

REGIONWISE COMPOUND GROWTH RATES IN AREA, PRODUCTION AND PRODUCTIVITY OF COTTON IN MAHARASHTRA

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Abstract: Cotton (*Gossypium SPP*) is considered as one of the most important cash crops playing vital role in the uplift of the country's economy. Cotton, The king of fibers is often quoted as 'white Gold' because its higher commercial values. Cotton production is the principle sources of raw material for textile the forgets agro-based industry which provides employment to about 42 percent of the industrial labour.

Cotton is cultivated in more than 70 countries of the world .China is the largest producer of cotton in the world, where as India is second largest followed by United States, Pakistan and Brazil world production of cotton risen steadily from about 26,640 ('000 tons) in 2006-2007 to 28,004 ('000 tons) in 2011-12 (Indian cotton-A profit, 2012).

The data were obtained for the period of 53 years beginning with 1960-61 to 2012-13. The data were divided into three sub periods i.e. period I, period II, period III and overall period for 53 years. The data obtained from secondary sources were analyzed to obtain estimates of annual compound growth rates of area, production and productivity of cotton in Maharashtra during different time periods. The area under cotton in Maharashtra has increased during the entire period under study. The area and production of cotton increased at the rate of 1.27 and 1.25 per cent per annum, respectively during the period from 1960-61 to 2012-13 in Maharashtra. Period II was characterized by the increase in area, production and productivity of cotton and decline in production and productivity of cotton compared to Period I and Period III. The increase in production was mainly due to the productivity improvement and area expansion of cotton. The growth rates in area, production and productivity of cotton were positive and significant in Marathwada and Western Maharashtra, while those were negative for Vidharbha.

The increase in production of cotton in Maharashtra during the period II and III was relatively more as compared to period I. This was due to the increase acreages under cotton and little due to increase in productivity of cotton. The study suggests that the efforts should be made to improve the productivity of cotton in order to increase cotton production in Maharashtra.

Introduction: Cotton (*Gossypium SPP*) is considered as one of the most important cash crops playing vital role in the uplift of the country's economy. Cotton, The king of fibers is often quoted as 'white Gold' because its higher commercial values. Cotton production is the principle sources of raw material for textile the forgets agro-based industry which provides employment to about 42 percent of the industrial labour.

Cotton is cultivated in more than 70 countries of the world introducing production of cotton in China (27.10 per cent), India (21.83 per cent), United States (12.67 per cent), Pakistan (8.58 per cent), Brazil (7.52 per cent), Uzbekistan (3.40 per cent) and other (18.90 per cent). China is the largest producer of cotton in the world, whereas, India is second largest followed by United states, Pakistan and Brazil.

The world trade figures are very different. The largest four major exporting countries are United States (10400.00), India (7500.00), Australia (4000.00) and Uzbekistan (2800.00) of 1000 480 lb. bales, where as four largest importers are china (11979.00), Bangladesh (3700.00), Turkey (3350) and Indonesia (1752.00) of 1000 480 lb. bales in 2013. (cot. crop gov. in 2013).

India's export of cotton was insignificant up to 2004-2005 and increased only during 2005-2006 and 2006-2007. India exports cotton 5000 (1000 480 lb. Bales)

in 2010 and 7500 (1000 480 lb. bales) in 2013. India exports cotton to Asian countries viz. Indonesia (50,534 Tons), Thailand (44,478 Tons), Vietnam(35,670 Tons) and negligible quantities to Philipines And Malaysia. India exports to these are approximately 12 per cent of their requirement. Main competition for India for export of cotton is from Australia and USA. India needs to strive for higher productivity and lower cost of production on one hand and improve quality on the other for enhancing export to these countries.

In India, there are mainly three cotton producing zones contributed about 95 percent to the national cotton, such as:

a) **Northern Zone (15.03 lakh Ha.)** : Punjab, Haryana, and Rajasthan.

b) **Central Zone (67.93 lakh hectore)** : Gujarat, Maharashtra and Madhya Pradesh.

c) **South Zone (17.04 lakh ha.)**: Andhra Pradesh and Tamil Nadu.

