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RESEARCH PAPER

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

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Abstract: The present study analyzed the growth, instability and factors contributing to output growth of turmeric in Karnataka, with a special focus on Bagalkot district for the period 2002-2022. Compound Annual Growth Rate (CAGR), Cuddy-Della Vella instability index (CDVI) and decomposition model were employed for data analysis.The findings on trends showed that the CAGR of turmeric productivity in Bagalkot was negative compared to the state, which was positive. The instability index of turmeric production was categorized as high both in Karnataka and Bagalkot. Further, the results showed that the contribution of yield to output growth during 2012-13 to 2021-22, both for Karnataka and Bagalkot, was higher compared to the area and interaction of area and yield effect. However, for the period 2002-03 to 2021-22, the output growth was primarily due to area expansion rather than yield and the interaction effect. Hence, focus on stabilization of production can be maximized by evolving location-specific varieties, training farmers on best agronomic practices and disease management and devising price stabilization measures.

Key words: Decomposition, Growth, Instability, Turmeric

Introduction

India is referred to as the "spice bowl of world" owing to its cultivation of wide variety of high-quality spices. It is also called the "home of spices" because it produces 75 of the 109 different types of spices listed by the International Organization for Standardization (Sharma, 2015). The variable climatic conditions in India has made it possible for the cultivation of a variety of spices, thus making the country the largest producer of spices (Kumar *et al*., 2018). Black pepper, chillies, ginger, cardamom, cumin, turmeric, clove, cinnamon, tamarind, saffron, vanilla and curry leaves are among the most important spices. India is the largest producer of spices in the world with 106.79 lakh tonnes of production from 45.28 lakh hectares of land (Anon, 2021). Among agricultural goods, spices are the country's fourth highest export earners.

Turmeric (*Curcuma longa* L.), the ancient spice of India known as 'Indian saffron' and 'Golden spice of India' is used in diverse forms as a condiment, flavouring, colouring agent and as a main ingredient in Indian culinary. A certain variety of turmeric is used to extract specific types of starch and it is a perfect produce to be used as a food colorant because of the increasing demand for natural products as food additives. Because of its antiviral and anticancer properties, its highly demanded for pharmaceutical and cosmetic industries. Also, turmeric was in high demand during Covid pandemic, as curcumin from turmeric proved beneficial in facilitating the recovery of several inflammatory diseases.

In the global landscape of turmeric production in the year 2022, India emerged as the undisputed leader, wielding significant influence over the world market. The total global production of turmeric reached approximately 11 lakh tonnes annually, and India played a pivotal role by contributing a staggering 80 per cent to this cumulative output (Anon, 2022). This dominance solidifies India's position as the primary hub for turmeric cultivation and supply on a global scale. Following India, China held the second position with an eight per cent share followed by Myanmar (4%), Nigeria and Bangladesh contributing three per cent each to the global turmeric production (Spice Board, 2022). These nations, although individually accounting for smaller shares, collectively played crucial roles in shaping the overall dynamics of worldwide turmeric cultivation and supply.

During the agricultural year of 2021-22, Telangana was the leading state in India in terms of turmeric production, contributing over a quarter of the country's total output. Maharashtra was the next largest producer, contributing over a fifth of the total production. Karnataka was also a significant producer, followed by Tamil Nadu, Andhra Pradesh, Madhya Pradesh, and West Bengal. Each of these states'unique agricultural practices, climate conditions, and soil characteristics influences their respective shares in the overall turmeric production.

Karnataka accounted for 9.6 per cent of the total turmeric area and 7.1 per cent of the total turmeric production in India during 2021-22 with a productivity of 28,356 kg/ha (GoK, 2022). In Karnataka, the district of Chamarajanagar has both the highest area and production, followed by Mysuru, Bagalkot, Belagavi and Bidar districts. Turmeric is largely dried in the field of the farmer itself, as a part of post-harvest operations, as fresh turmeric, has limited demand (Shroff, 2020). As dried turmeric has wide variety of uses across different sectors, its gaining importance both in domestic and international markets. Hence, the crop is cultivated extensively across the state's districts. However, the distribution of area, production and productivity has shown fluctuations over time. It is in this backdrop that the present study examines the growth and instability of area production and productivity and sources of

growth of turmeric in Karnataka with special reference to Bagalkot district, as it is one of the leading producers in Karnataka.

Material and methods

The secondary data on area, production and productivity of turmeric in Karnataka and Bagalkot was collected from the publication Horticulture Statistics at a Glance, published by the State Department of Horticulture, Government of Karnataka and National Horticulture Board for the period 2002 to 2022. The growth rate in the area, production and productivity of turmeric was computed both for Karnataka and Bagalkot district. Compound annual growth rates, test of significance and Cuddy Della Vella Index (CDVI) were used to measure growth and instability of turmeric production, while the 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 (CAGR)

The compound growth rates for area, production, and productivity of turmeric were estimated using an exponential function, *i.e.*, Yt=abt. The compound growth function is specified in the following form.

$$Yt = ab^t e^u \longrightarrow 1$$

WhereYt= area/ production /productivity in the year t, t = time period, a = intercept value (value of y when t = 0), b = (1+r), 'r' being the growth rate, u = error term.

