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Trend analysis of the raw cashewnut production in India

[1]Aswathy, Chandrakumar, [3]Thamban C, [3]Jayasekhar S, [4]Priyanka Singh, [5]Hema M, [2]Eradasappa E, [2]Thondaiman V, [2]Jyoti, Nishad, [2]TN Raviprasad and [2]J Dinakara Adiga

[1]Scientist, Department of Agricultural Extension, ICAR-Directorate of Cashew Research, Dakshina Kannada, Karnataka, India

[2]ICAR-Directorate of Cashew Research, Dakshina Kannada, Karnataka, India

[3]ICAR-Central Plantation Crops Research Institute, Kasaragod, Kerala, India

[4]ICAR-Central Agroforestry Research Institute, Jhansi, Uttar Pradesh, India

[5]College of Agriculture, Padanakkad, Kerala Agricultural University, Kasaragod, Kerala, India

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Corresponding Author: Aswathy Chandrakumar

Abstract

India first commercialized cashew as a horticulture crop, however the huge gap between domestic production and raw cashewnut requirement pose a major challenge to the sustainability of the processing capacity established in the country. There are huge differences in the way each state has organized, promoted and facilitated cashew cultivation. In this context, the study attempts to analyse the trend and instability of the raw cashewnut production in major cashew growing states and at the national level for the past five decades. The effect of area, yield and their variability on output growth over the years was also analysed using Hazell's decomposition analysis. The findings of the study reveal that raw cashewnut production increased significantly in the country at a decelerated rate with Compound Annual Growth Rate (CAGR) 4.01% during the period from TE 1971-72 to TE 2020-21 and this growth was attributed to a significant increase in area and yield. Kerala is the only state which shows a negative growth rate in area (-1.02) and production (-0.93) which calls for more concerted efforts towards reviving the cashew cultivation. Maharashtra with the highest production and second largest area under cashew cultivation shows highest instability. The study reiterates the need for a multi-pronged approach to boost the domestic cashew production and revive the Indian cashew sector.

Keywords: Raw cashewnut production, area, trend analysis, instability, Hazell's decomposition analysis

Introduction

Cashew (*Anacardium occidentale* L.) is an important crop to the Indian economy and plays a critical role in employment generation, ensuring nutritional security and achieving social objectives. There is a huge gap between domestic production and processing requirement posing a major challenge to the sustainability of the processing capacity established in the country. It is estimated that the processing industries in India require 45 lakh tonnes of raw cashewnuts upto 2050 (Saroj and Swamy, 2017) [20]. The quantity of raw cashewnuts imports has increased from 241161 MT in 1998-99 to 938038 MT in 2019-2020 (DCCD, 2020) to meet this demand. India and Vietnam accounted for 98 per cent of the total global raw cashewnuts imports by volume during the period from 2014-18 (UNCTAD, 2021) [25]. India heavily depends on African countries for imports, however with efforts made to strengthen the processing facilities in these countries, there will be a drastic decline in the RCN imports in future.

India remains the largest consumer for cashew and the domestic market is booming due to changing lifestyles and rising disposable income. There is enormous scope for cultivating cashew, however, farmers still need information on high yielding varieties suitable to their region, management of pests and diseases (Chandrakumar *et al*, 2023) [3] and non-crop information like market availability, domestic price of the nuts and about schemes and subsidies. Research studies indicate that there is a huge technology gap in the cashew growing areas (Sajeev and Saroj, 2014) [18] leading to low productivity of cashew orchards. There are huge differences in the way each state has organized, promoted and facilitated cashew cultivation in the country which requires in-depth studies. The growth performance of the crop across different states during different time periods have been analysed in few studies (Kulkarni *et al*, 2012; Elakkiya *et al*, 2017; Israrullah and Sonnad, 2018; Nayak and Palad, 2018; Das and Mishra, 2021; Manerikar *et al.*, 2022) [11, 6, 10, 15, 16], however a comparative analysis of the trends in area and production in major cashew growing states is limited. Also, the relative role of area and yield in production has not been given emphasis in any of the studies. The present study therefore aims to analyse the production scenario by studying these aspects for the past five decades.

Methodology

The study is primarily based on secondary data pertaining to area (in 000' ha), production (in metric tonnes) and productivity (metric tonnes/ha) of raw cashewnuts for a comprehensive period of 1969-70 to 2020-21. The data have been sourced from INDIASTAT* and covers all the major cashew growing states having an area greater than 50 thousand ha as per the 2020-21 estimates.

Compound annual growth rate

The compound annual growth rate of area, production and productivity of cashewnut for India over a period of triennium ending TE 1971-72 to TE 2020-21 and acceleration and deceleration in its growth rates were computed using the following log -quadratic model (Boyce, 1986) [2] -

$$\ln Y_t = a + bt + ct^2 + u_t$$

where,
ln(*Yt*) is the natural logarithm of the dependent variable
ln(*t*) is the natural logarithm of the independent variable
a, *b* and *c* are the coefficiants that need to be estimated
ut is the error term, representing the unobserved factors that affect

Computed value of b and c gives the measure of growth rate and acceleration or deceleration, respectively. A significant positive value indicates acceleration, while significant negative value shows deceleration in growth rate and if the value is insignificant, it implies stagnation in growth process (Ghosh, 2010; Singh *et al*, 2021). Time is normalized in mean deviation form, ie., t was set as 0 at the midpoint of the series, so that time (t) and its square (t^2) becomes orthogonal to avoid multicollinearity issue (Boyce, 1986) [2].

