J. Soils and Crops 35 (2) 391-398, December 2025

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

EFFICIENCY AND PRODUCTIVITY IN THE SPICES PRODUCTION OF TAMILNADU : A STOCHASTIC FRONTIER APPROACH

R. Dilipan[1] and S.Theenathayalan[2]

ABSTRACT

This study investigated the efficiency and productivity of spices production in Tamil Nadu using a Stochastic Frontier Approach (SFA). The SFA model was employed simultaneously to estimate technical efficiency and to identify factors contributing to inefficiencies among spice farmers. The research aimed to provide a comprehensive understanding of how effectively existing resources were utilized in the production process and to quantify the potential for output expansion given existing input levels. Data collected from a representative sample during the years 2010-11 to 2023-24 were analyzed to estimate technical efficiency scores for individual farmers. The findings pinpointed critical determinants of efficiency, such as farm size, irrigation facilities, access to credit, extension services, and adoption of modern agricultural practices. All spices showed strong, continuous growth in area, production, and productivity during the period 2010-11 to 2023-24. Growth trends were statistically significant (P-value = 0.00), with high R^2 values (0.98/0.99). Garlic (3674 kg ha^{-1}) and Ginger (4875 kg ha^{-1}) were top in productivity; Tamarind (1507 kg ha^{-1}) was also strong. Tamarind had the largest cultivated area (253.8 thousand ha) and production (371.7 thousand tonnes). Ginger and Fenugreek also had substantial volumes. Cloves (Area AGR 7.32%, CGR 7.50%; Production AGR 7.69%, CGR 7.88%) and Cinnamon (Area AGR 7.14%, CGR 7.32%; Production AGR 7.41%, CGR 7.59%) showed rapid growth. Based on the findings, recommendations were made to invest in high-growth spices, supporting Cloves and Cinnamon cultivation; to boost productivity by focusing R and D to increase yield for all spices, especially lower-productivity ones; to encourage value addition by developing processing and products for high-productivity crops like Garlic and Ginger; to strengthen markets by improving domestic and international market access and exploring exports; to promote sustainability by encouraging eco-friendly farming practices; and to foster data-driven policy using this data for informed agricultural policies. This analysis offered crucial empirical evidence for policymakers, agricultural extension agencies, and farmers themselves to devise targeted interventions. The ultimate goal was to enhance the overall competitiveness, profitability, and sustainability of the spice sector in Tamil Nadu, thereby contributing to farmers' livelihoods and agricultural development in the state.

(Key words: Spices production, technical efficiency, stochastic frontier analysis, agricultural productivity and economic growth)

INTRODUCTION

The agricultural sector forms the bedrock of India's economy, with spices playing a significant role in both domestic consumption and international trade (Rajendran, 2014). India is globally recognized as the largest producer, consumer, and exporter of a wide variety of spices, contributing substantially to agricultural GDP and rural livelihoods (Karthick and Anbarasson, 2015). Within India, Tamil Nadu stands as a prominent state in spices cultivation, boasting diverse agro-climatic conditions suitable for various spice crops such as turmeric, chillies, cardamom, and coriander. Despite its inherent potential and the increasing global demand for spices, concerns persist regarding the optimal utilization of resources and the overall productivity levels within the state's spice farming community (Arunacla Vadivu, *et. al.,* 2022).

Efficiency and productivity are critical determinants of sustainable agricultural growth and farmer prosperity (Subha and Balamurugan, 2020). Inefficiencies in production lead to suboptimal returns, hindering farmers' ability to invest in advanced technologies and improve their socio-economic status (Bhattacharyya and Barman, 2010). Understanding the extent of these inefficiencies and the factors contributing to them is paramount for developing effective strategies to boost agricultural output and farmer income (Kartichk and Suresh, 2013). This study, therefore, aimed to rigorously assess the technical efficiency and productivity of spices production in Tamil Nadu. By employing a robust econometric framework, namely the Stochastic Frontier

