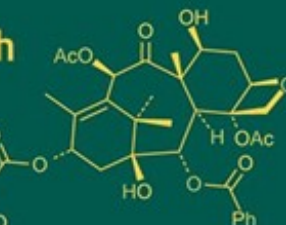


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Analysis of growth and instability in area, production, productivity and export performance of rice in India

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ABSTRACT

The present study was undertaken to examine the growth and instability in area, production, productivity, and export performance of rice in India. The study covered selected major rice-producing states, namely Uttar Pradesh, Telangana and Andhra Pradesh, West Bengal, Punjab, and Chhattisgarh, using secondary data for the period 2005–06 to 2024–25. Compound growth rate, coefficient of variation, and instability analysis were employed to assess the growth and variability in rice production and exports. The results indicated positive growth in area, production, and productivity during the Period I, Period II, and overall study period. The growth rate of area was 0.07, 1.64, and 0.55 per cent, while production recorded growth rates of 1.74, 3.80, and 2.37 per cent during Period I, Period II, and the overall period, respectively. Productivity registered growth rates of 1.46, 0.36, and 0.05 per cent, respectively. The highest instability in productivity was observed during Period I at 12.86 per cent. Rice exports also showed positive growth during the study period, indicating an increasing trend in India's rice export performance. Overall, the study revealed positive growth in rice production and exports, with varying levels of instability across the study periods.

Keywords: Rice, Growth rate, Coefficient of variation, Instability

Introduction

In Rice (*Oryza sativa*) is one of the most important food crops in the world and plays a vital role in food security and agricultural development. It is a major staple food for more than half of the world's population and contributes significantly to calorie and food requirements, particularly in Asia. India is one of the leading rice-producing countries, and rice occupies an important place in the country's agricultural economy, food security, and international trade.

During 2024–25, rice production in India showed considerable improvement over the previous year. The area under rice increased from 47.82 million hectares in 2023–24 to 51.27 million hectares in 2024–25, an increase of about 7.19 per cent. Rice production increased from 137.82 million tonnes to 150.18 million tonnes, registering a growth of about 8.97 per cent. Productivity also increased from 2,882 kg per hectare to 2,899 kg per hectare, showing an improvement of about 0.59 per cent. In Maharashtra, rice was cultivated over about 1,586.6 thousand hectares in 2024–25, with production of about 3,866.6 thousand tonnes and productivity of about 2,437.4 kg per hectare.

Objective

To estimate state wise growth rates and instability of area, production, productivity, and export of rice.

Methodology

The study was based on secondary data collected from official sources, including FAO, APEDA and Indiaagristat. Data on rice production and exports were collected for a period of 20 years, from 2005–06 to 2024–25. The study period was divided into Period I (2005–06 to 2014–15), Period II (2015–16 to 2024–25), and the Overall Period (2005–06 to 2024–25). Major rice-producing states were selected based on their importance in rice production during 2024–25. As Telangana was separated from Andhra Pradesh in June 2014, the data for Telangana and Andhra Pradesh were combined for the period before 2014, wherever necessary, to ensure continuity and comparability in the time-series analysis.

Compound growth rate and instability

Compound growth rate

For estimating growth rates in area, production, productivity and export of rice, compound growth rates were estimated. Compound growth rates were estimated separately for Period I, Period II, and the overall period. The compound growth rates of area, production, productivity and rice exports were estimated using the following exponential growth function.

$$Y = a.b^t$$

Where,

Y = Area/production/ productivity/export

a = Constant term (Intercept)

b = Regression coefficient

t = Time

Taking logarithms on both sides:

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

The annual compound growth rate of area, production, productivity, and export of rice was estimated using the following formula:

$$\text{CGR (r)} = [\text{Antilog}(\log b) - 1] \times 100$$

Where,

r = Compound Growth Rate

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

Instability analysis

To measure the instability of state wise export performance of rice from India: growth and determinants, an index of instability was used as a measure of variability through Coefficient of Variation (CV) and

Cuddy Della Valle's instability (CDVI) indices.

Coefficient of variation

In order to study the variability in the export of rice, coefficient of variation was used as a measure of variability.

The coefficient of variation (CV) was calculated using the following formula:

$$\text{C.V. (\%)} = \frac{\sigma}{\bar{x}} \times 100$$

Where,

C.V. = Coefficient of variation

σ = Standard deviation

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

$\bar{x}$ = Mean

x = Variable

Cuddy-Della Valle's instability index (CDVI)

It was used to measure instability of state wise export performance of rice in India which is close to approximation of the average year to year percent variation adjusted for trend. The algebraic form of it was,

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

Where,

CV = Coefficient of variation in per cent

R^2 = Coefficient of determination

Results and Discussion

The growth rate, coefficient of variation, and instability of rice area, production, productivity, and exports were analysed on a state-wise basis. The study covered five major rice-producing states, namely Uttar Pradesh, Telangana + Andhra Pradesh, West Bengal, Punjab, and Chhattisgarh. The remaining states were grouped under "Other States," which included Maharashtra, Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Rajasthan, Sikkim, Tamil Nadu, Tripura, and Uttarakhand.

