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An analytical study on the growth and decomposition of area, production, and productivity of banana in Theni District, Tamil Nadu

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Abstract

Banana, often referred to as the "poor man's apple" and the "fruit of the wise men," plays a vital role in India's rural economy. This study analyzes trends in banana cultivation over 21 years (2002-03 to 2022-23), focusing on area, production, and productivity using Compound Annual Growth Rate (CAGR), Cuddy-Della Valle Index (CDVI), and decomposition analysis. Results show annual growth rates of 3.63% in area, 5.61% in production, and 1.92% in productivity. CDVI indicates production (24.47%) is more inconsistent than area (14.63%) and productivity (19.26%). Decomposition analysis shows that area expansion (62.13%) contributed more to production growth than productivity (20.82%). Thus, to sustain production without increasing land use, productivity can be improved through better cultivation practices and technologies.

Keywords: Banana, CAGR, CDVI & decomposition analysis

Introduction

Banana and plantain (*Musa paradisicia*) are widely grown in India and are associated with the historical, economic and social fabric of Indian sub-continent. Banana is also known as the "fruit of the wise men" (Angles and Sundar, 2012) [4]. In India, banana is the second most important fruit crop after mango, both in terms of cultivated area and total production. It is highly valued for its high yield potential, year-round availability, and rich nutritional profile, including carbohydrates, vitamins (particularly B6 and C), potassium, and dietary fiber.

Banana serves as a stable food in many regions and also plays a vital role in the economy by supporting millions of small and marginal farmers. Besides fresh consumption, bananas are processed into products such as chips, puree, flour, and fiber. India is the world's largest producer of banana, with major cultivating states including Tamil Nadu, Maharashtra, Gujarat, Andhra Pradesh, and Kerala.

India leads global production with approximately 37.5 million tonnesin 2023-24, accounting for nearly 19.4% of the world's output.

Due to its commercial importance, banana cultivation demands scientific practices in planting, nutrition, irrigation, pest and disease management, and post-harvest handling to ensure high productivity and quality.

Review of Literature

Meenakshi and Monikanda (2022) [1] analyzed the instability for production of banana in Tamil Nadu. The time series data for 1991-92 to 2002-22 were uses for the study. This analysis reveals that the stability of banana production was relatively stable in India (88%) & Tamil Nadu (72%) by using coefficient of variation (C.V)%.

Saravanapandeeswari and Vanitha (2018) [2] analyzed Growth of area, production and productivity of banana cultivation in Theni district, Tamil Nadu. The time series data for 2003-04 to 2014-15 were uses for the study. The results of the study reveals that yield effected 26.80% and area effected 39.20%, having significant contribution in whole increase in production of banana cultivation.

Senthilkumar and Kannan (2019) [3] analyzed the area, production, productivity of banana in Tamil Nadu. The time series data for 2007-08 and 2016-17 were uses for the study. there was a significant growth in area and production, Tamil Nadu showed a marginal decline in productivity (CAGR= -3.11%). This indicates an unsatisfactory and declining trend in banana productivity despite overall national growth.

Objectives of the Study

- To analyze the growth rate and assess the extent of instability in the area, production, and productivity of banana cultivation in Theni district, Tamil Nadu.
- To determine the relative contribution of area, yield, and their interaction to the changes in banana production in Theni district, Tamil Nadu.

Methodology

The present study is based on time series data spanning from 2002-03 to 2022-23, focusing on the area, production, and yield of banana in Theni district, Tamil Nadu. Secondary data were sourced from the Season and Crop Report of Tamil Nadu, Statistical Abstract of Tamil Nadu, and the National Horticultural Board database. The collected data were analyzed using SPSS software to evaluate growth rate, instability, and contributing factors to production changes.

1. Compound Growth Rate

Several methods are available to estimated growth rates. In this study exponential function was used to estimate compound growth rate by taking time as the independent variable and area, production and productivity as dependent variable. This exponential trend equation gives constant rate of increase or decrease per unit of time and they are termed as compound growth rate were estimated by fitting exponential trend equation of the following type.

$Y = ab^t$

Where,
Y = the area/production/productivity
t = time variable in years
a = constant and b = (1 + r)

Where,
r = Compound Growth Rate
The above equation takes the linear form by taking logarithms of both sides of the equation,

ln y = lna + t ln b.

Compound growth rate is computed using the following formula.
Compound Growth Rate (CGR) = (Antilog ($\log_e$b)-1) *100
Growth rates are worked out to examine the tendency of variable to increase, decrease or remain stagnant over a period of time. It also indicates the magnitude of the rate of change in the variable under consideration per unit of time. For the present study, compound growth trend was used to estimate the growth in area, production and productivity of banana crop.

2. Instability index

Instability index was used to measure the deviation from the normal trend in the area, production and yields of banana crop. Cuddy Della Valle Index (Cuddy and Della, 1978) was used to determine the instability in area, production and yields of banana crop.
The Cuddy Della Valle index (CDVI) was calculated as follows:

$$CDVI\ (\%) = C.V.*\sqrt{1 - \text{Adj } R^2}$$

$$\text{Adj } R^2 = 1 - \left[\frac{(1-R^2)(n-1)}{N-k-1}\right]$$

Where,
C.V. = Coefficient of Variation
R^2 = Coefficient of multiple determination

3. Decomposition analysis

The relative contribution of area and yield to the total output change (growth) of an individual crop was first estimated by Minhas and Vaidyanathan (1964) using a component analysis model. Sharma (1977) redeveloped the model into the decomposition of output growth of an individual crop. In the present study, relative contribution of area, productivity and their interaction effect to the total output change in the study crops was worked out by Simple decomposition model.

