Original Research Article

Growth performance of Coconut production in Global scenario: A Quin-decadal analysis

ABSTRACT

The purpose of this study is to examine the coconut sector's growth performance and instability in the world context. Since Indonesia, Philippines and India are the world's biggest producer of coconuts which accounted for 75 per cent of overall production in the world and contribute around 80 percent of the total land for coconut farming.Area, production, and yield of coconut were collected from Faostat and ICC websites based on secondary data from 1990-91 to 2020-21. The study period was divided into period I (1990-91 to 2005-06) and period II (2006-07 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.Theresults revealed that growth rate of area was positive for Indonesia, Philippines and Indonesia for all the period. But production trend was negative in respective countries due to yield trend shows negative growth on period II. Similar results were found from instability index and decomposition analysis. This may due to poor management practices, severe diseases and pests of the plantations. Hence, greater attention needs to be given to the states where to attract and encourage many new farmers into coconut cultivation byaccessing modern technology, quality plantations, credit facilities by support of government.

Key words: Area, Coconut, Decomposition,Growth rate, Instability and Yield.

1.INTRODUCTION

The coconut (Cocos nucifera) is a significant horticultural crop that supplies food, oil, beverages, pharmaceuticals, fibers, and a number of raw ingredients for the manufacturing of a variety of goods with significant commercial value. The coconut seems to have spread from South East Asia, including Australasia, eastward through the Pacific Ocean and further into America, into the West. Over the calm tropical waters, it made its way to Madagascar and India. Sea travellers were also important for the introduction and spread of coconut plantations throughout the world, despite the fact that it was frequently thought to as an ocean-dispersed nut due to its sustained viability in sea water for over 100 days. The fact that the Portuguese brought it to Bahia and other regions of Brazil and the Spaniards brought it to the West Indies and southern Caribbean Sea coastlines makes this significant. It was further dispersed to other Pacific Islands by seafaring Polynesians. It was spread by the Arabs along the African coasts, and it was distributed into Indian Ocean territory by marine Tamils working with Bengali coast mariners [1].

The coconut tree, which thrives across the tropics, is frequently referred to as the "tree of life" for its significant contribution to smallholders' lives as a direct source of cash revenue, nutrition, and resources [2].Since more than 4,000 years ago, the Ayurvedic medical system has recognised coconut milk and oil as having health-promoting properties. In all of the Samhitas, or classical Ayurvedic books, the functional qualities of coconut are described in depth. Numerous historical and modern examples support the health benefits of coconut. Unfortunately, the soya bean lobby used misleading information to malign the coconut sector in order to promote soy oil. The demand for various items in non-producing nations has significantly increased now that the truth has come to light, turning the once-sunken coconut business into one that is rising[3].

The tropical belt of Asia, East Africa, and America is home to more than 93 countries that grow coconuts; these countries are also potential producers, with 11.58 million ha yielding 96.16 billion nuts at a productivity of 8307 nuts per ha during 2020-21. The top ten producers are Indonesia, Philippines, India, Brazil, Sri Lanka, Thailand, Vietnam, Malaysia, Papua New Guinea, and Tanzania. India is the third-largest producer of coconuts in the world, making up more than 22 percent of the world's total nut output [4]. Under a variety of climatic and soil conditions, coconut is grown in 16 states and 4 union territories in India. Production of coconut in the country is concentrated mainly in the four southern states, namely Kerala, Tamil Nadu, Karnataka and Andhra Pradesh [5].

Coconut has been used by human and their immediate ancestor species for at least half a million years as tender nut, dry fruit, source of food, drink, oil and wood as well as for shelter and aesthetic purposes. Neera and coconut water are becoming well-known health drinks worldwide, and the coconut water market is expanding to become a multi-billiondollar industry. The market for coconut products as functional foods, functional drinks, nutraceuticals, pharmaceuticals, and cosmeceuticals, among other uses, is expanding quickly. Because of their eco-friendliness, coconut value-added goods such coir, coir pith, coir pith briquettes, grow bags, husk chips, geotextiles, shell charcoal, activated carbon, etc. are increasing significance and are currently in high demand [6].

