	4.154	873	17.69	4.353
4.	Gadag	0.41	10.27	-0.976**	0.24	39.29	-2.502	643	40.46	1.746
5.	Bagalkote	0.35	7.14	0.702	0.26	95.28	0.496	589	37.21	-0.207
	Karnataka	2.55	7.05	-0.465	2.17	23.76	1.448	892	20.72	1.922

Note : ** and * indicate significance of values at P=0.01 and 0.05, respectively

Table 5 : Compound growth rates of area, production and productivity of total cereals in selected districts of Karnataka

Sr. No.	Major districts	Area			Production			Productivity		
		Mean area (lakh ha)	C.V. (%)	CGR (%pa)	Mean production (lakh tons)	C.V. (%)	CGR (%pa)	Mean productivity (kg/ha)	C.V. (%)	CGR (%pa)
1.	Belagavi	4.56	8.03	-0.433	6.9	27.36	2.827	1556	26.8	2.461
2.	Vijayapura	4.2	13.32	-1.410	3.93	27.43	3.406	993	28.14	4.931**
3.	Davangere	3.28	9.28	1.010	9.05	24.07	2.747	2799	20.47	0.636
4.	Kalaburagi	4.3	22.59	-4.559**	4.37	27.63	-1.708	1088	19.88	3.304**
5.	Raichur	3.41	9.75	-1.357*	5.78	20.12	1.882	1744	19.7	2.363*
	Karnataka	53.13	4.93	-0.356	93.2	18.40	2.109	1847	16.84	2.582*

Note : ** and * indicate significance of values at P=0.01 and 0.05, respectively

% per annum) and also in selected districts except increase in area in Davangere (1.01 %). It could be observed that growth rate of total cereals production showed a positive trend in selected districts except decrease in Kalaburagi district (2.1 %). The state is producing 93.2 lakh tonnes of cereals. The growth in the cereals output in the state is around 2.10 per cent per annum with a fluctuation of 18.40 per cent. Accordingly the productivity of total cereals showed increasing trend as indicated by their positive growth rates in case of all selected districts excluding Kalaburagi district and at state level. Among the major total cereals growing districts Vijayapura showed highest and significant growth rate of 4.93 per cent followed by Kalaburagi (3.30%) and Raichur (2.36%). Belagavi and Davangere showed a meagre growth of 2.46 per cent and 0.63 per cent per annum, respectively. The state as a whole registered an annual increment of 2.58 per cent growth in the productivity of total cereals. Notable achievements were made on the fronts of production and yield growth. Overall growth in production and yield of total cereals was commendable. Its production registered annual growth rate of 2.1 per cent per annum which was mainly contributed by growth in yield (Meenakshi and Gayathri, 2006, Dashora *et al.*, 2000 and Vani and Vyasula, 1996).

Summary and conclusion :

The above discussion highlighted the fact that the growth of area of total cereals showed a substantial annual decrement. However, the production and productivity of the total cereals were recorded a positive annual increment. The area under paddy, maize and wheat has recorded a mild annual increment. Therefore, it is necessary that measures should be taken to reverse the decreasing trend in area under most of the cereals in order to ensure food requirement in the state. Thus, there is a need to take up productivity enhancing measures in these crops like varietal improvement, improved cultural practices, distribution of planting materials, disease control measures, and selection of appropriate crop according to agro climatic conditions and irrigation facilities. The extension of cultivable land can be accomplished only by investing more in irrigation – oriented activities.

Increasing the area under total cereals cultivation can be achieved by policy initiations of government. The agriculture extension programmes have not been able to have a significant effect on expansion under cereals area. The government policies should strengthen the extension machinery to improve farmer's practices through extension service and training programmes, so that farmers can apply available agricultural technology more efficiently.

Authors' affiliations :

L.B. KUNNAL, Department of Agricultural Economics, University of Agricultural Sciences, DHARWAD (KARNATAKA) INDIA

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