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Growth and instability in potato cultivation in India

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Abstract

Potato is a vital food security crop in India. Potato is one of the most important vegetable crops in India, contributing significantly to food availability, farm income, and rural employment. The present study examines the growth pattern and instability in potato cultivation in India using time-series data from 2000-01 to 2022-23. Compound Annual Growth Rate (CAGR) and the Cuddy-Della Valle instability index were employed to analyze changes in area, production, and productivity. This study examines the instability of potato area, production, and productivity across three distinct periods: Period I (2001-02 to 2011-12), Period II (2012-13 to 2022-23), and an Overall period. The findings indicate that potato production has increased at a faster rate than cultivated area, reflecting improvements in productivity. While area and production exhibited high stability, productivity showed comparatively greater variability. The study emphasizes the need for sustained technological interventions, improved input management, and climate-resilient practices to ensure long-term growth in potato cultivation, suggesting improved technological adoption and policy interventions.

Keywords: Potato, growth analysis, instability, agricultural productivity, India

1. Introduction

Potato (*Solanum tuberosum* L.) plays a crucial role in India's agricultural economy due to its high yield potential, nutritional value, and wide adaptability across diverse agro-climatic regions. It serves as an important food crop as well as a source of income and employment for millions of farmers. With increasing population pressure and changing dietary patterns, the demand for potato and potato-based products has grown steadily. India is one of the world's largest producers of potatoes. However, the sector often faces fluctuations due to biotic and abiotic stresses.

Despite its importance, potato cultivation in India is influenced by several challenges such as climatic variability, pest and disease incidence, rising input costs, and inadequate post-harvest infrastructure. Analyzing long-term trends in production, cultivated area, and yield is essential for policymakers and farmers to maintain price stability and strengthen food security. Against this background, the present study evaluates the growth performance and instability of potato cultivation in India over the past three decades.

2. Data and Methodology

2.1 Data Source

The study is based on secondary data on area (hectares), production (tonnes), and productivity (tonnes per hectare) of potato collected from official publications of the National Horticultural Board for the period 2001-02 to 2022-23. For analytical consistency, growth estimates were computed for three periods Period I (2001-02 to 2011-12), Period II (2012-13 to 2022-23) and Overall Period (2001-02 to 2022-23).

To measure the growth trend, the exponential growth model was employed and to measure instability, the Cuddy-Della Valle Index (CDVI) was employed to correct the Coefficient of Variation (CV) for the presence of a time trend.

2.2 Analytical Framework

2.2.1 Compound Annual Growth Rate (CAGR)

Compound growth rate

To examine the trend in area, production, productivity of Potato in India compound growth rate (CGR) will be utilised, to examine the tendency of variable to increase, decrease or

stagnant over a period of time. Transforming the growth model into semi-log form, the compound growth rate was calculated using the Ordinary Least Square (OLS) technique, assuming a multiplicative errors term. This method has a number of drawbacks, though, one of which is the challenge of calculating the standard error of estimations of the original values. Thus, the compound growth rate was estimated using the exponential growth function as follows, a non-linear estimation method for solving an exponential model assuming additive error terms:

$$Y = a.b^t \dots \quad (1)$$

Where,

Y = Depended variable for which growth rate is to be estimated

a = Intercept

b = Regression Coefficient

t = Time Variable.

This equation was estimated after transforming (1) as follows,

$$\text{Log } y = \text{log } a + t \text{ Log } b \dots \quad (2)$$

Then the percent compound growth rate (g) was computed using the relationship.

$$\text{CAGR (g)} = (\text{antilog } b - 1) \times 100 \dots \quad (3)$$

The significance of the regression coefficient was tested using the student 't' test.

2.2.2 Instability Index

In order to study variability in area, production and yield of Potato an index of instability used as a measure of variability. The degree of instability in area, production, yield of Potato were measured by using coefficient of variation, Cuddy-Della Valle Index.