Gujarat state is the leading producer of cotton in India followed Maharashtra, Andhra Pradesh, Punjab, Madhya Pradesh and Haryana. Highest Productivity is also reported from Gujarat (733 kg/ha) followed by Tamil Nadu (731kg/ha), Haryana (663 kg per hectore) Punjab (562kg/ha) and Andhra-Pradesh (507 kg/ha).

Maharashtra account for 34 percent of Indian total cotton area and 22.21 per cent of the total output of

cotton. The area under cotton crop in state is 39.41 lakh hector with production of 31.60 lakh bales of 170kg each (2012-13).

With this view, the present study was undertaken to analyze regionwise changes in area, production and productivity of cotton in Maharashtra. The studies undertaken so far had mostly focused on the favorable effects of technological change and reasons of low productivity of cotton. The reasons for the rate of growth behind expectation have been virtually unexamined. Therefore, a study which focuses on both aspects of technical changes i.e. its growth rates in area, production and productivity etc. as well as the reasons for non-technological changes assumes great importance. Considering the above facts it is necessary to analyze the “regionwise compound growth rates in area, production and productivity of cotton in Maharashtra”.

Data and methodology: In order to analyze the changes in area, production and productivity of cotton in Maharashtra during period I, period II and periods III as well as overall period, annual compound growth rates were estimated. For this purpose, the data were obtained on the aspects such as area, production and productivity of cotton in Maharashtra as well as districtwise area, production and productivity of cotton. The year wise data were drawn from various volumes of Maharashtra for the period from 1960-61 to 2012-13.

Specification of time periods: To facilitate proper understanding of impact of on Maharashtra cotton cultivation with regard to percentage increase in area, production and productivity of cotton production, the overall period of 53 years from 1960-61 to 2012-13 was divided into three sub periods and one overall period as indicated below.

- Period- I : 1960-61 to 1979-80
- Period- II : 1980-81 to 1999-2000
- Period- III : 2000-01 to 2012-13
- Overall period: 1960-61 to 2012-13

Analysis of data:

Functional analysis: In order to analyze the changes in area, production and productivity of cotton in Maharashtra during period I, period II and periods III as well as overall period, annual compound growth rates were estimated. In the present study, the compound growth rates in area, production and productivity of cotton production in Maharashtra were estimated by fitting exponential type of equation.

$$Y = ab^t$$

Where,

Y = Area/production/productivity of cotton production

A=Intercept

b=Regression co-efficient or trend value

t=Time variable

$$CGR (\%) = (Antilog b-1) \times 100$$

The compound growth rates were estimated for the time periods of fifty three years.

The significance of the estimated compound growth rates were tested with the help of student “t” test.

Results and discussions:

Trends in area, production and productivity of cotton: The present study was to estimate compound growth rates area, production and productivity of cotton in Maharashtra in general, and those in different regions in particular, it was necessary to examine whether the changes had occurred in cotton acreage in absolute terms during the different time periods selected for the study in various regions and for the entire state. Similarly, whether changes had occurred in productivity and production of cotton in different districts of each of the region were also examined in order to know what so ever changes had occurred in area, production and productivity of cotton in different regions of Maharashtra State as a whole. The study revealed that the growth rates of area under cotton districts in Maharashtra. The results of the same presented below.

Districtwise and periodwise annual compound growth rates in area, production and productivity of cotton in Western Maharashtra: It is revealed from the table (Table 1) that, at the overall period, the compound growth rate of area was highly significant and production and productivity was positive. It clearly indicates that the production of cotton was only increased by area expansion during the entire period in Western Maharashtra. Among the districts, the production of cotton has increased both by area expansion and productivity improvement in Jalgaon, Dhule and Nandurbar districts. Whereas, the production has declined due to decline in both area and productivity in Nasik, Kolhapur, Satara, Sangali, Ahmednagar and Solapur districts in Western Maharashtra.

