



ISSN (E): 2277- 7695  
ISSN (P): 2349-8242  
NAAS Rating: 5.23  
TPI 2021; SP-10(11): 2019-2028  
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[www.thepharmajournal.com](http://www.thepharmajournal.com)  
Received: 21-09-2021  
Accepted: 23-10-2021

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## An analysis growth rate of area, production and productivity of major crops of India

**Vandana Kumari, SC Srivastava, AM Jaulkar and Mukesh Kumar**

### Abstract

Agriculture is indispensable for the sustenance and growth of the Indian economy. On an average, about 70 per cent of the households and 10 per cent of the urban population is depended on agriculture as their source of livelihood. Total geographical area of India is 328.37 million hectares of which 305.27 million hectare is the reporting area. As of 2018, total sown area of kharif crops in India reached 105.78 million hectares. India ranks second worldwide in farm outputs. Indian yields per hectare of crops are generally low compare to international standards. The major crops grown in India are Rice, Wheat, Coarse cereals, pulses, oilseeds, sugarcane, cotton etc. The study was undertaken with the objective to analyse the compound growth rates of area, production & productivity of major crops of India. Study observed that the decline in area under rice because various reason such as farmers are sifting of other crops, increases cost of cultivation and decreasing the net return etc and CGR of production and yield are positive so increases of production in future while in case of coarse cereals, CGR of area is negative that is not good sign of India because coarse cereal is cultivated in drought region and unproductive land. If we want to area of coarse cereals increases that good package and practice is used in cultivation and high price declared of coarse cereals crops.

**Keywords:** Compound growth rate, rice, wheat, coarse cereals, pulses, oilseed, sugarcane and cotton

### Introduction

Agriculture is the most important sector of Indian economy. Agriculture sector counts for 14 per cent of India's GDP and provides employment up to 50 per cent of the countries employees. India has the capability to produce the food which can build vast difference in Indian economy. Agriculture is indispensable for the sustenance and growth of the Indian economy. On an average, about 70 per cent of the households and 10 per cent of the urban population is depended on agriculture as their source of livelihood. Total geographical area of India is 328.37 million hectares of which 305.27 million hectare is the reporting area. As of 2018, total sown area of *kharif* crops in India reached 105.78 million hectares. India ranks second worldwide in farm outputs. Indian yields per hectare of crops are generally low compare to international standards. The major crops of India are Rice, Wheat, Coarse cereals, Pulses, Oilseeds, Sugarcane, Cotton, Jute & Mesta etc. The economic contribution of agriculture to India's GDP is regularly declining with the country's broad-based economic growth. Still, agriculture is demographically the broadest economic sector and plays a very important role in the overall socio-economic fabric of India.

India is one of the largest producers of agricultural production in the world. It is the second largest producer in the wheat and rice. Total cropped area in 2017-18 was 140.1 million hectare, in which total cropped area under rice was 437.891 lakh hectares, followed by wheat (295.76), coarse cereals (242.05), pulses (299.93), food grains (1275.63), oil seeds (246.45), sugarcane (47.32) and cotton (124.29) lakh hectare in 2017-18. Total cereals crops production in 2017-18 was 279.51 million tonnes in which rice production were 112.91 million tonne, followed by wheat (99.70), coarse cereals (46.99), pulses (25.23), food grain (284.83), oilseeds (31.31), sugarcane (376.90) and cotton 34.89 million tonne in 2017-18. Total yield of rice is 2578 kilogram per hectare in 2017-18 followed by wheat (3371), coarse cereals (1941), pulses (841), food grains (2233), oilseeds (1270) sugarcane (79650) and cotton (477) kilogram per hectare in 2017-18.

