



ISSN Print: 2664-844X
ISSN Online: 2664-8458
NAAS Rating (2026): 4.97
IJAFS 2026; 8(7): 542-547
www.agriculturaljournals.com
Received: 25-04-2026
Accepted: 30-05-2026

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Analysis of growth trends, instability and export performance of the Indian coconut sector

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DOI: <https://www.doi.org/10.33545/2664844X.2026.v8.i7g.1730>

Abstract

Coconut (*Cocos nucifera*), often referred as the "Tree of Heaven" or Kalpavriksha, is one of the most versatile and economically significant crops cultivated year-round in tropical and subtropical regions globally. In India, coconut stands not only as a major agricultural crop but also as a vital pillar of cultural heritage, ecological balance, and rural livelihood. This study analyzes trends and growth patterns in the area, production, productivity, and export of coconut and its products in India using secondary data sourced from the Coconut Development Board, Kochi. The analytical tools such as compound growth rate analysis, instability assessment through coefficient of variation (CV), and Cuddy-Della Valle instability index were used. In world coconut cultivation displayed stagnation with negligible compound annual growth rates (CAGR) in area (-0.101%), production (-0.198%), and productivity (-0.097%) during 2014-2023, confirming low long-term growth and localized volatility driven by environmental and economic factors. In contrast, India showed a positive CAGR of 0.97% in area, but production and productivity exhibited declines of -0.96% and -1.91%, respectively. This underlines challenges such as aging plantations, pests, diseases, and climatic impacts negatively affecting yield despite expanded cultivation. Instability analyses showed that India's coconut production and productivity experienced higher variability compared to the global average, reflecting greater vulnerability. India's coconut exports, especially value-added products like activated carbon, refined coconut oil, and desiccated coconut, demonstrated high growth with an 11.98% CAGR between 2014-15 and 2024-25. Export earnings surged by 25.35 percent in 2024-25, driven by rising international demand and diversification toward processed coconut products. Despite moderate year-on-year fluctuations, the export sector's positive linear trend shows India's growing global competitiveness. This trend aligns with evolving health-conscious global consumption patterns favoring natural and organic coconut-derived products, creating further export opportunities. The findings emphasize the urgent need for targeted interventions in yield improvement, pest management, and climate resilience within coconut cultivation, coupled with strategies to enhance value addition and export infrastructure.

Keywords: Coconut cultivation, productivity, export trends, compound growth rate, instability analysis, value-added products, India, global coconut market

Introduction

Coconut (*Cocos nucifera*), often celebrated as the "Tree of Heaven" or Kalpavriksha, stands as one of the most versatile and economically significant crops in tropical and subtropical regions worldwide. In India, coconut holds a prominent place not only in agriculture but also as a vital component of cultural tradition, ecological sustainability, and the rural economy. The crop is cultivated year-round, with each part of the palm contributing uniquely to food security, industry, and livelihoods for millions. India, consistently among the world's leading producers, has seen its coconut industry contribute substantially to national GDP amounting to approximately ₹30,749.8 Corers in FY23 and generate export revenues of ₹4,349 crores in FY24-25, even as recent years have shown a decrease in production alongside rising export value. Hence, the present study was carried out to analyze the trend & growth in area, production & productivity and the export trend of coconut in India.

Methodology

The Trend in area, production and productivity of coconut and export data of coconut & its products from India was collected from Coconut Development Board, Kochi. The nature of data used for the study is entirely based on secondary source of data.

The different techniques used for the study were- Growth rate analysis, Instability analysis and Trend analysis (V.P. Preethi *et al.*,) [2].

Compound growth rate

The growth rates were used to measure the past performance of the economic variables. The growth rates in Area, Production and Productivity of Coconut and export Coconut Products in India were analyzed by using exponential growth function as given below.

$$Y = a.b^{t.....} (1)$$

Where,

Y = Depended variable for which growth rate is to be estimated (Quantity exported / export value / unit value)

a = Intercept

b = Regression Coefficient

t = Time Variable

This equation was estimated after transforming (1) as follows,

$$\text{Log } y = \log a + t \text{ Log } b.... (2)$$

Then the percent compound growth rate (g) was computed using the relationship.

$$\text{CGR (g)} = [\text{Antilog (log } b) - 1] \times 100.. (3)$$

The significance of the regression coefficient was tested using the p value.

