Original Research Article

Growth and instability analysis of coconut in India and Kerala

ABSTRACT

The present study was carried out to analyze the growth trends and to observe magnitude of variations in area, production and productivity of coconut in India, Kerala and two major coconut growing districts (Kozhikode and Malappuram) of Kerala. This study is based on secondary data on area, production and productivity of coconut in India, Kerala and two districts of Kerala state collected from the website of Coconut Development Board (CDB) for a period of 20 years, i.e., from 2000-01 to 2019-20. The study used averages, coefficient of variation, instability index and compound annual growth rate for the analysis of the data. The growth trend was estimated using Compound Annual Growth Rate while the instability was measured using Cuddy Della Valle Instability index with the aid of coefficient of variation. The entire study period was further divided into two sub-periods: Period I (2000-01 to 2009-10) and Period II (2010-11 to 2019-20). The results of the growth rate analysis indicated that the highest growth rate was observed in production (3.85 %) followed by productivity (3.07 %) and area (0.75 %) at one per cent level of significance in the overall period in India. Whereas in Kerala, the area (-1.05 %) and production (-0.49 %) registered negative growth in the overall study period, but the productivity (0.57 %) showed a positive growth rate which was significant at five per cent level of probability. The results of the instability index reveal that the production of coconut in India experienced a highest variation of 10.59 per cent, followed by productivity (9.89 %) and area (3.36 %). Similarly, in Kerala, the instability index was found to be highest in production (11.12 %) followed by productivity (7.57 %) and area (5.71 %).

Keywords: Coconut, Area, production and productivity, Compound Annual Growth rate, Instability index, CDVI

1. INTRODUCTION

Coconut (Cocos nucifera), also known as 'Tree of Paradise', is a member of palm family (Arecaceae) and only living member of the genus Cocos. The coconut palm is grown throughout the tropics for decoration as well as for its culinary and non-culinary uses. Virtually every part of the coconut palm is being used by human being in some manner and has significant economic value. Coconut plays a considerable role in the Indian agrarian economy, which has a documented history of about three thousand years. Coconut palm provides food security and livelihood to a large portion of the world, particularly in Asian Pacific countries.

Coconut is grown in more than 93 countries throughout the tropics and subtropics, with an annual production of around 65.67 million nuts obtained from an area of 12.26 million hectares (2019-20). The coconut productivity is 5,357 nuts per hectare. About 75 per cent of the global supply of coconut comes from three countries, viz., India, the Philippines and Indonesia. India stood first among the leading growing countries, accounting for 30.9 per cent (20,309 million nuts) of the total world production of coconut in 2019-20 followed by the Philippines (14,491 million nuts) and Indonesia (13,994 million nuts). India occupies 17.7 per cent (2.2 million ha) of the total world area under coconut cultivation, after the Philippines (3.6 million ha) and Indonesia (3.4 million ha). In India, coconut is grown in 19 states and three union territories under varying soil and climatic conditions. The four southern states of India, viz., Kerala (34.37%), Tamil Nadu (26.46%), Karnataka (21.17%) and Andhra Pradesh (7.6%) account for 90 per cent of country's coconut production.

Kerala is named after the coconut tree, with 'Kera' meaning coconut tree and 'alam' meaning land, resulting in 'the Land of coconut trees'. Various terms like copra and coir are derived from the native Malayalam language. Among all the states of India, Kerala occupies the first position both in terms of area and production during 2020-21. In Kerala, coconut is

cultivated over an area of 7.6 lakh hectare with a production of 48,140 lakh nuts. The productivity of coconut in Kerala is 6,328 nuts per hectare. All the 14 districts of the state are producing coconut, and out of those, Malappuram and Kozhikode are the two major districts of Kerala having the highest production and area under coconut cultivation, respectively. The instability index and growth rates of coconut in these two districts alone cannot give us a signal to the state's coconut production performance. However, the application of trend analysis would help us to cross-check the reliability of the growth model and instability index. In this context, the prime objectives of this paper are:

1. To analyze the growth trends in area, production and productivity of coconut in India and Kerala and
2. To examine the magnitude of variations in trends of coconut production in India and Kerala

2. MATERIAL AND METHODS

The secondary data regarding the area, production and productivity of coconut in India, Kerala and Kozhikode and Malappuram districts of Kerala state were collected for a period of 20 years, i.e., from 2000-01 to 2019-20, from the website of the Coconut Development Board (CDB). The study used statistical tools like average, coefficient of variation, instability index and compound annual growth analysis for analyzing the data. The growth trend was measured using Compound Annual Growth Rate analysis (CAGR) while instability / magnitude of variations was estimated using Cuddy Della Valle Instability (CDVI) with the aid of coefficient of variation. The entire study period was further divided into two sub-periods: Period I (2000-01 to 2009-10) and Period II (2010-11 to 2019-20). Table 1 shows the area, production and productivity of coconut in major coconut growing states of India (2019-20) and Table 2 shows the area, production and productivity of coconut in all the districts of Kerala (2019-2020).