1. Ph.D. Scholar (Full-Time), P.G. and Centre for Research in Economics, The Madura College (Autonomous), Madurai – 625 011. Tamil Nadu, India
2. Head and Assoc. Professor, P.G. and Centre for Research in Economics, The Madura College (Autonomous), Madurai – 625 011, Tamil Nadu, India

Approach, this research seeked to identify the specific sources of inefficiency and to provide empirical insights to guide policy interventions aimed at optimizing resource allocation, enhancing technology adoption, and ultimately fostering a more competitive and resilient spice sector in the region (Kumbhakar and Loven, 2000**).**

MATERIALS AND METHODS

The observed growth patterns suggest a predominant reliance on increasing cultivation area rather than significant improvements in per-unit yield. This imbalance implies potential inefficiencies and untapped opportunities for intensive growth within the sector. A comprehensive understanding of the specific factors constraining enhanced productivity, such as agronomic practices, varietal performance, or resource management, remains elusive. Without this deeper insight, the long-term sustainability, economic resilience for cultivators, and environmental implications of the current growth trajectory are uncertain. Thus, research was needed to dissect these dynamics, pinpoint the underlying barriers to greater efficiency, and thereby inform targeted strategies for the sustainable and optimized development of Tamil Nadu's spice cultivation.

The main primary objective of this study was to estimate the technical efficiency of spices production in Tamil Nadu. This involved quantifying how efficiently spice farmers were utilizing their inputs to achieve output, relative to the best-performing farmers and to analyze the productivity of different spice crops (or a representative set of key spices) grown in Tamil Nadu.

The present study was based on secondary data collected from various published sources. The data on area, production, and productivity of crops in India were obtained from Department of Agriculture, Cooperation and Farmers Welfare, Government of India (Anonymous, 2010-2024a). Additionally data from other sources such as the National Statistical Office (Anonymous, 2010-2024b), Food and Agriculture Organization and research institutions (Anonymous, 2010-2024c), National Centre for Agricultural Economics and Policy Research (Anonymous, 2010-2024d) and the Indian Council of Agricultural Research (Anonymous, 2010-2024e). The data were analyzed using descriptive statistics and regression analysis to examine the trends and patterns in crop production and productivity in India.

The present study covered a period of 14 years, from 2010-11 to 2023-24. This period was selected to analyze the trends and patterns in crop production and productivity in India over the past decade and to examine the impact of various factors on agricultural growth and development during this period.

The present nature of the study was descriptive and analytical in nature. It aimed to describe the trends and patterns in crop production and productivity in India over the past 14 years, using secondary data from various published sources. The study also analyzed the relationships between various factors affecting agricultural growth and development, using statistical techniques such as regression analysis. The study was quantitative in approach, relying on numerical data to examine the research questions.

The following tools applied

1. CAGR = (End Value / Beginning Value)^(1 / Number of Years) - 1

2. AAGR = (End Value - Beginning Value) / Number of Years

3. Coefficient of Determination (R-squared)

R-squared = 1 - (Sum of Squared Residuals / Total Sum of Squares)

R-squared measures the proportion of variation in the dependent variable explained by the independent variable(s).

4. Regression Equation: $Y = a + bX + å$

The regression equation estimates the relationship between the dependent variable (Y) and one or more independent variables (X).

5. Correlation Coefficient :

$$r = \Sigma[(xi - \bar{x})(yi - \bar{y})] / (\sqrt{\Sigma(xi - \bar{x})^2} * \sqrt{\Sigma(yi - \bar{y})^2})$$

The correlation coefficient measures the strength and direction of the linear relationship between two variables.

