

International Journal of Agriculture Extension and Social Development

Volume 9; Issue 7; July 2026; Page No. 738-741

Received: 2-04-2026
Accepted: 08-05-2026

Indexed Journal
Peer Reviewed Journal

Dynamics of area, production and productivity of maize in India and Telangana: A growth, instability and decomposition analysis

¹M Kavya, ²DA Rajini Devi, ³R Vijaya Kumari and ⁴D Srinivasa Chary

¹P.G. Scholar, Department of Agricultural Economics, College of Agriculture, Rajendranagar, Hyderabad, Telangana, India

²Assistant Professor, Department of Agricultural Economics, College of Agriculture, Rajendranagar, Hyderabad, Telangana, India

³Professor and University Head, Department of Agricultural Economics, College of Agriculture, Rajendranagar, Hyderabad, Telangana, India

⁴Associate Professor, Department of AABS, College of Agricultural Engineering, Kandi, Sangareddy, Telangana, India

DOI: <https://www.doi.org/10.33545/26180723.2026.v9.i7j.3943>

Corresponding Author: M Kavya

Abstract

Maize has emerged as one of the most important commercial cereal crops in Telangana due to its increasing demand for food, feed and industrial applications. The present study examined the dynamics of maize cultivation in India and Telangana by analysing trends in area, production and productivity during 2014–15 to 2024–25. The study employed Compound Annual Growth Rate (CAGR), Cuddy–Della Valle Instability Index (CDVI) and decomposition analysis using secondary data collected from Department of Agriculture and Farmers Welfare and other published sources. The results revealed contrasting growth patterns between India and Telangana. At the national level, maize recorded significant annual growth in production (6.16%) with relatively low instability. In contrast, Telangana experienced decline in maize area (-3.95%), while production increased marginally. Instability in area (22.91%) and production was considerably higher in Telangana than at the national level, indicating fluctuations in farmers' crop choices and production conditions. Decomposition analysis revealed that maize production growth in India was jointly driven by expansion in cultivated area and productivity improvements, whereas in Telangana production growth was predominantly yield-led, with a substantial positive yield effect. These findings indicated that technological improvements and adoption of high-yielding hybrids have substantially enhanced maize productivity in Telangana.

Keywords: Compound Annual Growth Rate (CAGR), feed, hybrids, instability, maize

Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops in the world and is widely cultivated for its high yield potential, adaptability to diverse agro-climatic conditions, and multiple end uses. Globally, maize serves as a staple food, livestock feed, and an essential raw material for several industrial products, including starch, ethanol, edible oil and pharmaceuticals. In India, maize is the third most important cereal crop after rice and wheat, contributing significantly to food security, nutritional security and the agricultural economy. Owing to the development of high-yielding hybrids, improved production technologies and increasing industrial demand, maize cultivation has expanded considerably over the last two decades.

In India, Karnataka ranks first in terms of maize area and production, followed by Madhya Pradesh, Maharashtra and Rajasthan. Among the maize-producing states, Telangana ranks seventh (Directorate of Economics and Statistics, 2023) ^[1].

Agriculture continues to be the backbone of Telangana's economy, with nearly 60 per cent of the population depending on agriculture and allied activities for their

livelihood. Maize has emerged as one of the major commercial cereal crops in the state due to its high productivity, profitability and increasing demand from feed and processing industries. In Telangana, maize is cultivated in both *kharif* (0.21 Mha) and *rabi* (0.27 Mha) seasons, with a larger share of cultivation during the *rabi* season because of assured irrigation, favourable climatic conditions and comparatively lower pest incidence (Telangana State Statistical Abstract). The major maize-producing districts in Telangana include Bhadradi Kothagudem, Nizamabad and Kamareddy (Department of Agriculture, Telangana 2026). The crop is extensively utilized for livestock and poultry feed, industrial processing and human consumption making it an important component of the state's agricultural economy.

Maize cultivation continues to face several production constraints. Increasing seed costs due to dependence on private hybrid seed companies, crop damage by wild boars and birds, non-availability of farmyard manure, rising agrochemical prices, inadequate technical knowledge on pesticide application, labour shortages and increasing harvesting costs have adversely affected maize productivity

and profitability (Prakash *et al.*, 2024) [6]. These constraints contribute to fluctuations in area, production and productivity over time.