Equation1 was converted into the logarithmic form to facilitate the use of linear regression. Taking logarithms on both sides of the equation,

$$\ln Yt = \ln a + t \ln b + u$$

Ln a and Ln b are obtained by application of ordinary least squares (OLS) procedure to the equation and the growth rate 'r' is computed as below:

The CAGR (r) is obtained as [(Antilog of b) - 1]x 100

Instability analysis

The instability in the area, production, and productivity of turmeric, was analysed using coefficient of Variation (CV) and Cuddy Della Valla instability index. The coefficient of variation is commonly used for estimating instability but in the case of time series data characterized by time trend, the coefficient of variation sometimes overestimates the instability, so Cuddy Della Valla instability index given by Cuddy (1978) as;

$$CDVI = CV\sqrt{(1-R^2)}$$

Where CV= Coefficient of Variation, R^2 = Coefficient of determination.

$$\text{Coefficient of variation (CV)} = \frac{\sigma}{\bar{x}} \times 100$$

Where, σ- Standard deviation = $\sqrt{\frac{\sum(x-\bar{x})^2}{N}}$, and X is the arithmetic mean of variable X

and N- No. of observations

The index of instability was categorized as low level (0 to 15), medium level (15 to 30) and high level (above 30).

Decomposition analysis

Any change in the production of a crop, either an increase or a decrease, fundamentally depends on the changes in the area and its yield. To disintegrate the effect of area and productivity and their interaction in increasing the production of a crop, the equation given by Sharma (1977) was used:

$$\Delta P = Ao\,\Delta Y + Yo\,\Delta A + \Delta Y \Delta A$$

Where ΔP is a change in production, Ao- Area in the base year, Yo- Yield in the base year,

Ao ΔY is the area effect, Y_o ΔA is the yield effect and ΔYΔA is the interaction effect.

Results and discussion

CAGR of area, production and productivity of turmeric in Karnataka

The trends in the area, production, and productivity of turmeric in Karnataka from 2002 to 2022 is presented in Table 1. The area under turmeric cultivation has shown a positive trend over the years, from 6,596 hectares in 2002-03 to 19,400 ha in 2021-22 with a CAGR of 7.66 per cent. The turmeric cultivation in Karnataka has undergone a significant shift from limited cultivation to an almost 80 per cent increase in area from 2006 to 2007 onwards. However, the area share of Bagalkot, which was eight percent of the total cultivated area of turmeric in Karnataka during 2002-03, almost doubled, contributing to 15.5 per cent of the cultivated area of turmeric in Karnataka during 2021-22 with a CAGR of 13.95 per cent during the same period. The area

Table 1. Area, production, and productivity of turmeric in Karnataka and Bagalkot

Years	Area (ha)		Production (t)		Productivity(t/ha)	
	Karnataka	Bagalkot	Karnataka	Bagalkot	Karnataka	Bagalkot
2002-03	6596	356	28603	1991	4.34	5.59
2003-04	5410	402	26381	4399	4.88	10.94
2004-05	4080	374	19386	2277	4.75	6.09
2005-06	6346	368	33891	4453	5.34	12.10
2006-07	7477	591	37752	4045	5.05	6.84
2007-08	13500	1203	104980	15696	7.78	13.05
2008-09	14159	1994	67404	13402	4.76	6.72
2009-10	17873	3231	89932	24717	5.03	7.65
2010-11	14162	2150	70158	13177	4.95	6.13
2011-12	25525	3225	128206	22475	5.02	6.97
2012-13	19688	1797	92405	9159	4.69	5.10
2013-14	13356	1703	63617	9670	4.76	5.68
2014-15	12824	2164	76777	15005	5.99	6.93
2015-16	14994	2611	76490	16089	5.10	6.16
2016-17	19327	3333	114511	27551	5.92	8.27
2017-18	19339	4059	122764	20875	6.35	5.14
2018-19	26579	4549	153757	26816	5.78	5.89
2019-20	20740	3580	132668	25150	6.40	7.03
2020-21	20560	3675	131140	27779	6.38	7.56
2021-22	19400	3010	110030	20272	5.67	6.73
CAGR (%)	7.66***	13.95***	8.99***	12.35***	1.23**	-1.41 NS

Note:***and**indicate significance at one per cent and five per cent probability level, respectively; NS - Non-significant; ha - Hectare/s, t - Tonne/s

Table 2. Instability indices of area, production and productivity of turmeric

Period	Instability index (%)		
	Area	Production	Productivity
Karnataka			
2002-03 to 2011-12 (Period I)	28.20	35.29	19.02
2012-13 to 2021-22 (Period II)	19.26	35.29	19.02
2002-03 to 2021-22 (Over all)	27.33	27.83	13.95
Bagalkot district			
2002-03 to 2011-12 (Period I)	39.09	42.84	34.99
2012-13 to 2021-22 (Period II)	22.98	23.73	15.42
2002-03 to 2021-22 (Over all)	31.54	35.81	12.69