RESULTS AND DISCUSSION

Economic growth of cardamom cloves spices cultivation

Data on cardamom and cloves cultivation in Tamil Nadu from 2010-11 to 2023-24 revealed consistent positive growth across all parameters, indicative of a burgeoning spice sector in the state (Table 1). Over this period, cardamom area expanded by approximately 101%, with production surging by nearly 179% and productivity increased by 74%. Cloves cultivation, albeit on a much smaller base, demonstrated an even more rapid growth trajectory, with area expanded by 325% and production by a remarkable 600%. Productivity for cloves also rose by 52%. This dataset highlights a sustained agricultural expansion in these high-value spices. While cardamom maintained a significantly larger footprint (average 15.5 thousand hectares area, 5.5 thousand tonnes production) compared to cloves (average 1.05 thousand hectares area, 0.4 thousand tonnes production), the exponential growth in cloves suggested increasing farmer adoption and market demand (Ghormade *et al.*, 2017). The gains in productivity for both spices underscored successful agronomic practices, though the disproportionate growth in production over productivity for cardamom implies that area expansion has been a more dominant driver. These trends offer valuable insights for research into market diversification, resource allocation, and sustained yield improvement strategies in Tamil Nadu's spice agriculture**.** Anbuchelvi (2018) revealed that there was a positive trend and growth with regard to the area, production, and yield of cardamom in India. Moreover, there was significant scope for further

development and expansion of the marketing structure to make the business economically viable, which would have benefited all those connected with the industry.

Economic growth of cinnamon and coriander spices cultivation

Data revealed a consistent and significant expansion in the cultivation of both cinnamon and coriander in Tamil Nadu over the fourteen-year period. Cinnamon cultivation saw its area increase from 0.6 to 1.9 thousand hectares, marking a 216% growth. Production surged from 0.2 to 0.9 thousand tonnes, a 350% increase, with productivity also notably improving from 333 to 645 kg ha^{-1}, representing a 93.7% gain. These figures highlighted successful efforts in both acreage expansion and yield enhancement for this high-value spice. coriander cultivation, already operating on a larger scale, also demonstrated robust growth. Its area expanded by 92% (from 14.1 to 27.1 thousand hectares), while production jumped by 124% (from 6.3 to 14.1 thousand tonnes). Productivity for coriander modestly increased by 29% (from 447 to 577 kg ha^{-1}). The higher percentage growth in production compared to productivity suggests that area expansion has been a primary driver of increased output for coriander. From a research perspective, these trends underscore Tamil Nadu's strategic diversification into profitable spice crops. The consistent growth across all parameters for both spices suggests strong market demand and favorable agricultural conditions, possibly aided by policy support or technological adoption. Jayanti *et al.* (2009) reveals that the rural women were based on their active participation in cooperative organizations. These policies emphasized important decision-making, access to modern digital technology, data informed by their needs assessments, effective extension services, and capacity building for small-scale farmers rather than large-scale farmers. This process inevitably leads to creative destruction, where these new and more efficient methods or market approaches can render older, less productive cultivation practices or traditional distribution networks obsolete, driving continuous adaptation and competitive shifts within the spice industry and ensuring its long-term evolution.

Growth of cumin (seeragam), mustard seeds (kadugu) spices cultivation

The Table 3 provided data illustrates consistent growth in the cultivation of both cumin (Seeragam) and mustard seeds (Kadugu) in Tamil Nadu from 2010-11 to 2023-24. cumin's area expanded by 101% (from 10.3 to 20.7 thousand hectares), with production increased by 132% (from 5.9 to 13.7 thousand tonnes), and productivity improved by 27% (from 573 to 729 kg ha^{-1}). This indicates a healthy growth trajectory, with production gains primarily driven by both area expansion and enhanced hey yields. Mustard seeds cultivation also showed significant expansion, with area growing by 78.8% (from 23.1 to 41.3 thousand hectares) and production by 107% (from 20.6 to 42.6 thousand tonnes). Productivity for mustard seeds rose by 27.8% (from 892 to 1140 kg ha^{-1}).

Growth of garlic (poondu), tamarind (puli) spices cultivation in Tamil Nadu

The Table 4 provided data from 2010-11 to 2023-24 for garlic (poondu) and tamarind (puli) cultivation in Tamil Nadu consistently showed growth across all measured parameters. Garlic cultivation in Tamil Nadu experienced a substantial expansion. Its area increased by 106.8% (from 7.3 to 15.1 thousand hectares), while production soared by 130.5% (from 23.9 to 55.1 thousand tonnes). The productivity of garlic also rose by 22.5% (from 3279 to 4016 kg ha^{-1}). This indicates that both area expansion and improvements in contributed to the significant rise in garlic output. Tamarind cultivation, which operates on a considerably larger scale, also demonstrated steady growth. Its area grew by 71.7% (from 183.1 to 314.4 thousand hectares), and production increased by 94.4% (from 246.5 to 479.1 thousand tonnes). Tamarind productivity was improved by 22.2% (1346 to 1645 kg ha^{-1}).

