International Journal of Plant & Soil Science

Volume 38, Issue 4, Page 152-158, 2026; Article no.IJPSS.153916
ISSN: 2320-7035

Estimation of Maize Crop Growth Rates in Telangana State by Coppock's Instability Index

Bandi Srikanth [a++] and K. V. Deshmukh [a#*]

[a] Department Agricultural Economics, VNMKV, Parbhani 431402 (Maharashtra), India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ijpss/2026/v38i46038

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/153916

Original Research Article

Received: 29/01/2026
Accepted: 23/03/2026
Published: 09/04/2026

Abstract

Agricultural growth and instability have remained subject of intense debate in the agricultural economics literature in India. Instability is a very essential characteristic of agriculture. Since agriculture is dependent on weather conditions, the area, production and yield of the crops are subject to significant variations over time. This study aims at studying the growth and instability in the Maize crop of India. Coppock's instability index has been calculated, in order to assess the performance of area, production and productivity of maize in Telangana, the present study was taken up by estimating the patterns of growth and magnitude of instability. Time series data for the period 2002-03 to 2016-17. On area, production and productivity were collected. The instability of the area under maize in Telangana State was calculated by Coppock's instability index. The period of study was divided into four periods to show variation in different periods (every five years), i.e. Period-I (2002-03 to 2006-07), Period-II (2007-08 to 2011-12), Period-III (2012-13 to 2016-17) and the overall period (2002-03 to 2016-17). It is revealed from the results that during Period-I, the highest instability in the area was observed in Nalgonda district (66.55 per cent) followed by Rangareddy, while lowest

[++]Ph.D. Scholar; [#] Associate Professor (Agricultural Economics) & Technical Officer to Hon. Vice-Chancellor;
**Corresponding author: E-mail: deshmukh_kv@rediffmail.com;*

Cite as: *Srikanth, B., & Deshmukh, K. V. (2026). Estimation of Maize Crop Growth Rates in Telangana State by Coppock's Instability Index. International Journal of Plant & Soil Science, 38(4), 152–158. https://doi.org/10.9734/ijpss/2026/v38i46038*

instability index percentage was observed in Adilabad (8.70 per cent) During overall period of study (Period-IV) instability of Telangana State was 16.63 per cent. During Period-I, the highest instability in production was observed in Nalgonda district (118.32 per cent), The instability in production recorded for Telangana State was 47.57 per cent. The coefficient of instability in productivity of maize during the overall period of study (Period-IV) of Mahabubnagar (113.21 per cent), in the productivity of Telangana State, was 28.95 per cent. It was concluded that there was no stability in area, production, productivity under maize crop in Telangana State over period of study.

Keywords: Maize; Coppock's instability index; percentage; time series data.

1. Introduction

India has been a primarily Agri based economy, and agriculture continues to be main stay of our economy even today. With the globalization, the agricultural sector is opening up with the new avenues especially for agricultural enterprises. Agriculture is an important sector in economic growth, and it needs to be made more remunerative by creating a necessary framework for strengthening the entire agriculture value chain. The cereals are of vital importance not only in providing nutritional support but also in earning additional income (Basantaray et al., 2024; Ralte, 2023). Among the cereals, Maize is a multifaceted crop used as food and an industrial crop globally. It is an important cereal is grown extensively almost all over the world. Maize has now become the third largest cereal crop grown in India, and cultivation of maize has increased in the past decades, it is an important staple food in many parts of the world (Sachan et al., 2023). Maize is a crop that is susceptible to both excess moisture and drought. The importance of maize lies in its wide industrial applications besides serving as human food and animal feed (Erenstein et al., 2022; Mukherjee et al., 2024). As the demand for maize is growing globally due to its multiple uses for food, feed and industrial sectors, and used as an important raw material for many products and having nutritional values also brings the crop in to limelight. Among cereals and millets, oil is extracted only from maize; strong demand for ethanol production has resulted in increased maize prices and has provided incentives to increase maize acreage (www.fao.org).

The production and consumption of maize have been rising frequently in India. Maize is not only used as human food and animal feed, but is also commonly used in several other industries as a raw material. The uses of maize are projected to increase drastically in the coming years in-line with industries that are poised to grow largely in the future. India's maize production depends on the southwest monsoon as more than three-fourth of the maize is produced in the *Kharif* season and only one-fourth in the *Rabi* and summer seasons (apeda.gov.in).

