J. Farm Sci., 38(2): (155-158) 2025

RESEARCH PAPER

Growth, instability and decomposition analysis of cashew nut production in India and Kerala

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(Received: August, 2024 ; Accepted: June, 2025)

DOI: 10.61475/JFS.2025.v38i2.13

Abstract: Cashew tree (*Anacardium occidentale*) is an evergreen tropical tree originated in Eastern Brazil. India is the second largest producer, exporter and largest consumer of cashew nuts in the world. Cashew cultivation is primarily concentrated in the peninsular regions of India, including Kerala, Karnataka, Goa, and Maharashtra. This study analyses the growth, instability and decomposition of cashew nut production in India and Kerala over the last two decades. The analysis utilizes secondary data on area, production and productivity from 2004 to 2023, with a focus on two sub-periods: 2004-2013 and 2014-2023. Compound Annual Growth Rate (CAGR) and Cuddy-Della Valle Instability Index (CDVI) were employed to assess the growth and variability. Decomposition analysis was used to evaluate the relative contributions of harvested area and productivity to cashew production.The results indicated that in India, the area under cashew cultivation grew steadily in both periods with growth rates of 2.62 per cent and 2.14 per cent in period-I and period-II respectively, but growth in production (0.37%) slowed in the second period due to declining productivity (-1.73%). The primary driver of cashew production growth in India was area expansion, while declining productivity had a negative impact, particularly in the second period. In Kerala, the findings were similar, with area expansion contributing positively to production, but productivity declines offsetting these gains. The study concludes that increasing cashew production in India relies heavily on expanding the cultivated area, but addressing productivity challenges is crucial for sustainable growth.

Key words: Cashew productivity, Compound annual growth rate, Decomposition analysis, Instability, Production

Introduction

The cashew (*Anacardium occidentale*), a member of family Anacardiaceae is an evergreen tropical tree which is the only species in the family to have attained commercial significance. The name comes from the Portuguese name for the fruit *caju* or *acaju,* which means "nut that produces itself". Cashew is a native to Eastern Brazil and was introduced by the Portuguese to other tropical regions. It was first introduced to India in 16th century in Goa, from where it gradually spread to other parts of the country. Initially, cashew was considered as a crop for afforestation and soil stabilization to prevent erosion. Over time, it evolved into a high-value crop, achieving the status of an export-oriented commodity. The primary products of the cashew crop include raw cashew nuts, kernels, cashew nut shell liquid (CNSL) and cashew apples. Cashew kernels are produced through the processing of raw cashew nuts, which involves roasting, shelling, peeling, grading and packing.

Cashew is grown in 32 countries in the world including seven in Latin America, eight in Asia, and seventeen in Africa and Australia. Globally, cashew is cultivated in a total area of 68,56,460 hectares with total production of 38,53,095 tonnes and average productivity is 1.36 t/ha in 2022. Cote'd Ivory, India, Tanzania, Vietnam, Benin, Indonesia and Brazil are the major cashew nut producing countries. India occupies the second position in terms of area as well as production after Cote'd Ivory.

India is the second largest producer, exporter and largest consumer of cashew nuts in the world. Indian cashews are known worldwide for its highest quality. India have more than 30 varieties of cashew nuts which are having exportable grade of kernels. Cashew is a significant horticultural crop in the country and is among the top agri-horticultural commodities exported from India. India accounts for 20 per cent of global cashew production. During 2022-23, India had a production of 7.82 lakh tonnes of cashew nuts from an area of 11.95 lakh ha and the average productivity is 650 kg/ha. India stands second in the world in the exports of cashew kernels holding an 8.72 per cent market share. India exported cashew kernels and CNSL worth of ₹ 2808.8 crores and ₹ 16.01 crores, respectively during 2023-24. Country also exported cardanol worth of 61.19 crores during 2023-24.

Cultivation of cashew in India is confined mainly to the peninsular areas. Cashew cultivation is prominent in Kerala, Karnataka, Goa and Maharashtra along the west coast of India. On the east coast, it is grown in Tamil Nadu, Andhra Pradesh, Odisha and West Bengal. Additionally, cashew farming has been seen to a limited extent in regions such as Chhattisgarh and the North Eastern states, including Assam, Manipur, Tripura, Meghalaya and Nagaland. In India, major cashew producing states are Maharashtra, Orissa, Andhra Pradesh, Karnataka, Tamil Nadu and Kerala. In 2022-23, Orissa contributed the largest area (2.23 lakh hectares) under cashew cultivation which accounts to 19 per cent of total area under the crop in India. Whereas, Maharashtra topped in productivity (1.03 t/ha) and production (1.97 lakh tonnes) by contributing 25 per cent of the total production of cashew nuts in the country. Cashew nut is one of the important commercial crops cultivated in Kerala. In 2022-23, Kerala covered an area of 1.09 lakh hectares under cashew cultivation, with production of 74,630 tonnes