Table 1: Area, production and productivity of coconut in major coconut growing states of India (2019-20)

SN	State	Area ('000 ha)	Percent share to total area	Production (million nuts)	Percent share to total production
1	Kerala	760.78	35.00	6980.30	34.37
2	Karnataka	624.03	28.71	4300.69	21.17
3	Tamil Nadu	437.57	20.13	5373.21	26.46
4	Andhra Pradesh	111.38	5.12	1555.82	7.6
5	Others	239.52	11.02	2098.68	10.3
	TOTAL	**2173.28**	100.00	**20308.70**	100.00

Source: Coconut Development Board (website), 2022

Table 2: Area, production and productivity of coconut in districts of Kerala (2019-2020)

SN	District	Area (ha)	Percent share to total area	Production (lakh nuts)	Percent share to total production
1	Kozhikode	1,14,865	15.10	7410	15.39
2	Malappuram	1,05,381	13.85	7780	16.16
3	Kannur	86,877	11.42	4120	8.56
4	Thrissur	77,785	10.22	5250	10.91
5	Thiruvananthapuram	70,373	9.25	4240	8.81
6	Kasargod	63,303	8.32	5430	11.28
7	Palakkad	57,428	7.55	4540	9.43
8	Kollam	45,348	5.96	2910	6.04

9	Ernakulam	40,580	5.33	1590	3.30
10	Alappuzha	34,205	4.50	2000	4.15
11	Kottayam	25,221	3.32	1020	2.12
12	Pathanamthitta	16,056	2.11	760	1.58
13	Idukki	13,613	1.79	560	1.16
14	Wayanad	9,741	1.28	530	1.10
	TOTAL	**7,60,776**	100.00	**48,140**	100.00

Source: Coconut Development Board (website), 2022

2.1 Compound Annual Growth Rate (CAGR)

To compute the growth in area, production and productivity of coconut, compound annual growth rates were computed using the following model;

$$Y = ab^t e^u$$

Where,

Y = Dependent variable (area/ production/ productivity)
a =Intercept
b = Regression coefficient (1+ r)
r =Compound annual growth rate per cent per annum (b - 1)
t = Time period in years
e^u =Error term

In logarithmic form the function is expressed as,

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

Log a and log b were obtained using Ordinary Least Square (OLS) procedures, and the R^2 was computed for the goodness of fit. (Antilog of log (b-1)) x 100 gave the per cent growth rate. The significance of the obtained results was tested using t- test.

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

2.2 Cuddy-Della Valle Instability Index (CDVI)

The coefficient of variation (CV) was used as the measure of instability and was calculated using the equation given below:

$$CV(\%) = \frac{\text{Standard deviation (sd)}}{\text{Mean}} \times 100$$

The coefficient of variation (CV) was modified as the Cuddy-Della Valle Instability Index and in this study Cuddy-Della Valle InstabilityIndex was used to measure the instability in area, production and productivity of coconut. The instability index is given by the expression;

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

Where,
R^{*2} = Adjusted Coefficient of Multiple Determination

3. RESULTS AND DISCUSSION

3.1 Growth and instability in area, production and productivity of coconut in India

The growth rates and instability indices in area, production and productivity of coconut in India is presented in Table 3. It was observed that in India, the area under coconut cultivation registered a significant and higher positive growth rate in Period-II (0.84 %) than in Period-I (0.10 %). The overall period witnessed a positive growth rate in area (0.75 %) which was significant at one per cent level of probability, while the instability index has shown a 3.36 per cent variation in area under coconut cultivation. Production of coconut had experienced a higher magnitude of variation (4.10 %) as compared to the area under coconut cultivation (1.49 %). The production has shown a higher growth rate in Period-I (3.51 %) than in Period-II (0.97 %). The extent of variation in production was greater in Period-II (9.87 %) as compared to Period-I (5.71 %). The overall study period showed a positive annual growth rate of 3.85 per cent. Instability index in production was found highest (10.59 %) in overall period. Productivity of coconut also increased at a faster rate in Period I (3.41 %), followed by overall study period (3.07 %) and Period II (0.14 %). The productivity of coconut in India had experienced a variation of 9.89 per cent in the overall period, followed by variations of 7.95 and 5.36 per cent in Period-II and Period-I, respectively.