Instability analysis

In order to study the instability in the Area, production, productivity in India and world and export of coconut, Coefficient of variation and Cuddy Della Valle instability index was used.

Coefficient of variation (CV)

Coefficient of variation (CV) = $\sigma \times 100$

Where,

σ = Standard deviation

X = Arithmetic mean 2.2.2

Cuddy- Della Valle's Instability Indices (C & D)

Instability Index = $CV\sqrt{(1 - R^2)}$

Where,

CV = Simple Estimates of coefficient of variation in per cent

R² = Coefficient of determination from a time trend regression adjusted by the number of degree of freedom.

The ranges of CDVI are given as follows

1. Low instability = 0 to 15
2. Medium instability = 15 to 30
3. High instability = 30 and above

Results and Discussion

World Coconut Trend

Global coconut production during 2023 is 67,617 million nuts from 12.39 million hectares annually, yet data reveal notable variability in production trends. As per the annexure 1 the global area under coconut saw a modest year-on-year increase of 1.32 percent, with production rising by 0.89 percent. However, average productivity dipped slightly by -0.41 percent, to 5,457 nuts per hectare from the previous year.

Cote d'Ivoire experienced a substantial 51.92% surge in production and productivity, while the Solomon Islands suffered a drastic -44.13% decline in productivity despite expanding its cultivated area. In Vietnam, both production and productivity saw significant drops of -13.98% and -14.97%, respectively. These shifts highlight that, global coconut agriculture continues to grow in area and output, localized environmental, economic, and management factors drive considerable volatility in productivity across countries. The compound annual growth rate (CAGR) analysis for global coconut cultivation between 2014 and 2023 in table 1 shows that the trends in area, production, and productivity have remained largely stagnant. The CAGR for area was -0.101 percent, production -0.198%, and productivity -0.097 percent, with all values statistically non-significant (NS), as indicated by their respective p-values well above the threshold for significance (0.3308, 0.2794, and 0.5920). The R² values for area (0.120), production (0.144), and productivity (0.037) are low, suggesting that the time trend explains only a small fraction of the observed variation in these parameters. These results indicate that there has been no consistent or significant long-term growth or decline in global coconut cultivation, yield, or output during this period.

Table 1: The compound annual growth rate of Area, production and productivity of world 2014-2023

Particulars	CAGR	P value	R ²
Area	-0.101 ^{NS}	0.3308	0.119
Production	-0.198 ^{NS}	0.2794	0.144
Productivity	-0.097 ^{NS}	0.5920	0.037

^{NS} Not Significant

Indian Coconut Trend

In the fiscal year 2024-25 (2nd advance estimates), India's total coconut cultivation area stood at 2.22 million hectares, recording a growth from 2023-24 increase of 2.3 percent. However, total coconut production declined by 4.6 percent to approximately 20.4 billion nuts, while productivity fell by 6.7 percent to about 9,206 nuts per hectare (Annexure II).

The compound annual growth rate (CAGR) analysis of coconut cultivation in India from 2014-15 to 2024-25 in the table 2 reveals that the area under coconut cultivation exhibited a significant positive growth rate of 0.97 percent per annum ($p = 0.0011$, $R^2 = 0.7126$), indicating a steady expansion in the coconut cultivation. The coconut production showed a negative CAGR of -0.96%, although this decline was statistically non-significant ($p = 0.1385$, $R^2 = 0.227$), reflecting fluctuations without a clear downward trend in output. The productivity experienced a significant decrease of -1.91% per year ($p = 0.0110$, $R^2 = 0.52$), signaling a decline in yield per hectare despite increased cultivation area.

