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Trends of area, production, productivity and exports of rice in India and Telangana

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Abstract

Rice is the staple food for more than half the world's population. India the world's largest producer and exporter plays a central role in global rice trade. Within India, Telangana has emerged as the second-largest rice-producing state. This study examines the growth and instability in area, production, productivity, and exports of rice in Telangana and India from 2015-2024, using secondary data drawn from APEDA and DES Telangana. Compound Annual Growth Rate, Coefficient of Variation and the Cuddy-Della Valle Instability Index were used. Results show that India's rice area, production, and productivity all grew significantly (CAGR of 1.65%, 3.80%, and 2.12% respectively) with low instability rate. Telangana's area (17.97%), production (20.53%) and productivity (1.575%) grew significantly, indicating an area-led rather than yield-led expansion. Rice exports grew in both regions, Telangana at 9.57% and India at 8.78% per annum but both showed medium instability. The findings suggest India's rice economy is expanding vertically through productivity gains, while Telangana's growth remains largely horizontal, pointing to productivity-enhancing interventions as the key opportunity for the state going forward.

Keywords: Rice production, rice exports, Telangana, growth rate, instability index

1. Introduction

Agriculture is the backbone of Indian economy. Agriculture and allied sectors account for around 17.94 per cent of India's GDP for the year 2024-2025. Roughly one-fifth of the GDP is derived from agriculture. Approximately two-thirds of the nation's population depends on agriculture for their livelihood (Central Statistical Organization). Agriculture is the largest private sector occupation and employs half of the nation's workforce. About 10 per cent of export earnings comes from agriculture, and it is source of raw materials to many allied sectors. Above all, agriculture is the only source of food security for the nation. In addition to meeting the food security of nation, Indian agriculture has become a significant contributor to international agricultural trade by exporting a variety of agricultural products.

Rice is one of the most important food crops in the world and serves as the staple food for more than half of the global population. Scientifically it is known as *Oryza sativa* and it belongs to the grass family Poaceae. Rice has been originated in South East Asia, particularly in parts of modern-day India, Burma and neighbouring nations and eventually made its way from Asia to Africa, Europe, and America. India is one of the world's largest exporters of rice and it is particularly well-known for basmati and non-basmati rice varieties. Due to its quality, aroma, taste, and competitive prices Indian rice highly demanded in the Middle East, Africa, Europe, and Asia.

Rice is widely grown and serving as a staple food for more than 60 per cent of the world's population. According to USDA-FAS database, global rice production in 2024-25 was estimated at around 537.7 million metric tonnes. Asia alone produces approximately 485-490 million metric tonnes contributing nearly 90 per cent of world rice production. For the year 2024-25 India has become the world's largest rice producer, with total rice output of about 150.18 million metric tonnes (which contributes nearly 28% of total global production) surpassing the China which produced 145.28 million metric tonnes. Over the past three decades, the consistent growth of rice production in India has not only ensured food security in the nation but also helped to become one of the world's largest rice exporters (Adhikari *et al.*, 2016) [2]. Favourable monsoon conditions, extensive irrigation facilities, and the adoption of high-yielding varieties helped India to maintain its leading position in global rice production.

In India, Uttar Pradesh has been the largest rice producing state with the total production of 20.76 million tonnes accounting about 13.82 per cent of total rice output in the country followed by Telangana, West Bengal, Punjab, Chhattisgarh for the year 2024-25. These top 5 major rice producing states together contribute nearly to 50 per cent of country's rice output (Agricultural Statistics at a Glance 2024-25). Favourable monsoon conditions, irrigation

expansion, and strong procurement support led the Uttar Pradesh to occupy top position in rice production.

Telangana has emerged as one of India's top rice-producing states. Rice production has increased from 4 million metric tonnes in the year 2015-16 to over 17.45 million metric tonnes in 2024-25, contributing about 11.62 per cent of the nation's total rice output (Economic Survey 2024-25). This made Telangana the second largest rice producing state in India after Uttar Pradesh. The increase production is mainly due to irrigation expansion such as Kaleshwaram project, strong government support and large scale paddy procurement by the state government.