All time sequence data is characterized by a unique cycle. Despite its ascertainable uniqueness from conditions that lead to boom times to triggers that result in reversals, historical narratives (Brockwell & Davis, 2009) <sup>[5]</sup> suggest that most cycles display common features. Boom times are related with periods of credit expansion and persistent increases in asset prices often

followed by rapid reversals. These commonalities definite by different observed work (Bordo, Eichengreen, Klingebiel & Martinez-Peria, 2001) [4]. Rice and wheat are the staple food for a large percentage of population in India. India is one of the top two producers of rice and wheat. Most of the rice and wheat produced is consumed domestically. In Indian agriculture rice and wheat holds a special place. It is well suited to soil and climate of the country and is intertwined with different religious observations, festivals, customs and traditions. Moreover being a labor intensive crop it absorbs a large section of rural labor force and is a effective source of employment in the country (Ghosh & Neogi, 1995; Ghosh, 2002; Ghosh& Ray Chaudhury 2007) [10, 8, 9]. Above all, several studies have demonstrated India's competitive advantage in rice and under the given conditions the prospect of rice exports. True to this assumption rice has emerged as an important export item with the initiation of economic reforms. Until recently, export in India was a residual in nature so the demand projections will enable us to determine the export potentiality of some commodities (Ghosh, 2002; Ghosh& RayChaudhuri (2007) [8, 9]. Research in this direction requires high number of inputs resulting in intensive costs. Therefore, keeping the above facts in view the present study was conducted with the objective to analyse the compound growth rates of area, production & productivity of major crops of India.

### Research Methodology

The study was based on secondary data. The secondary data were collected from the website of Ministry of Agriculture and Farmers' Welfare, Government of India and Agricultural Statistics at a Glance, Directorate of Economics and Statistics, and Food and Agriculture Organization (FAO). The secondary data on area, production and productivity from 1998-99 to 2017-18 was used for analysis. The secondary time series data on area, production and productivity of major crops of India were used to analysis.

The collected data was tabulated in the view of the cited objectives and was interrelated by using suitable statistical measures. Followings statistical measures were used for present study.

### Compound Growth Rate (CGR)

By taking time as the independent variable and the area, production and productivity of the major crops of India, as the dependent variable, the compound growth rates was estimated by using the formula:

$$Y_t = a (1 + r)^t$$

Where,

$Y_t$  = Dependent Variable like area, production and productivity of major crops of India in the year's' for which growth rate was estimated.

$a$  = Constant

$r$  = rate of annual increment

$t$  = time element which takes the value of 1, 2, 3...n

The above exponential equation can be expressed in terms of log forms as follows:

$$\text{Log } Y_t = \text{Log } a + t \text{ Log } (1 + r)$$

$$\text{Log } Y_t = \text{log } a + t \text{ log } b, \text{ where, } b = 1 + r$$

By putting  $\text{log } Y_t = y$ ,  $\text{log } a = A$  and  $\text{log } b = B$ , the model becomes linear between  $y$  and  $t$ , as  $y = A + Bt$ ,

Now,

CGR per cent can be expressed as:

$$\text{CGR in per cent} = (\text{Antilog } b - 1) \times 100$$

To test the significance of compound growth rate  $t$  test was used as follows:

$$t = r/S.E (r) \text{ with } (n - 2) \text{ degrees of freedom}$$

Where,

$$S.E (r) = 100 \times b \times S.E. (\text{log } b) / 0.4343$$

$r$  = CGR per cent;

$n$  = number of year

This research paper finding used for future production of major crops because in future Indian population will be increase significantly that population would be need more food so researcher is want to how to growth rate of production of major crops which fulfillment of food for population for future of India.

