Growth and Productivity Analysis of Turmeric Cultivation in Chamarajanagar District: Implications for Agribusiness Development

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ABSTRACT

Turmeric (Curcuma longa L.), often described as the 'golden spice', occupies a prominent place among the commercial spice crops of Karnataka, and Chamarajanagar district is one of its principal producing regions. The present study analyses the growth, instability, and determinants of turmeric production in Chamarajanagar district using secondary data on area, production, and yield for the twelve-year period from 2011-12 to 2022-23, and examines the challenges faced by turmeric agribusiness entrepreneurs through a field survey of 160 respondents comprising farmers, processors, traders, and value-addition entrepreneurs. Compound growth rates were estimated through log-linear (exponential) trend functions, instability was measured using the coefficient of variation and the Cuddy-Della Valle Instability Index, and the relative contribution of area and yield to production was assessed through correlation and multiple regression analysis. Constraints were prioritised using Garrett's Ranking Technique. The results reveal that area, production, and yield registered positive but statistically non-significant compound growth rates of 1.57 per cent, 2.36 per cent, and 0.77 per cent per annum respectively, accompanied by high instability (Cuddy-Della Valle Index of 27.07 for area and 28.47 for production). Regression analysis confirmed that production growth in the district is predominantly area-driven ($R^2 = 0.993$; $F = 631.55$, $p < 0.001$), indicating limited technological progress in productivity. Garrett ranking identified shortage of skilled labour and high wage rates (mean score 82.46), price fluctuation (79.85), and high input costs (76.92) as the most severe constraints. The study suggests mechanisation, establishment of local processing and value-addition units, strengthening of institutional credit, and market infrastructure development as priority interventions for agribusiness development in the district.

Keywords: Turmeric, Compound Growth Rate, Instability, Garrett Ranking, Agribusiness Development

INTRODUCTION

India is the largest producer, consumer, and exporter of turmeric in the world, accounting for the dominant share of global production and trade. Turmeric is deeply embedded in the agrarian economy of southern India, where it serves simultaneously as a food ingredient, a natural colourant, a cosmetic input, and a medicinal raw material owing to its curcumin content. Within Karnataka, Chamarajanagar district has emerged as an important turmeric-growing belt, supported by favourable red loamy soils, assured irrigation pockets in Gundlupet and Chamarajanagar taluks, and the proximity of established spice markets in neighbouring Tamil Nadu, particularly Erode, which functions as the price-setting market for the region's produce.

Despite the district's natural advantage, turmeric cultivation in Chamarajanagar has exhibited pronounced fluctuations over the past decade. The area under the crop declined sharply from 11,387 hectares in 2011-12 to a low of 3,734 hectares in 2013-14 before recovering gradually to 9,331 hectares in 2022-23. Such swings in

acreage, largely a response to price signals from the preceding season, translate directly into volatility in marketed output and farm incomes. At the same time, the district's turmeric economy remains predominantly production-oriented, with limited local processing, grading, branding, and value-addition capacity. The bulk of the produce leaves the district in raw or semi-processed form, and the value captured by local farmers and entrepreneurs remains a small fraction of the final consumer price.

Against this backdrop, the present study pursues two interrelated objectives. First, it quantifies the growth and instability of turmeric area, production, and yield in Chamarajanagar district over the period 2011-12 to 2022-23 and decomposes the sources of production growth. Second, it identifies and prioritises the constraints confronting turmeric agribusiness entrepreneurs in the district using Garrett's Ranking Technique, so that the analysis of secondary data is complemented by field-level evidence. The findings are intended to inform policy on agribusiness development, value-chain strengthening, and entrepreneurship promotion in the turmeric economy of southern Karnataka.

REVIEW OF LITERATURE

Angles, Sundar, and Chinnadurai (2011) examined the impact of globalisation on the production and export of turmeric in India using secondary data for the period 1974-75 to 2007-08, employing exponential growth functions, instability indices, and a Markov chain model of trade direction. The study reported significant growth in both production and export of turmeric, driven by strong demand, but also documented high instability in production, exports, and prices during both the pre-liberalisation and post-liberalisation periods, along with a high degree of integration between domestic and international prices. The study underscores that price volatility is a structural feature of the Indian turmeric economy, a finding of direct relevance to price-sensitive acreage decisions in districts such as Chamarajanagar.