Instability analysis

Instability in raw cashewnut production was measured using Cuddy-Della Valle Index (CDVI) which gives an exact direction of instability (Cuddy and Valle, 1978). CDVI was calculated as follows-

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

Where,
CV is coefficient of variation in per cent and is calculated as

$$CV = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

R^2 = Coefficient of determination

Hazell's Decomposition Analysis

The model was employed in the study to examine quantitatively the effect of area and yield and their variability on output growth over the years.
Let Q represent production, A the area sown and Y the yield. Then for each state

$$Q = AY \quad (1)$$

The variance of production V(Q) can be expressed as

$$V(Q) = \bar{A}^2 V(Y) + \overline{Y^2} V(A) + 2\bar{A}\, Y \mathrm{Cov}(A,Y)\, \mathrm{Cov}(A,Y)^2 + R \quad (2)$$

Where
($\bar{A}$)= Mean area
($\overline{Y}$) =Mean yield and R is a Residual term which is expected to be very small

From equation (2) it is clear that V(Q) is not only a function of the variances of yield and area sown, but also of the mean area and yield and of the covariance between area and yield. Change in any one of these will lead to change in V (Q).
For decomposing the change in average production ΔE (Q), using equation (1), average production in the first period is (1969-70 to 1994-95)

$$E(Q_1) = \bar{A}_1 \overline{Y}_1 + \mathrm{Cov}(A_1, Y_1) \quad (3)$$

And in the second period it is (1995-96 to 2020-2021)

$$E(Q_2) = \bar{A}_2 \overline{Y}_2 + \mathrm{Cov}(A_2, Y_2) \quad (4)$$

Each variable in the second period can be expressed as its counterpart in the first plus the change in the variable between the two. For example,

$$\bar{A}_2 = \bar{A}_1 + \Delta\bar{A} \quad (5)$$

Where

$$\Delta\bar{A} = \bar{A}_2 - \bar{A}_1.$$

Therefore equation (4) can be written as

$$E(Q_2) = (\bar{A}_1 + \Delta\bar{A})(Y_1 + \Delta\bar{Y}) + \mathrm{Cov}\,\overline{(A_1, Y_1)} + \Delta\,\mathrm{Cov}(A, Y) \quad (6)$$

The change in average production, Δ E(Q), is obtained by subtracting equation (6) from equation (3).

Table 1: Components of change in average production

Sl. No.	Sources of Change	Symbol	Component of change
1.	Change in mean yield	$\Delta\overline{Y}$	$\bar{A}_1\, \Delta\overline{Y}$
2.	Change in mean area	$\Delta\bar{A}$	$\overline{Y}_1\, \Delta\bar{A}$
3.	Interaction between change in mean area and mean yield	$\Delta\overline{Y}$, $\Delta\bar{A}$	$\Delta\bar{A}\, \Delta\overline{Y}$
4.	Change in area-yield covariance	Δ Cov(A,Y)	Δ Cov(A,Y)

Source: Hazell, 1982

Results and Discussion

As a first-hand information, Table 2 provides the area, production and yield dynamics of raw cashewnuts in India during the overall period TE 1971-72 to TE 2020-21 and for the 5 decades TE 1971/72 to TE 1980/81, TE1981/82 to TE1990/91, TE1991/92 to TE2000/01, TE2001/02 to TE2010/11, TE2011/12 to TE2020/21. Raw cashewnuts production increased significantly in the country at a decelerated rate with CAGR 4.01% during the overall period and this growth was mainly caused by a significant increase in area and yield (Fig. 1). It is noteworthy that the area expansion under cashew gained momentum at the global level with the introduction of National Horticulture Mission in 2005-06 (NABARD, 2006) [13].

Table 2: Area, production and yield dynamics of raw cashewnuts in India

Periods	Area		Production		Yield	
	Growth rate	Acceleration/Deceleration	Growth rate	Acceleration/Deceleration	Growth rate	Acceleration/Deceleration
TE 1971/72 to TE1980/81	3.96* (24.07)	0.01* (0.20)	4.15* (19.56)	0.01* (0.12)	0.19* (0.54)	0.00** (0.04)
TE1981/82 to TE1990/91	1.72* (2.18)	-0.67* (-3.13)	7.46* (7.58)	0.93* (4.15)	5.77** (3.88)	1.49* (5.43)
TE1991/92 to TE2000/01	3.55* (15.10)	0.02 (0.27)	1.23** (1.10)	1.08* (4.72)	-2.31** (-2.17)	1.06* (5.36)
TE2001/02 to TE2010/11	2.55* (48.48)	-0.03** (-1.95)	4.18* (13.18)	-0.09 (-0.72)	1.62* (4.66)	-0.04 (-0.30)
TE2011/12 to TE2020/21	1.65* (8.88)	0.09 (1.32)	0.84* (2.20)	-0.26* (-2.09)	-0.78* (-1.79)	-0.36* (-2.87)
TE 1971/92 to TE2020/21	2.52* (43.13)	-0.01* (-3.06)	4.01* (33.05)	-0.04* (-6.61)	1.48* (10.81)	-0.03* (-3.41)