### Result and Discussion

The compound growth rates of area, production & productivity of major crops (Rice, Wheat, Coarse Cereals, Pulses, Oil Seed, Sugarcane and Cotton) of India during last 20 years (1998-99 to 2017-18) are presented in table 4.1a & b. the details are as below;

**Rice:** For rice crop, the area was decreased from 44.80 to 43.79 million hectares i.e. 1.01 million hectares while the production and productivity for India were increase 86.08 to 112.91 million tonnes and 1921 to 2578 kg/ ha respectively for India during the last 20 years (1998-2018). Under rice crop compound growth rates of area -0.043 per cent was observed in India for 1998-99 to 2017-18 period, while the compound growth rates were 1.585 per cent and 1.628 per cent for production and productivity respectively in case of India. Compound growth rate of area sign is negative that means area of rice crop was decreased and also compound growth rate was found to be negatively but not significant, while production and productivity were increased and compound growth rate are positive and non significant. The values of "t" calculation found to be -0.41, 6.24 and 9.47 for area, production and productivity respectively.

**Wheat:** For wheat crop, the area was increases from 27.52 to 29.58 million hectares i.e. 2.06 million hectares while the production and productivity were increase 71.29 to 99.70 million tonnes and 2590 to 3371 kg/ ha respectively for India during the last 20 years (1998-2018). For wheat crop compound growth rates of area 0.957 per cent was observed in India for 1998-99 to 2017-18 period, while the compound growth rates were found to be 2.070 per cent and 1.103 per cent for production and productivity respectively in case of India. Area, production and productivity were increased and compound growth rate are positive and non- significant. The values of "t" calculation found to be 7.22, 8.39 and 5.94 for area, production and productivity respectively.

**Coarse Cereals:** it was observed coarse cereals crop, the area was decreases from 29.34 to 24.21 million hectares i.e. 5.13 million hectares while increase in production and productivity were 31.34 to 46.99 million tonne and 1068 to 1941 kg/ha respectively for India during the last 20 years (1998-2018). For coarse cereals crop compound growth rates of area -1.145 per cent was observed in India for 1998-99 to 2017-18 period, while the compound growth rates were found to be 2.227 per

cent and 3.411 per cent for production and productivity respectively in case of India. CGR of area was negative and non-significant that area of coarse cereals crop was decreased, while production and productivity were increased and compound growth rate of production was positive and significant, compound growth rate of productivity of coarse cereals was positive and highly significant for India. The values of “t” calculation found to be -8.00, 6.40 and 11.39 for area, production and productivity respectively.

**Total Pulses:** For total pulses crop, the area was increases from 23.50 to 29.99 million hectares i.e. 6.49 million hectares while the annual increase in production and productivity were 14.91 to 25.23 million tonne and 634 to 841 kg/ha respectively for India during the last 20 years (1998-2018). For total pulses crop compound growth rates of area 1.337 per cent was observed in India for 1998-99 to 2017-18 period, while the Compound growth rates were found to be 6.027 and 1.672 for production and productivity respectively in case of India. Compound growth rate of area was positive and non significant that area of total pulses crop was increased, while production was found to be positive and highly significant and productivity was found to be increased positive but non significant for India. The values of “t” calculation found to be 5.16, 6.25 and 5.69 for area, production and productivity respectively.

**Total oilseeds:** For oilseeds crop, the area was decreases from 26.20 to 24.65 million hectares i.e. 1.55 million hectares while the annual increase in production and productivity were found to be 24.75 to 31.31 million tonne and 945 to 1270 kg/ha respectively for India during the last 20 years(1998-2018). For oilseeds crop compound growth rates of area 0.547 per cent was observed in India for 1998-99 to 2017-18 period, while the compound growth rates were 2.483 per cent and 1.925 per cent for production and productivity respectively. Compound growth rate of area was found to be positive and non significant, while production was found to be positive and significant and productivity was increased and their compound growth rate was found to be positive and non significant. The values “t” calculation found to be 2.02, 4.18, and 4.56 for area, production and productivity respectively.

**Sugarcane:** For sugarcane crop, the area was increases from 4.05 to 4.73 million hectares i.e. 0.68 million hectares as well as increase in production and productivity were 288.72 to 376.90 million tonne and 71203 to 79650 kg/ha respectively for India during the last 20 years (1998-2018). For sugarcane crop compound growth rates of area 0.988 per cent was observed in India for 1998-99 to 2017-18 period, while the compound growth rates were 1.457 per cent and 0.468 per cent for production and productivity respectively. Compound growth rate of area, production and productivity found to be positively and non significant. The values of “t” calculation found to be 3.07, 3.39 and 2.25 for area, production and productivity respectively.

