AN ANALYSIS ON THE DISPARITY IN THE GROWTH OF COTTON AMONG THE INDIAN STATES

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Abstract: The study attempted to examine the growth in area, production and productivity of cotton among the major cotton growing states of India. The objective of the study is accomplished with the help of secondary data considered for a period of 53 years from 1964-65 to 202016-17. The linear and compound growth rates were worked out. The magnitude of variability was calculated through the instability index. The contribution of area and productivity to increase in output was worked out by using decomposition analysis. From study it is observed that during the Period II, the area has increased in a majority of the states of India while the output and yield of cotton has increased in all the states. The increase in yield of cotton is far higher in all the cotton growing states. This is due to the adopting of Bt cotton in all the states.

INTRODUCTION

Cotton is one of the largest non-food crop grown in over 100 countries of the world. With the increasing demand for cotton all over the world, though the area under cultivation has not increased, the output of cotton has more than tripled and the reason is the introduction of genetically modified crop. Tracing the development of cotton over the past century in developed countries shows that labor-intensive production patterns have been replaced by systems dependent on capital inputs (source: World Wildlife Fund). However, in the context of the developing countries, there is a different scenario. The agricultural sector is still labour intensive absorbing a lion's share of labour force. There is no organization and co-operation among the cultivators. So, the village traders exploit the illiterate farmers by fixing the prices for below the cost of production. With no much support from the government, the farmers are not able to get a competitive price resulting poor area under cultivation of cotton. In India, the situation is further expected to be worse as there has been a continuous increase in the demand for agricultural land or nonagricultural purpose. Thus, on the one hand there has been a continuous increase in the demand for cotton worldwide

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and in the Indian context there has been a decline in the Gross Cropped Area which may affect the area under cotton also. Given the situation it becomes pertinent to understand whether the phenomena of decline in the area and yield of cotton are operating in the context of Indian cotton also. The study attempted to examine this issue in the context of the major cotton producing states of India.

LITERATURE REVIEW

To Joseph Vackayil (2008), the cotton production in India was estimated by the Cotton Association of India, to be at a record level of 310 lakh bales in 2007-08 with an increase of 280 lakh bales compared to the previous season. However, the productivity of Indian cotton stood at 553 kgms per hectare which is far below the world average of 765 kg per hectare. The study viewed that the increased use of genetic cotton has helped to bridnge the gap in the productivity gradually. According to CAB statistics, productivity had increased from 427 kg a hectare before 2000-01, the year in which Bt was introduced to Indian fields, to 553 kg last season. The study viewed that during 2007-08, the national shortfall was anticipated to be only 212 kg per hectare and the four major cotton-producing states of Gujarat, Tamil Nadu, Andhra Pradesh and Punjab were expected to achieve yields of 743, 691, 667 and 630 kg, cotton per hectare, respectively. The Cotton Advisory Board statistics showed that 66% of cotton grown in the current season in the country was transgenic. Cotton acreage in India totals more than 95 lakh hectares.

According to Adarsha et al.(2011) under the rain fed condition, application of fertilizer namely nitrogen and potassium recorded significantly high seed cotton yield (1020 kg /ha) when compared to the cotton fields which did not receive any fertilizer. The study concluded that with fertilizer application in rainfed and in irrigated condition recorded more yield and higher harvest index. A further increase in N and P2O5 had resulted in higher yield in spite of increase in biomass.

The study by Sanka Bharathi et al.(2011) to find out the optimum spacing and fertilizer level for Bt and Non Bt cotton concluded that application of fertilizers, over and above had significant difference on seed cotton yield. and the different spacing and fertilizer levels did not exert any significant improvement on quality of fibre.

Buttar(2012) viewed that cotton cultivation in semi-arid region of Indian Punjab is highly risky as its yield is very sensitive to rainfall and temperature. The study also viewed that in future due to global warming

increase in the temperature is expected which may influence the growth and yield of cotton and other fiber crops like other cereals. The regression results of the study indicated that with the increase in temperature from 28 to 32°C, the yield of cotton has declined by half, that is from 4700Kilograms per hectare to 2300 kilograms per hectare. The coefficient of determination is also found to be high with 0.97 indicating that the reduction was more with increased temperature during sowing to flowering stage than other pheno-phases. Total evapo-transpiration (ET) during crop period and crop water productivity was also decreased with increased temperature.