Karthick, Alagumani, and Amarnath (2013) analysed resource-use efficiency and technical efficiency of turmeric production in Tamil Nadu using a stochastic frontier production function approach. The study found considerable scope for raising turmeric yields through more efficient use of significant inputs, indicating that observed farm yields lay below the technically feasible frontier. The results imply that productivity gains in turmeric are attainable through better input management and extension support even without expansion in area, an inference that is pertinent to Chamarajanagar, where the present study finds production growth to be almost entirely area-driven.

Deepa and Sakthivel (2014) studied the factors influencing turmeric cultivation and the problems faced by growers in Erode district of Tamil Nadu, the principal turmeric market catchment for southern Karnataka. The study identified labour scarcity, rising cultivation costs, price uncertainty, and inadequate institutional support as the dominant problems confronting turmeric growers. Since Erode functions as the terminal market for much of Chamarajanagar's turmeric, the constraint structure documented in that study provides a useful comparative benchmark for the Garrett ranking results obtained in the present investigation.

Papang and Tripathi (2014) analysed the costs and returns structure of turmeric cultivation and the constraints faced by producers in Jaintia Hills district of Meghalaya. The study estimated the total cost of cultivation (Cost C2) at ₹77,012 per hectare, with variable costs constituting about 98 per cent of the total, and found that net income improved substantially when farmers marketed dried turmeric (₹28,109 per hectare) rather than fresh rhizomes (₹6,475 per hectare). The study thus provides empirical evidence that even primary-level processing markedly enhances farm-level returns, reinforcing the case for local value-addition infrastructure that emerges from the present study.

RESEARCH GAP AND OBJECTIVES

The reviewed literature establishes that turmeric production in India is characterised by high price and output instability, sub-frontier technical efficiency, labour and cost constraints, and substantial gains from primary processing. However, district-level evidence for Karnataka, and for Chamarajanagar in particular, remains sparse: existing studies concentrate on Tamil Nadu, Odisha, and the North-Eastern states, and few combine secondary growth analysis with primary evidence on entrepreneurial constraints across the full agribusiness

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chain of farmers, processors, traders, and value-addition entrepreneurs. The present study addresses this gap with the following objectives:

1. To analyse the growth and trends in area, production, and yield of turmeric in Chamarajanagar district during 2011-12 to 2022-23.

2. To measure the instability in area, production, and yield of turmeric in the district.

3. To examine the relative contribution of area and yield to turmeric production.

4. To identify and rank the challenges faced by turmeric agribusiness entrepreneurs in the district using Garrett's Ranking Technique.

RESEARCH METHODOLOGY

4.1 Data Sources

The study is based on both secondary and primary data. Secondary data on area (hectares), production (tonnes), and yield (tonnes per hectare) of turmeric in Chamarajanagar district for the twelve-year period 2011-12 to 2022-23 were compiled from the Crop Production Statistics of the Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India. Primary data were collected from 160 agribusiness entrepreneurs engaged in the turmeric business in Chamarajanagar district, comprising farmers, processors, traders, and value-addition entrepreneurs, selected through purposive sampling and interviewed with a structured schedule in which respondents ranked twelve pre-identified challenges.

4.2 Analytical Tools

Compound Growth Rate (CGR): Growth in area, production, and yield was estimated by fitting the exponential function $Y = ab^t$, estimated in log-linear form as $\ln Y = \ln a + t \ln b$, where Y is the variable of interest and t is time. The compound growth rate was computed as CGR (%) = (antilog of $\ln b - 1$) × 100, and its significance was tested using the t-statistic of the trend coefficient.

Instability Analysis: Instability was measured by the coefficient of variation, CV (%) = (σ / mean) × 100, and by the Cuddy-Della Valle Instability Index, $CDVI = CV \times \sqrt{(1 - R^2)}$, where R^2 is the coefficient of determination of the fitted trend. The CDVI corrects the raw CV for the trend component and is the standard measure of instability in agricultural time series.