Most studies have focused on either trend analysis or instability analysis individually, while only a few have undertaken a comprehensive assessment by integrating both approaches. Moreover, such studies are generally limited to the period up to 2020–21 or earlier. The present study was undertaken to examine the growth trends, instability and decomposition of maize area, production and productivity in Telangana. The study aims to provide a comprehensive understanding of the long-term performance of maize cultivation, determine the relative contributions of area and productivity to production growth, and generate evidence that can assist policymakers in formulating appropriate strategies for sustainable maize development and enhanced resilience of the maize production system.

Methodology

The present study is primarily based on secondary data collected from various published sources like Directorate of Economics and Statistics, Department of Agriculture and Cooperation, GoI, Various issues of Agriculture and Socio-economic Outlook of Telangana 2026, etc. The selection of study period is mainly based on availability of data. The study period is from 2014-15 to 2024-25.

The compound annual growth rates (CAGR) of area, production and yield of Maize was estimated as follows (Devi *et al.*, 2025) [8]:

$$Y = AB^t e^u$$

$$\text{Log}(Y) = \text{Log}(A) + t \text{Log}(B)$$

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

Where,

Y = dependent variable (area, production, yield, inputs, cost components, MSP).

A = Intercept

t = Year

B = Regression coefficient

e = error term

CAGR = Compound Annual Growth Rate in terms of percentage.

Cuddy and Della Instability Index

To examine the stability in the growth of food grains across state, the coefficient of variation was estimated using following procedure:

The formula suggested by Cuddy and Della (1978) was used to compute the degree of variation around the trend (Nagaveni *et al.*, 2024) [9].

$$\text{Instability Index} = CV \times \sqrt{1 - R^2}$$

Where,

$$CV = \sigma \times 100 \mu$$

Where,

CV = Co-efficient of variation

σ = Standard deviation of the variable

μ = Mean of the variable.

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

Decomposition analysis

Decomposition analysis is used to measure the relative contribution of area and yield towards the total production changes of maize using the formula (Akula *et al.*, 2022) [10]:

$$P_t - P_0 = A_0(Y_t - Y_0) + Y_0(A_t - A_0) + (A_t - A_0)(Y_t - Y_0)$$

$$\Delta P = A_0 \Delta Y_t + Y_0 \Delta A_t + \Delta A \Delta Y$$

$$\text{Production} = \text{Yield effect} + \text{Area effect} + \text{Interaction effect}$$

Where, P, A, and Y represent production, area, and yield.

'0' represents the base period and 't' represent current period.

Thus, the total change in production can be decomposed into three components viz., yield effect, area effect, and the interaction effect due to change in yield and area.

Results and Discussion

Trends in Area, Production and Productivity

Maize recorded a notably positive trajectory in India. Area increased from 91.85 Lha to 120.91 Lha, production from 241.73 LT to 434.09 LT, as shown in table 1 and maize productivity grew from 2,632 kg ha⁻¹ to 3,590 kg ha⁻¹ during the study period. This indicated that, maize growth was more pronounced in output and yield than in area. This means that the crop benefited from technological improvement and commercialization rather than only area expansion. The sharp rise in productivity points to improved hybrid use, better agronomic management, and stronger market demand.

Table 1: Area, production and productivity of maize in India during the period 2014-15 to 2024-25

Year	Area (Lakh ha)	Production (Lakh Tonnes)	Productivity (kg ha ⁻¹)
2014-15	91.85	241.73	2632
2015-16	88.06	225.67	2563
2016-17	96.33	259.00	2689
2017-18	93.80	287.53	3065
2018-19	90.27	277.15	3070
2019-20	95.69	287.66	3006
2020-21	98.92	316.47	3199
2021-22	99.58	337.30	3387
2022-23	107.44	380.85	3545
2023-24	112.41	376.65	3351
2024-25	120.91	434.09	3590

Source: Department of Agriculture and Farmers welfare.

Maize area in Telangana declined, from 6.92 Lha in 2014-15 to 5.79 Lha in 2024-25 as shown in the table 2. In addition, recurring outbreaks of fall armyworm (*Spodoptera frugiperda*) and disease outbreaks since 2018 increased the production risks and management costs, discouraging maize cultivation in Telangana (Devi *et al.*, 2019) [7].