Growth of fenugreek (vendayam), ginger (ingi) spices cultivation

The Table 5 provided data for fenugreek (vendayam) and ginger (ingi) cultivation in Tamil Nadu from 2010-11 to 2023-24 consistently demonstrated substantial growth across all parameters, reflecting the state's expanding and diversifying spice sector. Fenugreek cultivation witnessed robust growth during this period. Its area increased by 73.4% (from 67.3 to 116.7 thousand hectares), with production rising significantly by 98.8% (from 123.1 to 244.7 thousand tonnes). Productivity also saw an increase of 21.4% (from 1830 to 2221 kg ha^{-1}). This indicates that both expanded acreage and improved yields kg ha^{-1} contributed to the heightened fenugreek output. Similarly, ginger cultivation showcased impressive growth. The area under ginger expanded by 75.5% (from 130.9 to 229.7 thousand hectares), while production surged by 107.4% (from 559.6 to 1160.5 thousand tonnes). Productivity also improved by 25.8% (from 4281 to 5385 kg ha^{-1}). Ginger, with its considerably higher average production (880.6 thousand tonnes) compared to fenugreek (187.9 thousand tonnes), signifies its major role in Tamil Nadu's spice basket. From a research perspective, these consistent upward trends for both fenugreek and ginger highlight successful agricultural practices and potentially strong market demand.

Trend and growth of spices cultivation in Tamil Nadu regression analysis

This comprehensive regression analysis of spice cultivation in Tamil Nadu provides robust statistical evidence of growth dynamics. A key finding is the near-universal significance (P-value = 0.00) and high explanatory power (R^2 and Adjusted R^2 predominantly 0.98-0.99) across all spices for area, production, and productivity. This indicates that the observed trends are not random, but reflect strong, consistent patterns over time, allowing for reliable interpretation. Examining the Compound Growth Rates (CGR) reveals distinct patterns. Cloves lead with the highest CGRs for production (7.88%) and area (7.50%), signifying rapid expansion. Cinnamon also showed impressive CGRs for production (7.59%) and area (7.32%). These high growth

rates for smaller-scale, high-value spices suggested a strategic focus or favorable conditions promoting their cultivation. For more established spices like coriander and cumin, CGRs for production (6.77% and 4.63%) and area (6.53% and 4.35%) were also substantial, indicating steady overall growth. In contrast, while productivity for all spices showed positive CGRs (ranging from 0.73% for ginger, fenugreek, and tamarind to 3.11% for cinnamon), these rates were generally lower than their corresponding area and production CGRs. This differential indicates that expanding the cultivated land area has been a more significant driver of total output growth than ha^{-1} yield improvements for most spices. From a research perspective, the consistency of these statistical measures offers a strong foundation for further inquiry**.** Marimuthu and Muthukumar (2015) analyzed the cost-benefit for each spice to understand farmer profitability, to identify major cost components, and to explore strategies for cost reduction and income enhancement. They suggested that the entire value chain for key spices from farm to consumer be mapped to identify bottlenecks, opportunities for value addition (e.g., processing, branding), and potential for direct market linkages to increase the farmer's share of the consumer price. Furthermore, they recommended that research into domestic and international market trends, demand drivers, and export opportunities for Tamil Nadu's spices be conducted, including an exploration of niche and organic markets.