Rice is one of the important agricultural commodities traded in the international market. Rice exports contribute greatly to agricultural growth, rural development, and international trade and plays a key role in the economy of many developing countries by generating foreign exchange earnings and providing income and employment opportunities to farmers, traders, and exporters. The total global rice exports during 2024-2025 were estimated about 60.89 million metric tonnes (USDA-FAS). International rice trade is mainly dominated by Asian countries, which account for more than 85% of total world rice exports. India remained the world's largest rice exporter during 2024-25 with exports of around 20.19 million metric tonnes (APEDA). The major exports of rice include Vietnam, Thailand, Pakistan, Cambodia and The United States. India has emerged as the major rice exporter since 2017-18 onwards replacing Thailand and accounts for about 40% of total rice exports in the world. Indian rice was exported to more than 150 countries worldwide. Total 20.19 million tonnes of rice have been exported from India in the year 2024-25 with total export value of US\$12.47 billion (DGCIS, 2024-25). India exported about 6.06 million tonnes of Basmati rice, major importers included Saudi Arabia, Iran, Iraq, The United Arab Emirates, The United States, and Yemen. The export of non-Basmati rice reached approximately 14.12 million tonnes, with key destinations being Benin, Guinea, Iraq, and Nepal.

In India, Punjab is the leading rice export state followed by Haryana, Uttar Pradesh, Andhra Pradesh, Telangana and West Bengal. Andhra Pradesh, Telangana, Chhattisgarh, and West Bengal are significant exporters of non-Basmati rice whereas Punjab, Haryana, and western Uttar Pradesh account for the majority of Basmati rice exports. Telangana plays a key role in India's non-Basmati rice exports. The state boasts a robust network of rice mills and parboiled rice processing facilities, particularly in districts like Nizamabad, Karimnagar, Nalgonda, Warangal, and Khammam. The rice produced in Telangana is exported to Bangladesh, Sri Lanka, African, Middle Eastern, and Asian countries. Telangana's large surplus rice production has made it an important contributor to India's overall rice export growth.

Objectives of the Study

To examine the growth and instability area, production, productivity and exports of rice in India and Telangana.

Materials and Methods

Study Area and Data Source

The present study was conducted for India and Telangana using secondary data collected at both the national and state levels. Secondary data related to area under rice cultivation, production, productivity, quantity of exports were collected

from Agricultural and Processed Food Products Export Development Authority (APEDA), Directorate of Economics and Statistics (DES), Economic Survey (GOI), Ministry of Agriculture and Co-operation.

Analytical Tools and Techniques

To analyse the growth and instability of area, production, productivity and exports of rice, the Compound Annual Growth Rate (CAGR), Coefficient of Variation (CV), and Cuddy-Della Valle Instability Index (CDVI) were employed.

Compound Annual Growth Rate Analysis

Growth rates on area, production, productivity and exports of rice were computed for a period of 10 years from 2015 to 2024. In the proposed study, compound annual growth rates on area, production, productivity and exports of rice in the India and Telangana were estimated by using the exponential growth function of the form,

$$Y = ab^t$$

Where,

- Y-Quantity of export
- t-Time period
- b-Regression coefficient
- a-Intercept

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

The positive CAGR value indicates increasing trend of rice exports, and negative CAGR value indicates decreasing trend of rice exports over the study period.

Instability analysis

The extent of variability in area, production, productivity and exports of rice was computed for a period of 10 years from 2015 to 2024. In the proposed study instability of area, production, productivity and exports of rice in the India and Telangana were estimated through Coefficient of Variation and Cuddy Della Velle Index.