Despite year-to-year changes in the acreage and production of coconuts, there has been a remarkable increase in coconut plantations in India over the past two decades. India is a significant country in terms of the area and production of coconut crops due to the economic importance of coconut crops. The coconut industry is extremely competitive since countries like Indonesia and the Philippines actively market a wide range of products made from coconuts, whereas India is still just beginning to process coconuts due to rising domestic demand. Hence, the study is concerned with the global trend and increasing variability of coconut area, production, and yield.

2. METHODOLOGY

For the analysis, we chose the major coconut-producing countries of Indonesia, India, the Philippines, Sri Lanka, Brazil, Thailand, Malaysia, Papua New Guinea, and Vietnam, and we omitted other regions based on the availability of data. The research makes use of cross-sectional data on coconuts over 30 years (1990-91 to 2020–2021). We have collected information on factors like area ('000 hectares) under coconut cultivation, production (Million nuts), and yield (nuts per hectare) from the websites of the International Coconut Community (ICC) and the Food and Agriculture Organization (FAO). To derive relevant findings based on the Quin-decadal, the study period was divided into two sub-periods

as follows: Period I: 1990–1991 to 2005–06; Period II: 2006–2007 to 2020–2021; and overall period: 1990–1991 to 2020–21. Various econometric methodologies were used to analyse the study's goals, and presented below.

2.1 Compound growth rates (CGR):

By fitting an exponential growth function to the data, area, production and productivity of coconuts were calculated while taking growth rates into account[7]. It is determined by using the formula.

$$Yt = ab^t$$

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) x 100

Student't test is used to check the significance of the CGR.

2.2 Instability analysis

The instability index is an easy analytical tool for assessing variance or instability in any time series data [8]. Coppock's instability index (Coppock, 1962) was used to estimate and formula is given below.

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

The instability index = Antilog ($\sqrt{}$ V log – 1) x 100)

Where,

Xt = Area/production/productivity in the year 't',

t = number of years.

M= Mean of the difference between Logs of Xt+1, Xt.

Log V = logarithmic variance of the series.

2.3 Decomposition Analysis:

Using decomposition analysis [8] calculated the relative contributions of area and yield to the overall output change for the production of coconuts. According to the approach, A_0, P_0, and Y_0 represent area, production, and productivity in the base year, respectively, and A_n, P_n, and Y_n represent the values of the corresponding variable in the nth year item.

$P_0 = A_0 \times Y_0$, and $P_n = A_n \times Y_n$ …….. (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.

$P_n - P_0 = \Delta P$, $A_n - A_0 = \Delta A$ and $Y_n - Y_0 = \Delta Y$ …….. (2)

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

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

3. RESULTS AND DISCUSSION

3.1 Triennium Ending (TE) of major Coconut growing countries

The triennium endpoints of the world's major coconut-growing countries are displayed in Table 1. Philippines (31%), Indonesia (29%), and India (19%) make up the majority of the area used for coconut farming, followed by Sri Lanka, Papua New Guinea, Brazil, Vietnam, Thailand, and Malaysia. For three periods (TE1990-91, TE2005-06, and TE2020-21), the Triennium Ending was estimated and results shows that except for Brazil, Thailand, Malaysia, Papua New Guinea, and Vietnam, other countries show an increasing trend in area under coconut, which is doubled at TE2020-21 when compared to TE1990-91 which show that notable area expansion occurred. Hence, any future efforts should therefore concentrate on vertical expansion through the consolidation of coconut trees, filling in of gaps, replanting, and increased productivity in area declined countries [2].In case of production, Indonesia (33%), the Philippines (23%), and India (22%), which together account for almost 81 percent of world coconut production. The results of the Triennium Ending show that, compared to TE1990-91, coconut production increased by one-third in major countries in TE2020–21; however, compared to TE2005–06, production decreased in all countries with the exception of India and Sri Lanka.

Table 1: Triennium Ending (TE) of area and production of major coconut growing countries

Particulars	Area ('000 ha)				Production (million nuts)			
Countries	TE 1990	TE 2005	TE 2020	% share*	TE 1990	TE 2005	TE 2020	% share*
Indonesia	2668	3893	3387	29	22922	38185	32292	33
Philippines	3105	3240	3644	31	16203	22657	22915	23
India	1492	1939	2170	19	11297	13521	21458	22
Srilanka	417	404	463	4	2856	2862	3355	3
Brazil	212	285	191	2	1128	4801	3717	4
Thailand	345	271	123	1	2210	3222	1330	1
Malaysia	319	177	75	1	1702	925	830	1
Papua New Guinea	260	191	196	2	1039	1007	1880	2
Vietnam	211	120	159	1	1495	1475	2588	3
World	9962	10934	11681	100	65312	86922	97813	100

