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Growth, instability and sources of output growth of ginger in Karnataka- An analysis

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Abstract

The present study was undertaken to examine the growth and instability of area, production and productivity of ginger in the state with a special focus on Bidar district of Karnataka. The findings of the study have shown that both growth in area and yield of ginger in Karnataka were positive for study period. However, instability in area, production and productivity was found to be high in period II (2010-11 to 2019-20) compared to period I (2000-01 to 2009-10). For overall period, the instability was categorized as high for area, production and yield of ginger in Karnataka. Further, analysis indicates that area is the contributing factor for output growth rather that yield and interaction effect. For several decades, about 70-80 per cent the area under ginger cultivation in the state is dominated by varieties Rio- de – janero, Himagiri and Humnabad local. This suggests that there is significant scope for varietal improvement of ginger. Also, anecdotal evidence indicates that there is significant crop loss due to soft rot disease, inadequate management practices, biotic and abiotic factors leading to high instability in production.

Keywords: Instability, output growth, ginger, decomposition, Karnataka

Introduction

India's produces a wide variety of high-quality spices and its contribution to world trade in spices is about 20-25 per cent and hence is referred to as "spice bowl of the world". According to the Bureau of Indian Standards (BIS), India produces about 63 different spices (Lokesha, 2018). Spice crops are grown in almost all agroclimatic regions

of the country and ginger is one of the major spices produced in the country. It is a popular spice widely used for culinary purpose and for a variety of flavoring applications and medicinal purposes.

Despite having its origins in tropical South East Asia, it is also commonly grown in Nigeria, Australia, Jamaica, Hawaii and India. The world production of ginger increased from 1,15,884 tonnes in 1972 to 4.9 million tonnes in 2021 growing at an average annual growth rate of 8.41 per cent (Knoema, 2023). The top five countries producing ginger are India, Nigeria, China, Nepal, and Indonesia and these countries together account for 85 per cent of global production (Joshi & Khanal, 2021). As of 2022-23, the production of ginger in India was 2202 thousand metric tonnes accounting for 59.3 per cent of global ginger production (Spices Board, 2022).

In India, ginger is cultivated in most of the states with a cultivated area of over 190 thousand ha and yield of 11.9 tonnes per hectare. Madhya Pradesh, Karnataka, Odisha, Assam, and West Bengal together contribute 62 per cent to the country's total ginger production (Spices Board, 2022). Madhya Pradesh has the highest production of ginger in India accounting for about 25 per cent of the all-India production while Karnataka is the second highest producer with a share of 12 per cent.

In Karnataka, ginger is cultivated in an area of 24,963 ha and is mainly grown in the districts such as Uttara Kannada, Dakshina Kannada, Hassan, Shivamogga, Chikkamagaluru, Udupi, Kodagu and Mysuru. Among the spices grown in Karnataka in an area of 332 thousand ha during 2021, ginger has the third highest area with a share of 12 per cent of area under spices crop (GoK, 2021). Ginger, available in different forms such as raw ginger, dry ginger, bleached dry ginger, ginger powder, *etc.* is in high demand for exports. Karnataka is one of the major exporters of ginger apart from the states of West Bengal, Kerala and Maharashtra. Under the Pradhan Mantri Formalization of Micro Food Processing Enterprise Scheme (PMFME), of Government of India, it is intended to accelerate economic growth, generate employment and promote rural entrepreneurship through promotion of one district one product approach (ODOP) to realize the true potential of the district (GoI, 2022). Under ODOP scheme, ginger in Bidar district in Karnataka has been identified for ginger production and promotion. Also, the crop is cultivated extensively across the districts in the state as it provides higher profits compared to other crops grown across those regions. However, the area, production and productivity of ginger has been fluctuating over the years due to various factors. It is in this backdrop, the present study was undertaken to examine the growth and instability of area, production and productivity of ginger in the state with a special focus on Bidar district. The study also attempts to quantify the contribution of area, yield and their interaction to growth in production of ginger in Karnataka.