*Significant @ 1%, ** significant @ 5%

Note: Figures in parentheses shows two-tailed t-statistics

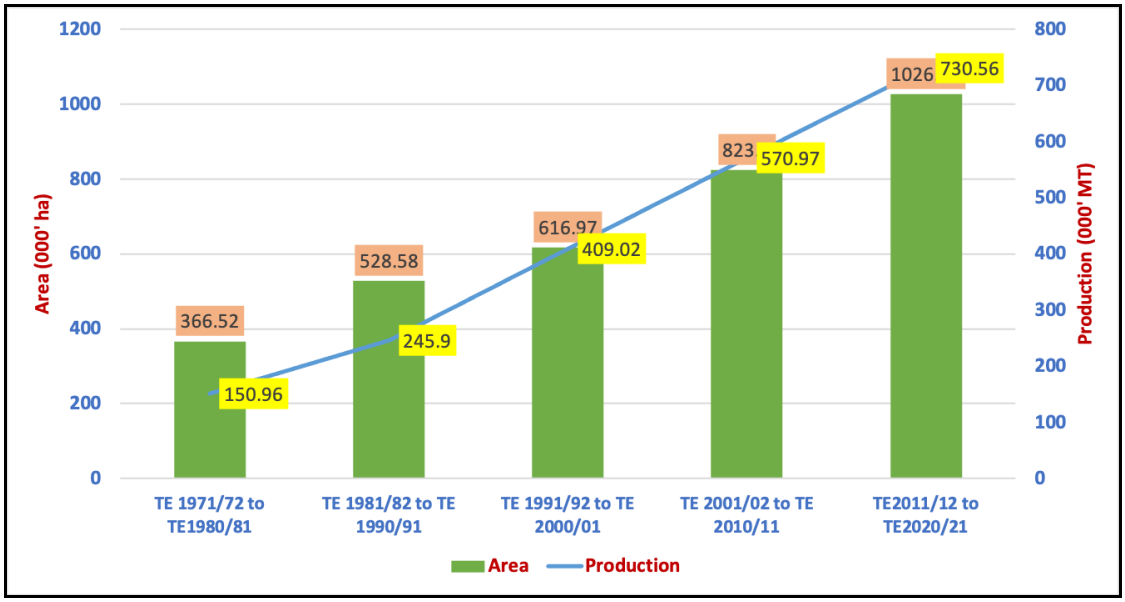


Fig 1: Trends in area and production of raw cashewnuts in India for different time periods

The percentage allocation of area under cashewnut out of the net sown area of the region, during 2019-20 is presented in Table 3 to ascertain the scope of spread of cashewnut to newer areas. With area allocation being less than five percent of their net sown area in all the cashew producing states except Goa, there is still scope for area expansion with appropriate policy interventions and adoption of improved cashew cultivation practices. The percentage share of the major cashewnut producing states in area and production has shown a declining trend as this group accounted for 94.76 percent of India's area under cashew during 2001-2020 (as against 98.77 percent during 1969-1980) (Fig. 2) and 93.93 percent of total production (as against 98.62 percent during 1969-1980) (Fig. 3). The percentage share of other states which includes West Bengal, Chhattisgarh, Gujarat, Jharkhand and North eastern states have increased from 1.23% to 5.24% as a result of the State Government's efforts to bring more area under cashew by providing financial assistance to the farmers.

Table 3: Percentage share of cashewnut to the net sown area of the major cashewnut growing states of India

States	Cashew area as percent of net sown area (2019-2020)
Andhra Pradesh	3.27
Goa	45.71
Karnataka	1.24
Kerala	4.88
Maharashtra	1.13
Odisha	5.22
Tamil Nadu	3.17
India	1.70

