

International Journal of Agriculture Extension and Social Development

Volume 9; Issue 9; September 2026; Page No. 421-423

Received: 24-06-2026
Accepted: 28-07-2026

Indexed Journal
Peer Reviewed Journal

Growth and instability analysis of selected fruits and vegetables in Telangana

¹T Anusha, ²I Shakuntala Devi, ³T Lavanya and ⁴A Meena

¹Department of Agricultural Economics, PJTAU, Rajendranagar, Hyderabad, Telangana, India

²Assistant Professor, Department of Agricultural Economics, Agricultural College, Warangal, Telangana, India

³Professor, Department of Agricultural Economics, Agricultural College, Sircilla, Telangana, India

⁴Assistant Professor, Department of Mathematics and Statistics, College of Agriculture Rajendranagar, PJTAU, Hyderabad, Telangana, India

DOI: <https://www.doi.org/10.33545/26180723.2026.v9.i9f.4218>

Corresponding Author: T Anusha

Abstract

Telangana has witnessed considerable development of its horticultural sector, increasing the need to understand the growth and stability of major fruit and vegetable crops. The present study assesses the growth rate and instability in the area, production and productivity of six major horticultural crops of Telangana, namely mango, sweet orange, acid lime, tomato, onion and green chilli. The study is based on secondary time-series data for the period 2014-15 to 2024-25, analysed using the Compound Annual Growth Rate (CAGR) and the Cuddy-Della Valle Instability Index (CDVI). The results reveal that area and production declined significantly for all six crops, with tomato recording the steepest decline in area (-16.34% per annum) and onion the steepest decline in production (-15.49%). Productivity trends were comparatively more favourable as tomato showed the highest positive and significant productivity growth rate at 3.14 per cent, while onion (0.10%) and acid lime (-1.45%) remained largely stagnant. Instability indices revealed that sweet orange recorded the highest instability in area and production, at 60.72 and 71.87 respectively, while onion and mango recorded the lowest instability in productivity with CDVI values of 8.32 and 6.15 respectively.

Keywords: Area, compound annual growth rate, fruits and vegetables, instability index, production, productivity, Telangana

Introduction

Horticulture has emerged as one of the most dynamic segments of Indian agriculture, generating higher farm income, supporting nutritional security, and creating substantial employment opportunities for small and marginal farmers (Priyanka and Kerur, 2023) ^[9]. Horticulture contributes about 33 per cent of India's agricultural GVA while occupying only around 18 per cent of the gross cropped area (Ministry of Agriculture and Farmers Welfare, 2025) ^[7]. Globally, fruits and vegetables account for a major share of horticultural output, and India ranks second in the world in the production of fruits and vegetables, after China. (Priyanka and Kerur, 2023) ^[9].

Telangana has emerged as one of the fast-growing horticultural states in India, aided by expanding irrigation and favourable agro-climatic conditions. Although horticulture occupies only about 6.5 per cent of the state's gross cropped area, it contributes around 31 per cent of the state's agricultural gross value output, underlining the economic importance of fruit and vegetable cultivation for the state's farmers (Telangana Socio-Economic Outlook, 2023) ^[12]. Major fruit crops such as mango, sweet orange (mosambi) and acid lime, and vegetable crops such as tomato, onion and green chilli, are widely grown across Telangana and form an important source of income, and employment (Telangana Socio-Economic Outlook, 2024) ^[11].

Despite this economic significance, growth in the area, production and productivity of these crops in Telangana has not always been stable (Vilhekar *et al.*, 2022) ^[13]. Frequent fluctuations arising from climatic variability, pest and disease incidence, price volatility and market uncertainty create income instability for growers (Patil and Yeledhalli, 2016) ^[8]. A purely descriptive reading of area, production or productivity figures over time can be misleading unless the underlying growth trend and the extent of instability around that trend are both examined together. A systematic assessment of growth and instability is therefore essential to evaluate crop performance, identify the crops most exposed to variability, and inform measures for stabilising production and improving farmers' livelihoods (Priyanka and Kerur, 2023) ^[9]. Consequently, the present study aims to comprehensively analyse the growth pattern and instability in area, production and productivity of six major fruits and vegetables of Telangana.

The specific objective of the study is: To study the growth and instability in area, production and productivity of selected major fruits and vegetables in Telangana.

Methodology

The study has utilised secondary time series data on area, production and productivity of selected fruits and vegetables in Telangana for the period 2014-15 to 2024-25. Data were

compiled from Department of Horticulture, Telangana, Directorate of Economics and Statistics (DES), Indiatat, and other published sources.

