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An Economic Analysis on Indian Scenario of Coconut Production: Trends and Prospects

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ABSTRACT

The purpose of this study is to examine the coconut sector's growth performance and instability in the Indian context. Since India is the world's biggest producer of coconuts (22.96 billion nuts), Kerala, Tamil Nadu, Karnataka, and Andhra Pradesh are the states in the country where coconut trees are widely farmed and produced in huge quantities. These states account for over 90 per cent of overall production in the country and contribute around 89 percent of the total land for coconut farming. Area, production, and yield of coconut were collected from CDB based on secondary data from 1985-86 to 2020-21. **The study period was divided into pre-TMC (1985-86 to 2000-01) and post-TMC (2001-02 to 2020-21).** The study examines growth patterns using the compound growth rate, measures instability using the Coppock's instability index, and investigates the role of area and yield on production using decomposition analysis. The results revealed that growth of area, production and productivity for major states in India was positive and statistically significant **during the period II (post-TMC period) than the period I (pre-TMC period)** except area under Kerala (-1.23%). Tamil Nadu and Karnataka reported a high level of instability in coconut production and its productivity during period II. Decomposition analysis shows that the area effect and yield effect play a crucial role in the total change of coconut production among the selected states. But area effect has negative in Kerala, which depicts that area expansion in coconut cultivation is merely nominal for other crops in the state. Hence, greater attention needs to be given to the states where to attract and encourage many new farmers into coconut cultivation by accessing modern technology, quality inputs, marketing and credit facilities under TMC by support of government, CBD and stakeholder.

HIGHLIGHTS

 ◉ The study focuses the trend, instability and decomposition of coconut area, production and yield across major producing states of the country.
 ◉ Except Kerala, other selected states show positive growth rate and positive area effect under area, production and productivity of coconut during period II.
 ◉ Tamil Nadu and Karnataka show high instability during the period II.

Keywords: Coconut, Decomposition, Growth rate, Instability, and TMC

Agriculture sector plays a vital part in economic growth, with about half of the rural people relying on it for their living. However, due to several hazards confronting the sector, the Indian agriculture sector has shown a sluggish development rate over the years. As a result, the Indian government has highlighted horticulture as a potential solution to the country's suffering agriculture industry.

India, with its different climatic conditions and soil, offers enormous potential for the horticulture sector to expand. Plantation crops are highly valued commercial crops in the horticulture industry because of their importance to the Indian economy. These crops help to boost export revenues, generate jobs for millions of people, and help to preserve the land and ecosystem (Bhovi and Savadatti, 2017). Coconut is a significant plantation crop that employs about 15 million people who rely on coconut cultivation, processing, and related industries, making it a vital part of the Indian economy (Abeysekara and Waidyarathne, 2020).

Coconut is mostly grown in coastal areas and islands in over 93 countries throughout the world's tropics and subtropics, with an annual production of around 96.15 billion nuts from an area of 11.58 million ha and an average productivity of 8307 nuts per ha. (Rani, 2019). Indonesia, India, Philippines and Srilanka collectively accounted for 83 percent of global coconut land and 79 percent of global coconut production. The production of coconut in India has been displaying a rising trend over the years, which reflects that coconut area has increasing from 1.82 to 2.15 m ha with production of 12.67 to 22.96 billion nuts and with the average productivity of 6951 to 10668 nuts/ha between 2000-01 to 2020-21 (FAO Stat and CDB, 2021).

The coconut is cultivated in 16 States and 4 Union Territories located in different parts of the country in varied agro-climatic zones. However, about 89 percent of total acreage and 90 percent of total production fall in the south peninsular region covering four States of Kerala, Tamil Nadu, Karnataka and Andhra Pradesh (Jayasekhar & Jacob, 2021). Kerala is the most productive of these states, producing 7.51 billion nuts from an area of 7.61 lakh acres. Karnataka is second in terms of area (6.34 lakh hectares) and third in terms of production (5.83 billion nuts). Tamil Nadu ranks second in production with 5.87 billion nuts and third in area, with roughly 4.42 lakh hectares and the highest productivity of 13239 nuts per ha (CBD, 2022).