These findings suggest that while coconut farming area is expanding in India, overall production and productivity are facing challenges. The decline in productivity are attributed to factors such as aging plantations, pest and disease incidence and adverse climatic impacts, These results align with recent studies done by Samsudin *et al* 2025 [4] and Shine Raju Kappil indicating that the growth in India's coconut sector is constrained by yield stagnation, even as the crop remains vital to rural livelihoods and the economy, particularly in southern states like Kerala, Tamil Nadu, and Karnataka, which dominate production.

Table 2: The compound annual growth rate of Area, production and productivity of India 2014-15 to 2024-25

Particulars	CAGR	P value	R ²
Area	0.97	0.0011	0.7126
Production	-0.96	0.1385	0.227
Productivity	-1.91	0.0110	0.52

*Significance at 1 percent, ** at 5 percent level and NS ^{NS} Not Significant

Instability trend in coconut production in world and India

The analysis of instability using Coefficient of Variation (CV) and Cuddy-Della Valle's Instability Index (CDVI) provides insights into the stability of coconut area, production, and productivity both globally and in India. The CV measures relative variability, while the CDVI adjusts this variability by accounting for trend strength (R²) to classify instability levels as low, medium, or high.

In the table 3 it indicate that the world exhibits relatively stable coconut cultivation with lower CV values, area (0.84), production (1.46), and productivity (0.96). These low CVs suggest minimal year-to-year fluctuations globally, the results align with Lekshmi *et al.*, 2025 ^[5] for moderate global growth and relatively stable production conditions. In India, the CVs are markedly higher area (2.01), production (6.01), and productivity (6.20) implying greater volatility, especially in production and productivity compared to the world average. Such higher instability in India aligns with studies attributing variability to factors like climatic changes, pest outbreaks, and aging plantations, which cause production and yield fluctuations despite area expansion

(Chavan *et al.*, 2023; Maruthi *et al.*, 2019) ^[1, 8].

Table 3: Instability Trend in Area, Production and Yield of India (2014-2025) and world (2014-2023)

Particulars	Area	Production	Productivity
World	0.84	1.460	0.963
India	2.01	6.006	6.204

Trends in Trade of Coconut Products

The table 4 revealed that India's export of coconut products in 2024-25 registered a total value of Rs. 4349.03 crore, marking a significant growth of 25.35 percent from previous year 2023-24 in export value. Among the various coconut products, Activated Carbon dominated exports, contributing 64.38 percent of the total export value with 176,435.58 tons shipped and a notable increase in quantity by 14.52 percent and value by 32.80 percent. Coconut Oil (refined) and Copra were also major contributors, with refined coconut oil accounting for 9.09 percent of the export value and showing 18.26 percent growth in value, while copra contributed 5.57 percent with a 39.21 percent increase in export value.

Desiccated Coconut and Other Endocarp products had a sudden increase by 353.36 percent and 147.67 percent respectively, despite their relatively smaller share in quantity exported. Fresh Endocarp and Coconut Oil (crude) also posted substantial growth, aligning with a global trend of increased demand for value-added coconut products. In contrast, several categories such as Coconut (dried), Shell Charcoal, and Other Coconuts excluding fresh/dried recorded declines in both quantity and value, reflecting shifting market preferences.

Table 4: Export of Coconut Products from India 2024-25

Sl. No.	Item	Quantity (in tons)	Value in (Rs in Crore)	Percent share	Y-O-Y percentage change in Quantity	Y-O-Y percentage change in Value
1	Activated Carbon	176435.58	2799.97	64.38	14.52	32.80
2	Coconut (dried)	1519.32	19.08	0.44	-41.91	-7.48
3	Coconut (fresh)	45370.61	232.02	5.34	-13.63	23.76
4	Coconut Oil (refined)	16440.02	395.27	9.09	1.81	18.26
5	Shell Charcoal	12227.00	58.78	1.35	-34.05	-14.76
6	Other Coconuts excluding fresh/dried	8148.91	86.53	1.99	-38.18	-72.98
7	Copra	17583.05	242.06	5.57	3.47	39.21
8	Fresh Endocarp	24063.03	101.74	2.34	17.17	49.52
9	Other Endocarp	22782.75	90.40	2.08	220.96	147.67
10	Desiccated Coconut	8195.01	163.44	3.76	239.31	353.36
11	Coconut Shell (raw)	33.77	0.73	0.02	-97.55	-95.02
12	Dried Endocarp	13501.52	104.01	2.39	13.29	39.67
13	Other Residues of Coconut or Copra	88.59	1.47	0.03	2213.11	715.00
14	Coconut Oil (crude)	2095.71	53.41	1.23	100.83	109.47
15	Miscellaneous	16.69	0.13	0.00	-25.49	-39.48
	Total		4349.03	100.00		25.35