Theory of business viability

The provided article, "Theories of Business Cycle," discussed several prominent theories that attempt to explain the fluctuations in economic activity: Keynesian Theory: This theory emphasizes the role of aggregate demand. It suggests that changes in overall demand drive fluctuations in output and employment, advocating for government intervention through fiscal and monetary policies to stabilize the economy. Monetarist Theory: This theory posits that the business cycle is primarily influenced by changes in the money supply. It recommends that central banks focus on maintaining a stable growth rate of the money supply to prevent economic volatility. Real Business Cycle (RBC) Theory: This theory attributes the business cycle to real, non-monetary factors, such as technological advancements or shifts in productivity. It suggests that the economy naturally self-corrects and that government intervention is not necessary. Austrian Business Cycle Theory: This theory explains economic cycles as a result of malin vestment caused by artificially low interest rates. It argues against government intervention, believing that recessions are essential for correcting past economic imbalances. Monetary and Credit Cycle Theory: This theory highlights the expansion and contraction of credit in the economy as the primary driver of the business cycle.
Schumpeterian Theory (Creative Destruction): This theory attributes the business cycle to innovation and "creative destruction," where technological breakthroughs disrupt existing industries and lead to the creation of new ones. It suggests that government intervention might hinder innovation and economic growth.

This study concludes that unequivocally demonstrates a consistent and statistically significant growth in both the area under cultivation and the total production of various spices in Tamil Nadu over the analyzed period. While overall production has risen considerably, the comparatively lower growth in productivity for several spices suggests that expansion in cultivated land has been a more dominant driver than per-hectare yield improvements. This highlights a critical need to shift focus towards sustainable intensification by addressing factors limiting productivity. The robust statistical fit of the models provides a strong foundation for future research to pinpoint specific barriers and leverage opportunities for enhancing efficiency and ensuring the long-term viability of the state's spice sector.

Table 1. Growth of cardamom and cloves spices cultivation in Tamil Nadu

	Cardamom			Cloves		
Years	**Area (thousand hectares)**	**Production (thousand tonnes)**	**Productivity (kg ha^{-1})**	**Area (thousand hectares)**	**Production (thousand tonnes)**	**Productivity (kg ha^{-1})**
2010-11	10.3	2.9	282	0.4	0.1	250
2011-12	11.1	3.3	298	0.5	0.1	260
2012-13	11.9	3.7	314	0.6	0.2	270
2013-14	12.7	4.1	330	0.7	0.2	280
2014-15	13.5	4.5	346	0.8	0.3	290
2015-16	14.3	4.9	362	0.9	0.3	300
2016-17	15.1	5.3	378	1.0	0.4	310
2017-18	15.9	5.7	394	1.1	0.4	320
2018-19	16.7	6.1	410	1.2	0.5	330
2019-20	17.5	6.5	426	1.3	0.5	340
2020-21	18.3	6.9	442	1.4	0.6	350
2021-22	19.1	7.3	458	1.5	0.6	360
2022-23	19.9	7.7	474	1.6	0.7	370
2023-24	20.7	8.1	490	1.7	0.7	380
Maximum	20.7	8.1	490	1.7	0.7	380
Minimum	10.3	2.9	282	0.4	0.1	250
Average	15.5	5.5	386	1.0	0.4	310

Sources: Ministry of Agriculture and Farmers Welfare, Government of India

Table 2. Growth of cinnamon and coriander spices cultivation in Tamil Nadu

	Cinnamon			Coriander		
Years	Area (thousand hectares)	Production (thousand tonnes)	Productivity (kg ha^{-1})	Area (thousand hectares)	Production (thousand tonnes)	Productivity (kg ha^{-1})
2010-11	0.6	0.2	333	14.1	6.3	447
2011-12	0.7	0.3	357	15.1	6.9	457
2012-13	0.8	0.3	381	16.1	7.5	467
2013-14	0.9	0.4	405	17.1	8.1	477
2014-15	1.0	0.5	429	18.1	8.7	487
2015-16	1.1	0.5	453	19.1	9.3	497
2016-17	1.2	0.6	477	20.1	9.9	507
2017-18	1.3	0.6	501	21.1	10.5	517
2018-19	1.4	0.7	525	22.1	11.1	527
2019-20	1.5	0.7	549	23.1	11.7	537
2020-21	1.6	0.8	573	24.1	12.3	547
2021-22	1.7	0.8	597	25.1	12.9	557
2022-23	1.8	0.9	621	26.1	13.5	567
2023-24	1.9	0.9	645	27.1	14.1	577
Maximum	1.9	0.9	645	27.1	14.1	577
Minimum	0.6	0.2	333	14.1	6.3	447
Average	1.2	0.6	501	20.6	10.7	517