The area, production, and productivity of coconut were expanded with efforts of stakeholders and the initiatives taken by the central government through the Coconut Development Board. The coconut sector is very competitive because nations like Indonesia and the Philippines promote a variety of coconut-based products, while India is still in the early stages of coconut processing. Because of this, the coconut farmers receive less remunerative price. Hence, the study focusses on trend and growth variability of coconut area, production, and yield in India.

MATERIALS AND METHODS

The study is based on annual time series data covering the period of 35 years *viz*, 1985-66 to 2020-21. The secondary data on area, production and productivity of coconut for four major coconut growing states, namely, Kerala, Tamil Nadu, Karnataka, Andhra Pradesh and India, were collected Coconut Development Board and Directorate of Economics and Statistic, Ministry of Agriculture, Government of India. During 2001, Coconut development board is trying to promote value addition through processing of coconut for various innovative products through Technology Mission on Coconut (TMC) in the country. In view of this, the study period was divided in to two sub-periods to draw meaningful conclusions with reference to the trends in area, production and yield of coconut crop, as follows: Period I – Before TMC (1985-86 to 2000-01), Period II – After TMC (2001-02 to 2020-2021) and overall period (1985-86 to 2020-2021).

Compound growth rates (CGR)

Considering growth rates in area, production and productivity of coconuts were determined by fitting an exponential growth function to time series data. It is computed by applying the formula:

$$Y_t = ab^t$$

In the log form, it is written as:

$$Log\ Y_t = Log\ a + t\ log\ b$$

Where, Y_t = Area/production/productivity in the year 't', t = time element which takes the value 1, 2, 3, ……. N, a = intercept and b = regression coefficient.

The value of b is computed by using OLS method. Further, the value of CGR was worked out as follows:

$$CGR\ (r) = (antilog\ b - 1) \times 100$$

Udhayakumar *et al.* (2021) used Student '*t*' test to check the significance of the CGR.

Instability analysis

The instability index is a simple analytical tool for determining the variation or instability in any time series data (Kalidas, 2020). It was estimated using Coppock's instability index (Coppock, 1962). The estimable form is given below

$$V \log = \sum [\log (X_{t+1} / X_t) - m]^2 / n$$

The instability index = *Antilog* ($\sqrt{V \log} - 1$) × 100)
Where,

X_t = Area/production/productivity in the year '*t*',

t = number of years.

M = Mean of the difference between Logs of X_{t+1}, X_t.

Log V = logarithmic variance of the series.

Decomposition Analysis

Narmadha and Kandeepan, (2017) measured the relative contribution of area and yield to the total output change for the coconut production by using decomposition analysis. The method states that the A_0, P_0 and Y_0 are area, production and productivity, respectively in base year and A_n, P_n and Y_n are values of the respective variable in n^{th} year item:

$$P_0 = A_0 \times Y_0, \text{ and } P_n = A_n \times Y_n \qquad \ldots(1)$$

Whereas, A_0 and A_n represent the area, and Y_0 and Y_n represent the yield in the base year and n^{th} year, respectively.

$$P_n - P_0 = \Delta P, A_n - A_0 = \Delta A \text{ and } Y_n - Y_0 = \Delta Y \quad \ldots(2)$$

Upon simplification of equations (1) and (2), it could be written:

$$P_0 + \Delta P_n = (A_0 + \Delta A_n)(Y_0 + \Delta Y_n) \text{ and}$$

$$\Delta P_n = (A_0 + \Delta A_n)(Y_0 + \Delta Y_n) - P_0$$

Substituting P_0 from (1) rearranging the terms gives:

$$\Delta P_n = (A_0 \Delta Y_n) + (Y_0 \Delta A_n) + (\Delta A_n \Delta Y_n)$$

Production change = area effect + yield effect + interaction effect

Thus, the total change in production can be decomposed into three components viz., area effect, yield effect and the interaction effect due to change in yield and area from the base period.

