

**RESEARCH ARTICLE :**

# Decomposition analysis of cotton in Amravati division

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**SUMMARY :** In this study, an attempt has been made to study the growth and instability of cotton crop in Amravati division. The study was based on secondary data on area, production and productivity of cotton crop collected from various government publications. The study revealed that compound growth rate of area under cotton was recorded high during period I. The growth rate of yield under cotton was recorded high during period III. The co-efficient of variation and Coppock's instability index with regards to area (5.41 and 6.35 %) was lowest in Akola district among cotton growing districts of Amravati division. However, co-efficient of variation with regards to productivity (31.58 %) was lowest in Yavatmal district and Coppock's instability index with regards to productivity (27.40 %) was lowest in Amravati district. At overall period, the area effect was most stronger factor for increasing production of cotton in all the districts and division as a whole.

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**KEY WORDS :**

Compound growth rates, Co-efficient of variation, Instability, Production, Productivity

## BACKGROUND AND OBJECTIVES

Agriculture is an important sector of the Indian economy, accounting for 14 per cent of the nation's GDP, about 11 per cent of its exports, about half of the population still relies on agriculture as its principal source of income and it is a source of raw material for a large number of industries. In India during 2012-13 area, production and productivity of cotton was 11.98Mha, 34 Mt and 482 kg/ha, respectively. In Maharashtra during 2012-13 area, production and productivity of cotton was 418700 ha, 679300 t and 8256 kg/ha, respectively. In Vidarbha during 2012-13 area, production and productivity of cotton was 1513500 ha, 3132200 t and 3132 kg/ha, respectively. In Amravati division during

2012-13 area, production and productivity of cotton was 11389 ha, 23508 t and 1721 kg/ha, respectively.

The present study was undertaken with following objectives :

- To study the growth rates in area, production and productivity of cotton crop.
- To study instability in rates in area, production and productivity of cotton crop.
- To study contribution of area and yield on production of cotton crop.

## RESOURCES AND METHODS

### **Selection of crop :**

For the present study cotton crop was selected. This crop accounted 42.86 per cent

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share to the gross cropped area of Amravati division and also play important role in cropping pattern of Amravati division.

### Selection of period :

For the analysis of growth rate, instability and decomposition for cotton crop, the period was divided into breakup of 10 years and overall as shown below.

Period I - 1983-84 to 1992-93.

Period II - 1993-94 to 2002-2003.

Period III - 2003-2004 to 2012-13.

Overall period - 1983-84 to 2012-13.

### Nature and source of data :

Data used for the present study were collected from various published sources. Time series secondary data on the area, production and productivity of selected crop and other relevant data were obtained from various Government published sources.

### Analytical techniques employed for analyzing the data:

The present study is based on time series secondary data of cotton crop in Amravati division.

### Growth rate analysis :

The compound growth rates of area, production and yield for cotton were estimated for three sub periods. The Period I was 1983-84 to 1992- 93, Period II was 1993- 94 to 2002- 03 and Period III was 2003-2004 to 2012-13.

The district-wise compound growth rates were estimated to study the growth. It was estimated with the following exponential model.

$$Y = ab^t$$

$$\log Y = \log a + t \log b$$

$$CGR(r) = [\text{Antilog}(\log b) - 1] \times 100$$

where,

CGR = Compound growth rate

t = time period in year

y = area/ production / productivity

a and b = Regression parameters

### Instability analysis :

To measure the instability in area, production and productivity, an index of instability was used as a measure of variability.

The co-efficient of variation (CV) was calculated

by the formula :

$$CV(\%) = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

The simple co-efficient of variation (CV) often contains the trend component and thus, overestimates the level of instability in time series data characterized by long-term trends. To overcome this problems, we used the instability index (II) given by Coppock's instability index of variation.

Coppock's instability index is a close approximation of the average year to year per cent variation adjusted for trend.