## Cotton

For cotton crop, the area was increases from 9.34 to 12.43 million hectares i.e. 3.09 million hectares while the increase in production and productivity were 12.29 to 34.89 million tonne and 224 to 477 kg/ha respectively for India during the last 20 years (1998-2018). For cotton crop compound growth rates of area was observed 2.427 per cent in India for 1998-99 to 2017-18 period, while the compound growth rates were found to be 8.059 per cent and 5.498 per cent for production and productivity respectively. Compound growth rate of area was found to be positive and significant, while production and productivity were found to be positively and highly significantly. The values of “t” calculation found to be 6.74, 9.25 and 7.11 per cent for area, production and productivity respectively.

## Summary and Conclusion

The present study concluded that In case of rice, the compound growth rate of rice area is negative so area of this crop can be decrease in future but CGR of production and yield are positive that mean production of rice will be increase in future that overall total production of rice would be increase which is fulfill of our requirement of food problem in future. Rice is main food of our daily life, 80 percent people are consuming the rice. The main problem is decreasing of area because various reason such as farmers are sifting of other crops, increases cost of cultivation and decreasing the net return etc. In case of wheat, CGR of area, production and yield are positive so production is increases in future which is also fulfillment in our food problem. Wheat is second main consuming food after rice in India. So positive value of CGR, this is good sign for India. In case of coarse cereals, CGR of production and yield are positive so increases of production in future while CGR of area is negative that is not good sign of India because coarse cereal is cultivated in drought region and unproductive land. If we want to area of coarse cereals increases that good package and practice is used in cultivation and high price declared of coarse cereals crops. In case of total pulses, CGR of area, production and yield are positive so production is increases in future that are also fulfillment in our food problem. Pulse is good source of protein for vegetarian people. India is fighting again pulse production after green revaluation but recently area of pulse crops is increasing significantly. In case of oilseed, CGR of area, production and yield are positive so production is increases in future that are fulfillment in our food problem. Oilseed is good source of fat for vegetarian people. India is fighting again oilseed production lost one decade but recently area of oilseeds crops is increasing significantly. In case of sugarcane, CGR of area, production and yield are positive so production of sugarcane is increases in future that are fulfillment in sugar, jury and ethanol problems. In case of cotton, CGR of area, production and yield are positive so production of cotton is increases. Cotton is main commercial crop of India. Textile industry depend on cotton that this crop is more employment and income generating crop for India.

**Table 1:** Compound growth rate of area, production and yield of Rice, Wheat, Course cereals and total pulses of India A=Area in Mha, P=Production in Million Tonnes (MT) and Y= Yield in kg/ha

Year	Rice			Wheat			Course cereals			Total Pulses		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1998-1999	44.80	86.08	1921	27.52	71.29	2590	29.34	31.34	1068	23.50	14.91	634
1999-2000	45.16	89.96	1986	27.49	76.37	2778	29.34	30.33	1034	21.12	13.42	635
2000-2001	44.71	84.98	1901	25.73	69.68	2708	30.26	31.08	1027	20.35	11.08	544