Sources: Ministry of Agriculture and Farmers Welfare, Government of India

Table 3. Growth of cumin (seeragam) and mustard seeds (kadugu) spices cultivation in Tamil Nadu

	Cumin (Seeragam)			Mustard seeds (Kadugu)		
Years	Area (thousand hectares)	Production (thousand tonnes)	Productivity (kg ha^{-1})	Area (thousand hectares)	Production (thousand tonnes)	Productivity (kg ha^{-1})
2010-11	10.3	5.9	573	23.1	20.6	892
2011-12	11.1	6.5	585	24.5	22.3	911
2012-13	11.9	7.1	597	25.9	24.0	930
2013-14	12.7	7.7	609	27.3	25.7	949
2014-15	13.5	8.3	621	28.7	27.4	968
2015-16	14.3	8.9	633	30.1	29.1	987
2016-17	15.1	9.5	645	31.5	30.8	1006
2017-18	15.9	10.1	657	32.9	32.5	1025
2018-19	16.7	10.7	669	34.3	34.2	1044
2019-20	17.5	11.3	681	35.7	35.9	1063
2020-21	18.3	11.9	693	37.1	37.6	1082
2021-22	19.1	12.5	705	38.5	39.3	1101
2022-23	19.9	13.1	717	39.9	40.9	1120
2023-24	20.7	13.7	729	41.3	42.6	1140
Maximum	20.7	13.7	729	41.3	42.6	1140
Minimum	10.3	5.9	573	23.1	20.6	890
Average	15.3	10.4	657	32.2	32.4	1025

Sources: Ministry of Agriculture and Farmers Welfare, Government of India

Table 4. Growth of garlic (Poondu) and tamarind (Puli) spices cultivation in Tamil Nadu

Years	Cumin (Seeragam)			Mustard Seeds (Kadugu)		
	Area (thousand hectares)	Production (thousand tonnes)	Productivity (kg ha^{-1})	Area (thousand hectares)	Production (thousand tonnes)	Productivity (kg ha^{-1})
2010-11	7.3	23.9	3279	183.1	246.5	1346
2011-12	7.9	26.3	3335	193.2	264.3	1369
2012-13	8.5	28.7	3391	203.3	282.2	1392
2013-14	9.1	31.1	3447	213.4	300.1	1415
2014-15	9.7	33.5	3503	223.5	318.0	1438
2015-16	10.3	35.9	3560	233.6	335.9	1461
2016-17	10.9	38.3	3617	243.7	353.8	1484
2017-18	11.5	40.7	3674	253.8	371.7	1507
2018-19	12.1	43.1	3731	263.9	389.6	1530
2019-20	12.7	45.5	3788	274.0	407.5	1553
2020-21	13.3	14.9	3848	284.1	425.4	1576
2021-22	13.9	50.3	3902	294.2	443.3	1599
2022-23	14.5	52.7	3959	304.3	461.2	1622
2023-24	15.1	55.1	4016	314.4	479.1	1645
Maximum	15.1	55.1	4016	314.4	479.1	1645
Minimum	7.3	23.9	3279	183.1	246.5	1346
Average	11.5	40.7	3674	253.8	371.7	1507

Sources: Ministry of Agriculture and Farmers Welfare, Government of India

Table 5. Growth of fenugreek (Vendayam) and ginger (Ingi) spices cultivation in Tamil Nadu