Compound growth analysis

The present study involved the computation of growth rates pertaining to the cultivation of area, production and productivity of the selected fruit and vegetable crops. Growth rates serve as evaluative metrics for economic parameters, designed to portray trends in variables across time rather than predict future outcomes. The compound growth rate was estimated using the following exponential model (Devi *et al.*, 2025) [5]:

$$Y = a b^t e^u$$

Where, Y = dependent variable for which the growth rate is estimated (Area, Production and Productivity); a = intercept; b = regression coefficient; t = time variable; e^u = error term. The logarithmic form of the above equation was used to estimate the compound growth rate:

$$\log Y = \log a + t \log b$$

The compound annual growth rate (g) was estimated using:

$$g = [\text{Antilog of } (b) - 1] \times 100$$

Measure of instability index

The instability in area, production and productivity of the selected crops was measured in relative terms using the Cuddy-Della Valle Index, which has been used in recent years by a number of researchers as a measure of variability in time-series data.

Cuddy-Della Valle index (CDVI)

The simple coefficient of variation over-estimates the level of variability in time-series data characterised by long-term trends, whereas the Cuddy-Della Valle Index corrects the coefficient of variation for this bias. The coefficient of variation is given by:

$$CV (\%) = [\text{Standard Deviation } (\sigma) / \text{Mean } (\bar{X})] \times 100$$

A linear trend was fitted to the area, production and productivity data of each crop, and the significance of the trend coefficient was examined. Where the time series exhibited a significant trend, emphasis was placed on assessing variation around the trend rather than variation around the mean. To quantify this instability, the formula advocated by Cuddy and Della Valle (1978) [2] was employed, which involves multiplying the coefficient of variation by the square root of the disparity between unity and the coefficient of determination (r²):

$$\text{Instability Index} = CV \times \sqrt{(1 - r^2)}$$

Results and Discussion

The compound growth rates and instability indices for area, production and productivity of major fruit crops of Telangana, namely mango, sweet orange and acid lime, for the period 2014-15 to 2024-25 were presented in Table 1.

Table 1 shows that among the three fruit crops, mango recorded by far the largest average cultivated area, at 147.09 thousand hectares, reflecting its long-established position as the principal fruit crop of Telangana, followed by sweet orange (39.67 thousand hectares) and acid lime (12.35 thousand hectares). All three crops recorded a negative and statistically significant compound growth rate in area, with sweet orange declining fastest at -12.37 per cent per annum, followed by acid lime at -11.89 per cent and mango at -4.43 per cent. Production also declined significantly for all three crops, led by acid lime at -13.18 per cent per annum, while sweet orange production declined by -9.41 per cent (significant only at the 10% level) and mango by -6.17 per cent. Productivity trends were more varied; mango (-1.82 per cent) and acid lime (-1.45 per cent, not statistically significant) showed mild declines, while sweet orange recorded a small positive but statistically non-significant productivity growth rate of 3.38 per cent.

Examining the instability indices in Table 1, sweet orange recorded exceptionally high instability in both area (60.72) and production (71.87), far higher than mango and acid lime, indicating that the crop has been the least stable among Telangana's major fruit crops over the study period. This is largely attributable to a sharp contraction in area from 118.10 to 30.53 thousand hectares between 2014-15 and 2016-17, a decline of nearly 74 percent, followed by comparatively stable but modest fluctuations between 22.36 and 25.70 thousand hectares through 2024-25. Acid lime recorded the highest instability in productivity among the three fruit crops (18.24), while mango recorded the lowest instability across all three parameters (12.29, 10.51 and 6.15 for area, production and productivity respectively), suggesting comparatively dependable, if gradually declining, performance.

Table 1: Growth and instability in area, production and productivity of major fruits in Telangana (2014-15 to 2024-25)

Particulars	Area ('000 Ha)	Production ('000 MT)	Productivity (MT/Ha)
Mango			
Average	147.09	1302.02	8.80
CV (%)	19.80	24.17	8.32
CAGR (%)	-4.43**	-6.17**	-1.82**
CDVI	12.29	10.51	6.15
Sweet Orange			
Average	39.67	722.78	18.92
CV (%)	84.69	82.34	23.57
CAGR (%)	-12.37**	-9.41*	3.38
CDVI	60.72	71.87	21.76
Acid Lime			
Average	12.35	209.24	16.86
CV (%)	43.21	48.47	18.09
CAGR (%)	-11.89**	-13.18**	-1.45
CDVI	15.20	13.60	18.24

Note: **Significant at 5 percent, *Significant at 10 percent

The compound growth rates and instability indices for area, production and productivity of major vegetable crops of Telangana, namely tomato, onion and green chilli, for the period 2014-15 to 2024-25 were presented in Table 2.

Table 2 reveals that onion recorded the highest average production among the three vegetable crops (239.55 thousand MT), while tomato recorded the highest average productivity

(26.01 MT/ha), reflecting the comparatively higher per-hectare yield potential of the crop. Examining compound growth rates, area declined significantly for all three vegetable crops, with tomato recording the steepest decline at -16.34 per cent per annum, followed by onion at -13.93 per cent and green chilli at -11.69 per cent. Production likewise declined significantly across all three crops, led by onion at -15.49 per cent, followed by tomato at -13.72 per cent and green chilli at -10.05 per cent. Productivity trends, however, diverged sharply from the area and production trends: as tomato recorded a positive and statistically significant productivity growth rate of 3.14 per cent per annum, attributable to improved varieties and crop management practices among the growers who continued cultivation (Anamika *et al.*, 2024) ^[1], whereas onion (0.10 per cent) and green chilli (1.84 per cent) recorded small, statistically non-significant productivity growth rates, indicating broadly stagnant yields.