Coefficient of variation (C.V)

The Coefficient of Variation is a relative measure of dispersion that expresses variability in a data series as a percentage of the mean. It is useful for comparing the degree of variability between variables having different units or different mean values. C.V is given by the formula,

$$\text{Coefficient of variation (C.V)} = [S.D/(\bar{X})] * 100$$

Where,

- C.V - Coefficient of variation
- S.D - Standard deviation
- $\bar{X}$ - Mean

Low CV - indicates low variability or higher stability

High CV - indicates high variability or low stability

2.2.2.2 Cuddy Della Valle index (CDVI)

The Cuddy-Della Valle Instability Index (CDVI) was originally developed by Cuddy and Della Valle in 1978 and is considered the best measure to find instability in

agricultural production. Unlike the simple coefficient of variation (CV), which tends to overstate the extent of fluctuation when a strong trend is present in the data, the CDVI corrects for this by "Detrending" the CV using the coefficient of determination (R^2) obtained from a time-trend regression. The index is computed by the formula,

$$CV_t = CV \sqrt{1 - R^2}$$

Where,

- CV - Coefficient of variation
- R^2 - Coefficient of determination

The resulting values are typically classified into three categories

- Low instability (0-15%),
- Medium instability (15-30%)
- High instability (more than 30%)

A lower value indicates greater stability in export of rice and higher value indicates greater instability and fluctuations over time.

3. Result and Discussion: The outcomes of the study are presented and interpreted in this section.

3.1 Growth trends in area, production and productivity of rice in India, 2015-2024

Table 1: Trends in area, production and productivity of rice in India, 2015-2024

Year	Area (million ha)	Production (million tonnes)	Productivity (kg/ha)
2015	43.48	104.48	2,400
2016	43.99	109.69	2,494
2017	43.77	112.75	2,576
2018	44.15	116.47	2,638
2019	43.66	118.87	2,722
2020	45.76	124.36	2,717
2021	46.27	129.47	2,798
2022	47.83	135.75	2,838
2023	47.82	137.82	2,882
2024	51.26	150.18	2,929
CAGR (%)	1.65**	3.80**	2.122**
R^2	0.831	0.984	0.967
t-value	6.266	21.876	15.196

Source: Directorate of Economics and Statistics Telangana

Note: ** indicates significance level at 5%

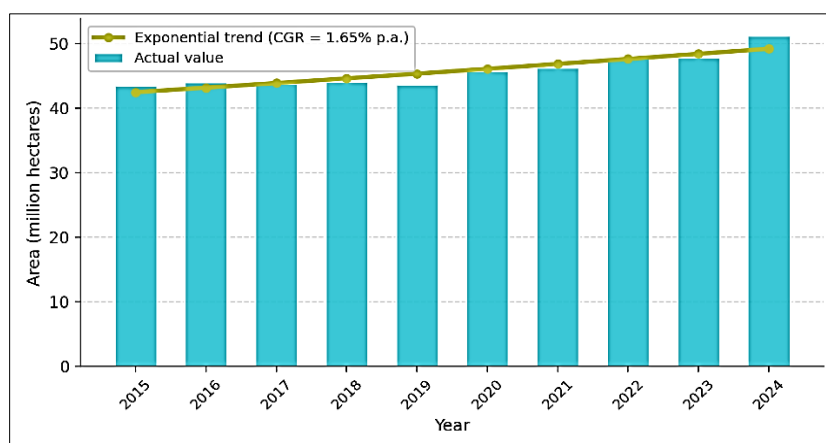


Fig 1: Trend in area under rice cultivation in India (2015-2024)

The area under rice cultivation increased from 43.48 million hectares in 2015 to 51.26 million hectares in 2024, at a compound growth rate of 1.65 per cent per annum. Regression coefficient ($b = 0.1868$) is positive and highly

significant at 5% level of significance ($t = 6.266$, $p < 0.05$). The model explained 83.1 per cent of the variation in area under rice ($R^2 = 0.831$), indicating a consistent, gradual national expansion rather than a volatile one.