2.2.3 Period-wise Classification

To capture changes over time, the study period was divided into three phases:

- **Phase I:** 2001-02 to 2011-12
- **Phase II:** 2012-13 to 2022-23
- **Phase III:** 2001-02 to 2022-23

2.2.4 Coefficient of variation (CV):

Wherever trend in time series data is non-significant, instability of that particular was analyzed with the help of conventional statistical tool of instability i.e. coefficient of variation.

The coefficient of variation was calculated by using formula,

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

Where, σ = Standard deviation

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n}}$$

$\bar{x}$ = Arithmetic mean

X = Variable

n = Number of observations.

2.2.5 Cuddy-Della Valle's Instability Indices (CDVI):

It was used to measure the instability in Potato, providing an approximation of the average year-to-year percentage variation adjusted for trends.

The algebraic form is:

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

Where,

CV = coefficient of variation

adjR² = Coefficient of determination.

3. Results and Discussion

3.1 Growth Trends in Potato Cultivation

The Compound Annual Growth Rate (CAGR) for potato cultivation in India has been calculated for three periods Period I(2001-02 to 2011-12), Period II (2012-13 to 2022-23) and Period III: (2001-02 to 2022-23).

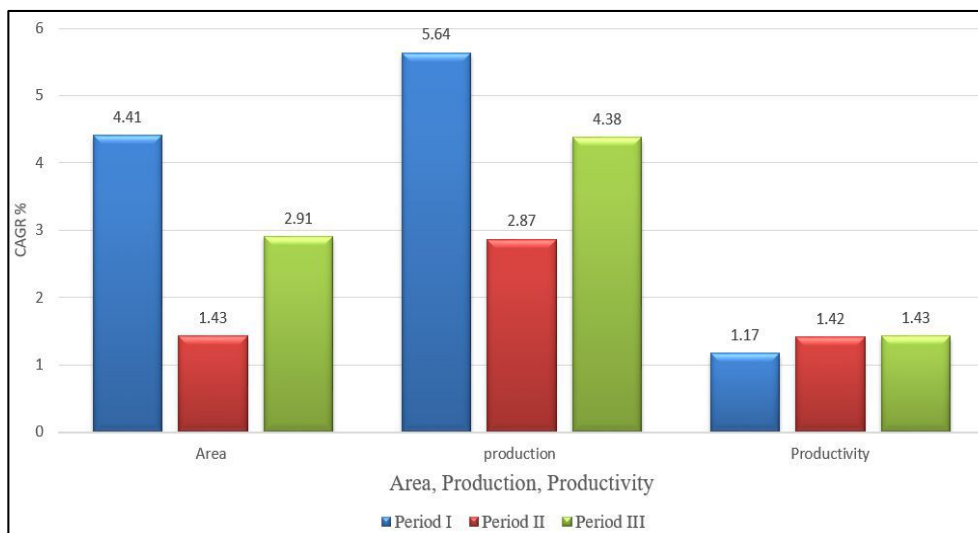
Table 1: Compound Annual Growth Rate (CAGR) (%)

Variable	Area (ha)	Production (tonnes)	Productivity (t/ha)
Period I (2001-02 to 2011-12)	4.41	5.64	1.17
Period II (2012-13 to 2022-23)	1.43	2.87	1.42
Overall (2001-02 to 2022-23)	2.91	4.38	1.43

Table 1 shows that there is a notable deceleration in production growth, which dropped from 5.64 percent in the first period to 2.87 percent in the second. Despite this, the overall growth remains robust at 4.38 percent. In Period I, growth was primarily driven by the expansion of the cultivation Area (4.41%). In Period II, the rate of area expansion slowed significantly to 1.43 percent. However, Productivity growth improved slightly (from 1.17% to 1.42%), indicating a shift toward more intensive and efficient farming practices. While Area and Production growth rates declined in the Period II, Productivity (yield per hectare) showed an upward trend in its growth rate. This suggests better adoption of technology, improved seed

varieties, or better irrigation over time.