Materials and methods

The data on area, production and yield of ginger in Karnataka was collected from

different published secondary sources such as Horticulture Statistics at a Glance, Directorate of Economics and Statistics, Government of Karnataka and National Horticulture Board for the period 2000-01 to 2019-20. For a meaningful comparison, the study period was divided into two, *viz.* Period I from 2000-01 to 2009-10 and Period II from 2010-11 to 2019-20. Compound annual growth rates, test of significance and Cuddy Della Vella Index (CDVI) were used to measure growth and instability of ginger production while a simple decomposition model was used to quantify the influence of area, yield and interaction effect of area and yield on output growth.

Compound annual growth rate

The compound annual growth rate (CAGR) of area, production and yield of ginger was estimated by using the exponential growth function of the form $Y_t = ab^t$

Where, Y_t = dependent variable to be estimated (area, production, yield) at time period t, a is the intercept, b is the parameter to be estimated where b = (1+r) where 'r' is the rate at which Y grows every year with respect to its value in the preceding year.

The equation was converted after logarithmic transformation into linear form as follows;

Log Y_t = Log a+ t Log b.

The CAGR was obtained as [(antilog of b) - 1] x 100

Instability index

To measure the instability in area, production and yield of ginger, Cuddy Della Vella Index (1978) was computed for three periods, *ie.*, 2000-2001, 2001-2021 and overall period of 2000-2021. The Cuddy Della Vella Index (CDVI) is an enhancement over widely used coefficient of variation method to measure instability in a time series data. The CDVI de-trends and shows the exact direction of instability.

CDVI = $\boldsymbol{Instability\ index = CV * \sqrt{(1 - R^2)}}$

Where CV the coefficient of variation (CV) expressed in percent and R^2 is the coefficient of determination from a time trend regression adjusted by the number of degrees of freedom. The index of instability was categorized as low level (0 to 15), medium level (15 to 30) and high level (above 30).

Decomposition of output growth

It is generally understood that change in area under the crop in question and its yield go on to determine the output. The sources of production growth were examined by using the decomposition model proposed by Sharma (1977) and relative contribution of area, yield and their interaction effect to the total output change in ginger was worked out as follows:

$P_n - P_0 = (Y_n - Y_0) A_0 + (A_n - A_0) Y_0 + (Y_n - Y_0) (A_n - A_0)$

$\Delta P = (\Delta Y_n) A_0 + (\Delta A_n) Y_0 + (\Delta Y) (\Delta A)$

Where, P, A and Y represents production, area and yield. 0 and n represent time periods such that n > 0 by an accounting period which is usually a single year.

$A_0 * \Delta Yn$ = Yield effect; $Y_0 * \Delta A_n$ = Area effect; $\Delta A * \Delta Y$ = Interaction effect

Results and discussion

The CAGR of area, production and yield of ginger across districts having highest area under ginger in Karnataka was disaggregated for different periods and presented in Table 1. In the period I, positive and high growth rates in ginger acreage was observed in the districts of Hassan, Uttara Kannada, Mysuru, Shivamoggga, Chikkamagaluru and Bidar, while negative growth rates were observed for Kodagu and Haveri districts. During period II, the growth rates were positive and low for Bidar and Chikkamagaluru districts and negative growth rates was observed in the districts of Hassan, Kodagu and Shivamogga. Though the districts of Hassan and Shivamogga showed positive growth rates in area during period I, the growth rate was negative in period II. However, during both the periods and for overall Karnataka the CAGR for area under cultivation of ginger was positive and, on an average, grew at 11.3 per cent.

The districts of Hassan, Haveri and Kodagu showed negative CAGR for production as the area under ginger cultivation declined with negative growth rate. However, in Shivamogga, though the growth rate was negative for area during period II, the growth rate for production was positive indicating yield as a contributing factor for increase in production of ginger in the district. Both for period I & II, yield of ginger showed positive growth rates across all the districts. Highest yield growth rate was observed for the district of Mysuru followed by Chikkamagaluru, Hassan and Kodagu which were in the range of 11 per cent.