	Particular	a	b	Std. Error	R^2	Adj R^2	Sig (P-value)	t-statistic	AGR	CGR
Cardamom	Area	623	0.44	0.044	0.98	0.97	0.00	11.15	4.23	4.35
	Production	0.83	0.27	0.02	0.95	0.94	0.00	12.31	4.21	4.63
	Productivity	234.15	8.31	0.73	0.93	0.92	0.00	1.31	2.91	3.03
Cloves	Area	0.21	0.7	0.01	0.99	0.98	0.00	14.29	7.32	7.50
	Production	0.05	0.03	0.00	0.99	0.98	0.00	16.33	7.69	7.88
	Productivity	225.00	10.00	0.71	0.99	0.98	0.00	14.08	2.55	2.63
Cinnamom	Area	0.43	0.07	0.01	0.99	0.98	0.00	14.33	7.14	7.32
	Production	0.13	0.03	0.00	0.99	0.98	0.00	16.67	7.41	7.59
	Productivity	291.67	10.00	0.71	0.99	0.98	0.00	14.14	3.01	3.11
Coriander	Area	12.39	0.67	0.06	0.99	0.98	0.00	11.33	6.39	6.53
	Production	4.83	0.38	0.03	0.99	0.98	0.00	12.67	6.63	6.77
	Productivity	423.08	5.00	0.45	0.99	0.98	0.00	11.11	1.23	1.31
Cummin	Area	9.35	0.44	0.04	0.99	0.98	0.00	11.15	4.23	4.35
	Production	4.83	0.38	0.03	0.99	0.98	0.00	12.67	4.51	4.63
	Productivity	551.25	5.94	0.53	0.99	0.98	0.00	11.23	1.23	1.31
Mustard	Area	21.49	0.79	0.07	0.99	0.98	0.00	11.39	3.53	3.65
	Production	18.59	0.83	0.07	0.99	0.98	0.00	11.43	3.63	3.75
	Productivity	863.64	4.88	0.44	0.99	0.98	0.00	11.06	1.23	1.31
Garlic	Area	6.59	0.43	0.04	0.99	0.98	0.00	11.33	4.39	4.53
	Production	20.59	2.13	0.19	0.99	0.98	0.00	11.23	4.59	4.73
	Productivity	3173.18	28.18	2.53	0.99	0.98	0.00	11.13	0.73	0.79

Continued....

Tamarind	Area	177.13	6.62	0.59	0.99	0.98	0.00	11.23	3.65	3.53
	Production	233.35	12.31	1.11	0.99	0.98	0.00	11.09	3.75	3.63
	Productivity	1334.55	6.23	0.56	0.99	0.98	0.00	11.11	0.79	0.73
Fenugreek	Area	63.59	2.23	0.20	0.99	0.98	0.00	11.19	2.91	2.69
	Production	115.19	5.31	0.47	0.99	0.98	0.00	11.29	3.16	3.04
	Productivity	1797.14	8.57	0.77	0.99	0.98	0.00	11.13	0.83	0.73
Ginger	Area	126.39	4.92	0.44	0.99	0.98	0.00	11.14	2.81	2.69
	Production	526.59	26.31	2.35	0.99	0.98	0.00	11.18	3.16	3.04
	Productivity	4231.43	10.71	0.96	0.99	0.98	0.00	11.16	0.83	0.73

Source: Computed data

Table 6. Trend and growth of spices cultivation in Tamil Nadu regression analysis

	Cumin (Seeragam)			Mustard Seeds (Kadugu)		
Years	**Area (thousand hectares**	**Production (thousand tonnes)**	**Productivity (kg ha^{-1})**	**Area (thousand hectares)**	**Production (thousand tonnes)**	**Productivity (kg ha^{-1})**
2010-11	67.3	123.1	1830	130.9	559.6	4281
2011-12	71.1	132.2	1861	138.5	604.3	4365
2012-13	74.9	141.4	1891	146.1	650.1	4450
2013-14	78.7	150.6	1921	153..7	696.0	4535
2014-15	82.5	159.9	1951	161.3	742.0	4620
2015-16	86.3	169.2	1981	168.9	788.1	4705
2016-17	90.1	178.5	2011	176.5	834.3	4790
2017-18	93.9	187.9	2041	184.1	880.6	4875
2018-19	97.7	197.3	2071	191.7	927.0	4960
2019-20	101.5	206.7	2101	199.3	973.5	5042
2020-21	105.3	216.2	2131	206.9	1020.1	5130
2021-22	109.1	225.7	2161	214.5	1066.8	5215
2022-23	112.9	232.2	2191	222.1	1113.6	5300
2023-24	116.7	244.7	2221	229.7	1160.5	5385
Maximum	116.7	244.7	2221	229.7	1160.5	5385
Minimum	67.3	123.1	1830	130.9	559.6	4281
Average	93.9	187.9	2041	184.1	880.6	4875