Table 1. State wise growth rate, coefficient of variation and instability of area of rice in India (In thousand hectare)

	Parameters	Uttar Pradesh	Telangana+ Andhra Pradesh	West Bengal	Punjab	Chhattisgarh	Other states	India
Period I	CGR	0.23**	-0.67	-0.43	1.19***	0.17*	-0.22	0.07
	CV	1.15	10.71	1.46	3.8	1.01	5.13	2.22
	Instability index	0.74	10.30	0.39	0.92	0.76	5.02	2.22
Period II	CGR	1.06*	4.10***	-0.20	1.70***	0.10*	1.27**	1.64
	CV	7.24	14.19	2.42	4.94	0.7	5.65	5.52
	Instability index	5.68	4.68	0.94	0.16	0.57	2.93	5.48
Overall period	CGR	0.33*	1.22***	-0.24***	1.07***	0.20***	0.83***	0.55
	CV	8.39	13.74	3.88	8.74	1.71	7.14	4.86
	Instability index	6.42	9.89	1.34	1.08	1.33	3.71	4.84

(***, **, and * denotes significant at 1%, 5% and 10% level of significance respectively.)

Table 2. State wise growth, coefficient of variation and instability of production of rice in India (in thousand tonnes)

Table 1. shows the state wise growth performance, coefficient of variation and instability in rice area in India during 2005–06 to 2024–25, Telangana + Andhra Pradesh recorded the highest growth 1.22, CV 13.74, and instability 9.89 in rice area, indicating greater variation. Punjab, (continued on next page)

Chhattisgarh, and other states showed significant positive growth, while West Bengal recorded a significant decline -0.24 . At the national level, rice area increased by 0.55 with relatively low CV 4.86 and instability 4.84 , indicating overall stability.

	Parameter	Uttar Pradesh	Telangana + Andhra Pradesh	West Bengal	Punjab	Chhattisgarh	Other states	India
Period I	CGR	4.23***	-0.22	1.11***	0.41*	3.18***	2.32***	1.74*
	CV	13.72	9.24	4.21	2.23	10.06	11.55	6.53
	Instability index	2.74	9.18	1.78	1.60	2.01	6.35	6.48
Period II	CGR	1.69**	9.90***	0.44***	3.46***	5.79***	3.10***	3.8*
	CV	9.38	27.83	2.13	10.42	17.04	10.26	11.54
	Instability index	6.26	2.22	1.40	1.03	0.76	1.43	11.35
Overall period	CGR	2.66**	4.36***	1.50***	1.59***	3.76***	3.27***	2.37*
	CV	17.17	32.93	3.96	12.65	27.10	20.46	15.08
	Instability index	8.99	10.20	8.11	2.62	2.76	2.25	14.93

(***, **, and * denotes significant at 1%, 5% and 10% level of significance respectively.)

Table 3. State wise growth, coefficient of variation and instability of productivity of rice in India. (Kg. / hectare)

Table 2. shows the state wise growth performance, coefficient of variation and instability in rice production in India during 2005–06 to 2024–25. Telangana + Andhra Pradesh recorded the highest overall growth 4.36 per cent, followed by Chhattisgarh 3.76 per cent and Uttar Pradesh 2.66 per cent. Telangana + Andhra Pradesh also showed the highest growth during Period II it was 9.90 per cent. The highest coefficient of variation and instability in Telangana + Andhra Pradesh indicate greater fluctuations in production. In contrast, West Bengal and Punjab showed more stable production. Overall, rice production increased, but the level of growth and variation differed across states and periods.

	Parameter	Uttar Pradesh	Telangana + Andhra Pradesh	West Bengal	Punjab	Chhattisgarh	Other states	India
Period I	CGR	2.88	0.94	1.12	-0.74	3.00	0.76**	1.46**
	CV	12.1	13.54	0.04	3.43	9.40	4.1	6.7
	Instability index	6.67	12.86	0.02	2.09	1.86	2.66	3.63
Period II	CGR	1.73	5.68***	0.31	1.72	5.67	0.94*	0.36
	CV	6.84	17.45	2.96	5.67	16.62	3.13	2.62
	Instability index	3.73	1.22	2.16	1.36	0.74	0.74	2.28
Overall period	CGR	2.32***	2.80***	0.75***	0.50***	3.54***	0.55*	0.05
	CV	14.98	21.50	5.34	5.54	22.70	4.38	5
	Instability index	3.74	6.66	1.70	3.9	1.81	1.58	4.98

(***, **, and * denotes significant at 1%, 5% and 10% level of significance respectively.)