The algebraic form of equation is :

$$CII = [(\text{Anti log} \sqrt{V \log} - 1 \times 100)]$$

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

where,

$x_t$  = Area/production/productivity in the year 't'

N = Number of year

m = Arithmetic mean of difference

Vlog = Logarithmic variation of the series

### Decomposition analysis :

To measure the relative contribution of area, yield to the total output change for the major crops, Minhas (1964), the decomposition analysis model as given below was used. Sharma (1977) redeveloped the model and several research workers (Kalamkar *et al.*, 2002) used this model and studied growth performance of crops on state. The method state that if  $A_0$ ,  $P_0$  and  $Y_0$ , respectively area, production and productivity in base year and  $A_n$ ,  $P_n$  and  $Y_n$  are values of the respective variable in  $n^{\text{th}}$  year item :

$$P_0 = A_0 \times Y_0 \text{ and}$$

$$P_n = A_n \times Y_n \quad (1)$$

where,

$A_0$  and  $A_n$  represent the area and  $Y_0$  and  $Y_n$  represents the yield in the base year and  $n^{\text{th}}$  year, respectively.

$$P_n - P_0 = \Delta P,$$

$$A_n - A_0 = \Delta A$$

$$Y_n - Y_0 = \Delta Y \quad (2)$$

From equation (1) and (2) we can write

$$P_0 + \Delta P = (A_0 + \Delta A) (Y_0 + \Delta Y)$$

hence,

$$P = \frac{A_0 Y}{P} \times 100 + \frac{Y_0 A}{P} \times 100 + \frac{Y A}{P} \times 100$$

Production = Yield effect + area effect + interaction effect

Thus, the total change in production can be decomposed into three components viz., yield effect, area effect and the interaction effect due to change in yield and area.

## OBSERVATIONS AND ANALYSIS

The results obtained from the present investigation have been presented in the following sub heads:

### Growth performance :

In this study, the growth in area, production and productivity of cotton crop were estimated using compound growth rates as indicated in the methodology. In this analysis, the general growth performance of the cotton crop in Western Vidarbha zone (*i.e.*, Amravati division) was examined by fitting exponential growth function with time normalization on area, production and productivity. The growth performance of the crop pertaining to three periods and overall is discussed separately for each district as under.

### Growth performance of cotton :

The growth performance of cotton pertaining to three period and overall is presented in the Table 1, which reveals that during period I, growth rate of production and productivity were found positive for cotton. Highest increasing trend in production and productivity was recorded in Amravati district *i.e.*, 9.88 per cent per annum and 10.05 per cent per annum, respectively. Statistically

area of cotton in Yavatmal district showed significance at 5 per cent level. Production of cotton in Amravati district showed significance at of 5 per cent level. Productivity of Amravati and Akola district showed significance at 5 per cent and 10 per cent, respectively. Statistically production and productivity of Amravati division as a whole showed significance at 10 per cent level (Awaghad *et al.*, 2010; Borkar and Patil, 2009 and Chahal *et al.*, 2003).

The result revealed that during period II picture had been drastically changed, the growth rate had been decreased in area, production and productivity. In Amravati and Buldhana district, it was found significant in area with 5 per cent and 10 per cent level of significance, respectively. In case of productivity of Akola district it was found significant at 10 per cent level of significance. There was negative growth in production in all districts (Jahagirdar *et al.*, 2004).

The result in the period III, revealed that there was positive growth in the production and productivity of cotton in all districts. In case of growth in area for Amravati and Akola district it was found to be negative. The highest increase in area was recorded in Buldhana district *i.e.*, 4.02 per cent per annum. Statistically compound growth rate of area of Akola, Buldhana, Yavatmal showed significance at 1 per cent level and that of Amravati district showed significance at 5 per cent level. In case of production Amravati and Buldhana district showed significance at 5 per cent level. Yavatmal district and Amravati division as a whole showed significance at 10 per cent level. Akola district showed significance at 1 per cent level. In productivity Amravati district and Amravati division as a whole showed significance at 1