RESULTS AND DISCUSSION

Triennium Ending (TE) of Major Coconut Producing States in India

Table 1 shows the triennium endings of India's key coconut producing states. Kerala (35%), Karnataka (29%), Tamil Nadu (20%), and Andhra Pradesh (5%) account for 89 percent of area under coconut cultivation. For three periods, TE 1987, TE 2001, and TE 2020, the Triennium Ending was estimated and results shows that except for Kerala, all other states show an increase in area under coconut, which is doubled at TE 2020 when compared to TE 1987.

In case of production, Kerala (35%), Tamil Nadu (26%), Karnataka (24%), and Andhra Pradesh (6%) are the four highest coconut-producing states, accounting for roughly 92 percent of total coconut production. The results of the Triennium Ending demonstrate that coconut production in major states increased by two-fold during three Triennium Endings. Since, the introduction of the coconut development board in the early 1980s, which improved productivity, area expansion, replanting and rejuvenation, processing and value addition, and implemented the Technology Mission on Coconut (TMC) in 2001-02, coconut production and productivity have increased dramatically (Abeysekara and Waidyarathne, 2020).

When compared to TE 1987, the results of the Triennium Ending demonstrate a growing yield, which is doubled by TE 2020. Andhra Pradesh had the highest yield (13003 nuts), followed by Tamil Nadu (12510 nuts), Kerala (9833 nuts) and Karnataka (8776 nuts) which depicts in Fig. 1. Hence, average yield of India (9888 nuts) also increased two- fold times. According to Lathika and Kumar (2005) main drivers of the impressive growth in coconut production and productivity in India were the widespread adoption of high yielding varieties (HYVs) as crop and farm management practises; policy support to improve irrigation facilities, market infrastructure, and thus the supply of agricultural credit; farm input subsidies; and farmers' enthusiasm to adopt HYVs.

Table 1: Triennium Ending (TE) of area and production of major coconut producing states in India

States	Area ('000 ha)				Production (million nuts)			
	TE 1987	TE 2001	TE 2020*	% share	TE 1987	TE 2001	TE 2020	% share*
Kerala	729	921	759	35	3299	5482	7504	35
Tamil Nadu	165	328	423	20	1436	3236	5623	26
Karnataka	209	342	622	29	1075	1643	5206	24
Andhra Pradesh	48	103	117	5	292	1090	1386	6
Others	117	148	248	11	705	1139	1738	8
India	1268	1841	2170	100	6806	12590	21458	100

*Shows percentage share of TE 2020; **Source:** *Coconut Development Board, 2022.*
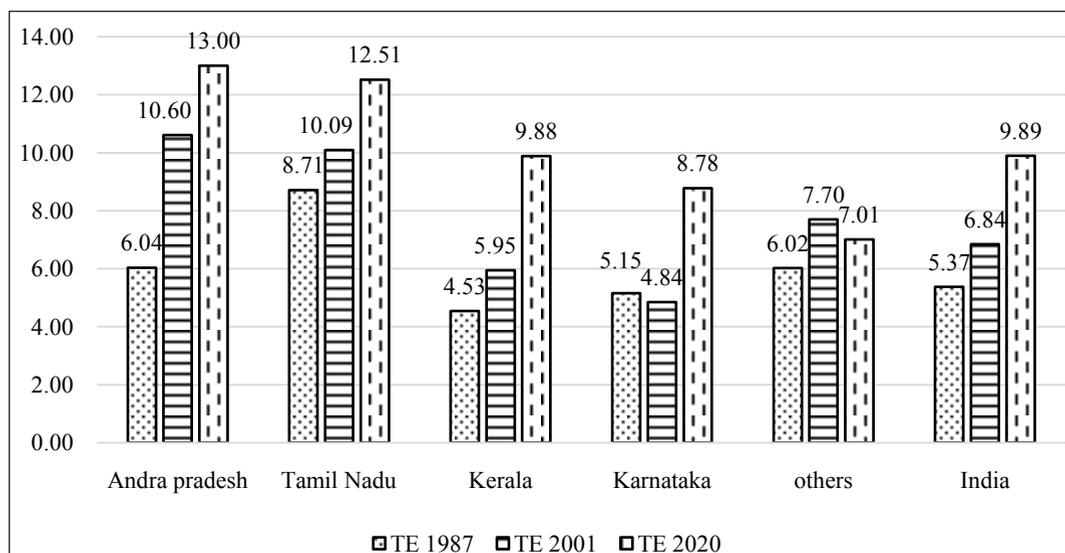
Source: Coconut Development Board, 2022