Table 4. Growth, coefficient of variation and instability analysis on export of rice in India

Table 3. shows the state wise growth performance, coefficient of variation and instability in rice productivity in India during 2005–06 to 2024–25. Rice productivity showed a positive growth trend, although growth varied across states and periods. During Period I, India recorded significant productivity growth of 1.46 per cent, while Chhattisgarh recorded the highest growth among the selected states. During Period II, Telangana + Andhra Pradesh recorded the highest growth of 5.68 per cent. Over the overall period, Chhattisgarh recorded the highest growth of 3.54 per cent, followed by Telangana + Andhra Pradesh 2.80 per cent and Uttar Pradesh 2.32 per cent. Telangana + Andhra Pradesh showed the highest overall instability 6.66 per cent, whereas West Bengal recorded the lowest 1.70 per cent. Overall, productivity improved, but variation and instability differed considerably among the states.

	Parameters	Export Quantity (MT)	Export Value (Rs. lakh)	Value per unit quantity (Rs. /tonnes)
Period I	CGR	12.83**	16.70**	11.26***
	CV (%)	57.91	48.15	30.88
	Instability index	41.86	57.35	29.45
Period II	CGR	8.46***	10.52***	5.53***
	CV (%)	30.48	32.32	16.20
	Instability index	10.12	2.68	15.82
Overall period	CGR	10.06***	10.78***	7.37***
	CV (%)	54.23	55.32	38.17
	Instability index	19.66	52.86	36.99

(***, **, and * denotes significant at 1%, 5% and 10% level of significance respectively.)

(continued on next page)

Rice exports from India in Table No. 4 shows growth performance, coefficient of variation and instability during 2005–06 to 2024–25. Rice exports from India showed positive and significant growth in quantity, value, and value per unit during all three periods. Export quantity increased the most during Period I 12.83 per cent, while export value and unit value also recorded strong growth. However, variation and instability were higher in Period I and the overall period, indicating more fluctuations in exports. Period II showed lower variation and instability, suggesting that rice exports became relatively more stable during this period. Overall, India's rice export performance showed steady growth with improved stability in Period II.

Conclusions

The analysis of rice area, production, productivity and exports during 2005–06 to 2024–25 revealed substantial differences in growth, variability and instability across states and periods. Telangana + Andhra Pradesh recorded the highest overall growth in rice area 1.22 per cent, production 4.36 per cent and showed the highest variability in both area and production, while Chhattisgarh recorded the highest growth in productivity 3.54 per cent. During Period II, Telangana + Andhra Pradesh registered particularly high growth in production 9.90 per cent and productivity 5.68 per cent, indicating substantial improvement in rice performance during the later period. In contrast, West Bengal recorded a decline in rice area, while Punjab showed comparatively lower variability and instability in production. At the national level, rice area, production and productivity recorded growth rates of 0.55, 2.37 and 0.05 per cent, respectively, indicating that the increase in national rice production was associated mainly with changes in cultivated area and improvements in productivity in specific states rather than a substantial rise in average national productivity.

India's rice export performance showed considerably higher growth than domestic rice area, production and productivity. Overall export quantity, export value and value per unit quantity increased by 10.06, 10.78 and 7.37 per cent, respectively. Export growth was particularly high during Period I, but export quantity and value also exhibited greater variability and instability during this period. In Period II, export quantity and value continued to grow at 8.46 and 10.52 per cent, respectively, while their instability declined substantially, indicating greater stability in rice exports during the later period. Overall, the findings indicated that India's rice export sector expanded at a much faster rate than domestic rice production indicators, with Telangana +

Andhra Pradesh and Chhattisgarh emerging as important contributors to improvements in production and productivity. The higher and more stable export performance during the later period highlighted the strengthening of India's position in the international rice market.

References

1. Basumatary P, Barman KK. Growth and instability of area, production and productivity of rice in Bodoland Territorial Area District (BTAD). *Agricultural Reviews*. 2025;46(5):823-827.
2. Gupta S, Devegowda SR, Yarazari SP, Chaudhary J, Kumar A. An economic analysis of growth and instability of vegetable production in Eastern India. *Agricultural Reviews*. 2025;46(3):483-491.
3. Jain A. Analysis of growth and instability in area, production, yield and price of rice in India. *Social change and development*. 2018;15(2):46-66.
4. Kumar A, Jain R. Growth and instability in agricultural productivity: A district level analysis. *Agricultural Economics Research Review*. 2013;26:31-42.
5. Kumar S, Singh PK, Rathi D, Nahatkar SB, Choudhary VK, Parey SK. Growth and instability in area, production and productivity of soyabean in India. *International Journal of Science, Environment and technology*. 2019;8(2):278-288.
6. Nayak AK, Singh N. Growth, instability and export performance of banana in India-an economic analysis. *Agriculture Industry*. 2018;74(10):25-33.
7. Paul R. Analysis of area, production, productivity, and export of black pepper with special reference to Kerala. *The Pharma Innovation*. 2023;12(8):1931-1935.
8. Sathiya R, Naveenkumar M, Senthilnathan S, Grunathan S, Nirmaladevi M, Banumathy V. Growth analysis and instability in fruits area, production, productivity and exports in India. *Asian Journal of Agricultural extension, economics and Sociology*. 2022;40(9):416-424.

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