J. Farm Sci., 36(3): (283-286) 2023

RESEARCH PAPER

Sowing seeds of prosperity: Uncovering the calculated growth, instability and decomposition of cotton in India

DEVEGOWDA S R[1], ANKIT YADAV[2], NAGAVENI M[3] AND SAKET KUSHWAHA[2]

[1]Department of Agricultural Economics, Rajiv Gandhi University (A Central University), Arunachal Pradesh -791 112
[2]Department of Agricultural Economics, Banaras Hindu University, Varanasi - 221 005, U P
[3]Department of Agricultural Economics, University of Agricultural Sciences, Dharwad - 580 005, India
E-mail: devegowda.sr@rgu.ac.in

(Received: July, 2023 ; Accepted: September, 2023)

DOI: 10.61475/JFS.2023.v36i3.11

Abstract: The present study examines the growth, instability and decomposition of cotton in India. The compound growth rate analysis revealed that the cotton cultivation area in India experienced a compound growth rate of 0.68 per cent, cotton production showed a compound growth rate of 3.31 per cent and cotton yield exhibited a compound growth rate of 2.6 per cent from 1951 to 2020. The instability analysis using the Cuddy-Della Valle index indicates that cotton production had a coefficient of variation of 42.45 per cent, while cotton yield had a coefficient of variation of 25.83 per cent. Decomposition analysis further reveals that the contribution of yield effect to cotton production in India ranged from 145.27 per cent in one period to -39.22 per cent in another period. The findings highlight significant growth in cotton area, production, and yield in India, although with some fluctuations and instabilities. Technological advancements were identified as the driving force behind the increased cotton production. The study emphasizes the importance of addressing production risks and suggests policies that focus on improving yield to further enhance cotton production in India.

Key words: Compound growth rate, Cuddy-della valle index, Decomposition, Instability

Introduction

Cotton is an essential crop for India's economy, providing a significant source of income and employment for millions of people. Cotton is one of the largest crops cultivated in the country, with a production of around 36 million bales in the year 2020-21 (DES, 2021). The cotton industry has played a significant role in India's economic growth over the years. However, the growth and development of the cotton industry in India have been accompanied by numerous challenges, including instabilities, which have adverse effects on the economy. Despite these challenges, the cotton industry in India has also experienced significant growth and development over the years. The growth of the cotton industry has been driven by a range of factors, including government policies, technological advancements, and global demand (Nayak and Debnath, 2021; OECD-FAO, 2021). These factors have led to increased productivity, improved quality, and increased competitiveness of Indian cotton in the global market.Instability of cotton prices was one of the significant challenge faced by the cotton industry in India. The prices of cotton in India were influenced by a host of factors, including global demand and supply, domestic production, and government policies (Voora *et al*., 2023). The volatility of cotton prices leads to significant uncertainty for farmers and traders, making it challenging to plan and invest in the cotton sector. Furthermore, fluctuations in cotton price have a ripple effect on other industries and the overall economy.

This paper examined the growth, instability, and decomposition of cotton in India and explored the various factors that have influenced the growth of the cotton industry in India, the challenges facing the industry, and the potential solutions to address these challenges by providing a comprehensive analysis of the cotton industry in India.

Material and methods

Estimation of growth rate

The data for the period 1951-2020 on the area, production, and yield of cotton was compiled from the Directorate of Economics and Statistics and Agricultural Statistics at a Glance, Government of India, to analyze the growth, instability and decomposition of the area, production and yield of cotton. The compound growth function was specified as follows:

$Y = ab^t u_t$

u_t = Error terms with usual assumptions

Y = area/production/yield

a = Intercept

t = Year

b = 1+r

r = Growth rate

Instability analysis

The coefficient of variation (CV) and Cuddy-Della Valle (1978) was used to calculate the instability of cotton area, production and yield in India. However, CV does not describe exactly how the trend value inherits in the data of the time series nature. Hence, Cuddy-Della Valle (1978) suggested an instability index, which explained the trend value inherited in the data of the time series. Instability was measured by using a coefficient of variation using the formula.

$$CV = \frac{\sigma}{\mu} \times 100$$

Where,

CV = Co-efficient of variation

σ = Standard deviation of the variable

μ = Mean of the variable.