The performance with regard to productivity of cotton was quite satisfactory in Period II as compared to Period I and Period III in all the districts of Western Maharashtra. It is interesting to note that the productivity of cotton has declined in Period I in all the districts of Western Maharashtra. In Period III, the productivity of cotton has increased in Jalgaon, Dhule, Nandurbar district.

The Period I was a pre-green revolution period and Period III was post-green revolution period. So, the production and productivity of cotton in all the districts of Western Maharashtra might be negative in Period I and Period III, because during this period division of districts place and cultivated land towards different development activities was transferre

Sr. No.	District	CGR (%)											
		Period-I (1960-61 to 1979-80)			Period-II (1980-81 to 1999-2000)			Period-III (2000-01 to 2012-13)			Overall (1960-61 to 2012-13)		
		A	P	Y	A	P	Y	A	P	Y	A	P	Y
1	Nasik	-9.62***	-7.32***	2.18 ^{NS}	1.80 ^{NS}	1.49 ^{NS}	0.23 ^{NS}	4.16***	3.27***	7.31***	0.92 ^{NS}	2.08 ^{NS}	1.02***
2	Dhule	-2.59***	-1.16 ^{NS}	1.15 ^{NS}	2.46***	5.29***	2.99***	5.52***	15.65***	9.77***	0.86***	2.75***	1.75***
3	Jalgaon	-2.95***	-2.70*	0.05 ^{NS}	3.23***	8.32***	4.91***	2.77***	8.98***	6.05***	1.65***	4.50***	2.71***
4	Pune	-1.99 ^{NS}	0.04 ^{NS}	2.23*	-16.08***	-12.88***	3.85***	-10.74**	-16.21**	-0.32 ^{NS}	-10.07***	-9.34***	1.44***
5	Ahmednagar	-10.55***	-6.93***	3.72**	4.44 ^{NS}	5.22 ^{NS}	0.76 ^{NS}	4.97***	8.41***	2.76 ^{NS}	0.10 ^{NS}	1.60 ^{NS}	1.36***
6	Solapur	-0.59 ^{NS}	2.22 ^{NS}	2.48**	-5.39**	-2.72 ^{NS}	2.82***	-18.62***	-12.90	7.06***	-5.65***	-4.37***	1.22***
7	Kolhapur	-3.98**	-3.48 ^{NS}	-0.34 ^{NS}	-4.98***	-2.54 ^{NS}	3.44**	2.10 ^{NS}	3.09 ^{NS}	8.32***	-6.40***	-3.59***	2.60***
8	Satara	4.02**	5.17**	0.43 ^{NS}	1.34 ^{NS}	4.25 ^{NS}	2.77**	-0.74 ^{NS}	3.54 ^{NS}	4.37 ^{NS}	-1.59**	-1.72**	-0.24 ^{NS}
9	Sangli	-4.13***	-3.95**	-0.03 ^{NS}	0.71 ^{NS}	3.44**	2.76***	7.32 ^{NS}	10.21 ^{NS}	2.54 ^{NS}	-1.44***	-0.61 ^{NS}	0.71 ^{NS}
10	Nandurbar	--	-	-	-	-	-	7.38***	8.66***	7.13***	6.14***	7.12***	8.60***
	Western Maharashtra	-3.29***	-2.16 ^{NS}	1.55*	2.70***	6.83 ^{NS}	2.56*	5.66***	12.16***	3.22 ^{NS}	1.39***	3.66***	1.34***

*, ** and *** indicates significance level at 10, 5 and 1 per cent level, respectively

Districtwise and periodwise annual compound growth rates in area, production and productivity of cotton in Marathwada: The information of districtwise and periodwise annual compound growth rates in area, production and productivity of cotton in Marathwada is depicted in Table 2.