Dilip Kumar Jha (2013) viewed that the Bt cotton crop in India has been losing its importance steadily due to the pest attacks emerging from frequent changes in climatic condition. As is evident from the data collated by the Cotton Advisory Board (CAB indicated that the cotton yield has started falling gradually since 2006 till the bollworm-resistant Bt cotton seed changed farmers' economy. After that, however, farmers have witnessed a sustained increase in yield from a peak level of 554.39 kg per hectare (ha) in the year 2006-07 (October – September) to an estimated 488.89 kg in 2012-13. To him, the remarkable increase in output, therefore, is attributed to farmers' rapid adoption of Bt technology resulting in higher acreage.

Rajendra Prasad et al(2001*)* conducted study on costs and returns in cotton production vis-a-vis its competing crops in Guntur district and revealed that the per hectare expenditure on PPC on cotton was Rs.11331.37. This was very high compared to Rs.4217.92 in soybean-bengalgram cropping system, Rs. 4379.81 in soybean -redgram and Rs. 1334.00 in soybean-jowar cropping systems. The PPC in total operational cost was highest in cotton (Rs. 29884.77) compared to soybean-bengalgram (Rs. 27802.84), soybean-redgram (Rs. 29171.42) and soybean-jowar (Rs. 2954.78), whereas net returns were very low in cotton compared to other cropping systems.

Mahantesh (2002) analysed costs and returns structure of cotton in Belgaum district. The total cost of cultivation was found to be Rs. 30058.77 per hectare. The gross returns realized from the sale of output amounted to Rs. 33147.75 per ha and thus the net returns obtained per hectare were Rs. 3088.98.

OBJECTIVES AND HYPOTHESES OF THE STUDY

The literature mentioned above indicated that the output and yield of cotton have grown positively. Given the importance of cotton in India, the present study primarily aimed at examining whether this significant

positive growth continues at present also. To achieve this end, the present study examines the trends in the growth of area, output and yield of cotton among the major cotton producing states of India and and also to find out the inequality in the growth. The Study hypothesized that 1) 'there is no significant growth in area, output and yield of cotton and .2) 'there is no significant difference in the growth of area, output and yield of cotton among the cotton growing states of India.

METHODS AND MATERIALS

To accomplish this objective, the data on area, output and yield of cotton were collected for a period of 52 years from 1964-65 to2016-17. The required secondary data were collected from the website of cotton board, from the published annual reports of the Ministry of Agriculture, Government of India and from the annual reports on Agriculture published by CMIE.

To calculate the average area, output and yield the simple arithmetic mean is calculated. The growth trend is measured in terms linear and compound growth rate. The volatility in the growth is measured using the Instability Index. The significance of the growth is tested using the't' test. The impact area effect.

Compound growth rates were estimated with the following exponential function

$Y=ABt$

Where,

Y = area/production/yield of crop

A = Intercept

B = regression coefficient

T = time variable

$B = r + 1$

The formula for computing the Compound growth rate is:

CGR = (Antilog (b) -1 x 100

The linear growth rate is estimated using the linear trend model of the form:

$$Y = A+Bt$$

Where,

Y = area/production/yield of crop

A = Intercept

B = regression coefficient

T = time variable

The linear growth rate = (B/ $\bar{x}$)*100

The Instability Index is calculated as:

$$I = \frac{\sqrt{\frac{e^2}{n-k}}}{\bar{x}} \times 100$$

Where,

E = the error term in the linear trend model

n-k = the degrees of freedom.

To know the contribution of area and productivity to incremental production for cotton, the model suggested by Sharma (1977) and Narula and Vidyasagar (1973) was used. The form of the model is :

$\Delta P = \Delta AYo + \Delta YAo + \Delta A\Delta Y$

Where,

ΔP = Change in Production of cotton

ΔA = Change in the area under cotton

ΔY = Change in the yield of cotton.

ΔAYo = Area Effect

ΔYAo = Yield Effect

$\Delta A\Delta Y$ = Interaction Effect (change in production due to change in area and yield together.)

GROWTH PERFORMANCE OF COTTON BY STATES OF INDIA

Based on the above reasoning, in this article it is attempted to make a comparative analysis of the growth of cotton among the major cotton producing states of India and the inequalities in them. To understand the relative contribution of area and yield on cotton production, a decomposition analysis has been made.