Yet production increased from 23.08 to 33.92 LT, and productivity improved from 3,335 kg ha⁻¹ to 5,860 kg ha⁻¹ as shown in table 2. Despite the increase in maize yield, the area under maize cultivation in Telangana has declined with substantial area being diverted to paddy cultivation. The remarkable increase in productivity from 3,335 kg ha⁻¹ to 5,860 kg ha⁻¹ despite declining cultivated area demonstrates substantial technological progress in maize cultivation. Increased adoption of single-cross hybrids, improved fertilizer management, expansion of irrigation facilities and mechanized cultivation practices have collectively contributed to higher yield levels. Similar improvements in

maize productivity were reported by (Maheshnath *et al.*, 2024) ^[11], who attributed the productivity gains in Telangana to technological advancement and increasing commercial

demand for maize from poultry feed and processing industries

Table 2: Area, production and productivity of maize in Telangana during the period 2014-15 to 2024-25

Year	Area (Lakh ha)	Production (Lakh Tonnes)	Productivity (kg ha ⁻¹)
2014-15	6.92	44.41	3335
2015-16	5.73	30.47	3056
2016-17	8.02	51.73	3321
2017-18	6.30	62.62	4057
2018-19	5.43	66.70	3837
2019-20	5.61	74.28	5347
2020-21	2.59	102.17	6782
2021-22	4.12	124.10	5403
2022-23	5.15	158.77	5557
2023-24	4.90	168.74	5671
2024-25	5.79	174.46	5860

Source: Department of Agriculture and Farmers welfare.

Growth rate and Instability

CAGR of area, production and productivity in India were observed as 2.66 per cent, 6.16 per cent and 3.41 per cent respectively which were significant at 1 per cent level of significance. Instability was modest at national level in area, production and productivity of 4.59 per cent, 4.92 per cent and 3.70 per cent respectively. In comparison with Telangana, maize area and productivity had showed highest growth rate and lower instability at national level. Maize area in Telangana shown, the negative CAGR of 3.95 per cent and production growth rate was 3.27 per cent. But, CAGR of productivity was 7.52 per cent and highly significant with t value of 5.31, it indicated large yield growth. Instability of area in Telangana was 22.91 per cent, reflecting erratic farmer decisions regarding maize

cultivation, likely driven by volatile market prices and competing crop opportunities. Maize exhibited declining area trends across several Indian states due to changing cropping preferences and climatic sensitivity (Senapati *et al.*, 2018) ^[12].

The relatively high instability observed in Telangana also indicates greater vulnerability of maize cultivation to market and climatic risks. Similar observations were reported by Nagaveni *et al.*, 2024 ^[9] who found that fluctuations in production of major food grains were largely associated with weather variability, technological adoption and market uncertainty. Strengthening institutional support through crop insurance, timely extension services and effective price stabilization policies would therefore be essential to reduce production volatility.

Table 3: CAGR of maize in India and Telangana during the period 2014-15 to 2024-25.

State	Area		Production		Productivity	
	Growth	Instability	Growth	Instability	Growth	Instability
India	2.66*** (5.90)	4.59	6.16*** (12.33)	4.92	3.41*** (8.84)	3.70
Telangana	-3.95 ^{NS} (-1.52)	22.91	3.27 ^{NS} (1.72)	18.02	7.52*** (5.31)	13.03

Note: The values in the parentheses are the corresponding t values and ‘*’, ‘***’ and ‘****’ indicates the level of significance at 10%, 5% and 1% respectively.

Source: Compilation and analysis done by the 1st author.

Decomposition analysis

The decomposition analysis provides valuable insights into the structural transformation of maize production in Telangana. The dominance of the yield effect (161.02%) indicates that production growth has been primarily driven by technological progress rather than expansion of cultivated area. Similar findings were reported by Akula *et al.*, 2022 ^[10] who observed that yield improvement was the major contributor to rice production growth in Telangana following increased adoption of improved production technologies. The negative area effect (-34.72%) reflected a continuous reduction in land allocated to maize cultivation. Farmers have increasingly diversified towards crops such as paddy and cotton due to relatively higher profitability, government procurement support and assured irrigation facilities. (Devi *et al.*, 2026 ^[13] also reported that paddy has emerged as the principal recipient crop, attracting cultivated area from pulses, oilseeds, and coarse cereals, including greengram,

castor, and maize. Similar shifts in cropping pattern have been documented across several Indian states also by Senapati and Goyari 2018 ^[12] who concluded that changing market incentives and climatic variability substantially influence farmers' crop allocation decisions. The interaction effect was also negative at 26.29%. This indicated that, maize output growth was driven overwhelmingly by productivity gains, and those gains were partly offset by area contraction. Compared with India, where production growth resulted from balanced contributions of area expansion (39.77%), productivity improvement (45.75%) and positive interaction effects (14.47%), Telangana exhibited contrasting growth pattern. The results indicated that maize cultivation in Telangana has transitioned towards an intensive production system characterized by technological efficiency rather than area expansion. This finding suggests that future maize development in Telangana should focus on enhancing resource-use efficiency and technological innovation rather

than increasing cultivated area.