It is seen from the table that, during the entire period, the area and production was negatively significant in all districts of Marathwada in I period and productivity was non significant, but productivity in III period is positively significant and area of cotton has declined. The performance of productivity was satisfactory in Period II and III, in all the districts of Marathwada region as compared to Period I.

It was noticed that during Period II i.e. green revolution period, where the productivity of cotton was positively significant in all districts of Marathwada

while it was positive but highly significant in Jalna and Latur districts at 1 per cent level of significance. Period I is pre green revolution period and Period III was post-green revolution period. However, the production and productivity of cotton in all districts of Marathwada was found negative in both the periods. In Marathwada region during this period division two districts, transfer of cultivated land towards other non agricultural activities and in prevalent of drought conditions affected the production of cotton in the region. Looking to conditions of scanty rainfall in some parts and seasonality of rainfall in other parts, Marathwada could be considered as one of the water resource scare zone in Maharashtra. It could be concluded that, the decline in area under cotton during overall period may be due to the shifting of area towards sugarcane and soybean crops as a substitution crop. As a result of decline in area, the

Table 2. Districtwise and periodwise annual compound growth rates in area, production and productivity of cotton in Marathwada

Sr. No	District	CGR (%)											
		Period-I (1960-61 to 1979-80)			Period-II (1980-81 to 1999-2000)			Period-III (2000-01 to 2012-13)			Overall (1960-61 to 2012-13)		
		A	P	Y	A	P	Y	A	P	Y	A	P	Y
1	Aurangabad	-3.31***	-1.41 ^{NS}	1.32 ^{NS}	4.23***	5.86***	1.41 ^{NS}	9.77***	22.30***	11.41***	0.52 ^{NS}	3.53***	2.81***
2	Parbhani	-0.93**	0.64 ^{NS}	1.11 ^{NS}	2.95***	6.24***	3.17*	-1.04 ^{NS}	8.65***	9.80***	0.13 ^{NS}	3.51***	3.26***
3	Beed	-6.42***	-5.51*	0.80 ^{NS}	7.40***	9.54***	2.00*	13.58***	19.63***	5.33**	3.45***	5.95***	2.27***
4	Nanded	0.98 ^{NS}	0.82 ^{NS}	0.53 ^{NS}	1.43***	3.54*	2.02 ^{NS}	2.52**	13.44***	10.63***	0.99***	3.02***	2.03***
5	Osmanabad	-4.84***	-3.79 ^{NS}	0.78 ^{NS}	10.42 ^{NS}	10.54*	11.47 ^{NS}	12.25***	15.54***	12.84***	-6.24***	-3.48*	1.71 ^{NS}
6	Jalna	-	-	-	12.58*	13.07**	8.08*	8.61***	11.97***	3.90 ^{NS}	13.00***	14.71***	15.60***
7	Latur				9.92*	13.62***	11.19**	-12.06**	-0.27 ^{NS}	13.42***	12.26***	12.90***	15.59***
8	Hingoli	-	-	-	-	-	-	15.81 ^{NS}	14.08**	7.15**	5.34***	6.41***	8.76***
	Marathwada	-1.63***	-0.78 ^{NS}	0.81 ^{NS}	2.89***	5.25***	3.01**	5.48***	14.53***	10.15***	1.52***	4.48***	4.03***

*, ** and *** indicates significance level at 10, 5 and 1per cent level, respective

production has declined in Marathwada region.

Districtwise and periodwise annual compound growth rates in area, production and productivity of cotton in Vidarbha: Table 3 revealed that, at the overall period, the productivity of cotton was positive and highly significant during the entire period in Vidarbha region. Among the districts, the production of cotton has increased both by production and productivity all districts of Vidarbha in period II and III than period I ,while, the production has declined due to both decline in area.

The performance of productivity of cotton was satisfactory in Period III as compared to Period I and Period III in all districts of Vidarbha region..