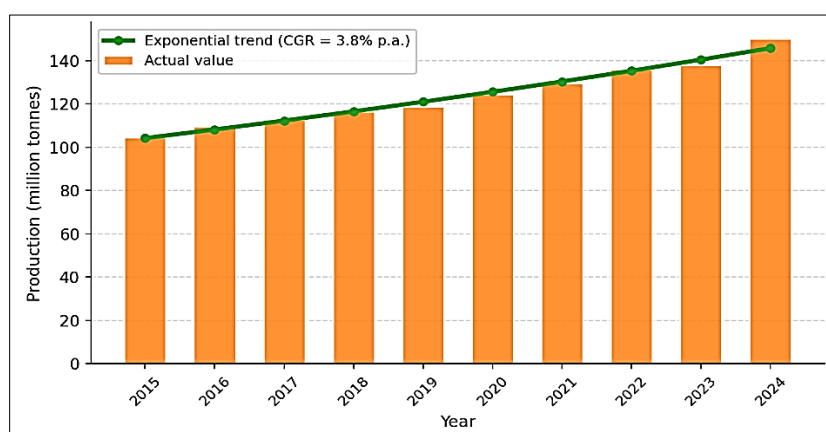


Fig 2: Trend in production of rice in India (2015-2024)

India's total rice production has increased from 104.48 million tonnes in 2015 to 150.18 million tonnes in 2024, at a compound growth rate of 3.80 per cent per annum. The regression coefficient ($b=0.0373$) is positive and statistically significant at 5 per cent level of significance ($t=21.876$, $p<$

0.05). The coefficient of determination ($R^2=0.984$) indicates that 98.4 per cent of the year-to-year variation in production volume is explained by the linear time trend. It is characterised by a very stable, almost linear growth path with little deviation from year to year.

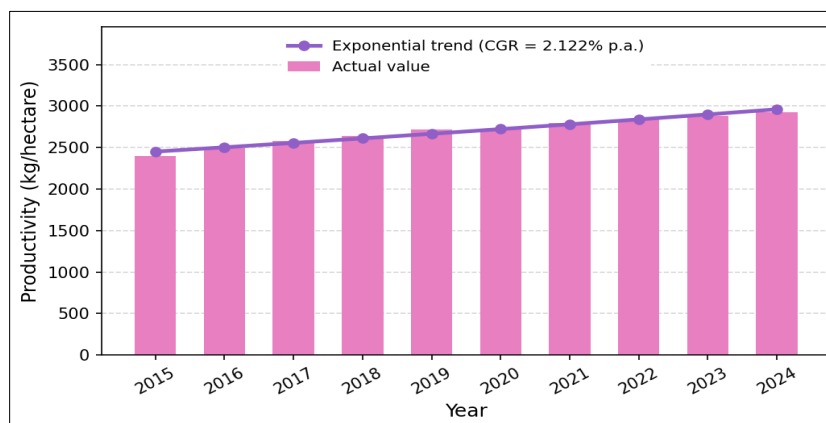


Fig 3: Trend in productivity of rice in India (2015-2024)

India's rice productivity has increased from 2,400 kg/ha in 2015 to 2,929 kg/ha in 2024, at a compound growth rate of 2.122 per cent per annum. The trend is highly significant at 5 per cent level of significance ($t = 15.196$, $p < 0.05$) with positive regression coefficient ($b=0.21$). The coefficient of determination ($R^2 = 0.967$) indicates that 96.7 per cent of the year-to-year variation in productivity is explained by the

linear time trend, indicating consistent, technology-driven yield improvement at the national level with very little annual volatility.