More than two-thirds of the maize produced in India is consumed for feed and other industrial uses. The feed industry, with a CAGR of 6-7% globally and within India at a CAGR of 9%, presents a huge opportunity for maize growers. With the largest global livestock population, India has always remained a feed starved country. Keeping these factors in view, maize will continue to remain an important crop for food, feed and fodder purposes. Maize consumption in India can broadly be divided into three categories viz., feed, food and Industrial non-food products (mainly starch). Feed accounts for about 60% of the maize consumption in India. The most important use and demand driver of maize is poultry feed, which accounts for 47% of total maize consumption. Livestock feed accounts for 13%. The food consumption accounts for 20% of Maize consumption, with direct consumption being 13% and that in the form of processed food being 7% (Source**:** USDA, food grain and feed annual, world markets and trade, Jan 2017).

Telangana is one of the large maizes producing state in India. In Telangana, maize is cultivated in all the districts (except Hyderabad) in both the *Kharif* and *Rabi* seasons. The total maize production doubled in the state within the past ten years (Anonymous, 2014). The maize production in the state has been largely influenced by increasing demand from the feed industries and various industrial uses (Kumar *et al*. 2014). Major maize growing districts in Telangana are Karimnagar, Warangal, Nizamabad, Mahaboobnagar, Khammam, and Medak. Area and production of maize have increased manifold in the state during the previous decade. In most of the maize growing districts in Telangana, maize has occupied the area of some of the other crops viz; Jowar, Millets, Cotton and low-value crops, due to attractive markets and remunerative prices, in addition to the lower requirements of irrigation as compared with the high-value crops. Poor and unprecedented rainfall, improper power supply and availability of high yielding hybrids in the state are key reasons for the increase in maize area and production in the state. Recently, Mahaboobnagar has shown a significant increase in the maize area and which is mainly due to the replacement of other crops i.e. Jowar and small millets during the past decade.

2. Objective of the Study

Agricultural growth and instability have remained subject of intense debate in the agricultural economics literature in India. Instability is a very essential characteristic of agriculture. Since agriculture is dependent on weather conditions, the area, production and yield of the crops are subject to significant variations over time. This study aims at studying the growth and instability in Maize crop of Telangana. Thus, study helps in crop planning, and regional policy formulation, particularly in the context of climate change and market fluctuations. An improved understanding of instability patterns at the district level can support policymakers in designing more effective crop management and agricultural development strategies.

3. Methodology

The present study investigates some of the significant and sensitized issues of the crop. Agricultural growth and instability have remained subject of intense debate in the agricultural economics literature in India. Instability is a very essential characteristic of agriculture. Since agriculture is dependent on weather conditions, the area, production and yield of the crops are subject to significant variations over time. This study aims at studying the growth and instability in the Maize crop of India. Coppock's instability index has been calculated. The study is based on secondary data which are compiled from various published source. Data on area, production and yield were collected from the Directorate of Economics and Statistics (DES), Ministry of Agriculture. Data were collected for Maize crop for the period 2002-03 to 2016-17. The study period divided into three phases. I.e. period I (2002-03 to 2006- 07), period II (2007-12 to 2012-17) and overall period (2002-03 to 2016-17). The performance of Maize crop was examined by estimating (a) Growth rates of area, production and yield (b) Degree of instability in area, production and yield area, production and yield by using Coppock's instability Index

Coppock's Instability Index:

To measure the coefficient of instability, Coppock's instability Index will be estimated below:

$$\text{Delta M} = \frac{\sum[\text{Log}(\text{Xi}+1)-\text{Log}(\text{Xi})]}{(\text{N}-1)}$$

$$\text{V Log} = \frac{\sum\left[\{\text{Log}(\text{Xi}+1)-\text{Log}(\text{Xi})\}-\text{m}^2\right]}{(\text{N}-1)}$$

Coppock's Index = [Anti Log ($\sqrt{V\ Log}$)-1] x 100

Where,

Xt = Area, production or productivity of crop in year's

N = Number of years

M = the arithmetic mean of the difference between the Log of X_1 and X_{t-1}, X_{t-2}, etc.

V Log = Log arithmetic variance of the series.