The results indicate a consistent upward trend in potato cultivation in India. For the Overall period, compound annual growth rate (CAGR) of area under potato cultivation was estimated at 2.91 percent, while production increased at a higher rate of 4.38 percent per annum. Productivity registered a moderate growth rate of 1.43 percent per annum. which is a healthy indicator of food security and the commercial importance of the crop. The relatively higher growth in production compared to area suggests that improvements in farming practices, seed quality, and input use have contributed to increased output levels.



Area, Production and Productivity of Potato in India

3.2 Instability in Area, Production, and Productivity

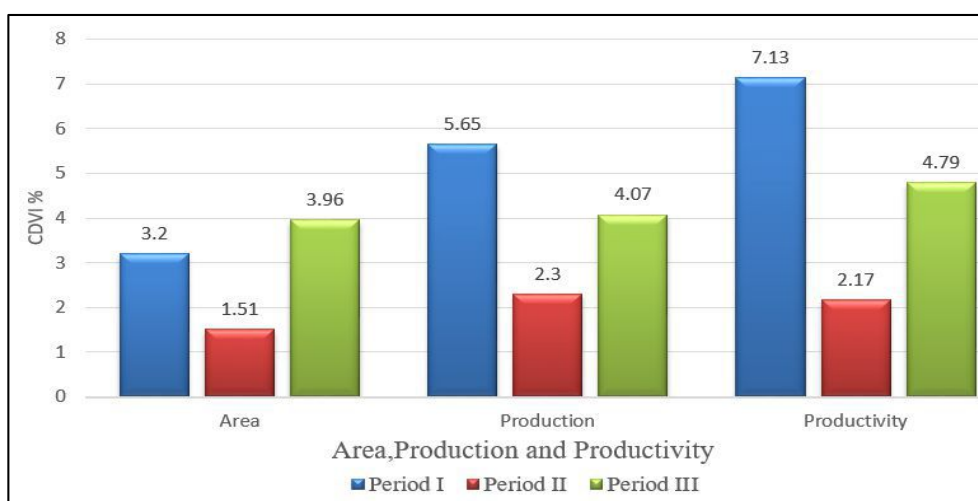
The instability analysis of potato area, production, and productivity in India was conducted by dividing the data into three periods: Period I (2001-02 to 2011-12), Period II (2012-13 to 2022-23), and the Overall period (2001-02 to 2022-23). The Cuddy-Della Valle Index (CDVI) was used to measure instability, as it accounts for the trend in the data.

Table 2: Instability Analysis of Potato in India (CDVI in %)

Variable	Area	Production	Productivity
Period I (2001-02 to 2011-12)	3.20	5.65	7.13
Period II (2012-13 to 2022-23)	1.51	2.30	2.17
Overall (2001-02 to 2022-23)	3.96	4.07	4.79

Table 2 reveals that, there is a significant decline in the instability of potato cultivation in India from Period I to Period II. This suggests that the sector has become more consistent and resilient over the last decade. During Period I (2001-02 to 2011-12) productivity exhibited the highest instability (7.13%), followed by Production (5.65%). This indicates that fluctuations in yield (due to weather, pests, or technology gaps) were the primary drivers of production volatility during these years. In Period II (2012-13 to 2022-23) instability values dropped sharply across all metrics. Instability in Area (1.51%) and Productivity (2.17%) reached very low levels, leading to a much more stable Production (2.30%).

In Overall period, when looking at the entire span, the instability indices are moderate (3.96% to 4.79%), reflecting the combined effect of the more volatile early 2000s and the stabilized growth of the 2010s.