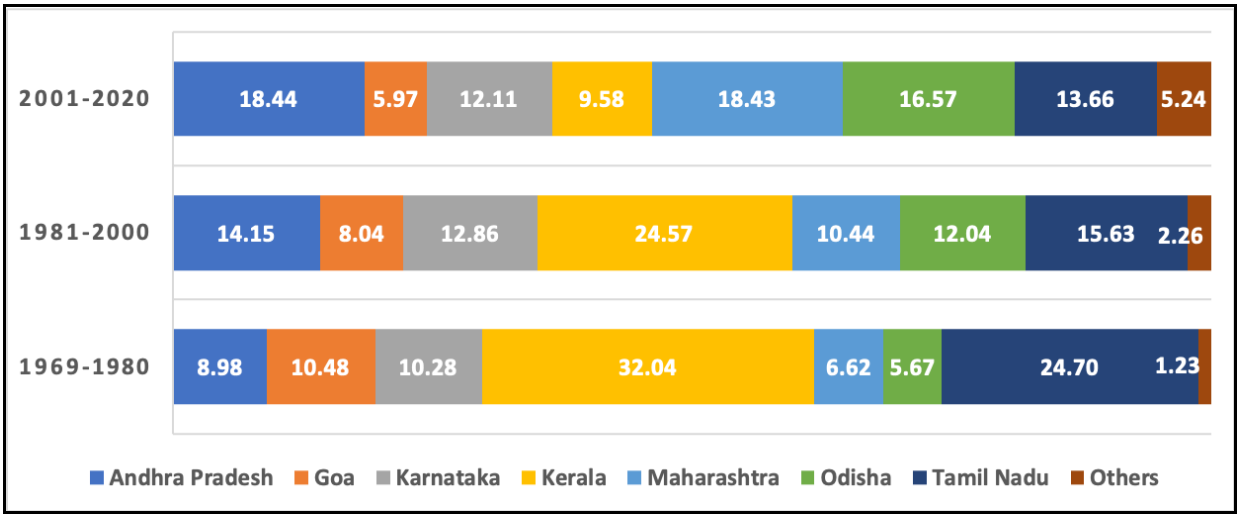


Fig 2: Changing share of states in area under cashew in India

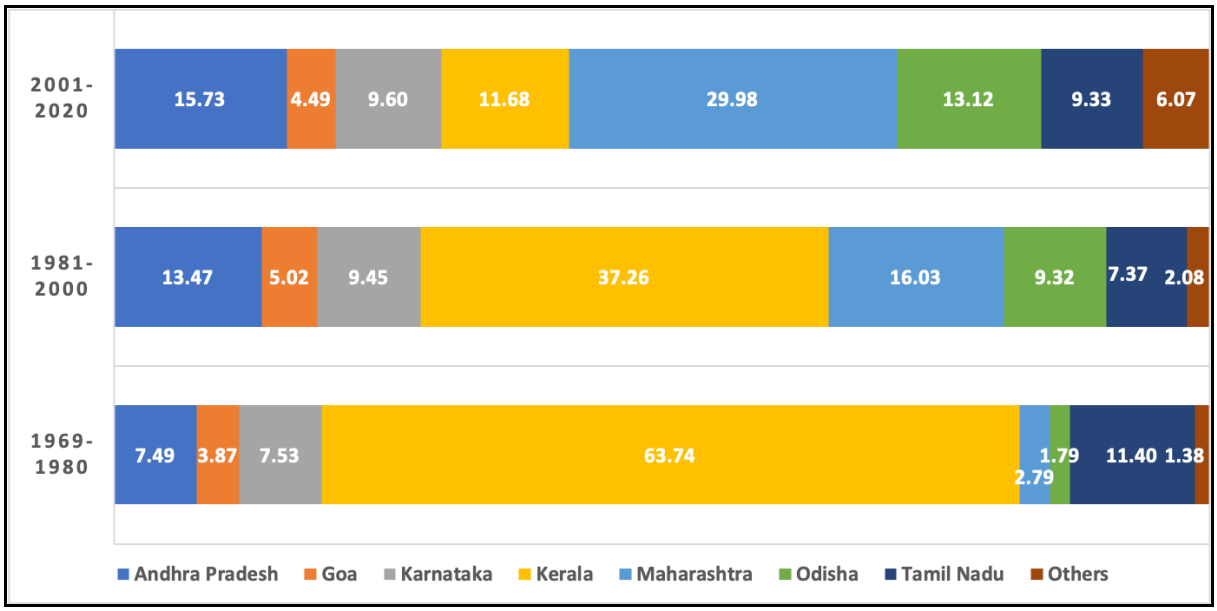
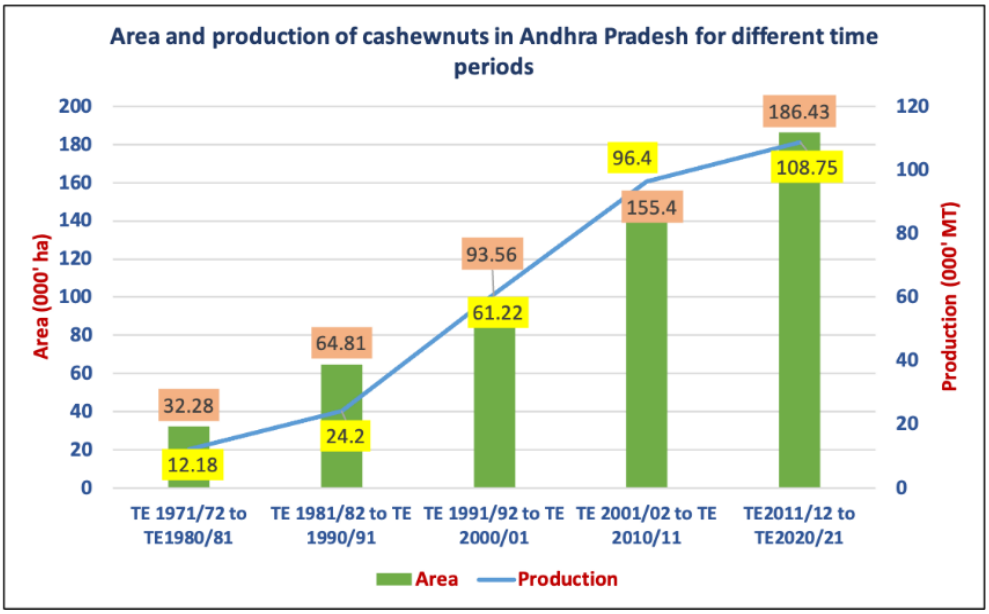