Table 1 : Districtwise compound growth rates for cotton

Particulars		Amravati	Akola	Buldhana	Yavatmal	Amravati division
Period I	Area	-0.12	-0.50	0.42	-0.57**	-0.26
	Production	9.88**	6.34	5.28	4.31	6.37*
	Yield	10.05**	6.84*	4.87	4.88	6.57*
Period II	Area	-1.93**	-0.03	-2.21*	0.26	-0.79
	Production	-5.59	-3.33	-1.59	-1.65	-3.06
	Yield	-3.78	7.04*	0.66	-1.91	1.37
Period III	Area	-4.75**	-3.14***	4.02***	3.63***	0.39
	Production	7.09**	6.24*	7.94**	12.41***	9.06***
	Yield	12.41***	8.76**	3.76	8.48**	8.44***
Overall period	Area	-2.73***	-1.70***	-0.14	-0.16	-1.05***
	Production	2.66***	3.38***	5.46***	5.19***	4.26***
	Yield	5.52***	8.84***	5.63***	5.35***	6.61***

Note: \*, \*\* and \*\*\* indicate significance of values at P=0.1, 0.05 and 0.01, respectively

per cent level. Yavatmal and Akola districts showed significance at 5 per cent level.

The growth rate in area worked for the overall period (pooled period of 30 years) for cotton was found to be negative. Statistically compound growth rate in production and productivity for all district and Amravati division as a whole showed significance at 1 per cent level. At overall level, in Amravati division the production and productivity of cotton were increased by 4.26 per cent and 6.61 per cent per annum, which was statistically significant.

Buldhana and Akola districts showed highest increase in production and productivity of cotton.

### Instability in cotton :

One should not be obvious of instability by taking the growth rates only. Because the growth rates will explain only the rate of growth over the period, whereas, instability would Judge, whether the growth performance was stable or unstable for the period for the pertinent variable. In order to know the instability in area, production and yield of cotton, the fluctuation was measured with the help of co-efficient of variation as well as Coppock's index as a co-efficient of instability. The results are presented in Table 2 and discussed as under for the period with ten years breakage and for overall period also. Fluctuation in area, production and productivity due to the uncontrollable factors like climatic conditions can cause upward bias in co-efficient of variation.

In Akola district co-efficient of variation for the area was 5.41 per cent per annum whereas co-efficient of variation for the yield 38.66 per cent per annum. Highest co-efficient of variation for area, production and yield were found in Amravati, Buldhana district *i.e.*, 6.35 per cent per annum, 42.56 per cent per annum and 40.56 per cent per annum, respectively. As a whole Amravati division co-efficient of variation was 3.83 per cent, 33.56 per cent and 34.74 per cent per annum, respectively (Borkar and Patil, 2009 and Hazell, 1984). In the same way CII was found highest for area, production and yield *i.e.*, 6.22 per cent, 39.90 per cent and 38.41 per cent per annum, respectively. On the other hand it showed CII in the range of 5 to 35 per cent per annum which indicates inconsistent in the area, production and productivity of cotton in all the districts and Amravati division. On the other hand high area instability than production and yield instability was estimated for all the districts of Western Vidarbha zone as well as a whole contributed towards area fluctuation in the period I (Mishra and Gajja, 2006; Mohammad *et al.*, 2000 and Naphade *et al.*, 2011).

The instability in the area was found to be increased in the period III. Similarly instability in production was increased for Amravati, Akola, Yavatmal districts and Amravati division as a whole *i.e.*, 36.46 per cent to 41.28 per cent, 31.18 per cent to 31.97 per cent, 30.81 per cent to 43.29 per cent and 33.56 per cent to 33.58 per cent per annum, respectively. In case of Buldhana district it showed decreased instability *i.e.*, 34.06 per cent per annum. On the other hand instability in yield has been