Fig. 1: Triennium Ending (TE) of Yield of major coconut producing states in India (1000 nuts /ha)

Trend in Area, Production and Yield of Major Coconut Producing States in India

The CGR was used to examine the area, production, and yield of coconuts in key Indian states and the data from 1985-86 to 2020-21 was divided into two periods: Period I – Before TMC (1985-86 to 2000-01), and Period II – After TMC (1985-86 to 2020-21).The compound growth rate of area, production and yield for major coconut producing states were given in Table 2. It is clear from the table 2 that coconut area under India shows a higher growth rate in period II (2.85 %) than period I (0.72%) with a 5% level of significance. There was positive growth in the production of coconut (4.82%) during period II which was significant at 1 per cent level. This increase in production of coconut was mainly due to increased area under the crop. Though yield also contributed to some extent by showing positive

growth but not significantly in period II (2.97%). The overall growth period shows positive trend of area (1.39%), production (3.39) and productivity (1.96%) with 5 percent level of significance. During this time, the area expanded mostly due to the Directorate of Coconut Development Board's implementation of agricultural acreage development programmes. Furthermore, the production and distribution of hybrid and high-quality planting materials at a low cost to farmers leads to an increase in the area under coconut cultivation (Kappil *et al*. 2021).

Kerala's dominance in coconut cultivation has been gradually eroding since the 1980s, according to many studies. According to recent study, Kerala's supreme and unique supremacy in the domain of coconut cultivation and production has been declining with negative growth rate since the early twenty-first century, viz period II (1.23 percent)

Table 2: Growth rate (%) of area, production and yield of coconut for major states in India

States	Area ('000 ha)			Production (million nuts)			Yield (Nuts/ha)		
	Period I	Period II	Overall	Period I	Period II	Overall	Period I	Period II	Overall
Kerala	2.23*	-1.23*	-0.32*	2.30*	1.64*	1.87*	2.03**	2.39**	2.05 NS
Tamil Nadu	1.55**	3.05**	2.99**	3.28 NS	5.38**	4.28**	1.33*	2.31*	1.15*
Karnataka	2.93*	3.31**	3.34**	3.38**	5.77*	5.68*	2.07 NS	4.88*	2.29*
Andhra Pradesh	0.68 NS	3.15*	2.49*	2.04**	4.73**	3.73**	1.81**	3.35*	1.32*
India	0.72*	2.85*	1.39*	3.92*	4.82**	3.39*	1.92*	2.97 NS	1.96*

*Note: ** and * denote significance at 1 per cent, and 5 per cent levels, respectively and NS- Non significant*

Source: Author's calculation based on data from CBD (2022).

and overall period (0.32 percent) with a 5 percent level of significance. The gradual stagnation has been attributed to the conversion of palm gardens to commercial plots, unprecedented volatility in coconut prices (Shanthini and Ramane, 2018), disease and pest outbreaks, lack of technology adoption (Preethi *et al*. 2018), acute labour shortages, and increased production costs (Elias, 2015). In comparison to Kerala's stepping-back performance, with a 1 percent level of significance, Table 2 shows that the area under Tamil Nadu has a positive growth rate in Period I (1.55%), Period II (3.05%), and overall period (2.99%) and Karnataka has a 5 percent level of significance in Period I (2.93%), 1 level of significance in Period II (3.31%), and overall period (3.34%).