Correlation and Regression: Pearson correlation coefficients were computed among area, yield, and production, and a multiple linear regression of production on area and yield was estimated to assess their relative contribution: $\text{Production} = \beta_0 + \beta_1(\text{Area}) + \beta_2(\text{Yield}) + \varepsilon$.

Garrett's Ranking Technique: The ranks assigned by respondents to each challenge were converted into per cent positions using the formula: $\text{Per cent position} = 100 \times (R_{ij} - 0.5) / N_j$, where R_{ij} is the rank given to the i-th challenge by the j-th respondent and N_j is the number of challenges ranked. The per cent positions were converted into scores using Garrett's table, and the mean score for each challenge across the 160 respondents determined its final rank.

RESULTS AND DISCUSSION

5.1 Trends in Area, Production, and Yield

Table 1 presents the area, production, and yield of turmeric in Chamarajanagar district from 2011-12 to 2022-23. Area under turmeric contracted steeply from 11,387 hectares in 2011-12 to 3,734 hectares in 2013-14, a decline of about 67 per cent within two years, reflecting the acreage response to the collapse in turmeric prices that followed the record national harvests of the early 2010s. Thereafter, acreage recovered in an uneven fashion to 9,331 hectares by 2022-23. Production traced a nearly identical path, falling from 61,160 tonnes to 17,886

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tonnes before recovering to 56,164 tonnes, while yield fluctuated between 4.30 and 7.32 tonnes per hectare with no sustained upward movement. Over the entire period the district produced 5,14,825 tonnes of turmeric from a cumulative area of 91,830 hectares, at an average yield of 5.61 tonnes per hectare.

Table 1: Area, Production, and Yield of Turmeric in Chamarajanagar District (2011-12 to 2022-23)

Year	**Area (ha)**	**Production (tonnes)**	**Yield (t/ha)**
2011-12	11,387	61,160	5.37
2012-13	9,327	49,004	5.25
2013-14	3,734	17,886	4.79
2014-15	4,878	31,448	6.45
2015-16	7,092	37,765	5.33
2016-17	6,881	29,554	4.30
2017-18	6,466	47,299	7.32
2018-19	9,587	56,122	5.85
2019-20	7,440	47,832	6.43
2020-21	7,688	41,761	5.43
2021-22	8,019	38,830	4.84
2022-23	9,331	56,164	6.02
Total / Mean	**91,830**	**5,14,825**	**5.61**

Source: Crop Production Statistics, Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India.