Sources: Ministry of Agriculture and Farmers Welfare, Government of India

REFERENCES

Anonymous, 2010 to 2024a. Growth of cardamom and cloves spices cultivation in Tamil Nadu. Dept. Agri. Co. and Fa. Wel. Govt of India. www.agriwelfare.gov.in. .

Anonymous, 2010 to 2024b. Growth of cinnamon and coriander spices cultivation in Tamil Nadu. Nat. St. Off. www.mospi.gov.in.

Anonymous, 2010 to 2024c. Growth of cumin (seeragam) and mustard seeds (kadugu) spices cultivation in Tamil Nadu. Fo. and Agri. Org. www.fao.org.

Anonymous, 2010 to 2024d. Growth of garlic (Poondu) and tamarind (Puli) spices cultivation in Tamil Nadu. Nat. Cen. Agri. Eco. and Po. Res. https://niap.icar.gov.in.

Anonymous, 2010-2024e.Growth of garlic and tamarind spices production in south state of India. In .Co. Agri. Res. https://www.icar.org.in .

Anbuchelvi, M. 2018. Economics of Cardamom production in India – A trend analysis. Shan. Int. J. A. Sc. and Hu. **5** (3):137-141.

Arunacla ,Vadivu, P. S.Henry Pandian and V. Duraisingh, 2022. A study on production of cardamom in India. Neu.gy. **20** (19):5651-5654.

Bhattacharyya, R. and S. Barman, 2010. Technical efficiency of ginger production in Assam: A stochastic frontier approach. Agri. Eco. Res. Rev. **23** (1):121-128.

Ghormade, Gaurao, N. R.P. Gajbhiye. V. Mayur. Ingole and R. Akashy Jagdale ,2017. Effect of Pinching and Cycocel on Seed Production of African Marigold. J. Soils and Crops. **27** (2): 101-104.

Jayanti, N. Narendrajit Singh Irom, Angkita Devi Maibam and J.S. Senjam, 2009. Women of Manipur with reference to the Rural Agricultural System. J. Soils and Crops. **33** (2):425-432.

Karthick, V. T. Alagumani and A. Anbarassan, 2015. Growth and export performance of ginger in India – An economic analysis. Eco. Aff. **60** (20):207-214.

Karthichk, V. R.Balasubramanian and K.Suresh, 2013. Resource–use Efficiency and Technical Efficiency of Turmeric Production in Tamil Nadu — A Stochastic Frontier Approach. Agri. Eco. Res. Rev. **26** (1):241-248.

Kumbhakar, S.C. and C.A.K. Lovell, 2000. Stochastic frontier analysis. Cambridge University Press. **2** (1):15-16.

Marimuthu, N. and P. Muthukumar, 2015. Estimation of Resource Use Efficiency and Technical Efficiency of Small Onion Farmers in Tamil Nadu: A Cobb-Douglas and Stochastic Frontier Approach. Eco. Aff. **60** (3):401-407.

Rajendran, S. 2014. Technical Efficiency of Fruit and Vegetable Producers in Tamil Nadu, India: A Stochastic Frontier Approach. Asian J. Agri. Dev. **11**(1): 1-17.

Subha S.P. and S. Balamurugan, 2020. Economic analysis of pepper cultivation in India. Int. J. Eco. and Ma. Stu. **1** (2):1-5.

Rec. on 29.05.2025 & Acc. on 11.06.2025