The Cuddy-Della Valle Index was developed by John Cuddy and Della Valle for measuring instability in time series data. Coefficient of variation was a good measure of instability but while analyzing time series data involving trends, and a better indicator of instability adjusted for trends often observed in time series data (Cuddy and Della Valle, 1978).

$$CDV = CV * \sqrt{1 - \bar{r}^2}$$

Where,

$\bar{r}^2$ = Adjusted R squared

CDV = Cuddy Della Valle index

Decomposition of analysis

To measure the comparative contribution of area and yield to the total change in cotton crop production, decomposition analysis was used (Minhas and Vaidyanathan,1965).To estimate the contribution of area, yield and interaction of the two in total production, the following additive scheme of decomposition can be used:

$$P = A_0 (Yn - Y_0) + (An - A_0) + \Delta A \Delta Y$$

$$1 = [(Y \Delta A)/P][(A \Delta Y)/P][(\Delta A \Delta Y)/P]$$

Where,

P = Change in production

A_0 = Area in the base year

An = Area in the current year

Y_0 = Yield in the base year

Yn = Yield in the current year

ΔA = Change in area ($An - A_0$)

ΔY = Change in yield ($Yn - Y_0$).

Production = Yield effect + area effect + interaction effect

The analysis was done for 7 periods *i.e*., Period I (1951-60), Period II (1961-70), Period III (1971-80), Period IV (1981-90), Period V (1991-2000), Period VI (2001-2010) and Period VII (2010-20).

Result and discussion

The growth rate for the area, production and yield of cotton in India

The trend in area, production and yield of cotton in India was given in Fig.1. The compound growth trend equations were fitted to assess growth trend in area, production and yield of Cotton. Trend in area, production and yield of cotton assessed over the period 1951 to 2020. Cotton cultivation was 6556 hectares in 1950-51 and eventually post-economic liberalization expanded to 9035 hectares in 1995-96 and 13286 hectares in 2020-21. The analyzed period saw a nearly two-fold increase in cotton area. The analyzed period indicated a nearly more than ten-fold increase in cotton production. Production of cotton during 1950-51 was 3276 lakh bales and increased to 35248 lakh bales in 2020-21.Over time, there has been a noticeable increase in cotton yield was 88 kg/ha in 1950-51 to 455 kg/ha in 2020-21. Area, production, and yield increases became more noticeable after 2002– 03.Table 1 displays the decadal growth rates of cotton area, production, and yield.

The compound growth rate (CGR) of the area in cotton during period VI indicated the highest growth rate of 3.16 per cent followed by period V, period I, period VII and period III with a significant growth rate of 2.18 per cent, 1.91 per cent, 1.02 per cent and 0.5 per cent respectively. Period II and period IV showed significant negative growth rates and overall CGR for the period 1951-20 was 0.68 per cent.