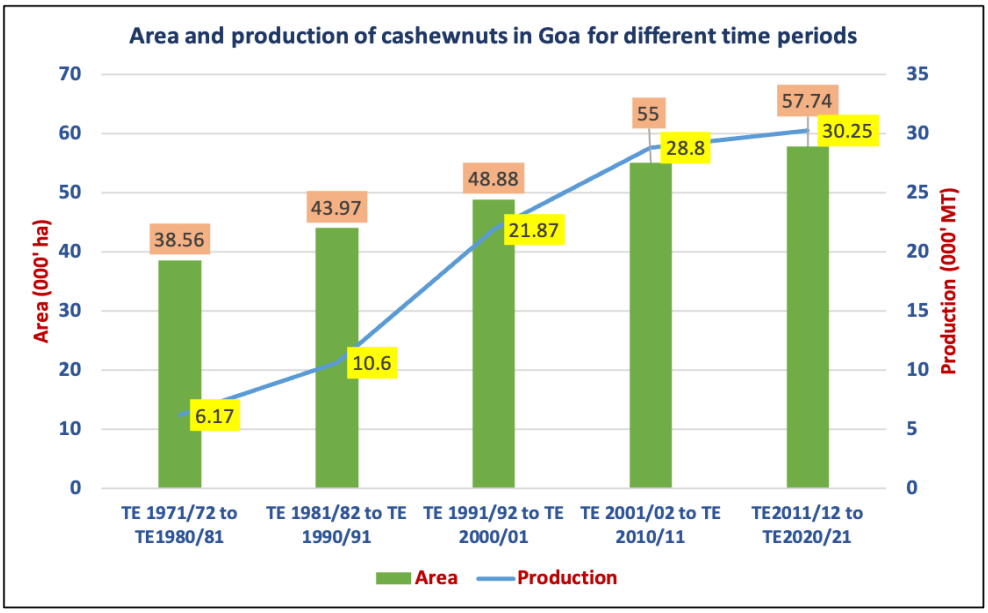
Fig 3: Changing share of states in country's production of raw cashewnuts

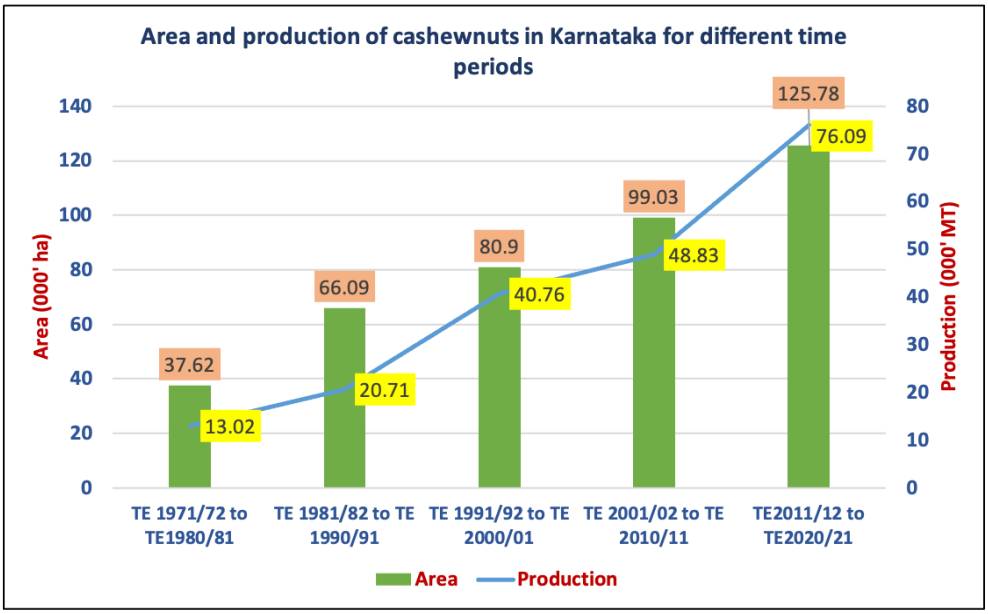
States like Maharashtra, Andhra Pradesh, Odisha and Karnataka registered a significant improvement in area and production consolidating their stakes over the decades (Fig. 4). In Maharashtra, there was a significant increase in area under cashew till 2000-01 due to the implementation of Employment Guarantee Scheme linked Horticulture Development Programme with maximum area brought under mango and cashew followed by citrus fruits (Shroff and Kajale, 2008; Manerikar *et al.*, 2022) [23, 12]. The average productivity of cashew in Maharashtra is 1.5t/ha and the state has a strong research extension linkage for promoting cashew (Gawankar *et al.*, 2020) [7].