**Table 2 : Districtwise instability indices for cotton**

Name of district	Particulars	Period I		Period II		Period III		Overall period	
		CV	CII	CV	CII	CV	CII	CV	CII
Amravati	Area	3.55	3.54	8.81	6.64	23.54	19.32	24.60	14.12
	Production	36.46	26.96	36.92	33.19	41.28	33.00	43.67	36.92
	Yield	37.28	27.40	34.70	33.07	47.56	28.20	67.96	42.31
Akola	Area	5.41	5.21	6.70	6.70	11.36	5.90	16.78	9.28
	Production	31.18	33.40	29.71	27.94	31.97	27.01	40.88	31.40
	Yield	38.66	34.46	34.37	29.61	35.96	27.78	76.17	31.88
Buldhana	Area	6.35	6.22	13.06	11.48	12.84	5.79	10.81	10.81
	Production	42.56	39.90	27.72	27.41	34.06	26.87	56.73	34.60
	Yield	40.56	38.41	30.35	30.30	27.36	25.23	54.50	32.11
Yavatmal	Area	2.96	2.41	5.60	5.54	13.26	7.91	8.58	8.47
	Production	30.81	24.50	27.30	26.86	43.29	28.14	61.82	36.93
	Yield	31.58	28.65	28.79	28.24	36.07	26.36	59.73	33.89
Amravati division	Area	3.83	3.76	7.26	6.88	6.06	5.95	11.66	7.42
	Production	33.56	28.90	28.02	26.61	33.58	22.70	47.27	30.51
	Yield	34.74	29.92	27.82	27.58	31.60	22.03	62.93	29.73

recorded increased in Amravati, Yavatmal district *i.e.*, 37.28 per cent per annum to 47.56 per cent per annum and 31.58 per cent to 36.07 per cent per annum, respectively. While in case of Akola, Buldhana and Amravati division as a whole it has been recorded decreased in instability in yield *i.e.*, 38.66 per cent to 35.96 per cent per annum, 40.56 per cent to 27.36 per cent per annum and 34.74 per cent to 31.60 per cent per annum, respectively. Yield of all four districts have been increased at increasing level. On the whole, in this period least CV and CII were obtained in the whole Western Vidarbha *i.e.*, 31.97 per cent per annum for Akola district and 22.70 per cent per annum for Amravati division as a whole.

During the overall period *i.e.*, 30 years as a whole, Yavatmal district recorded lowest degree of instability in area *i.e.*, CV 8.58 per cent and CII 8.47 per cent per annum. Similarly in production, Akola district was recorded with lowest co-efficient variation 40.88 per cent per annum and in yield Amravati division as a whole was recorded with lowest which showed CII 29.73 per cent per annum and highest instability in area *i.e.*, co-efficient of variation 24.60 per cent and 14.12 per cent CII per annum was recorded in Amravati district. In production, Yavatmal district exhibited highest instability *i.e.*, 61.82 per cent and CII 36.93 per cent per annum. Result indicates least consistency in terms of area, production and productivity during overall period of 30 years (Narala and Reddy, 2011; Shaheen and Shiyani, 2004; Shende *et al.*, 2011 and Suresh *et al.*, 2013).

**Decomposition analysis of cotton :**

A quantitative assessments of contribution of the

various factors to growth of crop at districts and Amravati division level is helpful in reorienting the programmes and setting priorities of agricultural development so as to achieve higher growth rates of agricultural production. There are many factors which affect the growth of crop output. These factors were believed to have affected the production of crop *viz.*, area, yield and their interaction have been considered in present study. The result of decomposition scheme was worked out for three sub period and overall period (Naraender *et al.*, 1989; Padmanabhan *et al.*, 1996 and Rehman *et al.*, 2011).

The decomposition of cotton production in area, yield and interaction effect is presented in Table 3 and results demonstrate the per cent contribution of area, yield and their interaction for increasing production of cotton in Western Vidarbha (*i.e.*, Amravati division) and overall also.

