Trend Analysis of Area, Production and Productivity of Coconuts in Kerala Using Exponential Trend and Forecasting

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Abstract— In addition to having a special place in the sociocultural fabric of the region, coconut farming is also vital to Kerala's agrarian economy. Palakkad, the largest district in Kerala, is the main agricultural area. The district ranks first in the state in producing almost all types of food and cash crops. A cropping pattern means the area's production under different crops at a time, which is crucial in creating a sizeable portion of the state's agricultural income and cropping area. This article examines the relative relevance of many factors to try to comprehend the significance of coconuts in Kerala's plantation sector—coconut production and productivity trends at the national and state level from 1990 to 2021. In India, there was an increase in coconut acreage, production, and productivity. Kerala's acreage and production of coconuts did not show a consistent upward trend relative to the Indian situation. In Kerala, the production of coconuts fell to less than 7,000 million nuts in the fiscal year 2020–21.

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I. INTRODUCTION

Aside from its special position in the socio-cultural fabric of the area, coconut farming is essential to the agrarian economy of Kerala state. Every time, Kerala has long held the top spot in the nation for coconut production and area, which is seen as a symbol of rural prosperity. However, the "land of the coconut," Kerala, is increasingly losing its dominance over the nation's coconut output. Coconut production and its area share in the nation are both dropping over time, and the crop's growers are experiencing a crisis due to their difficulty managing the crop profitably. Although the coconut industry has faced numerous difficulties recently, solutions remain. The most significant crop in Kerala is coconut, which takes up around 39% of the net area sown there. The production of coconuts did not show a consistent upward trend. One of the crucial plantation crops is coconut. It is grown in India. The coconut palm's kernel, shell, wood, water, and other components all have a reasonable economic value and a market price. Coconut is referred to as the tree of abundance or "Kalpavriksha" due to its many applications. After Indonesia and the Philippines, India is one of the top three coconut producers in the world in 2019 (CACP, 2021b), accounting for 23% of production and occupying 18% of the total area. In the 2019–20 crop year, India produced 20,309 million nuts on 2.17 million hectares, yielding 9345 nuts per hectare (CDB, 2021). It also provides food security and livelihood opportunities to 12 million people in India (CACP, 2021b). The four southern states, Kerala, Karnataka, Tamil Nadu, and Andhra Pradesh, are the country's main coconut growing areas, accounting for 90 percent of the area and production. Kerala has the longest history of coconut farming among the states that produce the most coconuts. The most significant crop farmed in Kerala in terms of area is coconut, which is grown on more than 0.76 million hectares. It makes up the greatest portion of the revenue, at 29.41%. In Kerala, less than 7,000 million coconuts were produced in the fiscal year 2020–21, compared to 8,452 million. 21207 million nuts were produced in the nation in 2020–21, or 34% of the total production worldwide. The highest productivity in the world is 9687 nuts per acre. Because of the expansion of new coconut companies and products, farmers are now able to find work.

Kerala, also known as the "land of coconuts," is the Indian state with the longest history of coconut farming. Kerala produces 5873 million nuts and 0.79 million hectares worth of coconuts each year. Despite having the biggest percentage of its land covered by coconuts (38.5%) in the entire nation, its productivity and production are lower than those of other states that produce a significant amount of coconuts, such as Tamil Nadu, Karnataka, and Andhra Pradesh (GOK, 2016). In order to analyse the trend and growth in the area, production, and productivity of coconut in India and Kerala, the current study was conducted. Evaluating trends in coconut production, area, and productivity was feasible using secondary time series data obtained from the Coconut Development Board in Kochi. The rates of production, consumption, and area.

II. OBJECTIVES OF THE STUDY

1. An attempt has been made to find out the relationship between production, productivity, and the area used for the yield of coconut.

2. An attempt has been made to assess the coconut production trend in Kerala.

3. An attempt has been made to assess the growth performance in area, production, and yield of coconut in Kerala.

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III. DATA ANALYSIS

It was decided to use the ordinary least squares method to estimate the coefficient (b). To calculate the compound growth rate in percentage, use the formula Compound Growth Rate (CGR) = (Antilog B - 1) X 100. The significance of the regression coefficient was assessed using the F-test.

Trends in coconut production, area, and productivity This section makes an effort to assess the growth pattern of coconut in India and Kerala in terms of area, production, and productivity between 1990 and 2021. The results are discussed in two areas.