Table 3. Decomposition of output growth of turmeric

Period	Decomposition (%)		
	Yield effect	Area effect	Interaction effect
Karnataka			
2002-03 to 2011-12 (Period I)	4.55	82.41	13.04
2012-13 to 2021-22 (Period II)	109.27	-7.67	-1.60
2002-03 to 2021-22 (Overall)	10.82	68.19	21.00
Bagalkot district			
2002-03 to 2011-12 (Period I)	2.40	78.29	19.33
2012-13 to 2021-22 (Period II)	26.36	55.67	17.79
2002-03 to 2021-22 (Overall)	2.22	81.15	16.55

increase was primarily driven by high prices and as prices continued to rise, the area further increased (Naik and Hosamani, 2017; Shroff, 2020). Due to area increase, the production of turmeric increased from 28603 tonnes in 2002-03 to 110030 tonnes in 2021-22 with a CAGR of 8.99 per cent in Karnataka, while in Bagalkot the CAGR of production was 12.35 per cent during the same period.

However, the productivity of turmeric in Karnataka has been hovering around 4-6 t/ha and the productivity grew at a modest CAGR of 1.23 per cent during the period 2002-03 to 2021-22 while Bagalkot saw a negative CAGR of 1.41 per cent during the same period. Though there are several high-yielding varieties such as IISR Prabha, IISR Pratibha, IISR Allepy supreme which can yield up to 38 t/ha of fresh rhizome, there is a significant yield gap observed between farmers realized yield and the potential yield. Hence, efforts have to be made to improve management practices for improving the productivity of turmeric through awareness and conducting training and field demonstrations.

Instability indices of area, production and yield of turmeric in Karnataka and Bagalkot.

The instability index analysis of area, production and productivity of turmeric cultivation across Karnataka and Bagalkot district is presented in Table 2. For a meaningful comparison, the study period was divided into three periods, *viz*. Period I from 2002-03 to 2011-12 and Period II from 2012-13 to 2021-22 and over a period: Period I (2002-03 to 2011-12), Period II (2012-13 to 2021-22) and the overall period (2002-03 to 2021-22).

In Karnataka, the area and productivity of turmeric showed moderate instability of 28.20 per cent and 19.02 per cent, respectively for period I and 19.26 per cent and 19.02 per cent, for period II. Whereas, for the Bagalkot district, both area and productivity showed high instability of 39.09 and 34.99 per cent for period I, while it was moderate during period II. For the overall period, though area and productivity were moderately unstable for Karnataka, instability in area for Bagalkot district was categorized as high.

However, the instability in turmeric production was categorized as high both for Karnataka and Bagalkot for period I & II in Karnataka and moderate for the overall period, while moderate instability of production was observed for Bagalkot in period II.

Some of the probable reasons for high instability in production might be due to high price volatility, leading to fluctuations in the area under cultivation and production. Apart from fluctuations in area, production fluctuations could also be due to pest and disease infestation, such as rhizome rot and inadequate crop protection methods.

Decomposition of output growth of turmeric in Karnataka

Decomposition analysis of turmeric production was carried out to find the relative contribution of area, yield and their interaction (area and yield) to the turmeric production in Karnataka and Bagalkot. The analysis also provides direction of changes in yield and area and general pattern of output growth.The source of production growth was partitioned to area, yield and interaction effects, examined individually for all the three periods (Period I: 2002-03 to 2011-12, Period II: 2012-13 to 2021-22) and the overall study period (2002-03 to 2021-22) and presented is Table 3.

In Karnataka, the contribution of yield, area and interaction on turmeric production for theoverall period was 10.82, 68.19 and 21.00 per cent respectively. During the period I an increase in production of turmeric was mainly due to increase in the effect of area,which was around 82 per cent but productivity was only 4.55 percent. As reasoned earlier, during the period, area expansion was primarily driven by increase in the price of turmeric from 2009 onwards. However, in period II, as the area decelerated, the focus was on improving efficiency through the release of improved varieties during 1995-2005, which contributed to productivity enhancement and increased production. However, for the overall period effect of area was more on production rather than yield and the interaction effect.

In Bagalkot district,though the effect of yield, area and interaction were positive on turmeric production, unlike in Karnataka, the production was primarily due to area effect for all three periods. The yield effect was better in period II at 26.36 per cent compared to period I.

Conclusion

The study findings highlight that the area, production and productivity of turmeric have increased over time in the state,

with higher instability in area than productivity. The results were similar except for a declining productivity trend for turmeric in Bagalkot,the second-highest producer of turmeric in Karnataka. While climatic, management and location factors contribute to yield instability, price contributes to area instability. Further, area effect is found to be the major factor contributing to output growth rather than yield growth. To meet the growing export demand, production has to be stable. Hence, evolving location-specific varieties, training farmers on best agronomic practices and disease management and devising price stabilization measures will help in stabilizing production. These measures will help farmers growing turmeric to maximize their profits.

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