Considering the instability indices in Table 2, green chilli recorded the highest instability in both area (34.80) and productivity (24.49) among the three vegetable crops, reflecting a pronounced mid-period expansion followed by a sharp contraction, together with pest- and price-driven fluctuation in yields (Vilhekar *et al.*, 2022) ^[13]. Onion recorded the highest instability in production (15.87) but, notably, the lowest instability in productivity (8.32) among all six crops examined in this study, indicating that although the area and aggregate output of onion have fluctuated considerably, per-hectare yields have remained comparatively dependable throughout the study period (Priyanka and Kerur, 2023) ^[9].

Table 2: Growth and instability in area, production and productivity of major vegetables in Telangana (2014-15 to 2024-25)

Particulars	Area ('000 Ha)	Production ('000 MT)	Productivity (MT/Ha)
Tomato			
Average	33.34	825.37	26.01
CV (%)	52.95	47.38	16.17
CAGR (%)	-16.34**	-13.72**	3.14**
CDVI	13.88	18.64	13.20
Onion			
Average	11.28	239.55	19.44
CV (%)	56.63	55.33	7.90
CAGR (%)	-13.93**	-15.49**	0.10
CDVI	22.67	15.87	8.32
Green Chilli			
Average	8.74	130.43	15.92
CV (%)	48.39	39.34	24.20
CAGR (%)	-11.69**	-10.05**	1.84
CDVI	34.80	27.84	24.49

Note: **Significant at 5 percent, *Significant at 10 percent

Conclusion

The results above highlight the varying trends in the growth of area, production and productivity for major fruits and vegetables of Telangana. These trends encompass both positive and negative changes, with the majority being statistically significant. Notably, area and production declined significantly across all six crops studied, while productivity trends were comparatively more favourable, with tomato recording the highest positive and significant compound growth rate. Instability indices for area and

production were found to be considerably high for sweet orange and green chilli, indicating that cultivation conditions for these crops have been less favourable and more volatile relative to the other crops studied. To bolster the yields of these crops, a targeted approach towards policy-making is necessary. Promoting the adoption of scientific cultivation methods, encouraging orchard rejuvenation and replanting, and advocating for sustainable agricultural practices are imperative for enhancing productivity. It is also crucial to strengthen research and extension support for the prominent fruits and vegetables cultivated in Telangana. These measures are pivotal for driving agricultural profitability through effective marketing, the dissemination of innovative technologies, and the facilitation of incentives for on-farm investment, particularly for crops such as sweet orange and green chilli that exhibit high instability.

References

1. Anamika, Ghalawat S, Goyal M, Mehla S, Malik JS, Yadav E. Growth trend in area, production and productivity of tomato in India and Haryana. 2024.
2. Cuddy JD, Della Valle PA. Measuring the instability of time series data. *Oxford Bulletin of Economics and Statistics*. 1978;40(1):79.
3. Dastagiri MB, Chand R, Immanuelraj TK, Hanumanthaiah CV, Paramsivam P, Sidhu RS, *et al.* Indian vegetables: production trends, marketing efficiency and export competitiveness. *American Journal of Agriculture and Forestry*. 2013;1(1):1-11.
4. Department of Horticulture, Telangana. Horticulture statistics. Government of Telangana; 2024.
5. 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.
6. Gogoi M, Pathok P, Bharadwaz PJ. Status of area, production and productivity of fruit crops (major and indigenous) of North East India, with special reference to Assam. *Pharma Innovation Journal*. 2022;11(3):1556-1561.
7. Ministry of Agriculture and Farmers Welfare, Government of India. 2025. <https://agriwelfare.gov.in/en/Horticulture>.
8. Patil NA, Yeledhalli RA. Growth and instability in area, production and productivity of different crops in Bengaluru division. *International Journal of Agriculture, Environment and Biotechnology*. 2016;9(4):599-611.
9. Priyanka T, Kerur NM. Growth and instability in area, production and productivity of major fresh fruits and vegetables in India. *The Pharma Innovation Journal*. 2023;12(9):1484-1488.
10. Ramachandra VA, Basanayak RT, Salunke RS, Ravusaheb MR. Growth in area, production and productivity of major crops in Karnataka. 2013.
11. Socio Economic Outlook. 2024. Retrieved from <https://www.telangana.gov.in/wp-content/uploads/2024/07/Telangana-Socio-Economic-Outlook-2024.pdf>
12. Telangana Socio-Economic Outlook. 2024.
13. Vilhekar RA, Pokharkar VG, Yadav DB. Growth and instability of area, production and productivity of acid lime in India and Maharashtra. *The Pharma Innovation Journal*. 2022;11(6):589-593.