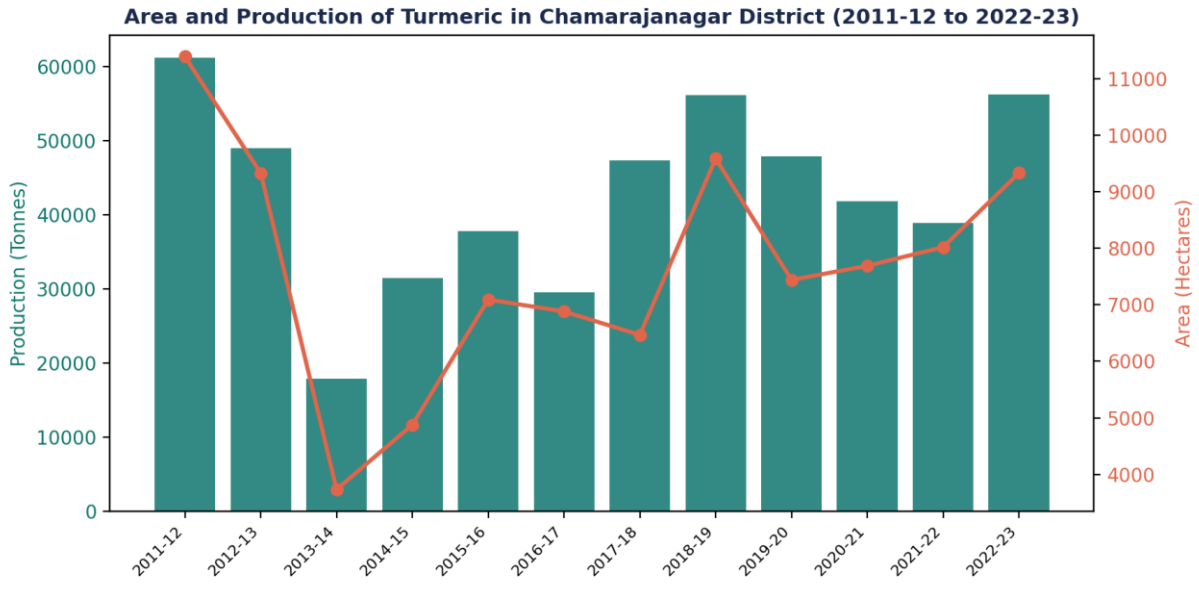

Figure 1: Area and Production of Turmeric in Chamarajanagar District (2011-12 to 2022-23)

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue VII July 2026

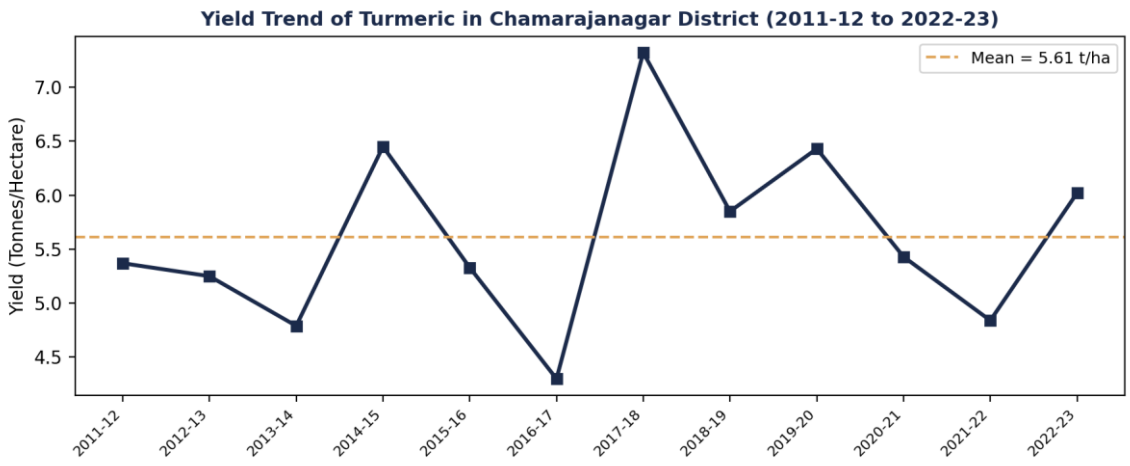

Figure 2: Yield Trend of Turmeric in Chamarajanagar District (2011-12 to 2022-23)

5.2 Growth and Instability Analysis

Table 2 reports the descriptive statistics, compound growth rates, and instability indices. The compound growth rates of area (1.57 per cent per annum), production (2.36 per cent per annum), and yield (0.77 per cent per annum) are all positive but statistically non-significant ($p > 0.05$), indicating the absence of a stable long-term growth trajectory in the district's turmeric economy during the study period. In contrast, instability is strikingly high: the Cuddy-Della Valle Index works out to 27.07 per cent for area and 28.47 per cent for production, against 14.74 per cent for yield. The instability in production is thus dominated by acreage fluctuations rather than by yield variability, which is consistent with the price-responsive acreage behaviour documented by Angles et al. (2011) at the national level.

Table 2: Descriptive Statistics, Compound Growth Rates, and Instability Indices of Turmeric in Chamarajanagar District (2011-12 to 2022-23)

Particulars	**Mean**	**SD**	**CV (%)**	**CGR (% p.a.)**	**t-value**	**CDVI (%)**
Area (ha)	7,652.50	2,107.57	27.54	1.57 (NS)	0.589	27.07
Production (tonnes)	42,902.08	12,592.61	29.35	2.36 (NS)	0.793	28.47
Yield (t/ha)	5.61	0.84	15.00	0.77 (NS)	0.601	14.74

Source: Computed from Table 1. NS = Non-significant at the 5 per cent level. CDVI = Cuddy-Della Valle Instability Index.