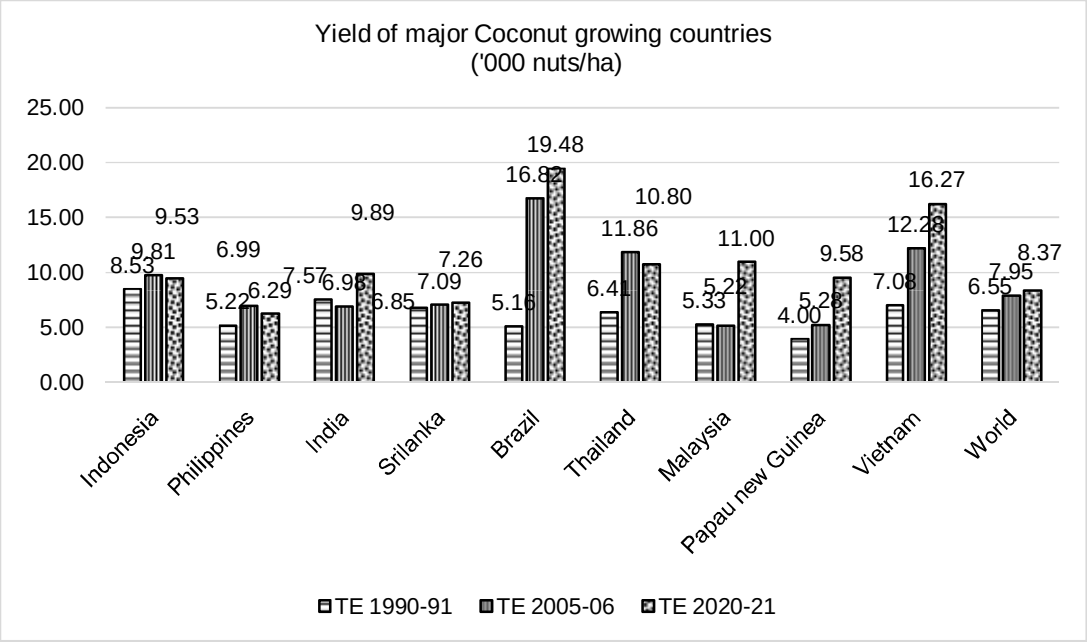
*Shows percentage share of TE 2020

Source: FAOSTAT and ICC, 2022

With the exception of Sri Lanka and the Philippines, all major nations have higher coconut yields than the global average. The productivity of Indonesia, India, Brazil, Thailand, Malaysia, Papua New Guinea, and Vietnam has shown rapid improvement. Because the majority of the current coconut trees are elderly and nearly a third are senile, there has not been much improvement in the productivity of coconuts over TE 2020–21 compared to TE 2005–2006. Coconuts are frequently

cultivated on plantations with poor management practises. Severe diseases like root wilt, stem bleeding, leaf rot, etc., and pests like Rhinoceros beetle**are,** Mealy bug, Red palm weevil, etc.,also a problem for the plantations. Except perhaps in India, particularly in regions where coconut is grown under irrigation, the varieties and hybrids generated in various research institutes have had very little impact on the expansion of the growth region. Since bulk of the coconuts is produced under rainfed conditions, farmers prefer local talls than hybrids. Because many farmers are able to get more than 100 to 150 nuts per palm per year, coconut-producing nations should seek to reach a far higher production level, which is achievable with the adoption of suitable management measures. As of 2020–21, the average yield of coconuts in India was 10,423 nuts per ha[9].

Fig. 1: Triennium Ending (TE) of Yield of major coconut growing countries (1000 nuts /ha)



Source: FAOSTAT and ICC, 2022

3.2 Trend in Area, Production and Yield ofMajor Coconut growing countries

The CGR was used to examine the area, production, and yield of coconuts in major countries and the data from 1990-91 to 2020-21 was divided into two periods: Period I (1990-91 to 2005-06), and Period II (2006-07 to 2020-21). The compound growth rate of area, production and yield for major coconut growing countries were given in Table 2. It is clear from the table 2 that coconut area under Philippines, India, Srilanka and Vietnam shows a higher positive growth rate in period II (0.62, 1.59, 1.45 and 2.31 %) than period I with a 1 per cent level of significance. But Indonesia (-0.96%) and Brazil (-2.28%) show negative trend in period II. Malaysia, Thailand and Papua New Guinea shows negative trend in all the three periods.