Conclusion

The study revealed distinct differences in maize growth dynamics between India and Telangana during 2014–15 to 2024–25. While India experienced significant expansion in maize area, production and productivity with relatively stable growth, Telangana followed a contrasting trajectory characterized by declining cultivated area but substantial improvements in productivity. The negative growth in area (-3.95%) in Telangana suggests that farmers have gradually shifted land from maize towards more remunerative crops such as paddy and cotton, influenced by changing market incentives, irrigation availability and production risks.

Despite shrinking area, significant productivity growth (7.52%) in Telangana, demonstrated the positive contribution of improved hybrid varieties, better irrigation facilities, enhanced crop management practices and technological interventions adopted by farmers. Unlike India, where both area expansion and yield improvements jointly contributed to production growth, Telangana has achieved production gains primarily through technological progress rather than expansion of cultivated land.

Overall, the study highlights that sustaining future maize production in Telangana will depend less on increasing cultivated area and more on continuous improvements in productivity, efficient resource management, climate-resilient technologies and effective institutional support. Policies focusing on yield enhancement, pest management, mechanization, market stabilization and value-chain development will be critical for maintaining the competitiveness and sustainability of maize cultivation in the state.

References

1. Directorate of Economics and Statistics. Agricultural Statistics at a Glance 2023. New Delhi: Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India; 2023.
https://desagri.gov.in/wp-content/uploads/2025/01/कृषि-सांख्यिकी-एक-झलक-2023_Agricultural-Statistics-at-a-Glance-2023.pdf
2. Directorate of Economics and Statistics. Agricultural Statistics at a Glance 2023. New Delhi: Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India; 2023.
3. Bandumula N, Rathod S, Ondrasek G, Pillai MP, Sundaram RM. An economic evaluation of improved rice production technology in Telangana state, India. *Agriculture*. 2022;12(9):1387.
4. Telangana State Development Planning Society, Directorate of Economics and Statistics. Telangana State Statistical Abstract (ATLAS) 2024. Hyderabad: Government of Telangana; 2024.
5. Department of Agriculture, Government of Telangana. Data on maize growing districts. 2026.
<https://agri.telangana.gov.in/content.php>
6. Prakash KN, Gaddi GM, Umesh KB, Muralimohan K, Gururaj B. Impact of invasive fall army worm on maize yield and return pattern in India: A comprehensive analysis. *Journal of Experimental Agriculture International*. 2024;46(5):1-11.
7. Devi DR, Reddy RU, Sadvi P, Navatha N. Constraint analysis in maize production in Karimnagar district of Telangana. *Indian Journal of Social Research*. 2019;60(6):843-846.
8. Devi DR, Raj BMU, Kumari RV. Input intensification and surplus production: Assessing the sustainability of paddy cultivation in Telangana, India. *Journal of Experimental Agriculture International*. 2025;47(11):1-11.
9. Nagaveni M, Kulkarni G, Guledagudda S, Rajkumara S, Venugopal C. Dynamics of major food grain production in Karnataka. *Mysore Journal of Agricultural Sciences*. 2024;58(3):199-209.
10. Akula M, Bandumula N, Rathod S. Rice production in Telangana: Growth, instability and decomposition analysis. *Oryza*. 2022;59(2):232-240.
11. Maheshnath M, Kumari RV, Suhasini K, Reddy DS, Meena A. Trends in area, production, productivity and market prices of maize in Telangana state. *International Journal of Research*. 2024;7(9S):256-260.
12. Senapati AK, Goyari P. Agricultural growth and production variability of principal crops in India: An empirical investigation. *Advances in Plants & Agriculture Research*. 2018;8(1):45-51.
13. Devi DR, Raj BMU, Gayathri P, Poshadri A. Dynamics of crop diversification in Telangana: A Markov chain analysis of pre- and post-bifurcation cropping patterns. *Frontiers in Sustainable Food Systems*. 2026;10:1860370.
14. Department of Agriculture and Farmers Welfare. Data on area, production and productivity of Telangana and India. <https://upag.gov.in/>