4. Results and Discussion

4.1 Coppock's Instability Index of Area, Production and Productivity of Maize in Telangana State

The coefficient of instability is another measure of instability besides the coefficient of variation. The coefficient of instability, also known as the instability index, measures the variation around the trend. It is a close approximation of the average year to year percentage variation adjusted for trend. Thus, variations around the trend are more pronounced than the absolute variation. The instability index of area, production and productivity of maize is computed by using Coppock's instability index and the results are presented in the following sections.

4.2 Coppock's Instability Index of Maize Area

The instability of the area under maize in Telangana State was calculated by Coppock's instability index and is presented in Table 1. It is revealed from the results that during Period-I, the highest instability in area was observed in Nalgonda district (66.55 per cent) followed by Rangareddy, Karimnagar and Khammam, while the lowest instability index percentage was observed in Adilabad (8.70 per cent), followed by Mahabubnagar, Nizamabad, medak and Warangal. As consideration of Telangana State, the instability of the area was 18.52 per cent. The increased instability was observed during Period-II, during this period highest and increased instability observed in Nizamabad district (44.78 per cent) followed by Adilabad, Mahabubnagar district and Khammam district and lowest instability was recorded in Warangal (6.94 per cent), instability was steeply declined in Nalgonda district (35.72 per cent) and during this period decreased instability observed in Rangareddy 40.46 percent followed by Khammam district and Karimnagar. As regards to Telangana State, the instability of the area was decreased in period-II from period-I. It is revealed that the instability of the area was comparatively high, which means there was instability of area in this period. During Period-III the instability in area under maize was increased in Nalgonda (61.36 per cent) which was highest during study period, followed by Warangal, Khammam, Medak, and While lowest instability observed in Karimnagar district (12.88 per cent), during this period the decreased instability was found in Nizamabad and Mahabubnagar districts, and Rangareddy and Adilabad districts have shown steeply decreased variability from previous period which was against period-I. As regards to Telangana State, the instability was 22.25 per cent. During the overall period of study (Period-IV) the highest instability was observed in Nalgonda district, followed by Rangareddy and Adilabad, while the lowest instability was found to be in Medak district (18.59 per cent) followed by Mahabubnagar. Warangal and Khammam districts have shown the same percent degree of variability in the overall fifteen years area i.e. 23.52 percentage As regards to Telangana State, the instability was 16.63 per cent. Similar types of results were also stated by Birhanu (2016), Joshi & Singh (2015), Pichad et al. (2014).

It was concluded from the above discussion that there was no stability of area under maize in Telangana State.

Table 1. Instability in area under maize by Coppock's instability index

Districts	Period I	Period II	Period III	Overall period
Mahabubnagar	12.21	32.74	13.27	22.86
Rangareddy	47.08	40.47	16.70	33.53
Medak	14.48	18.31	24.49	18.60
Nizamabad	13.30	44.78	24.49	24.62
Adilabad	8.71	40.90	18.08	25.07
Karimnagar	36.76	14.01	12.89	23.52
Warangal	15.31	6.95	37.28	23.53
Khammam	23.71	20.60	27.51	23.53
Nalgonda	66.56	35.72	61.37	56.21
Telangana State	18.53	10.06	22.25	16.63

4.3 Coppock's Instability Index of Maize Production

The instability in the production of maize in Telangana State was calculated by Coppock's instability index and is presented in Table 2. It is revealed from the table that during Period-I the highest instability in production was observed in Nalgonda district (118.32 per cent) followed by Mahabubnagar and Karimnagar, while the lowest instability was observed in Warangal district (32.23 per cent) followed by Nizamabad, Adilabad and the degree of instability of production in Khammam district was found 83.62 per cent, As regards to Telangana State the instability was 19.24 per cent which mean that all the districts of Telangana State failed to achieve the stability in Period-I. During Period-II the instability of production in Medak district was 102.19 per cent which was highest instability throughout the study period, the degree of instability steeply declined in Nalgonda district the lowest instability index has recorded in Nizamabad district 28 percent followed by Warangal district, the instability decreased in Mahabubnagar and increased instability was in Adilabad, as regards to Telangana State the instability was increased in this period. During Period-III, the highest instability was recorded in Nalgonda, which was highest among all the study periods i.e. 133.83, followed by Khammam and Mahabubnagar district, while the lowest instability was recorded in Karimnagar district (29.54 per cent). The instability of Telangana State decreased. During the overall period of study (Period-IV), the highest instability was observed in

Mahabubnagar district (96.75 per cent) followed by Nalgonda district, while the lowest instability was recorded in Warangal (45.47 per cent) followed by Nizamabad. The instability recorded for Telangana State was 47.57 per cent. Similar types of results were also discussed by Singh *& Sidana* (2017), Savitha & Kunnal (2015).