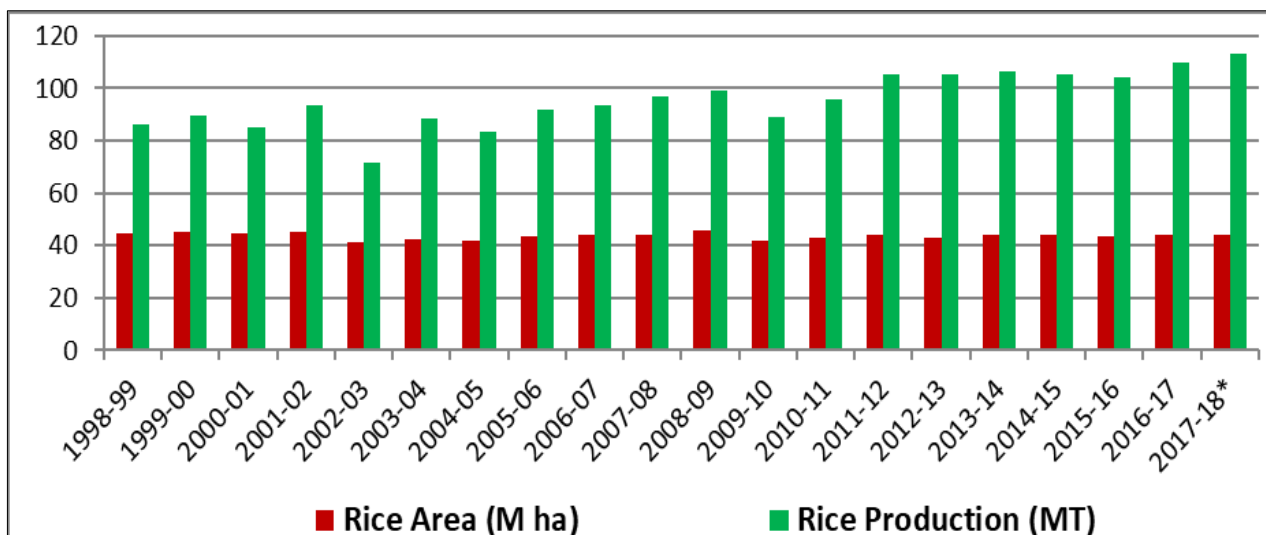
2001-2002	44.90	93.34	2079	26.34	72.77	2762	29.52	33.38	1131	22.01	13.37	607
2002-2003	41.18	71.82	1744	25.20	65.76	2610	26.99	26.07	966	20.50	11.13	543
2003-2004	42.59	88.53	2079	26.59	72.16	2713	30.80	37.60	1221	23.46	14.91	635
2004-2005	41.91	83.13	1984	26.38	68.64	2602	29.03	33.46	1153	22.76	13.13	577
2005-2006	43.66	91.79	2102	26.48	69.35	2619	29.06	34.07	1172	22.39	13.38	598
2006-2007	43.81	93.35	2131	27.99	75.81	2708	28.71	33.92	1182	23.19	14.20	612
2007-2008	43.91	96.69	2202	28.04	78.57	2802	28.48	40.75	1431	23.63	14.76	625
2008-2009	45.54	99.18	2178	27.75	80.68	2907	27.45	40.04	1459	22.09	14.57	659
2009-2010	41.92	89.09	2125	28.46	80.80	2839	27.68	33.55	1212	23.28	14.66	630
2010-2011	42.86	95.98	2239	29.07	86.87	2988	28.34	43.40	1531	26.40	18.24	691
2011-2012	44.01	105.30	2393	29.86	94.88	3177	26.42	42.01	1590	24.46	17.09	699
2012-2013	42.75	105.24	2461	30.00	93.51	3117	24.76	40.04	1617	23.26	18.34	789
2013-2014	44.14	106.65	2416	30.47	95.85	3146	25.22	43.29	1717	25.21	19.25	764
2014-2015	44.11	105.48	2391	31.47	86.53	2750	25.17	42.86	1703	23.55	17.15	728
2015-2016	43.50	104.41	2400	30.42	92.29	3034	24.39	38.52	1579	24.91	16.32	655
2016-2017	43.99	109.70	2494	30.79	98.51	3200	25.01	43.77	1750	29.45	23.13	786
2017-2018*	43.79	112.91	2578	29.58	99.70	3371	24.21	46.99	1941	29.99	25.23	841
CGR (%)	-0.043	1.585	1.628	0.957	2.070	1.103	-1.145	2.227*	3.411**	1.337	6.027**	1.672
"t" value	-0.41	6.24	9.47	7.22	8.39	5.94	-8.00	6.40	11.39	5.16	6.25	5.69