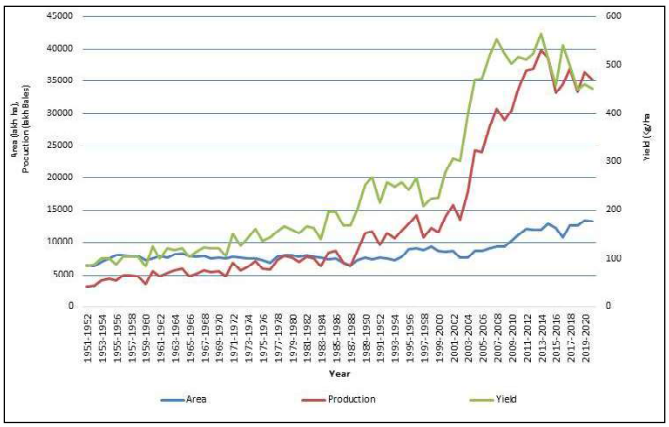

Fig 1. Area, production and yield of cotton in India

Table 1. Compound growth rate in area, production and yield of cotton in India

Items	Particulars	Period I (1951-60)	Period II (1961-70)	Period III (1971-80)	Period IV (1981-90)	Period V (1991-00)	Period VI (2001-10)	Period VII (2011-20)	Overall period (1951-20)
Area	F value	6.145	3.697	0.836	2.163	9.488	14.814	2.640	90.731
	R^2	0.434	0.316	0.095	0.213	0.543	0.649	0.248	0.572
	CGR	1.91***	-0.60***	0.5***	-0.97***	2.18***	3.16***	1.02***	0.68***
Production	F value	7.593	0.013	2.915	3.187	0.029	59.304	0.370	572.645
	R^2	0.487	0.002	0.267	0.285	0.004	0.881	0.044	0.894
	CGR	4.22***	-0.11***	2.0***	3.33***	0.24***	14.19***	-0.58***	3.31***
Yield	F value	1.729	0.409	8.717	8.981	0.162	36.907	4.575	726.914
	R^2	0.178	0.049	0.521	0.529	0.020	0.822	0.364	0.914
	CGR	1.23***	0.56***	3.30***	4.11***	-0.39***	11.34***	-1.94***	2.60***

***, ** and * significant at one, five and ten per cent.

Table 2. Instability in area, production and yield of cotton in India

Items	Particulars	Period I (1951-60)	Period II (1961-70)	Period III (1971-80)	Period IV (1981-90)	Period V (1991-00)	Period VI (2001-10)	Period VII (2011-20)	Overall period (1951-20)
Area	SD	7443.60	7901.90	7678.50	7446.10	8400.50	9119.70	12404.20	8627.79
	MEAN	630.07	253.68	369.39	460.98	735.59	1074.61	755.35	1767.28
	CV	8.46	3.21	4.81	6.19	8.76	11.78	6.09	20.48
	CDV	6.87	2.83	4.81	5.77	6.38	7.36	5.51	13.74
Production	SD	4341.30	5361.30	6779.80	8238.30	11501.80	19509.20	33486.90	12745.51
	MEAN	765.19	432.13	779.38	1576.48	1423.10	7552.05	2663.62	10226.27
	CV	17.63	8.06	11.50	19.14	12.37	38.71	7.95	80.23
	CDV	13.31	8.53	10.41	16.80	13.03	13.41	8.22	42.45
Yield	SD	99.5	113.7	141.5	171.5	239.4	307	459.8	225.49
	MEAN	13.79	12.90	18.95	20.38	19.88	105.13	47.90	130.59
	CV	13.86	11.35	13.39	11.88	8.31	34.24	10.42	57.91
	CDV	13.29	11.77	9.73	8.67	9.13	15.00	8.80	25.83

SD- Standard devition, Mean- (000, hectare), CV- Coefficient of variation, CDV - Cuddy Della Valle's

The production growth rate for period VI noticed a 14.19 per cent growth rate followed by period I, period IV, period III and period V with significant growth rates of 4.22 per cent, 3.33 per cent, 2 per cent and 0.24 per cent respectively. Period II and period IV were negative growth rates. The growth rate from the 1951-2020 periods was 3.31 per cent.

The yield growth rate was calculated to know the period that noticed a significant growth rate and the reason behind it. Period VI was the highest growth rate with 11.34 per cent, period IV was the second highest significant growth rate with 4.11 per cent followed by Period III with 3.30 per cent, period I with 1.23 per cent and Period II with 0.56 per cent growth rate. Period -V and period VI noticed a significant negative growth rate. Overall period yield noticed a significant growth rate of 2.6 per cent from 1951 to 2020.

Instability for the area, production and yield of cotton in India

Instability in area, production and yield of cotton in India were analyzed using a coefficient of variation and Cuddy Della Valle's Index during the period and the results were presented in Table 2.The result found that there was more instability in production compared to yield and area. The area had a coefficient of variation of only 20.48 per cent, whereas production and yield had coefficients of variation of 80.23 per cent and 57.91 per cent, respectively. Cotton was the region with the least instability from 1961-1970, followed by 1971- 1980. 2001–2010 saw the highest levels, followed by 1991-2000 and 1951-1960. Cotton production was the most unstable from 2001-2010 and the most stable from 2011-2020. The highest yield coefficient was also found between 2001-2010 and then again between 1951-1960. Cuddy Della Valle's Index showed similar instability in area among all the decades and overall instability was 13.74 percent. a similar pattern followed in production and yield instability for decades, whereas CDV was 42.45 per cent for the overall period in production and 25.83 per cent for yield.