Table1: Area, production, and productivity of coconut in Kerala state with a growth rate

	Area	Growth Rate	Production	Growth Rate	Productivity	Growth Rate
1990-1991	870022	0	4232	0	4864	0
1991-1992	863061	-0.008000947	4641	0.09664461	5377	0.10546875
1992-1993	877012	0.016164558	5124	0.1040724	5843	0.086665427
1993-1994	882293	0.006021582	5192	0.01327088	5885	0.007188088
1994-1995	910960	0.032491474	5336	0.02773498	5858	-0.004587935
1995-1996	914370	0.003743304	5155	-0.0339205	5638	-0.03755548
1996-1997	902104	-0.013414701	5276	0.02347236	5849	0.037424619
1997-1998	884344	-0.019687309	5209	-0.012699	5890	0.007009745
1998-1999	882288	-0.002324887	5132	-0.0147821	5817	-0.012393888
1999-2000	925035	0.048450166	5680	0.10678098	6140	0.055526904
2000-2001	925783	0.000808618	5536	-0.0253521	5980	-0.026058632
2001-2002	905718	-0.021673546	5479	-0.0102962	6049	0.011538462
2002-2003	899198	-0.007198709	5709	0.04197846	6349	0.049594974
2003-2004	898498	-0.000778471	5876	0.02925206	6540	0.030083478
2004-2005	899267	0.000855873	6001	0.02127297	6673	0.020336391
2005-2006	897833	-0.001594632	6326	0.05415764	7046	0.055896898
2006-2007	872943	-0.027722305	6054	-0.0429972	6935	-0.015753619
2007-	818812	-0.062009776	5641	-0.0682194	6889	-0.006633021

2008						
2008-2009	787769	-0.037912244	5802	0.02854104	7384	0.07185368
2009-2010	778618	-0.011616349	5667	-0.0232678	7278	-0.014355363
2010-2011	770473	-0.010460842	5287	-0.0670549	6862	-0.05715856
2011-2012	820867	0.065406575	5941	0.12369964	7237	0.05464879
2012-2013	798162	-0.027659779	5799	-0.0239017	7265	0.003869006
2013-2014	808647	0.013136431	5921	0.02103811	7322	0.007845836
2014-2015	793856	-0.018291047	5947	0.00439115	7491	0.023081125
2015-2016	790223	-0.004576397	5873	-0.0124432	7432	-0.007876118
2016-2017	781496	-0.011043718	5384	-0.0832624	6889	-0.073062433
2017-2018	760443	-0.026939357	5230	-0.0286033	6859	-0.004354768
2018-2019	760946	0.000661457	5299	0.01319312	6964	0.015308354
2019-2020	760776	-0.000223406	4814	-0.0915267	6328	-0.091326824
2020-2021	768809	0.010558956	4788	-0.0054009	6228	-0.015802781
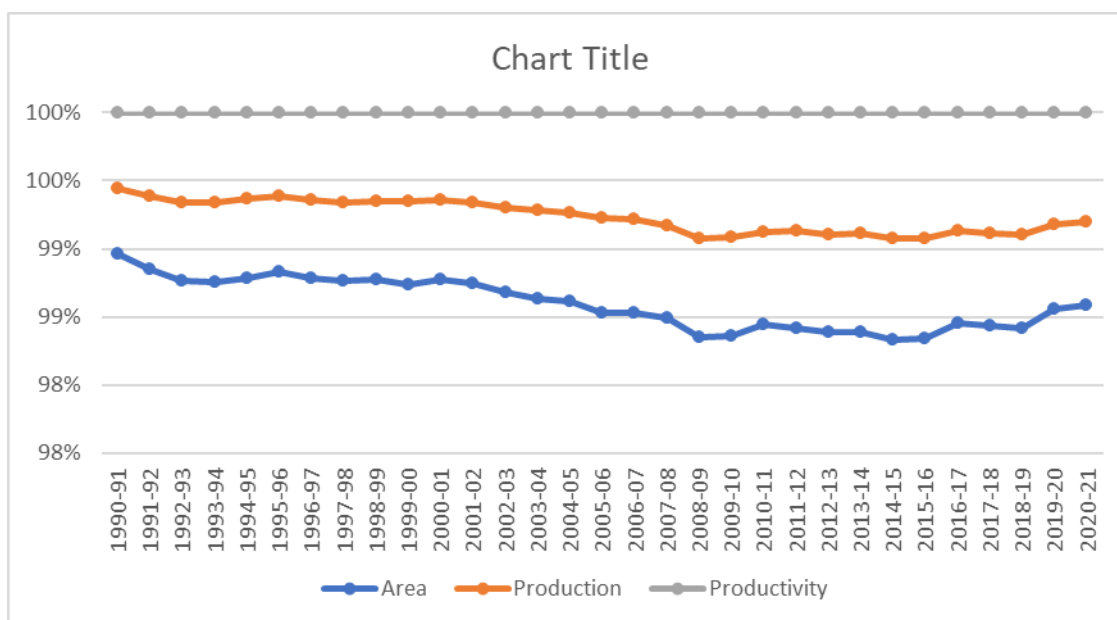
Figure 1: The trend in the area, production, and productivity of coconuts in Kerala