During Period I, the productivity of cotton has declined in Akola, Amravati, and Nagpur districts, while positively significant in Yavatmal, Vardha and Chandrapur districts. It is noted that during Period II i.e. green revolution period, the productivity of cotton was positive in almost all the districts. Period I was a pre-green revolution period ,so, that the production and productivity of cotton in all the districts of Vidarbha region were negative in Period I

Table 3. Districtwise and periodwise annual compound growth rates in area, production and productivity of cotton in Vidarbha													
Sr. No	District	CGR (%)											
		Period-I (1960-61 to 1979-80)			Period-II (1980-81 to 1999-2000)			Period-III (2000-01 to 2012-13)			Overall (1960-61 to 2012-13)		
		A	P	Y	A	P	Y	A	P	Y	A	P	Y
1	Buldhana	-1.49***	-1.22 ^{NS}	-0.06 ^{NS}	0.52**	4.29**	4.17**	2.69***	11.67***	8.73***	-0.12 ^{NS}	2.50***	2.54***
2	Akola	0.14 ^{NS}	0.64 ^{NS}	0.08 ^{NS}	0.10 ^{NS}	5.41***	5.45***	-6.06***	2.79 ^{NS}	9.42***	-1.01***	2.21***	3.08***
3	Amrawati	-0.20 ^{NS}	-0.64 ^{NS}	-0.58 ^{NS}	-0.22 ^{NS}	3.75**	3.98**	-5.44***	6.28***	12.39***	-1.05***	1.49***	2.51***
4	Yavatmal	0.99***	2.00 ^{NS}	0.70 ^{NS}	0.60**	4.06***	3.44**	1.00 ^{NS}	11.63***	10.50***	0.58***	3.21***	2.49***
5	Wardha	0.58***	3.75**	2.29 ^{NS}	-2.20***	1.69 ^{NS}	3.98**	1.73 ^{NS}	6.72**	5.07***	-1.72***	2.03***	3.53***
6	Nagpur	0.32 ^{NS}	1.56 ^{NS}	0.64 ^{NS}	-1.87***	3.01**	5.16***	0.82 ^{NS}	5.83***	4.96***	-0.47***	2.71***	3.02***
8	Chandrapur	2.75***	5.55***	2.42*	1.30**	5.85***	4.49***	4.88**	14.77***	9.42***	1.75***	5.17***	3.23***
9	Gadchiroli	-	-	-	2.56 ^{NS}	2.59*	10.22 ^{NS}	6.55***	5.59***	4.38***	4.17***	4.76***	13.10***
11	Washim	-	-	-	-	-	-	9.66 ^{NS}	7.35*	6.06**	9.3***	7.11***	11.16***
	Vidarbha	0.11 ^{NS}	0.71 ^{NS}	0.69 ^{NS}	-0.05 ^{NS}	4.03***	4.58***	-0.65 ^{NS}	0.005***	9.57***	-0.25***	2.62***	3.45***

*, ** and *** indicates significance level at 10, 5 and 1per cent level, respectively

Districtwise and periodwise annual compound growth rates in area, production and productivity of cotton in Maharashtra:

As discussed earlier, the area and production of cotton have increased since the formation of Maharashtra State. But the rate of increase in area and production of cotton was not uniform during different decades in the State as well as in different regions and districts. Also, the productivity of cotton has not only showed decreasing trends over a period of time but also varied greatly among the different districts and regions. The districtwise and regionwise compound growth rates of these variables have been examined for the period 1960-61 to 2012-13. The regionwise and periodwise annual compound growth rates of area, production and productivity of cotton are presented in Table 4 for all the individual region and state as a whole.

The area, production and productivity of cotton have fluctuated widely during the period under consideration in all the districts, regions and State as a whole. The growth rates of area and production of cotton for Maharashtra State as a whole observed to be positive and highly significant for the overall period of 53 years. The area and production and productivity of cotton have increased at the rate of 1.27 and 1.25 per cent per annum at 1 per cent level significance, respectively, during the overall period. It indicates that the production of cotton increased due to area expansion during the overall period in State as a whole.