3.2 Instability analysis of area, production and productivity of rice in India, 2015-2024

Table 2: CV and CDVI of area, production and productivity of rice in India, 2015-2024

	Area	Production	Productivity
Coefficient of Variation (%)	5.56	11.53	6.38
Cuddy-Della Valle Index (%)	2.28	1.46	1.16
Instability Category	Low	Low	Low

India's rice cultivation area has a coefficient of variation of 5.56 per cent and a Cuddy-Della Valle Index of 2.29 per cent, within the low-instability range ($CDVI < 10\%$). Production is the most stable series in the study, with a coefficient of variation of 11.53 per cent and very low Cuddy-Della Valle Index of 1.48 per cent. The low instability value indicates that national rice production has followed a smooth growth path over the study period with negligible variations. Productivity

has the coefficient of variation of 6.38 per cent and Cuddy-Della Valle Index of 1.17 per cent. Productivity has grown steadily, significantly, and with minimal year-to-year variation.

3.3 Growth trend in area, production and productivity of rice in Telangana, 2015-2024

Table 3: Trends in area, production and productivity of rice in Telangana, 2015-2024

Year	Area ('000 ha)	Production ('000 tonnes)	Productivity (kg/ha)
2015	10.46	30.47	2,913
2016	16.82	51.73	3,075
2017	20.94	62.62	3,624
2018	19.32	66.70	3,452
2019	20.11	74.27	3,694
2020	31.86	102.17	3,206
2021	36.54	124.09	3,395
2022	46.62	158.77	3,406
2023	46.85	168.74	3,602
2024	48.09	174.46	3,627
CAGR (%)	17.97**	20.53**	1.575*
R^2	0.925	0.956	0.359
t-value	9.899	13.212	2.119

Source: Directorate of Economics and Statistics Telangana **Note:** ** and * indicates significance level at 5% and 10% respectively.

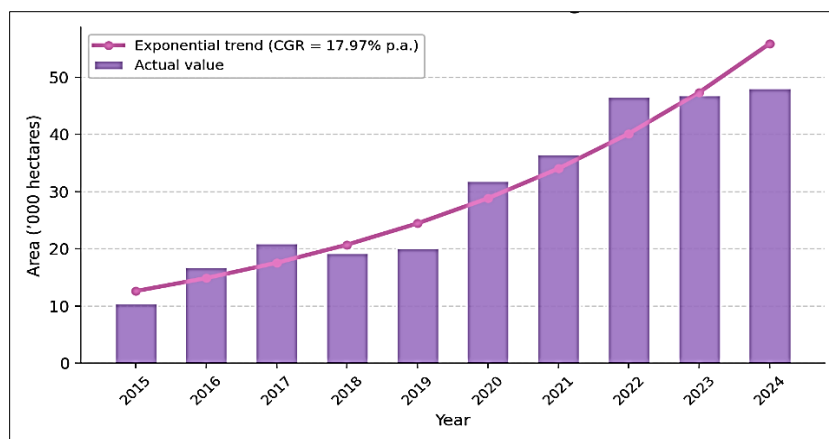


Fig 4: Trend in area under rice cultivation in Telangana (2015-2024)

The area under rice cultivation in Telangana expanded remarkably from 10.46 thousand hectares in 2015 to 48.09 thousand hectares in 2024 at almost five-fold increase at a compound growth rate of 17.97 per cent per annum. The

regression coefficient ($b = 0.1653$) is positive and statistically significant at the 5 per cent level of significance ($t = 9.899$, $p < 0.05$) and the model explained 92.5 per cent of the variation in area under cultivation.