Thus, the above discussion concluded that there was no stability in the production of the maize crop in Telangana State throughout the studied period.

Table 2. Instability in production of maize by Coppock's instability index

Districts	Period I	Period II	Period III	Overall period
Mahabubnagar	118.14	76.53	72.93	96.76
Rangareddy	110.78	32.29	45.62	71.51
Medak	52.85	102.20	72.69	84.33
Nizamabad	37.70	28.01	62.53	46.79
Adilabad	50.99	65.30	44.64	52.92
Karimnagar	88.35	35.69	29.55	58.29
Warangal	32.23	34.03	68.32	45.47
Khammam	83.63	38.38	94.01	72.83
Nalgonda	118.32	33.98	133.84	93.84
Telangana State	19.24	31.00	15.08	47.58

4.4 Coppock's Instability Index of Maize Productivity

The coefficient of instability in the productivity of the maize crop in Telangana State was calculated by Coppock's instability index and is presented in Table 3. It is revealed from the table that during Period-I the highest coefficient of instability was observed in Mahabubnagar district (88.46 per cent) followed by Khammam and Rangareddy. While the least instability was observed in Warangal district (16.96 per cent) followed by Nizamabad, the degree of Coppock's instability index of productivity was stable in Medak district and Karimnagar district, as regards to Telangana State the instability was 31.47 per cent. During Period-II, the coefficient of instability of Mahabubnagar district was increased, which was the highest instability throughout the studied period, followed by Medak, Nalgonda, the instability of Karimnagar, Adilabad and Rangareddy was decreased in this period. The lowest instability index was found in the Khammam district, which decreased from period-I; the instability of Telangana State was less or more equal to period-I. During Period-III, the instability of Mahabubnagar district was decreased over period-II, which was highest among all the districts in this period, followed by Nalgonda and lowest instability was recorded in Warangal district which decreased from period-II, the instability of Telangana State was decreased from period-II. The coefficient of instability in productivity of maize during the overall period of study (Period-IV) of Mahabubnagar, Medak, Nalgonda, Rangareddy, and Karimnagar was unstable during period of study, as regards to Telangana State the instability was 28.95 percent. By results we can observe that in the whole study period Mahabubnagar district shows the highest instability index among all the districts. Similar types of results were also stated by, Ayalew & Sekahar (2016) and kumar et al. (2014), Kumar & Paul (2017).

Thus, Table 3 discussion was concluded that there was no stability in the productivity of maize in Telangana State.

Coppock's instability index was used to analyze the instability in area, production, productivity under maize crop in Telangana state, it was revealed that during period-I there was low instability observed in maize area of Telangana state comparatively Period-II and Period-III, during Period-II the degree of variation in maize area was high as compare to Period-I and Period-II, in overall Period high instability was observed in Nalgonda district and lowest in Medak district as regards to Telangana state it was 16.63 percent, it was revealed that overall period recorded highest instability over four periods, there was inconsistent growth in area of maize crop in Telangana state throughout study period. In case of maize production, it was revealed that during period-I, there was high instability observed in maize production of Telangana state comparatively throughout study period, during Period-II the degree of variation was low as compare to whole four periods, in overall Period as compare to Telangana state instability was 47.58 percent, there was an inconsistent growth in production of maize crop in Telangana state throughout study period. it was revealed that there was high instability observed in maize productivity of Telangana state during Period-III compared to the overall study period, during Period-II the instability of maize productivity was low as compare to whole four periods, in overall Period as regards to

Telangana state instability was 28.96 percent, there was an inconsistent growth in productivity of maize crop in Telangana state throughout study period.