TRENDS IN STATE WISE AREA UNDER COTTON

As is seen in Table 1, among the major producing states of cotton in India, in the year 1964-65, the area under cotton stood highest in the case of Maharashtra with 28.24 lakh hectares. The least could be seen in the case of Haryana (1.74 lakh Hectare). In the year 2016-17, with Maharashtra (38.06 lakh Hectare), the state of Tamil Nadu (1.50 lakh Hectare) has taken the least area. During the study period, the area under cotton in the states of Maharashtra registered the highest positive value (9.82 hectares), followed by Gujrat (5.54 hectares), Haryana (3.24 hectares) and Andhra Pradesh, which registered the least increase of 0.76 hectares. However, the remaining states like, Tamil Nadu (-2.26 hectares), Punjab (-2.31 hectares), Madhya Pradesh (-3.06 hectares) and Karnataka (-5.49 hectares) have recorded the negative value in area. However, at the state level during the period under review there has been an increase in the area under cotton by 21.325 hectares. The growth rates worked out indicates that the states like, Andhra Pradesh (3.27 per cent), Haryana (2.07 per cent), Rajasthan (1.00 per cent), Gujarat (0.95 per cent) and Maharashtra (0.87 per cent), the states of Punjab (-0.07 per cent), Madhya Pradesh (-0.52 per cent), Karnataka (-1.75 per cent) and Tamil Nadu (-1.98 per cent) have experienced a decline in the area under cotton cultivation. As a result, the area under the country has experience a negligible growth of 0.82 per cent per annum.

The instability index worked for the entire study period indicates that the instability is found to be least in the case of Tamil Nadu (9.01 per cent), followed by the increasing volatility that can be given as : Madhya Pradesh (10.30 per cent), Haryana (11.61 per cent), Rajasthan (19.83 per cent), Punjab (24.35 per cent), Karnataka (30.91 per cent), Maharashtra (36.96 per cent), Gujarat (109.05 per cent) and Andhra Pradesh (140.06 per cent). The instability is registered as 124.23 per cent for the entire country.

A comparison of the average area under cotton between 1964-65 to 1900-91 and 1991-92 and 2016-17 indicated that in the case of Andhra Pradesh, Maharashtra, Gujarat, Haryana and Rajasthan the area under increased in their order. However, the states like, Punjab, Madhya Pradesh, Tamil Nadu and Karnataka have experienced a net decline in the area between the two periods. The total area under cotton for the entire country has increased between period I and Period II. The instability index worked out also indicates that

the instability is higher during the period II when comparted to Period I in the case of Andhra Pradesh, Madhya Pradesh, Maharashtra, Punjab, Karnataka and Gujarat. In the case of state Haryana, Rajasthan and Tamil Nadu the volatility is found to be more in the case of Haryana, Rajasthan and Tamil Nadu for the period I.

Thus, to sum up, overall, between 1964-65 and 2016-17, that is during the study period, the area under cotton in the state of Maharashtra, Gujarat, Haryana, Rajasthan and Andhra Pradesh have increased. While in the case of the states like, Tamil Nadu, Punjab, Madhya Pradesh and Karnataka the area under cotton has declined during the study period. However, for the entire country there has been a net increase in the area under cotton during the study period. The growth rates indicated that while during period II, the growth is found to be higher in the case of Gujarat, Madhya Pradesh, Karnataka and Maharashtra, for the remaining periods, the growth is found to be higher during period I.

TRENDS IN STATE WISE PRODUCTION PERFORMANCE OF COTTON

A similar analysis on the performance in the production of cotton among the leading producing states of cotton indicates that in the year 1964-65, Gujarat (15.55 lakh bales) has the highest level of production achieved. This is being followed by the other states in the declining order as: Maharashtra (12.51 lakh bales), Punjab (8.08 lakh bales), Karnataka (5.22 lakh bales), Madhya Pradesh (4.92 lakh bales), Tamil Nadu (3.57 lakh bales), Haryana (2.91 lakh bales), Andhra Pradesh (1.44 lakh bales) and Rajasthan (1.04 lakh bales). In the year 2016-17, the states have taken a new order with Gujarat (95 lakh bales), Maharashtra (89 lakh bales), Karnataka (21 lakh bales), Madhya Pradesh (21 lakh bales), Haryana (20 lakh bales), Andhra Pradesh (19 lakh bales), Rajasthan (18 lakh bales), Punjab (9 lakh bales) and Tamil Nadu (6 lakh bales).