While considering the production of coconut in Indonesia, Philippines and Thailand, period II (-1.52, -0.47, -1.62 %)shows negative growth rate, but period I(1.62, 1.69, 2.46%) shows positive growth ratedue to negative trend implies in the yield of respective countries during period II (-0.56, -1.08 and -0.13) with 5 per cent level of significance. Except Srilanka and Brazil, other countries such as India, Malaysia, Papua New Guinea and Vietnam were recorded positive growth rate in Period II (2.80, 0.03,

1.11, 3.92 %) compared to period I (0.08, -2.59, -1.02, -1.85) with 5 per cent level of significance due to improvement in yield growth rate in period II (1.74, 3.98, 2.26 and 1.58 %).

The growth rate of area under world in period II was higher than period I. Nevertheless, world production of coconut trend was decreased in period II due to declined yield trend in same period. During the overall period, India had registered highest growth in area (1.99%) and production (2.77%) of coconut, but yield growth of coconut was highest in Papua New Guinea (3.15%). The overall period growth rate of world has 5 percent level of significance in area (1.53%), production (2.12%) and yield (1.59%). The similar results were found in [1] and [6].

Table 2: Growth rate (%) of area, production and yield of major coconut growing countries (1990-91 to 2020-21)

Particulars	Area			Production			Yield		
Countries	Period I	Period II	overall	Period I	Period II	overall	Period I	Period II	overall
Indonesia	0.63*	-0.96*	-0.18*	1.62*	-1.52*	1.26**	0.99*	-0.56*	0.43*
Philippines	0.28 NS	0.62**	1.60*	1.69*	-0.47**	1.83 NS	1.41*	-1.08*	0.23**
India	1.04*	1.59**	1.99*	0.08*	2.80**	2.77*	-1.48 NS	1.74*	1.78*
Srilanka	-0.09 NS	1.45**	0.10 NS	0.76*	0.11*	0.74*	0.85*	-1.33*	0.64*
Brazil	1.81*	-2.28*	-0.33*	3.64 NS	2.01*	2.70 NS	2.72 NS	1.31**	3.04
Thailand	-1.85 NS	-5.74 NS	-3.46*	2.46 NS	-1.62**	-1.24 NS	2.40*	-0.13*	1.26*
Malaysia	-4.22NS	-3.79 NS	-5.26 NS	-2.59*	0.03*	-2.56 NS	-0.39*	3.98 NS	2.85 NS
PapuaNew Guinea	-2.62*	-1.13*	-0.94*	-1.02*	1.11*	2.19 NS	1.66**	2.26*	3.15*
Vietnam	-4.44*	2.31**	-0.98*	-1.85*	3.92 NS	1.44*	2.71*	1.58 NS	2.45*
World	0.51*	0.69*	1.53*	1.53**	1.13*	2.12*	1.02 NS	0.85*	1.59*

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 FAOSTAT (2022).

3.3 Instability in Area, Production and Yield of Major Coconut growing countries

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 countries. Based on the instability indices, comparing the fluctuations in the coconut area, Thailand, Malaysia, Papua New Guinea and Vietnam have more stability in period II and overall period, but Indonesia, Philippines and India show lower stability among the period I, period II and overall periodunder coconut area.

On the other hand, fluctuations in the production and yield of major coconut growing countries, Papua New Guinea has alarmingly high in period I (9.79 and 7.88%), period II (9.18 and 5.60%) and overall period (9.53 and 6.85 %) respectively, whereas other countries such as Indonesia, Philippines, India, Srilanka, Brazil, Thailand, Malaysia and Vietnam have shown medium instability during all the period which is between 2 to 4 percent.