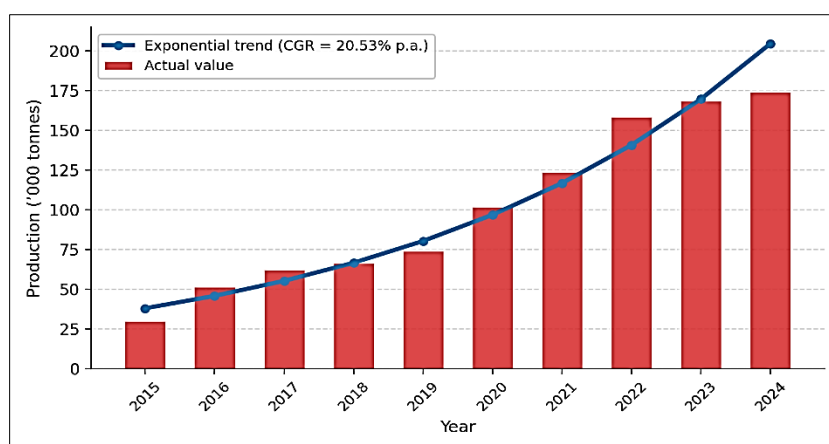


Fig 5: Trend in production of rice in Telangana (2015-2024)

Rice production in Telangana increased from 30.47 thousand tonnes in 2015 to 174.46 thousand tonnes in 2024. It is observed that there is more than a five-fold increase in production. The compound growth rate is 20.53 per cent per annum. The regression coefficient ($b = 0.0373$) is positive and statistically significant at the 5 per cent level of

significance ($t = 13.212$, $p < 0.05$). The coefficient of determination ($R^2 = 0.956$) indicates that 95.6 per cent of the year-to-year variation in production volume is explained by the linear time trend.

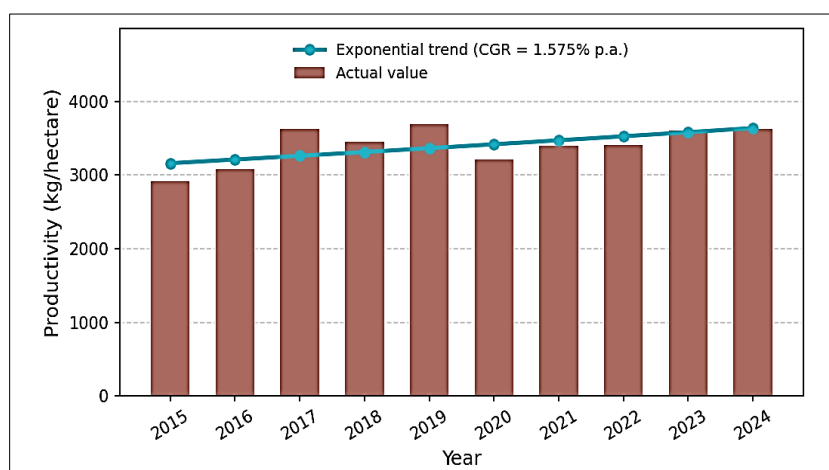


Fig 6: Trend in productivity of rice in Telangana (2015-2024)

Rice productivity in Telangana has increased from 2,913 kg/ha in 2015 to 3,627 kg/ha in 2024, indicating a modest compound growth rate of 1.575 per cent per annum. The Regression coefficient ($b = 0.0156$) is positive and statistically significant at 10 per cent level significance ($t = 2.119$, $p = 0.067$), and the model explains only about 36 per cent of the year-to-year variation ($R^2 = 0.359$). The productivity has sharply increased in 2017 and 2019 but again

decreased in 2018 and 2020-21 which indicates that a yield series may be influenced more by the natural forces such as seasonal variations in rainfall patterns, pests and diseases rather than a firm technology driven trend.

3.4 Instability analysis of area, production and productivity of rice in Telangana, 2015-2024

Table 4: CV and CDVI of area, production and productivity of rice in Telangana, 2015-2024

	Area	Production	Productivity
Coefficient of Variation (%)	47.29	51.58	7.67
Cuddy-Della Valle Index (%)	12.95	10.82	6.14
Instability Category	Low	Low	Low

The coefficient of variation for Telangana's rice area is 47.29 per cent. However, this largely reflects the strength of the growth trend itself rather than erratic fluctuation. The Cuddy-Della Valle Index is 12.99 per cent, placing the series in the low instability category ($CDVI < 15\%$). Production shows 51.58 per cent of coefficient of variation, which reflects extremely steep growth trend rather than random instability. Removing the trend, the Cuddy-Della Valle Index drops to 10.80 per cent, falling under low instability categories, and significantly lower than the CDVI for area

(12.99%). Productivity has a coefficient of variation of 7.67 per cent, once the trend is netted out, the Cuddy-Della Valle Index falls to 6.14 per cent, placing it in the low-instability category ($CDVI < 15\%$). A low CDVI of 6.14 per cent indicates the year-to-year fluctuations are small in absolute terms.