The trend in the area, production, and productivity of coconuts in Kerala from 1990 to 2021 is shown in Figure 1. Kerala placed first in the area (0.79 million hectares) under coconut cultivation and second in

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coconut production (5873 million nuts) during the 2015–16 crop year, with a productivity of 7432 nuts per hectare. In 2000–01, Kerala reported having coconuts on an area larger than 0.925 million hectares. The productivity peaked in 2014–2015, even though the highest coconuts yield was in 2005–2006. The area and output from 1990 to the present did not exhibit a steadily increasing trend, in contrast to the Indian scenario depicted in Figs. 2, 3, and 4. The price of coconuts did not consistently rise.
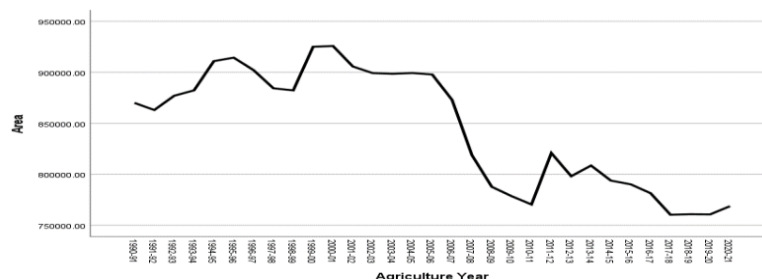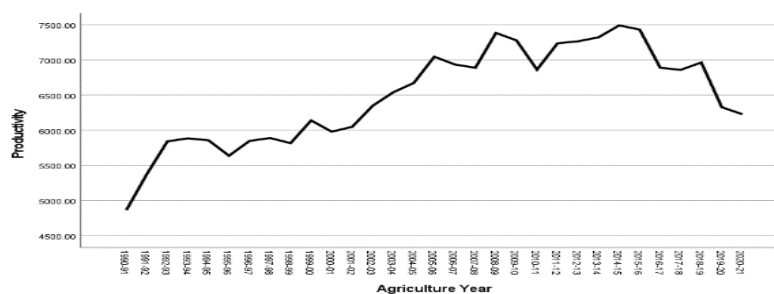

Figure 2: Trend in area under coconut in Kerala

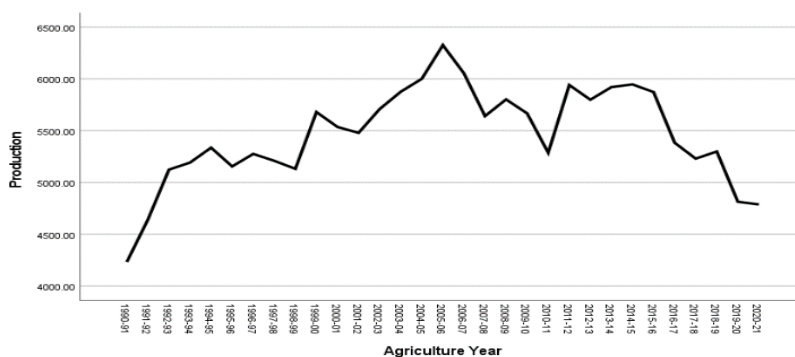**Figure 3: Trend in productivity of coconut in Kerala**

Figure 4: The trend in the production of coconut in Kerala

Growth rates of coconut production, area, and productivity. The findings of trend analysis have given an overview of the changes in the area, production, and productivity of coconut in India and Kerala. Its compound growth rate has been computed to incorporate the year-to-year variation in area, production, and productivity. The growth rate of a variable may be defined as the rate of change per unit of time, usually a year. Here, a time series of data on coconut's area, production, and productivity was fitted with an exponential growth model, and the findings are described. In Kerala, the growth rates for area, production, and productivity of coconuts were 0.4%, 2.12%, and 1.71%, respectively, throughout the period, with a greater contribution to production coming from productivity increases than from area growth. In the period-wise analysis, growth rates in area (2.63 per cent) and productivity (2.02 per cent) were positive and