Decomposition of cotton production in India

An effort has been made to analyze the contribution of area and yield for change in the production of cotton in India. The study period was divided into seven sub-periods and an overall period taking into consideration the importance of each sub-period as discussed in the methodology. Period-wise analysis of the percentage contribution of area, yield and their interaction for change in production of cotton in India was carried out and the results have been shown in Table 3. The analysis showed that there was less instability in the area when compared to production and yield. The area had a coefficient of variation of only 11.91 per cent, whereas interaction effect and yield had coefficients of variation of 43.57 per cent and 44.52 per cent, respectively. The result for the first period indicated area and yield were 83.18 per cent and 14.64 per cent contribution respectively. A different trend was observed during the second sub-period and overall period of research, where the contribution of area and yield was - 39.22 and 145.27 per cent, respectively in the second sub-period and 11.91 and 44.52 per cent in the overall study period. It indicated that the contribution of the area in periods II and IV was negative. In period VII the contribution of yield was also negative. The results showed contribution of yield was more dominant in cotton production compared to the area. Similarly reported that the yield of cotton was a significant factor for boosting cotton production in India (Chahal *et al*., 2003, Sharma, 1977).

Conclusion

Compound growth rate, instability and decomposition calculated for area, production and yield of cotton analyzed

Table 3. Decomposition of cotton production in India

Items	Period I (1951-60)	Period II (1961-70)	Period III (1971-80)	Period IV (1981-90)	Period V (1991-00)	Period VI (2001-10)	Period VII (2011-20)	Overall period (1951-20)
Yield effect (%)	14.64	145.27	81.19	175.83	3.83	67.17	-99.34	44.52
Area effect (%)	83.18	-39.22	15.24	-67.12	95.48	15.28	208.31	11.91
Interaction effect (%)	2.18	-6.05	3.58	-8.71	0.69	17.55	-8.97	43.57

for the period 1951-2020. The overall period was subdivided to calculate the decadal growth rate. The growth performance of cotton in India witnessed that had a positive and significant growth rate in the area under cotton, production of cotton and yield of cotton during the overall study period and decadal growth was highest for the period 2001-10. Cuddy Della Valle's Index showed similar instability in area among all the decades for area, production and yield and overall instability was highest for production followed by yield and area. The contribution of yield effect was more in the production of cotton in India during the overall study period. It played a dominant role in increasing cotton production in almost all periods, the area effect was found to have a more important role in the production of cotton during the period under study. In a nutshell, technology was found to be largely responsible for the increased production of cotton in India in the period under study. There were several fluctuations in the growth pattern of area, production and yield of the cotton. Therefore, policies should be framed to reduce the risks in production. Decomposition analysis revealed that the yield effect was responsible for increasing the production of cotton in India. Enhancement in yield was the major factor responsible for the improvement in cotton production in India state compared to the area.

References

Anonymous, Agricultural Statistics at a Glance (various issues) Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi.

Chahal S S, Singh R H and Singh S, 2003, A study in to growth analysis of production and acreage responce of cotton in Punjab. *Agricultural Situation in India,* 60(1): 3-10.

Cuddy J D and Della Valle P A, 1978, Measuring the instability of time series data. *Oxford Bulletin of Economics and Statistics*, 40(1): 79-85.

DES, 2021, Cotton. Ministry of Agriculture and Farmers Welfare. Retrieved from https://eands.dacnet.nic.in/PDF/Cotton-2021.pdf

Minhas B S and Vaidhyanathan A, 1965, Growth of crop output in India. *Journal of Indian Society of Agricultural Statistics*, 28(2): 230-252. 21.

Nayak L and Debnath S, 2021, Cotton textile industry in India: A review. *International Journal of Management, Technology, and Social Sciences*, 6(2): 223-236.

OECD-FAO, 2021,*OECD-FAO Agricultural Outlook 2021-2030*. OECD iLibrary. https://www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2021-2030_19428846-en.

Sharma K L, 1977, Measurement of the effects to area, yield and prices in the increase of value of crop output in India. *Agricultural Situation in India*, 32: 348-350.

Voora V, Bermudez S, Farrell J J, Larrea C and Luna E, 2023, Global Market Report: Cotton prices and sustainability. https://www.iisd.org/system/files/2023-01/2023-global-market-report-cotton.pdf