The area and production of cotton have increased at higher rates during Period III as compared to Period I and Period II. The productivity of cotton showed a dismal picture and it has declined continuously from Period I to Period III. The growth rate was even negative (-2.37, -1.56

-0.17 per cent and -0.37 per cent) during Period I, II, III Period at overall period. The gains of production increase of cotton arising out of area expansion phenomenon were reducing to some extent because of productivity decline.

In period - I, II and III area and productivity was positively significant, while the productivity was negative but significant. The similar trends were observed during all the periods.

The performance with regard to area of cotton was quite satisfactory in Period- I, II and III. However, the productivity of cotton in Maharashtra was found negative in both the periods.

Among the different region, at the overall level the area was highly significant at 1 per cent level except

Vidarbha region. The production and productivity was highly significant at 1 per cent level in both region of Maharashtra. It clearly indicates that the production of cotton was only increase by in area expansion during the overall period in Western Maharashtra, Marathwada and except Vidarbha region. In general, the area and production of cotton increased at increasing rates during Period II and Period III and however it was declined during Period I almost in all the regions.

In conclusion, the analysis revealed that there existed wide variation in the performance of cotton crop in terms of changes in area, production and productivity among the districts and regions over a period of time. The increases in area under cotton during overall period may be due to the transfer of area towards from soybean, groundnut and kharif jawar crops. As a result of increased in area, the production has increases of Maharashtra. The increase in production was slightly due to area expansion and mainly due to improvement in the productivity of cotton. These findings confirmed the results reported by Sheteet *al.* (1997), Kalyankar and Ghulghule (1997) and Kalamkar (2003).

Conclusions: The study has revealed that the area under cotton in Maharashtra and especially in all cotton growing district and states as whole has been increased during period-II and it has declined in period-I

The area under cotton in Maharashtra increased during the period under study. The area under cotton had increased in all the regions of the state except, Western Maharashtra region. The performance of cotton was quite satisfactory as regards to productivity in the state as it was almost triple over the base period. Highest productivity was increased in Vidarbha and Marathwada region of the state. The production of cotton in the state had increased more than two folds during the green revolution period. The area under cotton in Maharashtra increased during the period under study. The increase in production was mainly due to the productivity improvement and area expansion of cotton.

The area, production and productivity of cotton were increased significantly at the rate of 1.27, 1.25 and - 0.37 per cent per annum, respectively in the state. The increase in production was mainly due to the productivity improvement. The growth rates in area, production and productivity of cotton were positive and significant in Vidharbh Marathwada and Western Maharashtra.

Table 4. Districtwise and periodwise annual compound growth rates in area, production and productivity of cotton in Maharashtra

Sr. No.	Region	CGR (%)											
		Period-I (1960-61 to 1979-80)			Period-II (1980-81 to 1999-2000)			Period-III (2000-01 to 2012-13)			Overall (1960-61 to 2012-13)		
		A	P	Y	A	P	Y	A	P	Y	A	P	Y
2	Western Maharashtra	- 3.29***	-2.16 ^{NS}	1.55*	2.70** *	6.83 ^{NS}	2.56*	5.66** *	12.16* **	3.22 ^{NS}	1.39** *	3.66***	1.34***
3	Marathwada	- 1.63***	-0.78 ^{NS}	0.81 ^{NS}	2.89** *	5.25***	3.01**	5.48** *	14.53* **	10.15***	1.52** *	4.48***	4.03***
4	Vidarbha	0.11 ^{NS}	0.71 ^{NS}	0.69 ^{NS}	-0.05 ^{NS}	4.03***	4.58** *	-0.65 ^{NS}	0.005* **	9.57***	- 0.25** *	2.62***	3.45***
	Maharashtra	3.29***	2.33** *	-2.37***	2.92** *	3.44***	- 1.56** *	3.08** *	3.27** *	-0.17 ^{NS}	1.27** *	1.25***	-0.37***

*, ** and *** indicates significance level at 10, 5 and 1per cent level, respectively

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