Table 1. Growth rate and instability index of area, production and productivity of cashew in India

Study period	Area (ha)	Production (Mt)		Productivity (Mt/ha)	
CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)
Period I(2004-13)2.62***	0.89	3.54***	5.56	0.90*	6.40
Period II(2014-23)2.14***	2.93	0.37***	5.48	-1.73**	11.61
Entire Period(2004-23)2.13***	2.29	1.70***	6.70	-0.43^{NS}	9.26

*Note: *** Significant at 1 per cent level, ** Significant at 5 per cent level, * Significant at 10 per cent level, NS- Non-Significant*

and an average productivity of 680 kg/ha.Given these factors, the present study is carried out with the objective to estimate the growth, instability and decomposition in area, production and productivity of cashew in India and Kerala.

Material and methods

The study was entirely based on secondary data on area, production and productivity of cashew nut. The secondary data pertaining to last 20 years were collected from Directorate of Cashew nut and Cocoa Development Board (DCCD) website. The time series data for 20 years (2004 - 2023) was divided into two sub periods: Period-I(2004 - 2013) and Period-II (2014- 2023).

Compound annual growth rate (CAGR) analysis

To compare the growth in area, production and productivity of cashew, compound growth rates were computed using the following model;

$Y = ab^te^u$

Where,

Y = Dependent variable (area/ production/ productivity)

a = Intercept

b = Regression coefficient

r = Compound annual growth rate per annum (b-1)

t = Time period in years

e^u = Error term

In logarithmic form the function is expressed as, Log Y= log a + t log b + u

CAGR in per cent (r) = (Antilog of log b-1) x 100

Cuddy-Della valle instability index

Cuddy-Della Valle Instability Index is calculated to measure the instability in area, production and productivity of cashew. The instability index is given by the expression;

$CDVI = CV \times \sqrt{(1-R^2)}$

Where,

CV = Coefficient of variation

R^2 = Coefficient of determination from a time-trend regression adjusted for its degrees of freedom.

Decomposition analysis

Table 2. Percentage contributions of area, productivity and their interaction towards changing Indian cashew production

Effects (%)	Period I (2004-13)	Period II (2014-23)	Entire Period (2004-23)
Area (ha)	66.69	472.57	115.24
Productivity (Mt/ha)	26.22	-315.20	-9.95
Interaction	7.09	-57.37	-5.29

The alteration in crop production volume is mainly determined by changes in the harvested area and fluctuation in its average yield. A decomposition analysis model was used to measure the relative contribution of harvested area and productivity and the interaction of the two in total cashew production. The Decomposition Analysis Model by Minhas (1965) was used in this study, as given by the following equation;

$$p = \frac{Y_0 \Delta A}{\Delta P} \times 100 + \frac{A_0 \Delta Y}{\Delta P} \times 100 + \frac{\Delta A \Delta Y}{\Delta P} \times 100$$

Where, $\Delta P = P_n - P_0$, $\Delta Y = Y_n - Y_0$, $\Delta A = A_n - A_0$

A_0, P_0 and Y_0 are the area, production and productivity of the base year

A_n, P_n and Y_n are the area, production and productivity of the n^{th} year

Results and discussion

Growth rate, instability and decomposition in area, production and productivity of cashew nut in India

The table 1 indicates the Compound Annual Growth Rate (CAGR) and Cuddy Della Valle Instability Index (CDVI) for the area under cultivation, production, and productivity of cashew nut in India over three periods: period I (2004-13), period II (2014-23), and the overall period (2004-23). During period-I, the area under cashew cultivation was significant with growth rate of 2.62 per cent and low variability (0.89%). This growth continued in period-II albe it at a slightly slower rate (2.14%) with variability of 2.93 per cent. Overall, for the entire period, the area under cashew nut cultivation grew at a growth rate of 2.13 per cent, with low variability (2.29%). In terms of production, period I experienced the highest growth of 3.54 per cent. However, this growth declined in period-II, with a CAGR of only 0.37 per cent and for overall period 1.7 per cent growth was seen. The instability indices were low for period-I (5.56%), period-II (5.48%) and overall period (6.70%). Productivity showed a marginal growth in period-I (0.90%) with low variability (6.40%), but declined in period-II with a negative growth rate of -1.73 per cent and showed slightly increased variability (11.61%). Over the entire period, productivity showed negative growth rate (-0.43%) which was non-significant with instability index of 9.26 per cent. The reduced yield in cashew in India can be attributed to use of low yielding local varieties, planting of cashew in marginal and poor land, old and senile orchards and pest incidence that leads to yield reduction of 30-40 per cent (Kulkarni *et al*., 2012). The declining cashew productivity in India was also reported by Nayak and Paled (2018). The low CDVI values across all three metrics suggest relatively low