Table 3: Instability index (%) of area, production and yield ofmajor coconut growing countries

Particulars	Area			Production			Yield		
Countries	Period I	Period II	overall	Period I	Period II	overall	Period I	Period II	overall
Indonesia	0.68	0.87	0.87	1.81	2.64	2.42	1.90	2.15	2.09
Philippines	1.72	0.60	1.30	3.97	1.30	2.97	2.88	1.38	2.32
India	1.98	1.54	1.78	2.53	5.19	4.18	2.09	5.22	4.13
Srilanka	1.08	1.77	1.53	4.54	3.53	4.45	4.69	3.33	4.49
Brazil	1.76	1.32	1.83	3.68	3.06	3.78	3.52	2.48	3.15
Thailand	1.02	4.92	3.60	3.27	3.49	3.80	3.75	4.16	4.09
Malaysia	1.38	2.94	3.83	3.16	3.99	3.79	3.56	3.20	4.18
PapuaNew Guinea	4.01	3.68	3.87	9.79	9.18	9.53	7.88	5.60	6.85
Vietnam	2.30	2.06	2.55	4.60	0.75	3.40	3.37	2.09	2.83
World	0.50	0.62	0.57	0.88	1.71	1.40	0.86	1.60	1.31

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

3.4 Decomposition analysis on major Coconut growing countries

Area, production, and yield analysis in world's major countries 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 major coconut growing countrieswere presented in Table 4. It indicates a trend in production changes, the contribution by area has been positive in Philippines, India and Srilanka for period II and overall period and yieldeffect has been positive for all the countries in overall period, but in period II there has been negative effect in Indonesia, Philippines, Srilanka and Thailand.

The interaction effect is positive for India and Papua New Guinea in all the period whereas Indonesia is negative in period I and overall period. Philippines and Brazil are negative in period II and overall period. Srilanka and Thailand are had negative interaction effect in all the periods. By comparing period I with period II, the maximum area effect was found in Philippines from 9.27 to 16.11 percent and declined in Indonesia, India and Brazil. The yield effect was increased from -9.70 to 7.31 percent in India, and 3.10 to 8.05 percent in Papua New Guinea. Conversely, yield effect was decreased in Indonesia, Philippines, Srilanka and Thailand. Correct low production estimates are produced in certain of the countries because adequate harvesting is not carried out, and even the fallen nuts are not entirely collected.

Table 4: Decomposition analysis of area, production and yield of major coconut growing countries

Particulars	Area effect			Yield effect			Interaction effect		
Countries	Period I	Period II	overall	Period I	Period II	overall	Period I	Period II	overall
Indonesia	20.52	-30.63	-0.87	45.15	-1.24	0.89	-0.51	1.68	-0.07
Philippines	9.27	16.11	1.39	32.67	-2.51	0.43	2.50	-0.51	-0.09
India	24.25	15.29	1.88	-9.70	7.31	2.03	0.89	0.72	0.08
Srilanka	-1.31	5.86	0.22	1.26	-4.81	0.06	-0.21	-0.25	-0.02
Brazil	5.32	-12.68	-0.36	15.36	6.85	1.00	0.11	-0.03	0.00
Thailand	-5.25	-8.58	-0.69	11.01	-3.37	0.33	-0.51	-0.92	-0.07
Malaysia	-6.06	-2.90	-0.58	1.02	3.25	0.28	-0.23	-0.19	0.06
PapuaNew Guinea	-2.33	-0.25	-0.12	3.10	8.05	0.53	0.40	1.48	0.09
Vietnam	-6.69	4.61	-0.10	5.82	3.07	0.44	-0.03	-0.34	0.02
World	4.36	8.64	3.89	10.95	9.43	5.59	0.14	0.05	0.01

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

4. CONCLUSION

The paper has attempted to understand and analyse the growth pattern of major coconut growingcountries in the world.Area under cultivation continues to assume positive growth in some countries like India, Philippines, Sri Lanka and Indonesia. In Brazil, Thailand, Malaysia, Papua New Guinea and Vietnam has observed significant negative trend in area. India, Malaysia, Papua New Guinea and Vietnam were recorded positive growth rate in positive trend in production as well as yield. Conversely, other countries like Indonesia, Philippines, Brazil, and Thailand were shows negative trend. Similar results also found in instability analysis and decomposition analysis. Hence, any future efforts should therefore concentrate on vertical expansion through the consolidation of coconut trees, filling in of gaps, replanting, and increased productivity in area declined countries. Indonesia, Philippines, and Srilanka were have slightly declined yield during period II. So, these nations should be concentrated on yield development through good management practices with availability of quality planting material to meet the increasing demand and productivity.

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