Positive growth rate was observed for area, production and yield of ginger in Karnataka as a whole during period I. However, the growth in production was the highest (30.90%) in period I while the growth rate of both production and yield were negative in period II with -1.46 per cent and -2.56 per cent respectively. Though, positive growth rates were observed for both production and productivity in all the years of period II, the CAGR for overall Karnataka was negative. This is due to high year to year fluctuations observed in production caused by dynamic factors such as disease, price, market and climatic factors which influence ginger cultivation. However, for the overall period, the growth rates of area, production and yield of ginger was positive for the state of Karnataka with production registering 11.30 per cent CAGR. The yield growth rate was marginally high compared to area and hence varietal improvement in ginger could have contributed to increase in yield. However, during period II though there was decline in production and yield of ginger while the area expanded which could be attributed to increase in prices and demand for ginger. Similar findings were observed by Singh *et al*. (2022) on growth and instability of ginger and turmeric in North Eastern region of India.

Table 1. Growth rate of area, production and yield of ginger in Karnataka (%)

District	Period I			Period II			Overall period		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
Bidar	2.16	13.24	10.85	0.08	14.66	14.57	0.82	2.32	1.49
Chikkamagaluru	5.52	17.55	11.40	2.29	15.87	13.28	3.18	6.48	3.20
Uttara Kannada	24.76	38.26	10.82	2.35	16.00	13.33	17.26	20.32	2.61
Hassan	45.71	61.88	11.10	-13.46	-2.81	12.30	9.00	12.13	2.87
Haveri	-11.63	-4.08	8.55	34.91	53.83	14.03	15.78	19.33	3.07
Kodagu	-4.87	5.92	11.35	-11.96	-6.13	6.62	-9.29	-7.31	2.18
Mysuru	11.40	25.03	12.23	10.54	25.78	13.78	14.68	18.28	3.14
Shivamogga	6.47	13.14	6.27	-4.28	6.90	11.68	6.19	7.21	0.96
Overall Karnataka	19.28	30.90	9.87	1.01	-1.46	-2.56	5.11	11.30	5.97

Note: Area was measured in hectare, production in metric tonnes and yield in tonnes/hectare

Instability indices of area, production and yield of ginger in Karnataka

In order to assess the consistency of growth performance, instability analysis was carried out for the three periods and the findings are presented in Table 2. The lowest variability for area was observed in Kodagu, Haveri, Bidar, Shivamogga, Chikkamagaluru districts for all the periods and were in the range of 16.93 per cent to 29.68 per cent and hence was categorized as medium. However, the variability in yield was observed to be high for period II for all the districts chosen for the study. The variability in productivity of ginger in period I was moderate except for Shivamogga (19.93%) while in period II, the variability was high (51.12- 61.4%) across all the districts in Karnataka with highest variability observed in Shivamogga (62.16%). Between period I and II, the instability in yield was categorized as high for period II and medium for period I. Some of the probable reasons for instability in yield could be due to non-availability of varieties, poor management practices and low adoption of disease management strategies and other biotic and abiotic factors. Since the last three decades, about 70-80 per cent of the area under cultivation is dominated by Rio- de – janero, Himagiri and Humnabad local varieties of ginger (Jayashree *et al.,* 2014). However, the high variability in yield of ginger might be due to crop loss (production) due to diseases such as soft- rot, poor management practices and fluctuations in rainfall and other climatic factors

The variability in area was categorized as medium for both period I & II in Karnataka. However, the variability was low in period I compared to period II. Some of the probable reasons for low variability in area compared to production and yield could be due to assured price, profitability of ginger cultivation and ginger cultivation is not

rainfall dependent. For the overall period, for majority of the districts, the instability index was between moderate to high when compared to period I & II.

Decomposition of output growth of ginger in Karnataka

In order to provide an empirical support for designing policies to improve the pace of agriculture growth, a better understanding of different sources of growth and their magnitude is of prime importance (Joshi and Khanal, 2021). Further, it also provides direction of changes in yield and area and general pattern of output growth. Table 3 depicts decomposition of ginger output growth into area effect, yield effect and interaction effect. The relative contribution of area, yield and their interaction to changes in output of ginger has been discussed below.