Instability Index of Potato in India

3.3 Growth and Instability of Potato Cultivation in India

Table 3: Growth and Instability of Potato Cultivation in India

	CAGR (%)	Instability Index (%)	Interpretation
Area	2.91	0.48	Stable expansion of cultivated area over time
Production	4.38	0.30	Higher growth due to technological improvements
Productivity	1.43	0.92	Moderate growth with relatively higher variability

The instability analysis from Table 3 revealed that area and production remained largely stable throughout the study period, with instability indices of 0.48 percent and 0.30 percent, respectively. In contrast, productivity exhibited relatively higher instability (0.92 percent), reflecting the influence of climatic variability, pest outbreaks, and fluctuations in input availability. Overall, the low instability values indicate a relatively resilient potato production system in India

4. Conclusion

The study concludes that potato cultivation in India has experienced sustained growth with relatively low instability over the past two decades. Production growth has been driven primarily by improvements in productivity alongside moderate expansion of cultivated area. However, productivity showed comparatively higher instability (0.92%), which may be due to climatic fluctuations, pest and disease incidence, and variability in input availability. Nevertheless, variability in productivity remains a concern, underscoring the need for continued technological innovation and policy support. Strengthening research-extension linkages and investment in post-harvest infrastructure will be crucial for ensuring long-term sustainability of potato production in India. The instability index values suggest that area and production remained relatively stable, reflecting farmers' confidence in potato cultivation. Overall, the results indicate a resilient potato production system, though strengthening climate-resilient technologies and input management is essential for sustained growth. Future policies should focus on maintaining this stability through climate-resilient varieties and market-linked infrastructure to prevent price crashes during surplus years.

5. Policy Implications

1. Promotion of high-yielding and disease-resistant potato varieties to enhance productivity.
2. Strengthening irrigation infrastructure and climate-smart agricultural practices.
3. Expansion of cold storage and value-chain infrastructure to reduce post-harvest losses.
4. Region-specific extension strategies to minimize productivity fluctuations.

References

1. Camire ME, Kubow S, Donnelly DJ. Potatoes and human health. *Crit Rev Food Sci Nutr*. 2009;49(10):823-840.
2. Cuddy JDA, Della Valle PA. Measuring the instability of time series data. *Oxf Bull Econ Stat*. 1978;40(1):79-85.
3. Das M, Sarkar B, Sahu PK. Potato in India: its growth, trend and export. *Potato Res*. 2025;68:1-22.
4. Food and Agriculture Organization. FAOSTAT database. Rome: FAO; n.d.
5. Government of India. Directorate of Economics and Statistics, Ministry of Agriculture & Farmers Welfare. New Delhi: Government of India; n.d.
6. Kaur K, Sharma S. Analysis of growth rate and instability index of potato crop in Punjab. *J Agric Dev Policy*. 2024;1(1):1-10.
7. Kumar S, Kingsly IT, Kumar NR, Pandey NK. Growth, instability and profitability of potato production in Eastern India. *Potato J*. 2021;48(2):93-98.
8. Mahir ME, Abdelaziz HH. Analysis of agricultural production instability in the Gezira scheme. *J Saudi Soc Agric Sci*. 2011;10(2):53-58.
9. National Horticulture Board. NHB database. Gurugram (India): NHB; n.d.
10. Pandit A, Chandran KP. Growth of potato production in India: a non-parametric analysis of time series data. *Potato J*. 2011;38(1):32-40.
11. Rana RK, Anwer ME. Potato production scenario and analysis of its total factor productivity in India. *Indian J Agric Sci*. 2018;88(9):1354-1361.
12. Roy A, Siddique G, Mandal MH. Productivity of potato in Hugli district, West Bengal, India. *J Geogr Environ Earth Sci Int*. 2019;20(4):1-14.
13. Saxena R, Mathur P. Analysis of potato production performance and yield variability in India. *Potato J*. 2013;40(1):38-44.
14. Singh BP, Rana RK. Potato for food and nutritional security in India. *Indian Farming*. 2013;63(7):37-43.
15. Sood S, Sethi D, Sharma K. Growth performance and economics of potato cultivation in Himachal Pradesh. *Potato J*. 2025;51(1):1-10.