3.5 Growth trend in exports of rice in India and Telangana, 2015-2024

Table 5: Trends in exports of rice in India and Telangana, 2015-2024

Year	Telangana Export ('000 tonnes)	India Export (tonnes)
2015	11,590.30	1,05,10,390
2016	12,856.08	1,07,56,000
2017	10,922.88	1,28,75,330
2018	11,927.15	1,20,62,510
2019	10,424.53	95,10,990
2020	27,406.03	1,77,79,330
2021	27,055.67	2,12,32,410
2022	22,498.32	2,23,45,070
2023	23,764.22	1,63,58,790
2024	17,579.70	2,01,89,510
CAGR (%)	9.57**	8.78**
R^2	0.49	0.63
t-value	2.77	3.76

Source: Agricultural and Processed Food Products Export Development Authority

Note: ** indicates significance level at 5%.

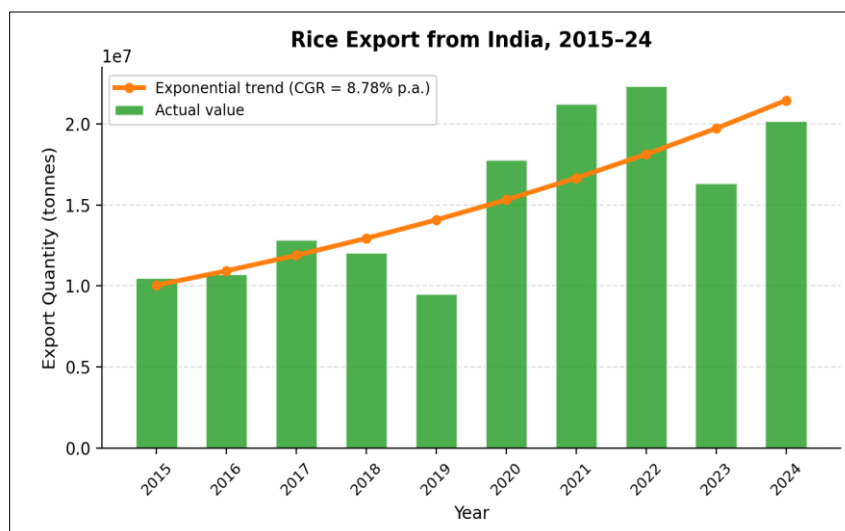


Fig 7: Trend in export quantity of rice in India (2015-2024)

India's total rice exports increased from 10.51 million tonnes in 2015 to 20.19 million tonnes in 2024, resulting a compound growth rate of 8.78 per cent per annum. The regression coefficient ($b = 0.0842$) is positive and statistically

significant at the 5 per cent level of significance ($p = 0.0055$, $t = 3.761$) and the model explained nearly 64 per cent of the variation in export volumes ($R^2 = 0.639$).