Compound Growth Rate (CGR)\*is Significant at 5% and \*\* is highly significant at 1% level

**Table 2:** Compound growth rate of area, production and yield of oilseeds, sugarcane and cotton of India

Year	Oilseeds			Sugarcane			Cotton		
	A	P	Y	A	P	Y	A	P	Y
1998-1999	26.20	24.75	945	4.05	288.72	71203	9.34	12.29	224
1999-2000	24.26	20.71	854	4.22	299.32	70934	8.71	11.53	225
2000-2001	22.77	18.44	810	4.32	295.96	68578	8.53	9.52	190
2001-2002	22.64	20.66	913	4.41	297.21	67370	9.13	10.00	186
2002-2003	21.49	14.84	691	4.52	287.38	63576	7.67	8.62	191
2003-2004	23.66	25.19	1064	3.93	233.86	59380	7.60	13.73	307
2004-2005	27.52	24.35	885	3.66	237.09	64752	8.79	16.43	318
2005-2006	27.86	27.98	1004	4.20	281.17	66919	8.68	18.50	362
2006-2007	26.51	24.29	916	5.15	355.52	69022	9.14	22.63	421
2007-2008	26.69	29.76	1115	5.06	348.19	68877	9.41	25.88	467
2008-2009	27.56	27.72	1006	4.42	285.03	64553	9.41	22.28	403
2009-2010	25.96	24.88	958	4.17	292.30	70020	10.13	24.02	403
2010-2011	27.22	32.48	1193	4.88	342.38	70091	11.24	33.00	499
2011-2012	26.31	29.80	1133	5.04	361.04	71668	12.18	35.20	491
2012-2013	26.48	30.94	1168	5.00	341.20	68254	11.98	34.22	486
2013-2014	28.05	32.75	1168	4.99	352.14	70522	11.96	35.90	510
2014-2015	25.60	27.51	1075	5.07	362.33	71511	12.82	34.80	462
2015-2016	26.09	25.25	968	4.93	348.45	70720	12.29	30.01	415
2016-2017	26.18	31.28	1195	4.44	306.07	69001	10.83	32.58	512
2017-2018*	24.65	31.31	1270	4.73	376.90	79650	12.43	34.89	477
CGR (%)	0.547	2.483*	1.925	0.988	1.457	0.468	2.427*	8.059**	5.498**
"t" value	2.02	4.18	4.56	3.07	3.39	2.25	6.74**	9.25**	7.11**

Compound Growth Rate \*is Significant at 5% and \*\* is highly significant at 1% level