While considering the production of coconut period II (5.38%, 5.77%, and 4.73%) shows highest growth rate than period I (3.28%, 3.38%, and 2.04%) in Tamil Nadu, Karnataka and Andhra Pradesh, respectively. Kerala also shows positive trend but higher in period I (2.30%) than period II (1.64%) with 5 percent significance level. During the overall period, Karnataka had registered highest growth in production (5.68%), followed by Tamil Nadu (4.28%), Andhra Pradesh (3.73%) and Kerela (1.87%). The yield growth rate also shows that period II (2.31, 4.88, 3.35%) has two-fold higher growth trend than period I (1.33%, 2.07%, and 1,81%) in Tamil Nadu, Karnataka and Andhra Pradesh respectively. This indicates after implementation of Technology Mission on Coconut (TMC) which was established by Coconut Development Board (CDB) to carry out development programmes such as increasing coconut demand, improving marketing conditions, assisting coconut growers in obtaining better prices for the product, and providing financial and other

assistance for coconut cultivation. In addition, efforts have been made to create technologies that will allow for product diversification and developing coconut-based companies in the state, which resulted in a considerable increase in the India coconut production (Bhovi and Savadatti, 2017). The overall period of yield growth rate in Kerala was not significant with 2.05 percent but Tamil Nadu (1.15%), Karnataka (2.29%) and Andhra Pradesh (1.32%) has 5 percent level of significance.

Instability in Area, Production and Yield of Major Coconut Producing States in India

In order to assess the consistency of growth, it becomes imperative to study the instability of the variables during the study period. Table 3 depicts the instability in area, production and yield of coconut for major states. India shown more instability over the period in area, production and yield of coconut. Based on the instability indices, comparing the fluctuations in the coconut area, Tamil Nadu (7.10% and 4.98%) has more stability in period I and overall period, but in period II Andhra Pradesh (4.56%) has more stability than other states whereas Karnataka and Kerala shown lower instability over the period.

On the other hand, fluctuations in the production and yield of major coconut producing states, Andhra Pradesh has alarmingly high in period I (18.33 and 18.37%) and overall period (13.78% and 13.08%) whereas Karnataka have shown medium-high instability during period II (9.97% and 9.03%) and overall period (7.41 and 6.91%) but have reduced to a considerable level during period I (1.30% and 0.26%), respectively. Tamil Nadu have shown medium-high instability during period 1 (7.39% and 8.05%) but have reduced to a considerable level during period II (6.08% and 5.82%) and overall period (6.62% and 6.82%) respectively. Kerala have

Table 3: Instability index (%) of area, production and yield of coconut for major states in India

States	Area			Production			Yield		
	Period I	Period II	Overall	Period I	Period II	Overall	Period I	Period II	Overall
Kerala	2.67	3.03	2.91	4.74	5.45	5.08	3.15	5.08	4.25
Tamil Nadu	7.10	1.76	4.98	7.39	6.08	6.62	8.05	5.82	6.82
Karnataka	1.33	2.06	1.82	1.30	9.97	7.41	0.26	9.03	6.91
Andhra Pradesh	1.74	4.56	3.64	18.33	8.62	13.78	18.37	7.02	13.08
India	1.55	1.41	1.55	2.86	4.30	3.68	2.40	3.69	3.14

Source: Author's calculation based on data from CBD (2022).