Source: Directorate General of Commercial Intelligence and Statistics, Kolkata

*Y-O-Y- Year on Year percent change viz., 2023-'24 to 2024-'25

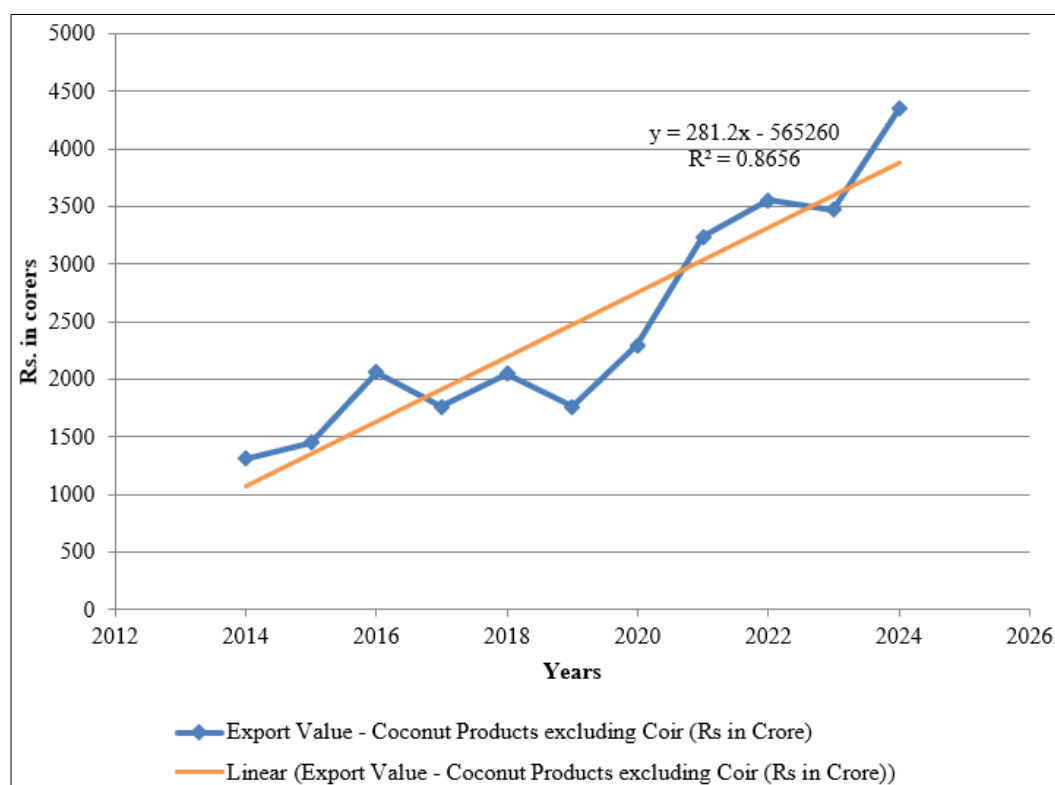
The table.5 depicts the export value of Indian coconut products excluding coir has exhibited a robust compound annual growth rate (CAGR) of 11.98 percent during the period from 2014-15 to 2024-25, showing the sector's strong export performance. However, the instability index of 14.81 indicates moderate variability in the export values year-to-year. These fluctuations are due to global market dynamics, climatic factors affecting production, and changing demand patterns for coconut products in

international markets. This pattern aligns with Chavan *et al.* (2023) ^[1], who demonstrated positive growth in India's coconut product exports over a 15-year period accompanied by moderate instability across the categories of coconut oil, desiccated coconut, and fresh coconut exports. Maruthi *et al.* (2019) ^[8], highlighting that production fluctuations influenced export performance, and that regional supply conditions are crucial for stabilizing India's export metrics.