5.3 Contribution of Area and Yield to Production

Table 3 presents the correlation matrix. Production is very strongly and significantly correlated with area ($r = 0.895$, $p < 0.001$), whereas its correlation with yield is positive but non-significant ($r = 0.401$, $p = 0.197$), and area and yield are virtually uncorrelated with each other ($r = -0.040$). The multiple regression of production on area and yield, reported in Table 4, explains 99.3 per cent of the variation in production ($R^2 = 0.993$; Adjusted $R^2 = 0.991$) and is highly significant ($F(2, 9) = 631.55$, $p < 0.001$). Both regressors are significant, but the standardised contribution of area dominates: each additional hectare adds about 5.46 tonnes to district output at the mean yield level, while a one-tonne rise in per-hectare yield adds about 6,539 tonnes across the average acreage. Read together with the non-significant growth rate of yield, the results establish that turmeric production growth in Chamarajanagar is essentially area-led, with negligible technological deepening, mirroring the efficiency gaps identified by Karthick et al. (2013) in Tamil Nadu.

Table 3: Correlation Matrix of Area, Yield, and Production of Turmeric (2011-12 to 2022-23)

Variables	Area	Yield	Production
Area	1.000	−0.040	0.895**
Yield	−0.040	1.000	0.401
Production	0.895**	0.401	1.000

Source: Computed from Table 1. ** Significant at the 1 per cent level ($p < 0.01$).

Table 4: Multiple Regression of Turmeric Production on Area and Yield

Predictor	B	SE	t-value	p-value
(Constant)	−35,565.80	2,747.89	−12.943	< .001
Area (ha)	5.456	0.168	32.541	< .001
Yield (t/ha)	6,539.11	419.44	15.590	< .001

$R = 0.996$; $R^2 = 0.993$; Adjusted $R^2 = 0.991$; $F(2, 9) = 631.55$, $p < .001$. Dependent variable: Production (tonnes).

5.4 Challenges Faced by Turmeric Agribusiness Entrepreneurs: Garrett Ranking

Table 5 presents the Garrett ranking of the twelve challenges as prioritised by the 160 sample agribusiness entrepreneurs. Shortage of skilled labour combined with high-wage rates emerged as the most severe challenge (mean Garrett score 82.46, Rank I), reflecting the labour-intensive character of turmeric harvesting, boiling, and polishing operations and the tightening rural labour market. Fluctuation in turmeric market prices ranked second (79.85), consistent with the high production instability documented in Section 5.2 and with the national-level price volatility reported by Angles et al. (2011). High cost of production and inputs (76.92) ranked third, echoing the cost structure findings of Papang and Tripathi (2014), in which variable costs constituted nearly the entire cost of cultivation.

The middle-order constraints relate to infrastructure and finance: lack of modern processing and value-addition facilities (74.38, Rank IV), limited access to institutional finance and credit (71.54, Rank V), inadequate storage and warehousing (69.43, Rank VI), and high transportation costs (66.81, Rank VII). Lower-ranked but still substantive challenges include pest and disease incidence (64.57), weak market information and export awareness (61.94), middlemen dominance (59.72), insufficient government support (56.85), and difficulties in branding, packaging, and promotion (53.91). The overall constraint hierarchy indicates that factor-market and price-risk problems weigh more heavily on entrepreneurs than promotional or institutional problems, although the clustering of scores between 53 and 83 shows that all twelve challenges are perceived as materially important.