The growth rates worked out for the entire study period indicates that the state of Andhra Pradesh (5.41 per cent) has registered the highest growth rate in output during the study period, followed by the other states like, Gujarat (4.72 per cent), Maharashtra (4.59 per cent), Madhya Pradesh (4.09 per cent), Rajasthan (3.39 per cent), Haryana (3.32 per cent), Karnataka (2.87 per cent), Punjab (0.96 per cent) and Tamil Nadu (0.89 per cent). For the entire Indian Union, the output of cotton between 1964-65 and 2016-17 has increased at an annual rate of 4.20 per cent. The instability during the entire study is found to be least in the case of Tamil Nadu (18.42 per cent), followed by

the increasing volatility as: Rajasthan (71.68 per cent), Haryana (74.37 per cent), Madhya Pradesh (125.61 per cent), Punjab (178.67 per cent), Karnataka (197.29 per cent), Maharashtra (570.38 per cent), Andhra Pradesh (648.71 per cent) and Gujarat (1049.19 per cent).

Interestingly, a comparison of the average output of cotton between Period I and Period II indicates that the output under cotton in Period II is higher in the case of all the states indicating the increased efficiency. The state of Gujrat has registered the highest net increase in output between the two periods while the state of Tamilnadu has recorded the least increase in output during the study period.

The growth rates worked out during the two periods indicate that in the case of states like, Andhra Pradesh, Haryana , Madhya Pradesh, Punjab, Rajasthan and Tamil Nadu the growth rate during Period I was higher than during period II, while in the case of the states like, Gujarat, Karnataka and Maharashtra the growth in output during Period II is higher than Period I. A comparison of the instability index worked out between Periods I and II indicates that the volatility in the growth of output of cotton is higher for all the states during Period II when compared to Period I except for the state of Tamilnadu.

Thus from the analysis it can be concluded that in the case of growth in output of cotton all the states have experienced a higher level of output during the entire study period with comparatively a higher growth rate registered in Period II than I. However, the volatility in the growth in output is also found to be higher during Period II when compared to Period I implying that a higher growth in output accompanies a higher instability in growth.

TRENDS IN STATE YIELD UNDER COTTON

With a constrained in the expansion in the area under cultivation, the farmers attempt to increase their output by increasing their productivity. In the present paragraph it is attempted to examine the trends in the productivity or yield of cotton crop in the leading cotton producing states of India.

As it is seen in table 3, among the major cotton producing states, in the year 1964-65, the productivity of Haryana **(**301 kg. per hectare) stood highest during the period 1964-65. This is being followed by other states in the order of declining yield, Punjab **(**299 kg. per hectare), Tamil Nadu **(**171 kg. per hectare), Gujarat **(**152 kg.

per hectare), Rajasthan (127 kg. per hectare), Karnataka (93 kg. per hectare), Madhya Pradesh (90 kg. per hectare), Maharashtra (80 kg. per hectare) and Andhra Pradesh (69 kg. per hectare).

However, in the year 2016-17, the order of the states in terms of yield of cotton can be given as: Karnataka (769 kilogram per hectare), Andhra Pradesh (719 kilogram per hectare), Rajasthan (692 kilogram per hectare), Haryana (683 kilogram per hectare), Tamil Nadu (680 kilogram per hectare), Gujarat (673 kilogram per hectare), Punjab (598 kilogram per hectare), Madhya Pradesh (596 kilogram per hectare) and Maharashtra (398 kilogram per hectare). The average level of yield in the year 2016-17 for the entire Indian union stood at 568 kilogram per hectare.

In terms of growth in yield Karnataka (4.22 per cent), registered the highest growth during the entire study period. The other states are in the order of: Madhya Pradesh (4.07 per cent), Maharashtra (3.68 per cent), Andhra Pradesh (3.56 per cent), Gujarat (3.52 per cent), Tamil Nadu (3.11 per cent), Rajasthan (2.72 per cent), Haryana (1.35 per cent) and Punjab (1.14 per cent). The yield has registered a positive growth rate of 3.30 per cent per annum for the entire Indian Union.

A comparison of the increase in yield indicates that the yield of all the states has increased during Period II when compared to period I. the highest increase in yield between the two periods could be observed in the case of Madhya Pradesh with an increase of 389.21 Kilograms per hectare followed by the other states in the order as: Andhra Pradesh (354.27 Kilograms per hectare), Gujarat (341.24 Kilograms per hectare), Tamil Nadu (335.05 Kilograms per hectare), Karnataka (246.65 Kilograms per hectare), Rajasthan (223.59 Kilograms per hectare), Maharashtra (151.46 Kilograms per hectare), Haryana (108.26 Kilograms per hectare), Punjab (95.22 Kilograms per hectare), Total (253.46 Kilograms per hectare). The above discussion clearly vindicates that the increase in yield in Period II over Period I stood at a minimum of 253.46 Kilograms to a maximum of 389.21 Kilograms This higher increase in yield is probably because of the introduction of genetically modified cotton variety. A comparison of the instability index worked out between period I and Period II indicates that for all the states, the instability index worked out is far higher in Period II when compared to Period II implying that a higher increase in yield brings about a higher volatility in the yield of crops also.