Table 2. Instability indices of area, production and productivity of ginger in Karnataka (%)

District	Period I			Period II			Overall period		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
Bidar	20.52	42.67	28.37	34.85	62.12	51.12	28.73	60.96	47.78
Chikkamagaluru	70.03	46.50	29.61	18.64	63.95	56.33	48.91	59.69	49.85
Uttara Kannada	76.71	104.44	28.35	28.06	49.83	57.12	42.14	66.53	49.66
Hassan	76.80	108.51	28.23	59.80	84.68	58.15	93.95	119.92	50.49
Haveri	26.60	32.54	34.60	30.06	67.04	53.69	70.29	97.23	48.23
Kodagu	16.93	20.78	31.29	31.17	67.30	61.40	22.10	47.57	53.70
Mysuru	58.16	81.07	34.84	35.99	48.86	59.82	46.51	58.18	54.07
Shivamogga	28.54	50.70	19.93	12.20	67.02	62.16	29.68	67.35	47.77
Overall Karnataka	36.32	72.37	29.23	49.02	127.39	79.21	44.13	134.53	82.80

During period I, output growth was primarily due to yield in all the major districts. The yield effect was the highest in Haveri (461.73%) and lowest in Hassan (1.63%). The area effect was negative in the districts of Chikkamagaluru, Haveri and Kodagu. However, during period I in Karnataka, area, yield and interaction were positive but the contribution of area (36.59%) was more than the yield effect (15.20%). In period II, except for Hassan and Kodagu the yield effect was positive in all the other districts. The highest yield effect was registered in the districts of Shivamogga (173.14%). However, in Kodagu district, the contribution of area was more than that of yield during period II with area effect of 1174.44 per cent. For Karnataka, in period II, yield and area had near equal contribution to total change in output growth.

For the overall period the area effect was negative in Chikkamagaluru, Hassan, Haveri and Mysuru while the yield effect was negative only in the district of Shivamogga. The highest yield effect was observed in the district of Chikkamagaluru. In Karnataka as a whole, only the area effect

was positive (162.54%) while the yield and interaction effect were negative. Hence, it was found that area effect is the major contributing factor for output growth of ginger compared to yield and interaction effect. Increasing demand for ginger and subsequent increase in prices could be the primary reason for expansion of area under ginger in the state.

Table 3. Decomposition of production growth of ginger in Karnataka (2010-20)

District	Effect	Period 1	Period 2	Over all
Bidar	Yield	86.48	71.22	66.41
	Area	3.52	11.62	27.37
	Interaction	10.00	17.16	6.22
Chikkamagaluru	Yield	212.40	59.03	378.8
	Area	-43.64	13.23	-229.2
	Interaction	-68.77	27.74	-49.6
Uttara Kannada	Yield	20.31	34.62	127.95
	Area	32.23	22.62	-5.09
	Interaction	47.47	42.76	-22.86
Hassan	Yield	1.63	-247.91	158.92
	Area	40.70	133.08	-12.08
	Interaction	57.68	214.83	-46.84
Haveri	Yield	461.73	7.81	100.18
	Area	-151.48	25.34	-0.01
	Interaction	-210.25	66.86	-0.16
Kodagu	Yield	299.68	-1749.74	91.64
	Area	-67.96	1174.44	25.92
	Interaction	-131.72	675.30	-17.56
Mysuru	Yield	15.43	17.31	123.15
	Area	30.36	24.44	-1.25
	Interaction	54.21	58.25	-21.90
Shivamogga	Yield	51.89	173.14	-1288.30
	Area	26.72	-25.56	940.36
	Interaction	21.39	-47.58	447.93
Overall Karnataka	Yield	15.20	69.87	-29.13
	Area	36.59	69.31	162.54
	Interaction	47.85	-36.23	-31.26

Conclusion

The findings of the study have shown that both growth in area and yield of ginger in Karnataka were positive for study period. However, instability in area, production and productivity was found to be high in period II compared to period I. For overall period,

the instability was categorized as high for area, production and yield of ginger in Karnataka. Further, the findings have shown that area is the contributing factor for output growth rather that yield and interaction effect. For several decades, about 70-80 per cent the area under ginger cultivation in the state is dominated by varieties Rio- de – janero, Himagiri and Humnabad local. This suggests that there is significant scope for varietal improvement of ginger. Also, anecdotal evidence indicates that there is significant crop loss due to soft rot disease, inadequate management practices, biotic and abiotic factors leading to high instability in production. Hence, future policies and programmes should focus on stabilizing production through building capacities of farmers on adoption of improved package of practices and disease management. Focus of the research and development should be towards standardizing production protocols and supply of quality planting material to the farmers.

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