The faster rate of growth that was observed in Period-II compared to Period-I might be due to the introduction and revision of various crop improvement schemes by the Coconut Development Board (CDB) during the twelfth five-year plan and the better management and disease control measures taken by coconut growers. The overall aim of these schemes was to increase the area and production under coconut cultivation. Meanwhile, production and productivity showed a higher growth rate in Period-I than in Period-II. Since coconut is a perennial crop with a long gestation period, the influence of changes in area would be reflected in production only after a time-lag. There was also incidence of pests and diseases, particularly root wilt and spiralling whitefly, which reduced the coconut production and productivity in India. Similar findings were reported by Kalidas *et al.* (2020), Preethi (2017) and Thamban*et al.* (2016). Their results also revealed an increasing growth rate in the area, production and productivity of coconut in India.

Table 3: Growth and instability in area, production and productivity of coconut in India

Period	Area (000' ha)		Production (million nuts)		Productivity (nuts/ ha)	
	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)
Period-I (2000-01 to 2009-10)	0.10 (1912)	1.49	3.51*** (14123)	5.71	3.41*** (7388)	5.36
Period-II (2010-11 to 2019-20)	0.84* (2081)	4.10	0.97** (21655)	9.87	0.14 (10398)	7.95
Overall Period (2000-01 to 2019-20)	0.75*** (1997)	3.36	3.85*** (17889)	10.59	3.07*** (8893)	9.89

Note: ***, ** and * indicates significance at one, five and ten per cent
Figures in parentheses indicates the mean value
Source: Coconut Development Board, Kochi.

3.2 Growth and instability in area, production and productivity of coconut in Kerala

Table 4 reveals that in Kerala State, the area under coconut registered a negative growth rate in all the periods. Area grew at a significant but negative rate (-1.86 %) with an instability index of 2.37 per cent in Period-I. Whereas it remained insignificant in Period-II at a decelerated growth rate (-0.60 %) with an instability index of 6.19 per cent. In the overall period, the rate of growth in area was significant but showed a decreasing trend (-1.05 %) and instability was 5.71 per cent. The production showed a positive growth in Period-I at a rate of 0.42 per cent per annum with an instability index of 4.65 per cent. It has recorded a significant negative growth in Period-II (-1.48 %) and overall period (-0.49 %), with instability indices of 12.97 and 11.12 per cent, respectively. The productivity of coconut recorded a significant and positive growth rate in Period-I (2.32 %) and a meagre growth in the overall period (0.57 %), while it remained negative and insignificant in Period-II (-0.88 %).

Due to labour scarcity, high labour cost, high fluctuations in the selling prices of nuts coupled with an increased demand for land in Kerala, coconut farmers began to convert their coconut plantations into other crops that would provide better returns, especially rubber (Preethi *et al.,* 2018), as well as into commercial plots. This was the major factor that contributed to the shrinkage in area under coconut cultivation over the years in Kerala. The reduction in area and incidence of pests and diseases, especially root wilt disease and spiralling whitefly attacks, might have been attributed for the decreasing growth rate in coconut production in the study area. Preethi *et al.* (2018) and Thamban*et al.* (2016) also

reported a decreasing trend in area and production under coconut cultivation in Kerala. There are chances of area expansion in other major coconut growing states like Tamil Nadu and Karnataka (Shine *et al.*, 2021).

Table 4: Growth and instability in area, production and productivity of coconut in Kerala

Period	Area (000' ha)		Production (million nuts)		Productivity (nuts/ ha)	
	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)
Period-I (2000-01 to 2009-10)	-1.86*** (873)	2.37	0.42 (5826)	4.65	2.32*** (6704)	3.86
Period-II (2010-11 to 2019-20)	-0.60** (767)	6.19	-1.48* (6711)	12.97	-0.88 (8736)	9.34
Overall Period (2000-01 to 2019-20)	-1.05*** (820)	5.71	-0.49** (6268)	11.12	0.57** (7720)	7.57

Note: ***, ** and * indicates significance at one, five and ten per cent
Figures in parentheses indicates the mean value
Source: Coconut Development Board, Kochi.