Table 3. Instability in productivity of maize by Coppock's instability index

Districts	Period I	Period II	Period III	Overall period
Mahabubnagar	88.47	121.23	114.92	113.21
Rangareddy	45.88	26.09	19.44	42.82
Medak	41.80	115.64	48.69	79.58
Nizamabad	22.94	30.80	13.37	28.66
Adilabad	39.03	23.56	29.92	29.67
Karimnagar	41.37	29.11	15.90	33.25
Warangal	16.97	28.87	8.24	19.10
Khammam	69.23	22.76	10.11	40.49
Nalgonda	32.11	30.37	84.10	46.99
Telangana State	31.48	31.48	20.54	28.96

5. Conclusion

The present study was revealed that the growth of area under maize showed a mixed trend in the overall study period (2002-2016), there was an inconsistent growth in the area of maize crop in Telangana state throughout study period. Deviation in area from year to year was observed due to the fluctuations of market price and climatic factors effecting area of maize cultivation in the state. The overall period recorded the highest instability over four periods. Production of maize growth rate in Telangana state perceive mixed trend in all periods; it was clear that all districts of Telangana state were failed to achieve the stability in maize production. Maize growth rate in the productivity of Telangana state showed both positive and negative trend in all periods; there was an inconsistent growth in the productivity of maize crop in Telangana state throughout the study period. Thus, the study helps in crop planning, and regional policy formulation, particularly in the context of climate change and market fluctuations. An improved understanding of instability patterns at the district level can support policymakers in designing more effective crop management and agricultural development strategies.

Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

Competing Interests

Authors have declared that no competing interests exist.

References

Ayalew, B., & Sekar, I. (2016). Trends and regional disparity of maize production in India. *Journal of Development and Agricultural Economics*, *8*(9), 193–199. https://academicjournals.org/journal/JDAE/article-abstract/D199CA972596

Basantaray, A. K., Acharya, S., & Patra, T. (2024). Crop diversification and income of agricultural households in India: an empirical analysis. *Discover Agriculture*, *2*(1), 8. https://doi.org/10.1007/s44279-024-00019-0

Erenstein, O., Jaleta, M., Sonder, K., Mottaleb, K., & Prasanna, B. M. (2022). Global maize production, consumption and trade: trends and R&D implications. *Food security*, *14*(5), 1295-1319. https://link.springer.com/article/10.1007/S12571-022-01288-7

Joshi, D., & Singh, H. P. (2015). An empirical analysis of growth and instability in major spices in India. *International Journal of Agriculture Sciences*, *7*(2), 440–444. https://www.bioinfopublication.org/pages.php?volid=10&issueid=25&act=view&artid=1000

Kumar, N. S. P., & Paul, K. S. R. (2017). Growth and instability of maize production in Andhra Pradesh: An inter-district analysis. *The Andhra Agricultural Journal*, *64*(4), 941–944. https://theandhraagriculturaljournal.com/archives-for-2017/vol-64-4/

Mukherjee, A., Shubha, K., Yadav, V. K., Kumar, U., Kumar, D., Singh, A. K., Raman, R. K., Pradhan, K., Chauhan, J. K., & Pal, A. K. (2024). Possibilities in quality protein maize adoption and its impact on food and nutritional security in India. *Indian Research Journal of Extension Education*, *24*(2), 1-9. https://doi.org/10.54986/irjee/2024/apr_jun/1-9

Pichad, S. P., Wagh, H. J., & Kadam, M. M. (2014). Growth in area, production and productivity of chickpea in Amravati district. *International Research Journal of Agricultural Economics and Statistics*, *5*(2), 289–292. https://doi.org/10.15740/HAS/IRJAES/5.2/289-292

Ralte, Rohlupuii. (2023). Growth and Instability Analysis of Cereal Crops in India. *International Journal of Agriculture, Environment and Biotechnology*, *16*(3), 205-210. https://doi.org/10.30954/0974-1712.03.2023.7

Sachan, D. S., Reddy, K. J., Sulochna, Saini, Y., Rai, A. K., Singh, O., & Laxman, T. (2023). Assessing Grain Yield and Achieving Enhanced Quality in Maize by Next Generation Fertilizer: A Review. *International Journal of Environment and Climate Change*, *13*(8), 626–637. https://doi.org/10.9734/ijecc/2023/v13i81991

Savitha, M. G., & Kunnal, L. B. (2015). Growth performance of cereals in Karnataka: A district wise analysis. *Agricultural Update*. https://doi.org/10.15740/HAS/AU/10.4/288-293

Singh, Y., & Sidana, B. K. (2017). Production performance of maize crop in Punjab. Indian Journal of Economics and Development, 3(1), 95–104. https://indianjournals.com/article/ijed1-13-1-012

Peer-review history:
The peer review history for this paper can be accessed here:
https://pr.sdiarticle5.com/review-history/153916