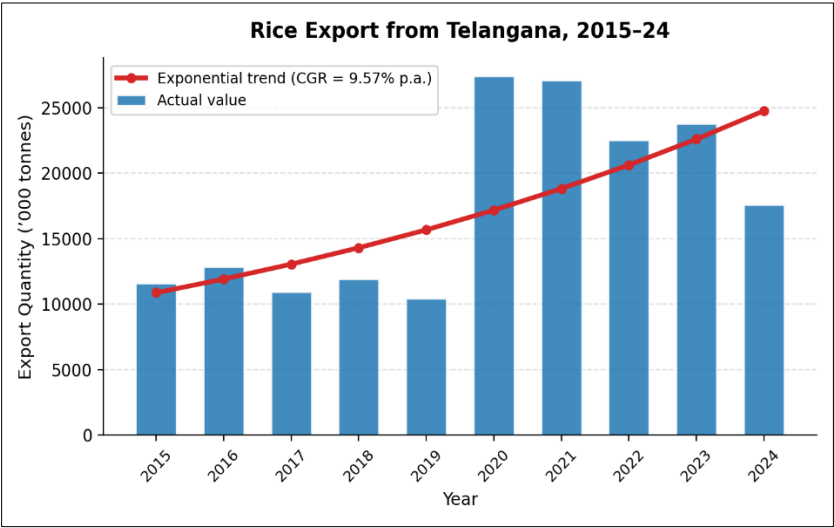


Fig 8: Trend in export quantity of rice in Telangana (2015-2024)

The export of rice from Telangana increased from about 11,590 thousand tonnes in 2015 to 17,580 thousand tonnes in 2024, growing at a compound growth rate of 9.57 per cent per annum. The regression coefficient ($b = 0.0914$) is positive and statistically significant at the 5 per cent level ($p = 0.0243$, $t = 2.771$), representing an upward trend rather than a chance fluctuation. However, the coefficient of determination ($R^2 = 0.49$) indicates that about half of the year-to-year variation in export volume is explained by the linear time trend.

3.6 Instability analysis of exports of rice in India and Telangana, 2015-2024

Table 6: CD and CDVI of exports of rice in India and Telangana, 2015-2024

	India's export	Telangana's export
Coefficient of Variation (%)	31.4	39.4
Cuddy-Della Valle Index (%)	18.87	28.14
Instability Category	Medium	Medium

India's rice export volume shows medium instability, with a coefficient of variation of 31.40 per cent. Adjusting for the trend component, the Cuddy-Della Valle Index falls to 18.87 per cent, which still falls in the medium-instability range ($CDVI > 15\%$). A larger share of the variation in the India's export is explained by progressive growth trends, rather than by random fluctuations. The coefficient of variation for Telangana's rice exports is high, reaching 39.40 per cent, which shows the large fluctuations in the volume of exports over the decade (the lowest volume being about 10,425 thousand tonnes in 2019 and the highest 27,406 thousand tonnes in 2020). After the effect of the underlying growth trend has been eliminated by means of the Cuddy-Della Valle Index, the level of instability drops to 28.14 per cent - this is still considered to be medium instability (since $CDVI$ is greater than 15%).

4. Conclusion

This study analysed the growth and instability of area, production, productivity and exports of rice in India and Telangana from 2015 to 2024. The study revealed that the growth in rice production in India is mainly driven by improvements in yield rather than expansion of area, and yield also shows the least instability, making it the most reliable source of production growth. This suggests a positive shift towards productivity-led growth in Indian rice cultivation. The substantial growth in rice production in Telangana is mainly driven by rapid expansion in area rather than yield improvements. Telangana's growth in area, production, productivity gains have been comparatively weak that the state's rice boom has been an area-led rather than a yield-led phenomenon.

Telangana has well performed the national average by a wide margin in area and production growth, but its productivity growth lags behind, whereas India has contrasting pattern-slow area growth but dependable, significant productivity gains. Telangana's rice economy has grown through horizontal expansion (more land under the crop) whereas India's rice economy shows vertical expansion (more output per hectare), and bridging this productivity gap through productivity-enhancing interventions (improved seed, precision nutrient management, better on-farm water-use efficiency) represents the key opportunity for the state going forward. Although Telangana's rice exports expanded at a faster rate, they were more unstable than India's overall exports. In contrast, India's rice exports exhibited relatively lower growth but greater stability, suggesting a more diversified and resilient export base.

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