DECOMPOSITION ANALYSIS OF AREA, YEILD AND COMBINED EFFECT: BETWEEN 1964-67 AND 2016-17

The earlier paragraphs provided a detailed discussion on the performance of the major states measured in terms of the indicators like, area, output and yield. In the present paragraph it is attempted to examine the contribution of area and yield to output growth of states for two set of periods namely, the Pre Economic Reforms period (1964-65 to 1990-91) and the Post Economic Reforms period (1991-92 to 2010-11). To segregate the impact of the contribution of area (Area Effect), yield (Yield Effect) and the Interaction Effect (combined effect) a decomposition analysis has been applied. Since, the agricultural performance is being determined greatly by the monsoon and the Indian monsoon is highly uncertain and volatile in nature, a triennium average is being considered for the beginning and end years is considered to measure the performance of cotton.

As it is seen in Table 5, for the period I, the decomposition of the impact of area and yield indicates that in the case of Andhra Pradesh the interaction effect constituted the highest to output change (44.21 per cent). The contribution of yield effect formed 43.58 per cent of the change.

In the case of Gujarat, the contribution of Area Effect formed the least to output change with 12.21 per cent. In the case of Gujarat, the contribution of interaction effect and area effect to changes in output is negative to an extent of 426.95 per cent and 545.87 per cent respectively. However, this negative contribution has been compensated by the positive impact of yield to changes in output to an extent of 1072.82 per cent.

For the state of Haryana, the contribution of area and yield is positive with a contribution of area to changes in output to an extent of 73.05 per cent. The combination of yield and area (Interaction Effect) to output change is 16.3 per cent. The impact of Yield alone to output change (Yield Effect) is 10.66 per cent. In the case of the state of Karnataka the Yield Effect is extremely high with a contribution of 186.09 per cent. However, the Area Effect (-22.57 per cent), and Interaction Effect (-63.52 per cent) have turned out to be negative.

In the case of the Madhya Pradesh a similar situation as found in the case of Karnataka and Maharashtra also. However, the negative contribution of interaction effect and area effect is slightly lower in Maharashtra than Karnataka.

That is, in the case of Karnataka, the Yield Effect is extremely high with a contribution of 189.05 per cent. However, the Area Effect (-27.82 per cent), and Interaction Effect (-61.82 per cent) have turned out to be negative. However, in the case of Maharashtra the Yield Effect (103.84 per cent) is slightly higher than 100 per cent which is being offset by the negative impact of Interaction Effect (-1.36 per cent) and Area Effect (-2.48 per cent).

It is interesting to note that in the case of Punjab and Rajasthan the contribution of Yield effect, area effect and interaction effect is positive to output change. In the case of Punjab Yield Effect is 41.61 per cent. While the Area Effect and interaction effects are 34.08 per cent, and 24.31per cent respectively. Similarly, in the case of Rajasthan, the contribution of yield (Yield Effect) is 59.11 per cent, while the Interaction Effect (29.89 per cent) and Area Effect (11 per cent) contribute totally to 40.89 per cent.

In the case of the Tamil Nadu during period I, the Yield Effect (433.88 per cent) contributed to the highest level to the output change. However, this is being offset by the reduction in the output change by 333.88 per cent by the Interaction Effect (-155.19 per cent) and Area Effect (-178.69 per cent).

The impact area and yield to changes in output at the all India level by all these major states put together indicates that the Yield Effect (114.3 per cent) higher when compared to Area Effect (-6.41per cent) and Interaction Effect (-7.9 per cent).

During Period II, it is interesting to note that out of nine states, for five states the contribution of all the three factors namely, area, yield and combined effect to output change is found to be positive indicating the contribution of both area and yield to output change. For example, in terms of area effect the contribution of these states include: Andhra Pradesh (86.33 per cent), Gujarat (33.14 per cent), Madhya Pradesh (22.31 per cent), Haryana (18.85 per cent) and Maharashtra (16.53 per cent) in their order. The contributions of these

states in terms of yield effect which are again positive are in the order of: Haryana (78.01per cent), Madhya Pradesh (66.51 per cent), Maharashtra (57.46 per cent), Gujarat (26.66 per cent) and Andhra Pradesh (5.59 per cent).