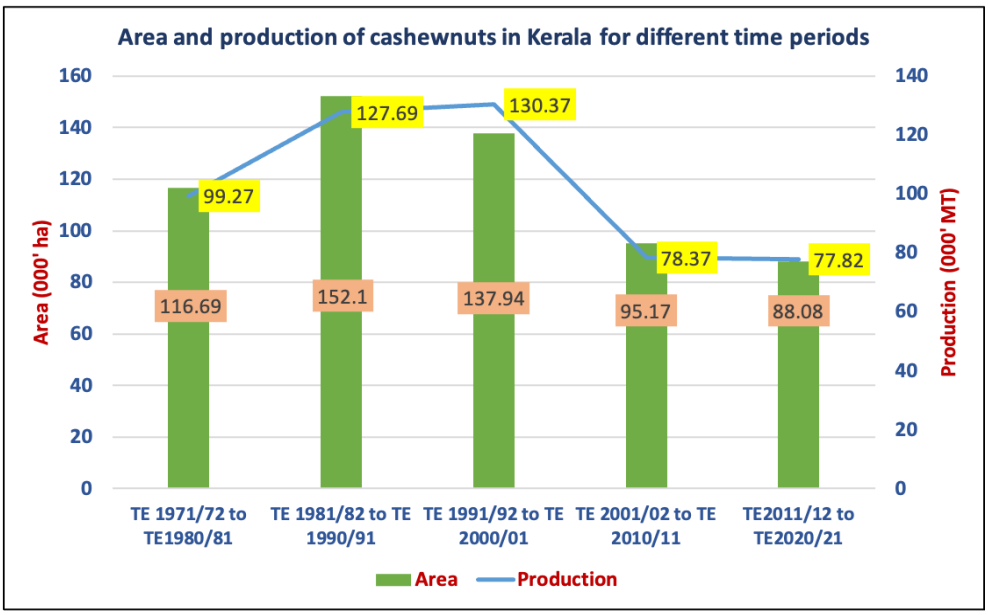
The decline in area and production of raw cashewnuts in Kerala during the study period is attributed to the paradigm shift to other lucrative crops like rubber in late 1980's (Sebastian and Jessy Thomas, 2001; Israrulla and Sonad, 2018) [21, 10] and raising of cashew plantations on marginal and poor fertile soils with farmers not adopting the suggested package of practice (Paul and Ushadevi, 2022) [17]. The heavy price fluctuations and low productivity of

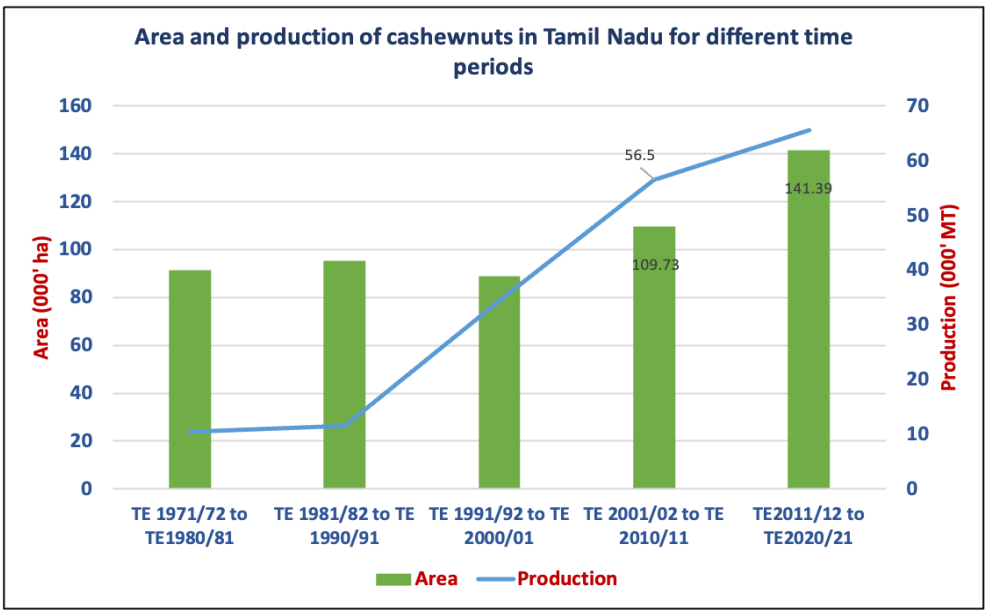
cashew orchards resulted in lower economic impact in Kerala when compared to the neighbouring cashew growing states of Karnataka and Maharashtra (Sajeev and Manjusha, 2016) [19]. The extensive fragmentation of land, with the average landholding size of 0.12ha (Anon, 2022) and the predominance of small farmers is another noticeable feature of Kerala that has led to negligible land available for cashew cultivation. The adoption of cashew production technologies, especially plant protection technologies with respect to control of Cashew Stem and Root Borer (CSRB) and Tea Mosquito Bug (TMB) was found to be very low (Sajeev and Saroj, 2014) [18]. This is a matter of great concern as yields are largely influenced by the attack of TMB while CSRB attack results in the death of the tree. The changing climate and the non-remunerative business for the processing industry have also led to a decrease in area and production.