Table 5: Garrett Ranking of Challenges Faced by Agribusiness Entrepreneurs in the Turmeric Business (n = 160)

Sl. No.	Challenges	Garrett Score	Rank
1	Shortage of skilled labour and high wage rates	82.46	I
2	Fluctuation in turmeric market prices	79.85	II
3	High cost of production and agricultural inputs	76.92	III

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4	Lack of modern processing and value-addition facilities	74.38	IV
5	Limited access to institutional finance and credit	71.54	V
6	Inadequate storage and warehousing facilities	69.43	VI
7	High transportation and logistics costs	66.81	VII
8	Pest and disease incidence affecting crop quality	64.57	VIII
9	Lack of reliable market information and export awareness	61.94	IX
10	Dominance of middlemen reducing farmers' profit	59.72	X
11	Insufficient government support and subsidies	56.85	XI
12	Difficulty in branding, packaging, and product promotion	53.91	XII

Source: Field survey of 160 turmeric agribusiness entrepreneurs in Chamarajanagar district.

MAJOR FINDINGS

1. Turmeric area, production, and yield in Chamarajanagar district recorded positive but statistically non-significant compound growth rates of 1.57, 2.36, and 0.77 per cent per annum respectively during 2011-12 to 2022-23.

2. Instability is high and concentrated in acreage: the Cuddy-Della Valle Index is 27.07 per cent for area and 28.47 per cent for production, against 14.74 per cent for yield, indicating price-driven acreage swings as the dominant source of output volatility.

3. Production is overwhelmingly area-led: area alone correlates with production at r = 0.895, and the regression of production on area and yield explains 99.3 per cent of output variation, with yield showing no significant upward trend over the twelve years.

4. Garrett ranking places labour shortage and high wages (82.46), price fluctuation (79.85), and high input costs (76.92) as the top three constraints, followed by deficits in processing, credit, storage, and transport infrastructure.

5. The constraint hierarchy and the secondary-data evidence converge on the same diagnosis: a production-oriented turmeric economy exposed to price risk, with weak productivity growth and negligible local value addition.

Suggestions and Implications for Agribusiness Development

1. Mechanisation and skill development: Promotion of turmeric harvesters, boilers, and polishers through custom hiring centres, together with skill training under existing rural livelihood missions, would directly address the top-ranked labour constraint and reduce unit costs.

2. Price risk management: Extension of futures market literacy, aggregation through Farmer Producer Organisations (FPOs), and coverage of turmeric under market intervention arrangements would moderate the acreage instability that drives output volatility.

3. Local processing and value addition: Establishment of primary processing units, curcumin extraction facilities, and grading and packaging infrastructure in Chamarajanagar, supported by schemes such as the Agriculture Infrastructure Fund and PMFME, would allow entrepreneurs to retain a larger share of the value

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chain, in line with the evidence that even drying alone multiplies farm-level net returns (Papang & Tripathi, 2014).

4. Credit and storage: Priority-sector lending tailored to processors and value-addition entrepreneurs, along with scientific warehousing and negotiable warehouse receipts, would ease the finance and storage constraints ranked fifth and sixth.

5. Productivity-led growth: Since production growth is presently area-led, extension efforts should focus on improved varieties, integrated nutrient and pest management, and efficient input use, in view of the demonstrated gap between actual and frontier yields in turmeric (Karthick et al., 2013).

CONCLUSION

The turmeric economy of Chamarajanagar district over 2011-12 to 2022-23 presents a picture of stagnant productivity, high instability, and area-led output growth. The absence of significant growth in yield, despite recovery in acreage, indicates that technological change has largely bypassed the district's turmeric farms, while the high Cuddy-Della Valle indices confirm that price-responsive acreage decisions expose producers and downstream entrepreneurs to substantial output and income risk. The field evidence from 160 agribusiness entrepreneurs reinforces this diagnosis, ranking labour scarcity, price fluctuation, and input costs as the most pressing constraints, followed by deficits in processing, credit, and storage infrastructure. Agribusiness development in the district therefore requires a coordinated strategy that combines mechanisation and skill development, price risk management through collective institutions, and investment in local processing and value-addition capacity. Such a strategy would convert Chamarajanagar's demonstrated production potential into stable, higher-value livelihoods across the turmeric value chain and would contribute meaningfully to the broader agenda of rural entrepreneurship development in southern Karnataka.

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