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significant during the period I. The positive growth rate in area and yield had a strong and high impact on production throughout the above period, which increased by 4.71 per cent.Period II, in contrast to the period I, had stationary production (0.6%) as a result of the combined effects of a markedly negative growth rate in area (-0.89%).and a significant and positive growth rate in productivity (1.71 per cent). But the productivity growth was lower in Period II than in Period I. The findings of Thamban et al. (2016), who stated lower area growth during the period from 2000-01 to 2013-14, with a compound growth rate of -0.96%, and who indicated that the productivity effect played a more significant part in coconut production than area, were consistent with the results mentioned above regarding the trend in growth of area, production, and productivity in Kerala. Furthermore, Lathika and Ku-mar (2005) reported lower growth in Kerala's coconut production (1.21%) and area (1.56%), suggesting that even though the effect continues to have a higher impact on output growth in virtually all of the country's coconut-growing relations.
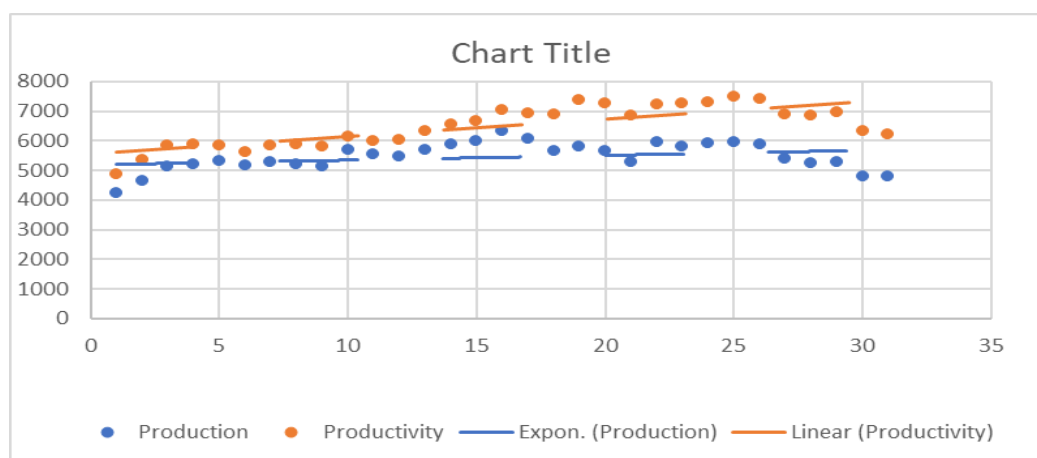

Figure 5

The growth model represents the product growth mechanism and plan: the spreadsheet model captures how the product acquires and retains users and the dynamics between different channels and platforms. The exponential growth model was run to estimate the growth rate of production, acreage, and yield of coconut in Kerala.

Exponential: $y = ae^{bx}$ where, Y is the amount of production, area, and productivity, x is the time, and b is the growth parameter to be estimated.

That is Y=5189.3e$^{0.003x}$ is the production trend line.

The straight line trend is Y=3.229X.

IV. SUMMARY OF ANOVA FOR REGRESSION

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	102052930938.596	2	51026465469.298	3698.393	<.001^b
	Residual	386314019.275	28	13796929.260		
	Total	102439244957.871	30			

H_0: There is no significant relation between production, area, and productivity. The analysis of the variance table shown above, the significant value of F =3698 and p-value is less than 0.001, so We reject the null hypothesis b1=b2= b3. And we infer a significant association between production, area and productivity.

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COEFFICIENTS

Unstandardized Coefficients			Standardized Coefficients			95.0% Confidence Interval for B	
Model	B	Std. Error	Beta			Lower Bound	Upper Bound
1 (Constant)	852392.453	8005.413		106.477	<.001	835994.107	868790.800
Production	152.043	2.224	1.211	68.366	<.001	147.488	156.599
Productivity	-129.062	1.504	-1.521	-85.839	<.001	-132.142	-125.982

The regression equation is $Y=852392.453+152.043X_1+(-129.062)X_2$ tests the significant relation between production, and productivity. Here, we conclude that our goal is to determine whether there is a significant relationship between productivity in terms of parameters and the production of coconuts and the area under cultivation. The results indicated a decline in productivity, which means that productivity can be calculated by dividing total production by the region from which it was produced. Production of coconuts in the region is rapidly declining.

VI. FORECAST

Agricultural Year	Area	Forecast (Area)
2015	790223	
2016	781496	
2017	760443	
2018	760946	
2019	760776	
2020	768809	768809
2021		756044.1504
2022		750822.6492
2023		745601.148
2024		740379.6468
2025		735158.1455
2026		729936.6443
2027		724715.1431
2028		719493.6419
2029		714272.1407
2030		709050.6395

Ten years forecasting showed a reduction of the area from 2020 to 2030.

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VII.CONCLUSION

Kerala's coconut business is struggling with several challenges, and serious action needs to be taken. Reclaiming the past magnificence of coconut riches should be a top goal. The implementation of comprehensive coconut rejuvenation plans, increased technological integration to increase production, and product diversification to add value are all necessary in addition to a policy framework that is supportive of these efforts. Local grassroots initiatives among the small and marginal coconut growers should be encouraged in order to resuscitate the state's coconut industry. If the state had a strong sectoral innovation system, where research and development activities were properly coordinated, resulting in beneficial policy outcomes and farmer-participated initiatives, the state's coconut sector would surely be at the top of the list among plantation crops. In Kerala, less land is being used for coconut production as a result of declining land ownership.

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