3.3 Growth and instability in area, production and productivity of coconut in Kozhikode district of Kerala

Table 5 shows the growth rate and instability index of area, production, and productivity of coconut in Kozhikode district of Kerala. It could be revealed from Table 5 that in Kozhikode district of Kerala, the area under coconut cultivation recorded a significant but decelerating growth rate in all the study periods. Period-II (-1.12 %) recorded the highest negative growth rate compared to Period-I (-0.84 %) and overall period (-0.64 %), with instability indices of 1.55, 2.04 and 2.49 per cent, respectively. The production of coconut registered a significant negative growth rate during Period-I (-0.29 %) with an instability index of 4.20 per cent, whereas it remained insignificant in Period-II (-1.01 %) and in the overall study period (-0.33 %). The productivity of coconut registered positive but insignificant growth rates in all the study periods.

Table 5: Growth and instability in area, production and productivity of coconut in Kozhikode district of Kerala state

Period	Area (000' ha)		Production (million nuts)		Productivity (nuts/ ha)	
	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)
Period-I (2000-01 to 2009-10)	-0.84*** (126)	2.04	-0.29* (877)	4.20	0.56 (6928)	5.78
Period-II (2010-11 to 2019-20)	-1.12*** (120)	1.55	-1.01 (861)	8.66	0.11 (7155)	9.16
Overall Period (2000-01 to 2019-20)	-0.64*** (123)	2.49	-0.33 (869)	7.63	0.31 (7041)	7.52

Note: ***, ** and * indicates significance at one, five and ten per cent
Figures in parentheses indicates the mean value
Source: Coconut Development Board, Kochi.

3.4 Growth and instability in area, production and productivity of coconut in Malappuram district of Kerala

The results of growth rate and instability analysis on area, production and productivity of coconut in Malappuram district of Kerala is given in Table 6. During the overall study period, the area under coconut grew at a significant but negative rate (-0.32 %) with an instability index of 2.81 per cent, whereas it remained insignificant during Period-I (-0.06 %) and Period-II (-0.09 %). The coconut production during Period-I recorded a positive and significant growth rate of 5.13 per cent at one

per cent level of significance. Whereas in Period-II (-1.91 %) the growth has witnessed negative trend at ten per cent significance level, with an instability index of 7.89 per cent. In the overall study period (1.29 %), the production recorded a significant and positive growth rate with an instability index of 13.66 per cent. Similarly, the productivity of coconut registered a significant and positive growth rate during Period-I (5.19 %) and overall period (1.62 %) with variations of 9.16 and 13.87 per cent, respectively, whereas it remained insignificant and negative during Period-II (-1.82 %).

Table 6: Growth and instability in area, production and productivity of coconut in Malappuram district of Kerala State

Period	Area (000' ha)		Production (million nuts)		Productivity (nuts/ ha)	
	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)
Period-I (2000-01 to 2009-10)	-0.06 (109)	3.35	5.13*** (834)	10.55	5.19* (7656)	9.16
Period-II (2010-11 to 2019-20)	-0.09 (105)	1.92	-1.91* (933)	7.89	-1.82 (8920)	9.40
Overall Period (2000-01 to 2019-20)	-0.32*** (107)	2.81	1.29** (883)	13.66	1.62* (8288)	13.87

Note: ***, ** and * indicates significance at one, five and ten per cent
Figures in parentheses indicates the mean value
Source: Coconut Development Board, Kochi.

4. CONCLUSION

The area, production and productivity of coconut in India have been increasing over the period. But in Kerala as well as in Kozhikode district, the area and production registered negative growth rates in the overall study period, while the productivity showed a positive trend. During the overall period, production and productivity witnessed positive growth rates at significant levels in Malappuram district, while area registered a negative growth rate. This was mainly due to the incidence of pests and diseases during that period, expansion of more area under coconut cultivation in the neighbouring states like Karnataka and Tamil Nadu and the conversion of coconut plantations into commercial plots as well as into other crops by farmers in order to realize better returns. Due to the negative growth rates of area in Kerala State (-1.05 %) and in the study districts viz., Kozhikode (-0.64 %) and Malappuram (-0.32 %), is less per capita availability of land and less scope for area expansion under coconut cultivation. Hence, there is a need to boost productivity through improved technological interventions with the help of concerned departments like Coconut Development Board. The promotion of intercropping and crop diversification in coconut plantations will be a better option to earn diversified income. To ensure fair prices for the coconuts and its by-products, there is a need to eliminate the exploitation by market intermediaries in the coconut industry.

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