Area and production of cashewnuts in Karnataka for different time periods
Area (000' ha)
Production (000' MT)
37.62
66.09
80.9
99.03
125.78
13.02
20.71
40.76
48.83
76.09
TE 1971/72 to TE1980/81
TE 1981/82 to TE 1990/91
TE 1991/92 to TE 2000/01
TE 2001/02 to TE 2010/11
TE2011/12 to TE2020/21
Area
Production


Area and production of cashewnuts in Kerala for different time periods
Area (000' ha)
Production (000' MT)
116.69
152.1
137.94
95.17
88.08
99.27
127.69
130.37
78.37
77.82
TE 1971/72 to TE1980/81
TE 1981/82 to TE 1990/91
TE 1991/92 to TE 2000/01
TE 2001/02 to TE 2010/11
TE2011/12 to TE2020/21
Area
Production


Area and production of cashewnuts in Tamil Nadu for different time periods
Area (000' ha)
Production (000' MT)
109.73
141.39
56.5
TE 1971/72 to TE1980/81
TE 1981/82 to TE 1990/91
TE 1991/92 to TE 2000/01
TE 2001/02 to TE 2010/11
TE2011/12 to TE2020/21
Area
Production

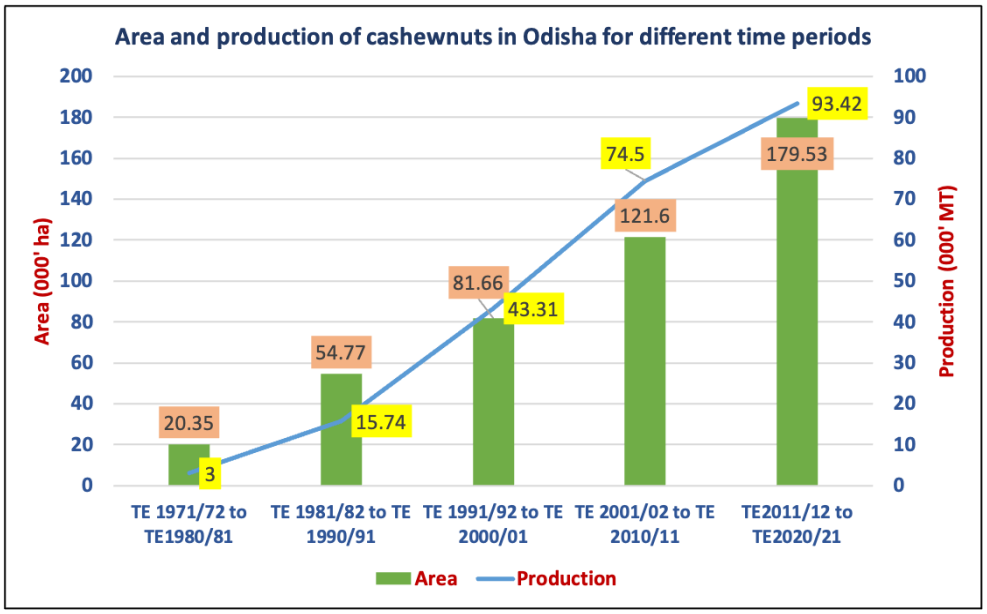


Fig 4: Trends in area and production of raw cashewnuts in major cashewnut producing states for the time period from TE 1970/71 to TE 2020/21

The table 4 reveals a positive growth rate in cashewnut area and production for India as well as for the major cashew growing states except Kerala, which indicates that the crop is still in the expansion phase. Expansion of area under cashewnut has been a vigorous phase in states like Maharashtra (5.54), Odisha (5.47) and Andhra Pradesh (4.38), when the whole period is considered.

Considering the long gestation period of cashew, the age composition of cashewnut trees also play an important role on productivity of farms, apart from the actual efficiency of the production systems. States like Goa and Tamil Nadu have high production growth, compared to growth rate in area which is much less than that of many states, implying a favourable age composition of cashewnut trees there. Table 3 also discloses the instabilities in area and production and it can be inferred that production instability is higher compared to area instability in India as well as the states underlying the role of productivity in the instabilities in production. The climatic variability is also a possible reason for the fluctuations in yield in the major cashew growing states (Nayak and Paled, 2018) [15, 16]. Maharashtra with the highest production and second largest area under cashew cultivation shows highest instability. Goa, where the area under cashew is small compared to the other states, show high instability in production.