Table 4: Decomposition analysis of area, production and yield of coconut for major states in India

States	Area effect			Yield effect			Interaction effect		
	Period I	Period II	Overall	Period I	Period II	Overall	Period I	Period II	Overall
Kerala	7.00	-7.05	-0.40	6.55	3.66	5.19	0.84	1.28	1.05
Tamil Nadu	14.78	3.29	9.20	0.69	3.26	1.98	-4.19	0.42	-1.63
Karnataka	4.41	11.64	8.67	0.19	10.92	4.70	0.00	-0.72	-0.51
Andhra Pradesh	4.72	0.86	2.58	1.24	2.00	1.66	0.03	-0.04	-0.01
India	26.13	13.72	21.00	13.15	25.57	18.04	0.10	1.52	0.77

Source: Author's calculation based on data from CBD (2022).

also shown medium-level fluctuations for coconut growth variables during the overall period (5.08% and 4.25 %) and within the period I (4.74% and 5.08%) and period II (5.45% and 4.25%) examined. It is not a good scenario for coconut farming since it may demotivate coconut growers to continue with the crop in the future, causing them to shift their focus to other crops. In order to continue the strong wave of coconut cultivation in areas like Tamil Nadu and Karnataka, several measures to alleviate instabilities in coconut production and productivity must be implemented (Gandhimathy, 2021).

Area, Yield, and their Interaction in increasing Coconut Production

Area, production, and yield analysis in India's selected states only explains the growth pattern. It is impossible to say whether area expansion and productivity have an impact on overall coconut production fluctuation. As a result, doing a decomposition analysis is to figure out the percentage contribution of area, yield, and their interaction impact on coconut production in four major coconut growing states and the India as a whole were presented in Table 4. It indicates a trend in production changes, the contribution by area has been positive in all states for all the period except Kerala in period II and overall period and

productivity has been positive for all the states in all the periods. The interaction effect is positive for Kerala in all the period whereas Tamil Nadu is negative in period I and overall period. Karnataka and Andhra Pradesh are negative in period II and overall period.

By comparing period I with period II, the maximum area effect was found in Karnataka from 4.41 to 11.64 percent and declined in Andhra Pradesh and Tamil Nadu. India area effect was decreased from 26.13 to 13.72 percent, conversely yield effect was increased from 13.15 to 25.57 percent. The yield effect was increased from 0.69 to 3.26 percent in Tamil Nadu, 0.19 to 10.92 percent in Karnataka and 1.24 to 2.00 percent in Andhra Pradesh but Kerala declined from 6.55 to 3.66 percent. These trends occurred due to developmental activities that took place during this period that had some positive impact on the productivity (Kappil *et al.* 2021). In case of an interaction effect, Kerala (0.84 to 1.28%) and Tamil Nadu (-4.19 to 0.42 %) exhibits the highest interaction effect whereas Karnataka and Andhra Pradesh show negative interaction effect and India's overall interaction effect also increased from 0.10 to 1.52 per cent. During the overall period, India recorded 21.00, 18.04 and 0.77 percent of area effect, yield effect and interaction effect respectively. Among the states Tamil Nadu was found to be

highest with area effect (9.20%), Kerala in yield effect (5.19%) and interaction effect (1.05%).

CONCLUSION

The paper has attempted to understand and analyse the growth pattern of coconut major coconut growing states in India. The above results highlighted that growth of area, production and productivity for major states in India was positive and statistically significant in period II (post-TMC period) than period I (pre-TMC period) except area under Kerala (-1.23%). Instability analysis indicates that these states showed fluctuating growth trends in the area, production and yield of coconut. Tamil Nadu and Karnataka reported a high level of instability in coconut production and its productivity during period II. It predicts that these states have a promising future in coconut cultivation among the supreme coconut-grown states in India. The area effect and yield effect play an indispensable role in the output growth of coconut in all the major coconut cultivating states during the study period. Area effect has negative in Kerala, which depicts that area expansion in coconut cultivation is merely nominal for other crops in the state. Despite the establishment of Technology Mission on Coconut by the CDB, the production of the coconut crop has not improved significantly. As a result, it is thought that enhanced coconut cultivation technology should be adopted. It is critical for the CDB to conduct successful productivity-boosting programmes in important coconut-growing states that contribute significantly to economic development. In the meantime, stakeholders and governments develop policies to organise various coconut farming awareness programmes and give credit-related services to coconut farmers who ready to cultivate coconut.

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