Table 5: CAGR and Instability of Indian Export of coconut products excluding coir 2014-15 to 2024-25

Year	Export Value - Coconut Products excluding Coir (Rs in Crore)	Percent growth
2014-15	1312.38	
2015-16	1450.24	10.50
2016-17	2061.70	42.16
2017-18	1764.31	-14.42
2018-19	2045.36	15.93
2019-20	1762.17	-13.85
2020-21	2294.81	30.23
2021-22	3236.83	41.05
2022-23	3554.23	9.81
2023-24	3469.40	-2.39
2024-25	4349.03	25.35
CAGR	11.98	
Instability	14.81	

Source: Directorate General of Commercial Intelligence and Statistics, Kolkata

**Fig 1:** Export Value liner trend of Coconut Products excluding Coir (Rs in Crore)

The linear trend graph of export value of coconut products excluding coir from India shows in fig1 has a general upward trajectory over the years 2014-15 to 2024-25. This indicates a steady and consistent increase in export earnings from coconut products, reflecting growing international demand and India's improved capacity to supply diverse coconut products. The graph illustrates temporary fluctuations or dips but maintains a positive slope, highlighting sustained growth despite short-term market volatilities.

This trend aligns with historical export data showing India's export value growing from about Rs. 1312 crore in 2014-15 to Rs. 4349 crore in 2024-25, representing a compound annual growth rate (CAGR) of around 11.98 percent. The linear increase asserts the expanding role of value-added products such as activated carbon, coconut oil, and desiccated coconut in global markets. These findings align with finds of Umesha and Tulasimala (2016) [7] highlighted the steady growth in export quantity and value

of coconut and coconut oil from India, driven by increased productivity and emerging markets.

Conclusion

The coconut industry in India remains a vital agricultural sector contributing significantly to the rural economy, food security, and national GDP. Despite global coconut cultivation showing stagnant trends in area, production, and productivity over the last decade, India has demonstrated steady growth in cultivated area but faces challenges of declining production and yield, mainly due to aging plantations, pest pressures, and climate variability. India's coconut sector exhibits higher instability compared to the global scenario, highlighting the need for focused interventions to enhance yield stability. The export performance of Indian coconut products, excluding coir, has shown strong and consistent growth, with a compound annual growth rate of nearly 12 percent over the last decade. Value-added products like activated carbon, refined coconut oil, and desiccated coconut have significantly contributed to

export earnings and diversification. Despite moderate year-to-year fluctuations, the overall export value maintains a positive linear trend, reflecting increasing global demand and India's rising competitiveness in international markets.