Table 3. Growth rate and instability index of area, production and productivity of cashew in Kerala

Study period	Area (ha)		Production (Mt)		Productivity (Mt/ha)	
	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)
Period I (2004-13)	-2.18*	10.80	-0.59 NS	11.81	0.64 NS	5.61
Period II (2014-23)	3.02***	1.10	-1.17*	7.24	-1.45*	7.17
Entire Period (2004-23)	1.11**	10.72	0.18 NS	10.08	-0.51*	6.88

*Note: *** Significant at 1 per cent level, ** Significant at 5 per cent level, * Significant at 10 per cent level, NS- Non-Significant*

Table 4. Percentage contributions of area, productivity and their interaction towards changing cashew production of Kerala

Effects (%)	Period I (2004-13)	Period II (2014-23)	Entire Period) (2004-23
Area (ha)	84.05	-406.54	-35.04
Productivity (Mt/ha)	18.98	396.18	125.60
Interaction	-3.03	110.36	9.44

variability during all three periods for cashew production.

The relative contributions of harvested area, productivity, and their interaction effects to the total variability in cashew production growth are shown in table 2. The results revealed that in period-I, the area had the largest positive impact (66.69%), indicating increased land under the cultivation and was the primary driver for growth in production. Productivity also contributed positively (26.22%), with minimal interaction effects (7.09%). However, in period-II, the area contribution surged dramatically to 472.57 per cent, but this was counteracted by a significant negative impact from productivity (-315.20%), suggesting that while more land was brought under cultivation, declining productivity offset these gains. Similar was the case with the entire period where area expansion remained the dominant factor (115.24%). It can be inferred that, the increase in cashew production in all the three periods is majorly contributed by the area expansion alone.

Growth rate, instability and decomposition in area, production and productivity of cashew nut in Kerala

The growth rate and instability index of area, production, and productivity of cashew in Kerala, as presented in table 3, show varying trends across different periods. During period-I, the area under cashew cultivation experienced a significant negative growth rate of -2.18 per cent, with CDVI of 10.80 per cent. Production was declined marginally by -0.59 per cent, but this change was not statistically significant. Productivity showed a slight, non-significant growth of 0.64 per cent. In period-II, the area grew significantly at a rate of 3.02 per cent, but this period also showed a significant decline in production (-1.17%) and productivity (-1.45%). Across the entire period, there was a positive growth in area (1.11%) and a slight, non-significant increase in production (0.18%), while productivity declined with a significant CAGR of -0.51 per cent. These results indicated that, while efforts to expand the cultivated area were some what successful, the overall production was constrained by declining productivity. This could be due to use of low yielding varieties, high sensitivity of yield to weather conditions and use of infertile and marginal land for cashew cultivation. Paul and Ushadevi (2022) also reported similar results of declining trend in cashew nut production in Kerala.

Table 4 provides the percentage contributions of area, productivity, and their interaction to the changing cashew production in Kerala across the same periods. In period-I, the area had a dominant positive contribution of 84.05 per cent to the change in production, while productivity contributed 18.98 per cent, and the interaction effect was negative (-3.03%), which indicated the production has been declining due to the decrease in the area under cashew nuts in Kerala. However, in period-II, the contributions shifted dramatically, with the area showing a large negative impact (-406.54%), while productivity made a significant positive contribution (396.18%). This implies that in second period, the production of cashew nuts declined due to the lower productivity in Kerala. The production was declining in the second period despite an increasing area under cultivation. These results suggest that, despite efforts to expand the cultivated area, declining productivity and unfavourable interaction effects had a considerable impact on production trends in Kerala. Over the entire period, the area had a slightly negative contribution of -35.04 per cent, while effect of productivity (125.60%) and interaction (9.44%) were positive.

Conclusion

The study reveals that the growth of cashew nut production in India and Kerala over the past two decades has been primarily driven by the expansion of the area under cultivation. However, this growth has been limited by declining productivity, particularly during the second period (2014-2023). Factors contributing to reduced productivity include the use of low-yielding traditional varieties, cultivation on marginal lands, aging plantations and increased pest and disease infestations. In Kerala, although area expansion initially boosted production, productivity declines offset these gains in later years. The decomposition analysis highlights that the negative interaction between area and productivity further hampers production growth, suggesting that area expansion alone is insufficient for sustainable growth. To achieve long-term success in cashew production, both in India and Kerala, it is essential to improve productivity by adopting high-yielding varieties, rejuvenating old orchards and implementing effective pest and disease control measures. Additionally, investments in research, modern farming practices and farmer training are crucial to enhance yields and maintain India's competitive edge in the global cashew market. Sustainable farming practices, along side policy support for modernization, will ensure continued growth in the cashew industry, making it more profitable and resilient.

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