Table 4: Growth rate and Cuddy Della Valle Instability Index (CDVI) of cashew for India and different states for the period 1969-70 to 2020-21

States	Area			Production		
	000' ha (2020-21)	GR	CDVI	000' metric tonnes (2020-21)	GR	CDVI
Andhra Pradesh	196.2	4.38	12.32	121.20	5.80	18.53
Goa	57.72	1.04	3.52	31.55	4.12	25.49
Karnataka	137.40	2.86	5.42	74.20	4.40	22.85
Kerala	103.20	-1.02	20.32	73.10	-0.93	22.89
Maharashtra	191.50	5.54	35.92	190.20	9.92	44.50
Odisha	214.00	5.47	13.72	115.50	8.75	18.98
Tamil Nadu	167.00	1.00	13.44	73.60	5.09	34.52
India	1158.90	2.52	7.13	738.00	4.01	13.94

Components of change in mean production

The results of decomposition analysis have been summarized in Table 5. A close perusal of the table suggests that increase in mean area contributed to 54.57 per cent of the total increase in the cashewnuts production while increase in mean yield contributed to 24 per cent of the increase in production. The interaction between change in mean yield and change in mean area accounted for 22 per cent of the increase in raw cashewnuts production.

Table 5: Components of change in mean production of Cashew (1969-70 to 2020-21)

Components/States	Andhra Pradesh	Goa	Karnataka	Kerala	Maharashtra	Odisha	Tamil Nadu	India
Change in mean yield (%)	12.29	61.33	24.62	-10.99	3.32	14.84	66.14	24.08
Change in mean area (%)	65.70	19.76	50.42	106.56	76.73	51.91	14.93	54.57
Interaction between changes in mean area and mean yield (%)	25.68	20.11	23.84	3.18	11.75	37.73	17.70	22.11
Change in area yield covariance (%)	-3.67	-1.21	1.12	1.25	8.21	-4.48	1.23	-0.76
Total change in mean production (%)	299.65	161.37	188.44	-27.16	606.96	407.60	265.41	164.27
Total contribution of state to change in mean production of cashew at National level	19.61	4.69	10.43	-8.61	39.98	16.78	11.05	100.00

A cursory look at the table also reveals that an incremental percent share in the average production of raw cashewnuts in India is contributed by Maharashtra (39.98%) followed by Andhra Pradesh (19.61%), Odisha (16.78%), Tamil Nadu (11.05%) and Karnataka (10.43%). Change in mean area accounted for a very large proportion of increase in the average production in almost all states except Goa and Tamil Nadu. With a much lower share of yield effect on output growth, the negative growth of output in Kerala is explained largely by the declining rate (-1.02 per cent) in area during the study period.

There is a significant growth in production of raw cashewnuts in majority of the cashew producing states during the study period. The state governments and development agencies have devised different strategies to address the cashew crisis and move forward. The co-operative marketing strategy introduced in Goa the integration of FPO into the cashew value chain by BAIF in Odisha are some of the notable initiatives which support the small holder cashew farmers (Narayan, 2022) [14].

With profitability of cashew cultivation still a major concern due to fluctuating prices and increasing production costs, cashew apple utilization (Nayak *et al.*, 2018b; Sobhana, 2019) [15, 16, 24] and handholding of subsidiary enterprises can help farmers earn additional income and thus lead to financial viability of the cashew orchards.

Conclusions and Policy Recommendations

Cashew is an economically important crop and India was the first country to commercialise it as a horticulture crop**.** However**,** India now lags behind the major competitors in the global cashew market in terms of yield and quality, necessitating the need for impactful interventions. Immediate attention from policymakers, researchers, processors, and farmers is crucial for the development and revitalization of the cashew industry. A multi-pronged approach is therefore necessary to boost the domestic cashew production and revive the Indian cashew sector which stands at a critical juncture.

The study's findings reveal that the increase in raw cashewnut production is primarily driven by area expansion. This underscores the need for investing in research and development for genetic improvement of the crop as a key policy intervention. In most states, the plantations are of seedling origin raised from unknown varieties resulting in low productivity. It is essential to closely monitor the old plantations and replace trees yielding less than 4-5kgs of nuts per year with high yielding cashew grafts. Ensuring the timely availability of quality planting material is crucial to addressing this issue.

The extension and advisory services are critical in encouraging farmers to cultivate cashew and strengthening the value chain. Educating farmers about high yielding cashew varieties and scientific orchard management practices can have an encouraging effect on the production of raw cashew nuts. Organising awareness campaigns and integrating participatory and interactive approaches such as farmer participatory technology demonstrations and farmer field schools can further accentuate the adoption process.

Handholding of subsidiary enterprises is another effective strategy to attract farmers to cashew cultivation. Investing in secondary agriculture practices such as bee keeping can help in augmenting farmers' income. Cashew trees are planted at a wider spacing and therefore introducing intercrops between the tree spaces can help farmers earn more revenue from their plantations. Cashew apple processing provides a great opportunity in terms of value creation, employment and revenue generation. Currently, large volumes of cashew apples are wasted, except in Goa where it is profitably used for the preparation of feni, an alcoholic beverage. With much research in the pipeline, efforts are needed to mainstream cashew apple-based products into niche markets.

The raw cashewnut market in India is largely unregulated which allows the control of the cashew sector by few traders. The respective state governments should intervene to regulate the market and implement price support policies. Integrating farmer collectives, such as Farmer Producer Organisations, into the cashew value chains can enhance forward and backward linkages and increase their bargaining power, resulting in a higher share of consumer spending reaching the producers.

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