Let,P = A*Y

Where: 'P' is the production of Banana;
'A' is the area under a Banana; and
'Y' is the yield of Banana.

Then, $P_o = A_o*Y_o$ and $P_n = A_n * Y_n$

Accordingly, the simple decomposition model was specified as:

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

$\Delta P = (\Delta Y)A_0 + (\Delta A)Y_0 + (\Delta Y)(\Delta A)$
(Yield Effect) (Area Effect) (Interaction Effect)

Where:
'n' refers to current year and 'o' refers to base year of the study period.

Results and Discussion

During the period from 2002-03 to 2022-23, area, production and productivity of Banana have increased approximately by 1.8 times, 2.3 times and 1.3 times respectively. The details of mean, standard deviation, compound growth rate and Cuddy-Della Valle index of Banana area, production and productivity at Theni District of Tamil Naduare presented in Table 1.

Table 1: Area, Production and Productivity of Banana Cultivation in Theni District during 2002-03 to 2022-23

Year	Area (In Hectares) (A)	% Change Over Previous Year(ΔA)	Production (In Million tonnes) (P)	% Change Over Previous Year(ΔP)	Productivity (Million tonnes/Hectare) (Y)	% Change Over Previous Year(ΔY)
2002-03	3702	-	136800	-	36.95	-
2003-04	2592	70	91692	67	35.38	96
2004-05	2842	110	120720	132	42.48	120
2005-06	3328	117	163420	135	49.10	116
2006-07	4102	123	219802	135	53.58	109
2007-08	4577	112	194517	88	42.50	79
2008-09	4846	106	432852	223	89.32	210
2009-10	5779	119	449406	104	77.77	87
2010-11	5164	89	308845	69	60.00	77
2011-12	5767	112	453756	147	78.68	131
2012-13	6010	104	453756	100	76.00	97
2013-14	5996	100	398454	88	66.45	87
2014-15	6043	101	353658	89	58.52	88
2015-16	5914	98	379005	107	64.09	110
2016-17	5613	95	311281	82	55.46	87
2017-18	5134	91	358210	115	69.77	126
2018-19	5261	102	402381	112	76.48	110
2019-20	5966	113	409571	102	68.65	90
2020-21	6122	103	421134	103	68.79	100
2021-22	6403	105	356865	85	55.73	81
2022-23	6732	105	317037	89	47.09	84
Mean	5137.76		320626.8		60.61	
SD	1190.08		118277.69		14.95	
CGR (%)	3.63		5.61		1.92	
CV	23.16		36.89		24.66	
Adj R^2	0.601		0.56		0.39	
CDVI (%)	14.63		24.47		19.26	

Table1 presents the area, production, and productivity of banana cultivation in Theni district. It reveals that the area under banana cultivation has generally increased from 3,702 hectares in 2002-03 to 6,732 hectares in 2022-23, despite some fluctuations during the intervening years. The compound annual growth rate (CAGR) for the area was 3.63% over the study period.

The production of bananas also increased from 136,800 metric tonnes in 2002-03 to 317,037 metric tonnes in 2022-23, with some year-to-year variations. The compound annual growth rate for production was 5.61%.

Similarly, the productivity (measured in metric tonnes per hectare) rose from 36.95 tonnes/ha in 2002-03 to 47.09 tonnes/ha in 2022-23, again with some fluctuations over the years. The compound annual growth rate for productivity was 1.92% during the study period.

The CDVI shows that are apparent that the production (24.47%) of Banana is highly inconsistent compared to that of area (14.63%) and productivity (19.26%).

Relative Contribution of Area and Productivity on Production of Banana in Tamil Nadu.

$$\Delta_P = A_0 \Delta Y + Y_0 \Delta A + \Delta A \Delta Y$$

= (3702) (10.14) + (36.95) (3030) + (3030) (10.14)
= 37528.28+ 111958.5 + 30724.2
= 1,80,220.98 million tonnes

The effects of productivity, area, and their interaction on banana production in Tamil Nadu from 2002-03 to 2022-23 were analyzed. During this period, total banana production increased by approximately 1,80,220.98 million tonnes. Of this increase, 62.13% was attributed to the expansion in cultivated area, 20.82% to improved productivity, and 17.05% to the interaction between area and productivity. The analysis indicates that area expansion had a greater impact on production growth than productivity improvements.

Conclusion

Banana is a major fruit crop widely cultivated and consumed across India, particularly in Tamil Nadu. The study revealed that banana cultivation in Theni district lacked stability during the study period. The annual growth rate in production (5.61%) was higher than that of the cultivated area (3.63%) and productivity (1.92%). The Coefficient of Variation Index (CDVI) indicated that production (24.47%) was more inconsistent compared to area (14.63%) and productivity (19.26%). Decomposition analysis showed that the area effect contributed significantly (62.13%) to the increase in banana production, followed by the yield effect (20.82%). This suggests that while expansion in cultivated area played a key role in boosting production, there is still potential to improve productivity. Therefore, by maintaining the current area under cultivation, banana yields can be enhanced through the adoption of appropriate production technologies.

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