In period I, the result clearly indicated that the area effect 103.08 was most responsible for increasing the production of cotton in Amravati division with yield effect -0.96 per cent and interaction effect -2.12 per cent. Area effect was positive for all the districts and Amravati division as a whole. Buldhana district recorded highest area effect *i.e.*, 118.10 per cent. In all the districts and Amravati division as a whole yield and interaction effect was negative for cotton during period I. That means the production of cotton in Amravati division is increased only due to increase in area not due to increased in yield (Samuel and Basavaraja, 2013 and Shende and Suryawanshi, 2009).

In period II also area effect had got domination over the yield and interaction effect except for Buldhana district it showed negative yield effect *i.e.*, -215.98 per

**Table 3 : Per cent contribution of area, yield and their interaction for increasing production of cotton**

Period	Particulars	Amravati	Akola	Buldhana	Yavatmal	Amravati division
Period I	Area effect	103.08	119.42	118.10	109.10	110.70
	Yield effect	-0.96	-5.91	-11.38	-3.28	-3.94
	Interaction effect	-2.12	-13.51	-6.72	-5.82	-6.76
Period II	Area effect	68.53	108.29	-215.98	112.07	80.28
	Yield effect	41.49	-10.83	268.21	-16.57	24.44
	Interaction effect	-10.02	2.54	47.77	4.50	-4.72
Period III	Area effect	170.96	180.87	-5.82	67.88	96.44
	Yield effect	-22.68	-39.62	108.07	15.58	1.80
	Interaction effect	-48.28	-41.25	-2.25	16.54	1.76
Overall period	Area effect	189.66	165.64	88.52	89.75	120.95
	Yield effect	-6.65	-8.65	3.04	1.23	-2.67
	Interaction effect	-83.01	-56.99	8.44	9.02	-18.28

cent. In Amravati division as a whole area effect was found 80.28 per cent whereas yield effect was 24.44 per cent and interaction effect was -4.72 per cent, respectively. Highest area effect was found in Yavatmal district *i.e.*, 112.07 per cent and lowest area effect was found in Amravati district *i.e.*, 68.53 per cent. Highest yield effect was found in Buldhana district with 47.77 per cent. In Amravati division as a whole the production of cotton was increased due to both increased in area and yield.

Period III has also recorded as like the period II *i.e.*, area effect had dominated the yield and interaction effect except Buldhana district which showed negative a effect *i.e.*, -5.82 per cent. In whole Amravati division area effect, yield effect and interaction effect were 96.44 per cent, 1.80 per cent and 1.76 per cent, respectively. Highest area effect was recorded in Akola district *i.e.*, 180.87 per cent and negative interaction effect was seen in Amravati, Akola and Buldhana district *i.e.*, -48.28 per cent, -41.25 per cent and -2.28 per cent, respectively. Highest yield effect and lowest area effect were recorded in Buldhana district *i.e.*, 108.07 per cent and -5.82 per cent, respectively. So, it is concluded that in this period area effect was responsible for increasing production of cotton in the Western Vidarbha region of Maharashtra.

During overall period area effect had recorded domination over yield and interaction effect. Highest area effect was recorded in Amravati district *i.e.*, 189.66 per cent and lowest area effect was recorded in Buldhana district *i.e.*, 88.52 per cent. Amravati, Akola and Amravati division as a whole recorded negative yield and interaction effect. Whereas, Buldhana and Yavatmal districts recorded positive area, yield and interaction effect in this overall 30 years period. At overall level in all districts of Amravati division and in Amravati division and whole the production of cotton was increased due to the increased in area. Similar work related to the present topic was also conducted by Goswami *et al.* (2003); Kumar and Mor, 2001; Navadkar *et al.* (2003) and Reddy *et al.* (2012).

### Conclusion :

Thus, it is concluded from the above study that the compound growth rate for area under cotton has decreased in all the districts of Amravati division. However, for production compound growth rate has decreased in almost all the districts of Amravati division except for Buldhana, Yavatmal districts and Amravati

division as a whole in period II. The compound growth rate for yield under cotton has increased in period III as compared to period I. The per cent contribution of area effect was more responsible for cotton production.

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