Similarly, the yield effect to output change of these five states can be given as: Gujarat (40.2 per cent), Maharashtra (26.01per cent), Madhya Pradesh (11.18 per cent), Andhra Pradesh (8.08 per cent) and Haryana (3.14 per cent).

In the case of the remaining states while Karnataka and Rajasthan have recorded a negative contribution in area, -57.78 per cent and -42.72 per cent respectively, the only state that registered a negative value in the case of yield is Tamil Nadu with -1376.70 per cent.

Thus it can be concluded that while during the pre-economic reforms period, a mixed trends in the case of area effect and yield effect to output change could be observed in the case of a majority of the states, during the post economic reforms period, a majority of the states could contribute to output change positively by both area and yield indicating the increase in both area and yield to increase in output of cotton. This means, the new economic reforms has given a boost to the demand for cotton which resulted in the increase in both area and yield.

Conclusion

Thus the above analysis can be summarized as : 1) Out of Nine major cotton producing states, the area under cotton has increased in five states namely, Maharashtra, Gujarat, Haryana, Rajasthan and Andhra Pradesh have increased. The growth rates worked out indicated that the increase in area is higher during the Period II when compared to Period I. the growth is found to be higher in the case of Gujarat, Madhya Pradesh, Karnataka and Maharashtra. However, the volatility in the growth in output is also found to be higher during Period II when compared to Period I implying that a higher growth in output accompanies a higher instability in growth.2) In the case of output, the growth in output of cotton all the states have experienced a higher level of output during the entire study period with comparatively a higher growth rate registered in Period II than I. However, the volatility in the growth in output is also found to be higher

during Period II when compared to Period I implying that a higher growth in output accompanies a higher instability in growth. 3) The yield analysis indicates that the yield of all the states has increased during Period II when compared to period I. the highest increase in yield between the two periods could be observed in the case of Madhya Pradesh followed by the other states in the order as: Andhra Pradesh (354.27 Kilograms per hectare), Gujarat (341.24 Kilograms per hectare), Tamil Nadu (335.05 Kilograms per hectare), Karnataka (246.65 Kilograms per hectare), Rajasthan (223.59 Kilograms per hectare), Maharashtra (151.46 Kilograms per hectare), Haryana (108.26 Kilograms per hectare), Punjab (95.22 Kilograms per hectare), Total (253.46 Kilograms per hectare).

In nutshell, during the Period II, the area has increased in a majority of the states of India while the output and yield of cotton has increased in all the states. The increase in yield of cotton is far higher in all the cotton growing states. This is due to the adopting of Bt cotton in all the states. However, the studies carried out in the context of BT cotton all over the world come out with the mixed conclusion on the profitability of growing Bt cotton. Hence, skepticism remains still in the context of the growing benefit of Bt cotton. A multiplicity of factors including the climate, usage of inputs, the incidence of bollworm on the economic aspect of growing Bt cotton at the state levels are to be examined, as climatic conditions are varied widely across the states of India.

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TABLE:1
TRENDS IN AREA UNDER COTTON IN MAJOR PRODUCING STATES
(Area in lakh Ha.)