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Annexure-I

Area, production and productivity of coconut in world 2023

Sl. No.	Country	Area ("000" ha)	Percent share	Production (Million Nuts)	Percent share	Productivity (Nuts/ha)	*Y-O-Y percent change Area	*Y-O-Y percent change Production	*Y-O-Y percent change Productivity
1	Cote D' Ivoire	41.00	0.33	158.00	0.23	3854	0.00	51.92	51.92
2	F.S Micronesia	18.00	0.15	78.00	0.12	4333	0.00	-1.27	-1.27
3	Fiji	61.00	0.49	241.00	0.36	3951	0.00	-0.41	-0.41
4	Guyana	12.00	0.10	95.00	0.14	7917	-20.00	1.06	26.32
5	India	2277.00	18.38	20536.00	30.37	9019	5.71	6.35	0.60
6	Indonesia	3308.00	26.70	14966.00	22.13	4524	-1.02	-0.54	0.47
7	Jamaica	17.00	0.14	168.00	0.25	9882	0.00	0.60	0.59
8	Kenya	78.00	0.63	247.00	0.37	3167	2.63	0.00	-2.56
9	Kiribati	29.00	0.23	147.00	0.22	5069	0.00	-2.00	-1.99
10	Malaysia	79.00	0.64	624.00	0.92	7899	-7.06	3.31	11.16
11	Marshall Islands	7.00	0.06	36.00	0.05	5143	16.67	-5.26	-18.79
12	Papua New Guinea	229.00	1.85	1483.00	2.19	6476	0.00	-3.07	-3.07
13	Philippines	3665.00	29.58	14893.00	22.03	4064	1.69	-0.25	-1.92
14	Samoa	20.00	0.16	53.00	0.08	2650	0.00	0.00	0.00
15	Solomon Islands	68.00	0.55	100.00	0.15	1471	78.95	0.00	-44.13
16	Sri Lanka	480.00	3.87	3169.00	4.69	6602	3.90	-6.55	-10.05
17	Thailand	138.00	1.11	679.00	1.00	4920	0.00	0.44	0.43
18	Timor Leste	11.00	0.09	28.00	0.04	2545	0.00	7.69	7.68
19	Tonga	25.00	0.20	57.00	0.08	2280	-3.85	1.79	5.85
20	Vanuatu	89.00	0.72	303.00	0.45	3404	0.00	0.00	0.01
21	Vietnam	175.00	1.41	1243.00	1.84	7103	1.16	-13.98	-14.97
22	Other Countries	1563.00	12.62	8313.00	12.29	5319	-2.01	-1.33	2.03
World		12390.00	100.00	67617.00	100.00	5457	1.32	0.89	-0.41

Source: ICC Coconut Statistical Yearbook 2023

*Y-O-Y- Year on Year percent change viz., 2022 & 2023

ANNEXURE-II**Area, production and productivity of coconut in India 2024-25 (2nd advance)**

Sl. No.	States	Area ('000" ha)	Percent share	Production (Million Nuts)	Percent share	Productivity (Nuts/ha)	*Y-O-Y percent change Area	*Y-O-Y percent change production	*Y-O-Y percent change productivity
1	Andhra Pradesh	108.48	4.90	1735.73	8.51	16000	1.0	1.7	0.6
2	Arunachal Pradesh	0.12	0.01	0.13	0.00	1109	-4.2	-1.9	0.0
3	Assam	20.19	0.91	178.27	0.87	8830	0.0	0.0	0.0
4	Bihar	10.84	0.49	46.51	0.23	4292	0.2	0.2	0.0
5	Chhattisgarh	1.35	0.06	9.10	0.04	6755	-0.2	0.0	0.0
6	Gujarat	26.56	1.20	344.19	1.69	12958	0.0	39.9	39.9
7	Karnataka	600.62	27.11	4788.60	23.48	7973	6.4	-22.1	-26.8
8	Kerala	765.62	34.56	5612.00	27.51	7330	0.0	1.6	1.7
9	Maharashtra	31.37	1.42	260.39	1.28	8301	0.2	-0.8	-1.0
10	Manipur	0.05	0.00	0.18	0.00	3229	8.4	1650.0	3004.8
11	Mizoram	0.03	0.00	0.15	0.00	4360	13.3	-1.2	0.0
12	Nagaland	1.07	0.05	9.70	0.05	9106	-1.4	-0.5	0.4
13	Odisha	54.95	2.48	399.43	1.96	7269	0.0	0.0	0.0
14	Tamil Nadu	505.25	22.80	6248.45	30.63	12367	2.6	2.6	0.0
15	Tripura	4.98	0.22	20.71	0.10	4156	4.2	4.3	0.0
16	West Bengal	33.47	1.51	426.94	2.09	12755	1.6	1.4	-0.3
17	Others	50.67	2.29	317.21	1.56	6260	0.2	3.0	2.9
	Total	2215.62	100.00	20397.68	100.00	9206.00	2.3	-4.6	-6.7

Source: Department of Agriculture & Farmers Welfare, MoA&FW, Govt of India

*Y-O-Y- Year on Year percent change viz., 2023-'24 & 2024-'25