Year	Andhra Pradesh	Gujarat	Haryana	Karnataka	Madhya Pradesh	Maharashtra	Punjab	Rajasthan	Tamil Nadu	Total
1964-65	3.73	18.46	1.74	10.13	9.05	28.24	4.87	2.61	3.76	83.65
1970-71	3.16	15.82	1.93	9.95	6.92	28.12	3.97	2.25	3.11	76.05
1975-76	2.6	17.78	2.55	9.56	6.37	23.1	5.8	3.09	2.08	73.5
1980-81	4.19	15.72	3.17	9.56	5.95	26.67	6.48	3.57	2.23	78.23
1985-86	6.19	14.04	3.44	6.74	5.35	27.53	5.59	3.33	2.54	75.32
1990-91	6.55	9.21	4.9	5.96	6.08	27.3	7.01	4.55	2.64	74.39
1995-96	10.57	14.1	6.46	6.47	5.37	30.7	7.5	6.06	2.65	90.68
2000-01	10.22	16.15	5.55	5.6	5.06	30.77	4.74	5.1	1.93	85.8
2005-06	9.72	20.77	5.83	3.81	6.35	28.89	5.57	4.54	1.52	88.2
2010-11	17.84	26.33	4.92	5.45	6.5	39.32	5.3	3.35	1.22	111.42
2016-17	4.49	24	4.98	4.64	5.99	38.06	2.56	4.42	1.5	105
	ALL PERIODS									
Average	7.65	17.53	4.26	7.13	6.18	29.24	5.55	3.95	2.29	85.45
LGR	3.27*	0.95*	2.07*	-1.75*	-0.52*	0.87*	-0.07	1.00*	-1.98*	0.82*
CGR	3.34*	0.80*	2.40*	-1.74*	-0.48*	0.83*	-0.11	1.07*	-2.10*	0.75*
Instability(%)	140.06	109.05	11.61	30.91	10.30	36.96	24.35	19.83	9.01	124.23
	1964-65 TO 1990-91									
Average	4.18	15.47	2.97	8.83	6.56	25.95	5.61	3.29	2.82	76.39
LGR	**3.14**	**-1.82**	**3.64**	**-2.13**	**-1.50**	**0.00**	**1.98**	**1.84**	**-2.09**	**-0.31**
CGR	3.05	-2.06	3.70	-2.44	-1.46	0.01	2.04	1.89	-1.99	-0.32
Instability(%)	14.84	11.79	10.62	15.57	10.70	6.95	11.37	12.54	15.56	4.60
	1991-92 TO 2016-17									
Average	11.25	19.68	5.59	5.36	5.78	32.65	5.48	4.62	1.75	94.87
LGR	2.47*	3.68*	-0.08	-0.22	0.48*	1.71*	-2.24*	-1.18*	-3.57*	1.85*
CGR	1.78*	3.97*	-0.08	-0.35	0.48*	1.68*	-2.38*	-1.12*	-3.28*	1.82*
Instability(%)	188.74	21.48	6.21	27.72	4.81	28.26	11.79	18.56	10.50	88.11

*** Indicate Significant at 5 per cent level.**
Source: Directorate of Economics & Statistics, Ministry of Food and Agriculture, Government of India, various years.

TABLE: 2
TRENDS IN PRODUCTION UNDER COTTON IN MAJOR PRODUCING STATES

(Output in Lakh Bales)

Year	Andhra Pradesh	Gujarat	Haryana	Karnataka	Madhya Pradesh	Maharashtra	Punjab	Rajasthan	Tamil Nadu	Total
1964-65	1.44	15.55	2.91	5.22	4.92	12.51	8.08	1.04	3.57	55.96
1970-71	0.78	15.71	3.53	3.43	2.1	4.82	8.19	2.29	3.45	44.99
1975-76	2.39	16.77	4.65	5.87	2.72	7.72	12.35	4.04	2.53	59.5
1980-81	7.5	17.14	6.5	4.69	2.68	12.69	11.78	3.88	2.65	70.1
1985-86	7.43	19.86	6.1	5.49	2.86	19.89	14.03	4.74	4.84	87.27
1990-91	18.75	15	11.5	8	16	15	17.25	9.5	5	117
1995-96	27.35	31.25	11.3	9.5	14.25	28.75	14.35	13.75	5	156.5
2000-01	25.3	23.8	10	7.75	19.3	18.3	9.5	10.8	5.5	140
2005-06	30	89	14	6.5	18	36	21	11	5.5	244
2010-11	53	103	14	10	17	82	16	9	5	339.1
201617	19	95	20	21	21	89	9	18	6	351
	ALL PERIODS									
Average	19.30	40.16	9.67	8.25	10.30	29.46	13.34	7.79	4.47	150.97
LGR	5.41	4.72	3.32	2.87	4.09	4.59	0.96	3.39	0.89	4.20
CGR	8.42	4.47	3.65	2.64	5.09	4.54	0.92	4.29	0.97	4.36
Instability(%)	648.71	1049.19	74.37	197.29	125.61	570.38	178.67	71.68	18.42	1373.58
	1964-65 TO 1990-91									
Average	4.7	16.07	5.52	5.53	3.73	12.73	12.15	4.11	3.84	69.22
LGR	8.77	-0.22	4.42	2.57	2.93	1.73	3.74	5.63	0.87	2.67
CGR	10.67	-0.79	4.58	2.79	1.37	1.68	3.62	6.26	0.72	2.6
Instability(%)	50.5	23.03	15.95	29.77	67.33	26.47	20.21	31.09	25.55	14.99
	1991-92 TO 2016-17									
Average	34.46	65.18	13.97	11.07	17.13	46.84	14.57	11.62	5.13	235.87
LGR	3.64	6.64	2.99	4.69	1.36	6.49	0.00	1.51	-0.21	4.95
CGR	3.19	8.23	2.90	3.63	1.75	7.36	0.13	1.28	-0.20	5.22
Instability(%)	659.90	405.77	96.09	232.82	51.70	173.63	240.81	80.39	9.32	493.89

*** Indicate Significant at 5 per cent level.**

Source: Directorate of Economics & Statistics, Ministry of Food and Agriculture, Government of India, various years.

TABLE: 3
TRENDS IN YIELD UNDER COTTON IN MAJOR PRODUCING STATES

(Yield in Kg. per per Ha.)

Year	Andhra Pradesh	Gujarat	Haryana	Karnataka	Madhya Pradesh	Maharashtra	Punjab	Rajasthan	Tamil Nadu	Total
1964-65	69	152	301	93	90	80	299	127	171	120
1970-71	45	179	329	62	55	31	371	184	199	106
1975-76	156	160	310	104	73	57	362	223	207	138
1980-81	304	185	349	83	77	81	309	185	202	152
1985-86	204	241	368	123	138	91	426	242	324	197
1990-91	487	277	399	228	447	93	418	355	356	267
1995-96	440	377	297	240	451	159	325	386	321	293
2000-01	420	250	306	235	647	101	341	358	484	278
2005-06	527	794	373	268	494	213	610	397	668	478
2010-11	566	685	587	346	462	379	593	512	1003	517
2016-17	719	673	683	769	596	398	598	692	680	568
	ALL PERIODS									
Average	345.75	348.74	378.89	218.96	307.42	158.23	416.49	317.91	404.55	281.26
LGR	3.56*	3.52*	1.35*	4.22*	4.07*	3.68*	1.14*	2.72*	3.11*	3.30*
CGR	4.86*	3.57*	1.15*	4.49*	5.44*	3.63*	0.97*	2.95*	3.19*	3.49*
Instability(%)	1912.15	3334.25	2467.94	3452.43	3530.48	1711.87	3598.29	1330.45	3187.37	945.35
	1964-65 TO 1990-91									
Average	171.96	181.33	325.78	97.96	116.48	83.93	369.78	208.22	240.19	156.93
LGR	6.10	1.39	1.03	2.93	6.05	1.35	1.47	3.49	2.64	2.72
CGR	7.09	1.04	0.97	3.00	4.81	1.42	1.26	3.48	2.58	2.65
Instability(%)	39.22	21.82	10.46	31.02	52.28	20.42	17.98	23.96	15.36	12.92
	1991-92 TO 2016-17									
Average	526.23	522.58	434.04	344.62	505.69	235.38	465.00	431.81	575.23	410.38
LGR	1.45	3.71	3.17	4.61	0.95	4.97	2.45	2.69	3.32	3.18
CGR	1.49	4.14	3.15	4.11	1.31	5.63	2.72	2.53	3.59	3.34
Instability(%)	1319.63	2535.07	3084.99	2775.57	2252.62	772.64	5085.99	1275.88	3586.86	626.96

*** Indicate Significant at 5 per cent level.**

Source: Directorate of Economics & Statistics, Ministry of Food and Agriculture, Government of India, various years.

TABLE: 4
DECOMPOSITION ANALYSIS OF AREA, YEILD AND COMBINED EFFECT: BETWEEN 1964-67 AND 2016-17

	Andhra Pradesh	Gujarat	Haryana	Karnataka	Madhya Pradesh	Maharashtra	Punjab	Rajasthan	Tamil Nadu	Total
	BETWEEN 1964-67 AND 1990-91									
Area Effect	12.21	-545.87	73.05	-22.57	-27.82	-2.48	34.08	11.00	-178.69	-6.41
Yield Effect	43.58	1072.82	10.66	186.09	189.65	103.84	41.61	59.11	433.88	114.30
Interaction Effect	44.21	-426.95	16.30	-63.52	-61.82	-1.36	24.31	29.89	-155.19	-7.90
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	BETWEEN 1991-94 AND 2014-17									
Area Effect	86.33	33.14	18.85	-57.78	22.31	16.53	97.48	-42.72	717.18	29.98
Yield Effect	5.59	26.66	78.01	178.36	66.51	57.46	3.24	152.75	-1376.66	47.19
Interaction Effect	8.08	40.20	3.14	-20.58	11.18	26.01	-0.72	-10.03	759.47	22.83
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Computed from Tables 1, 2 and 3.