**Fig 1:** Area and production of rice in India in 1998-99 to 2017-18

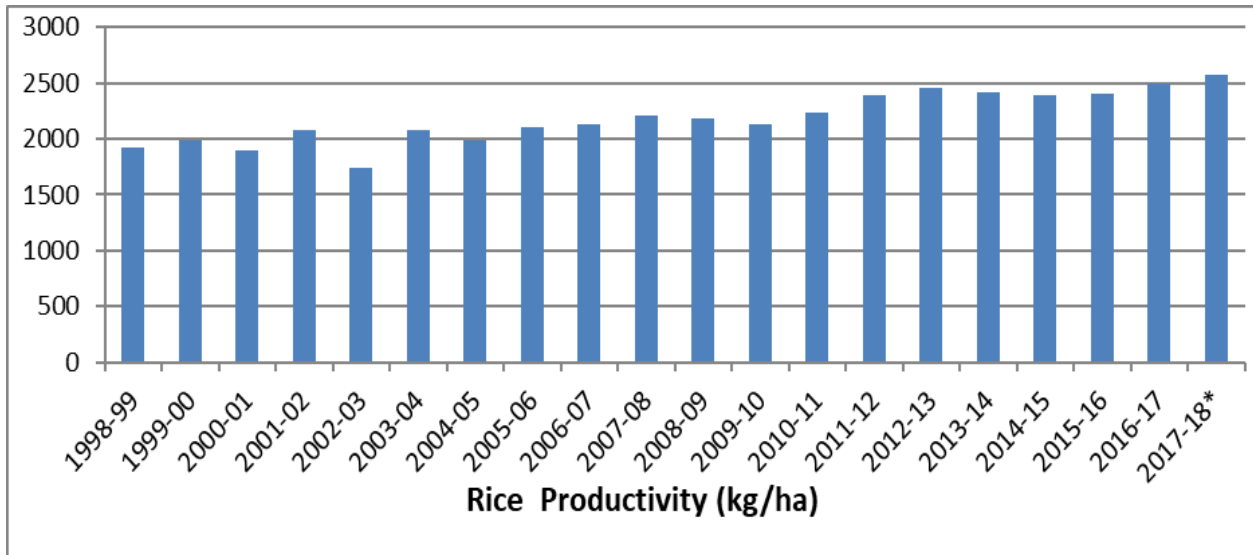


Fig 2: Productivity of rice in India in 1998-99 to 2017-18

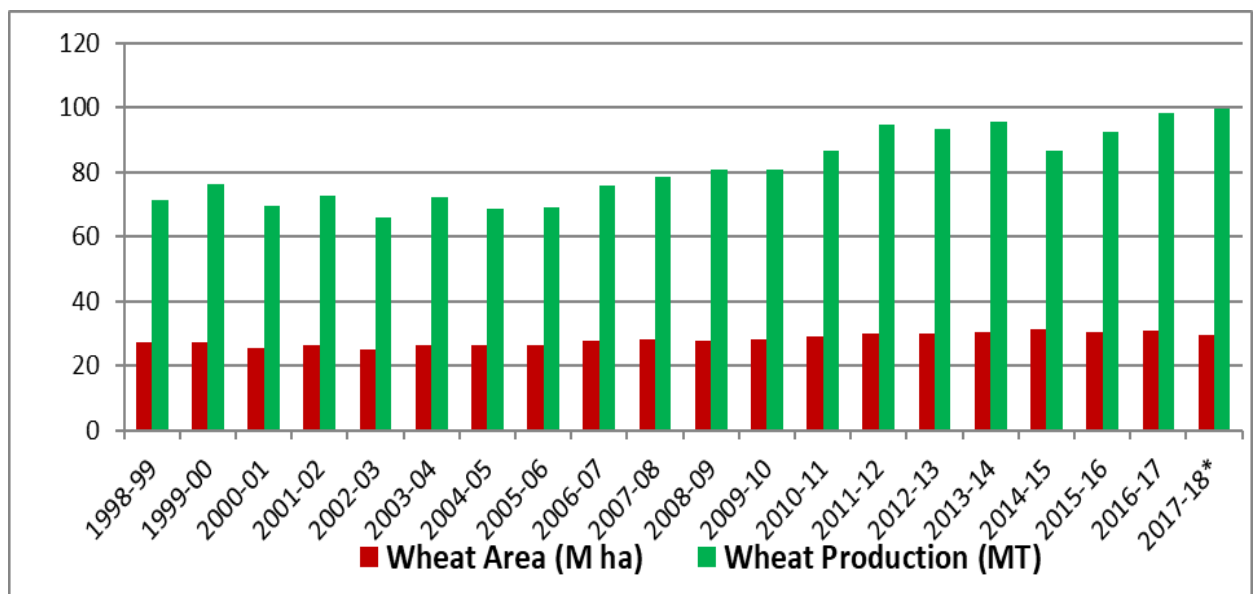


Fig 3: Area and production of wheat in India in 1998-99 to 2017-18

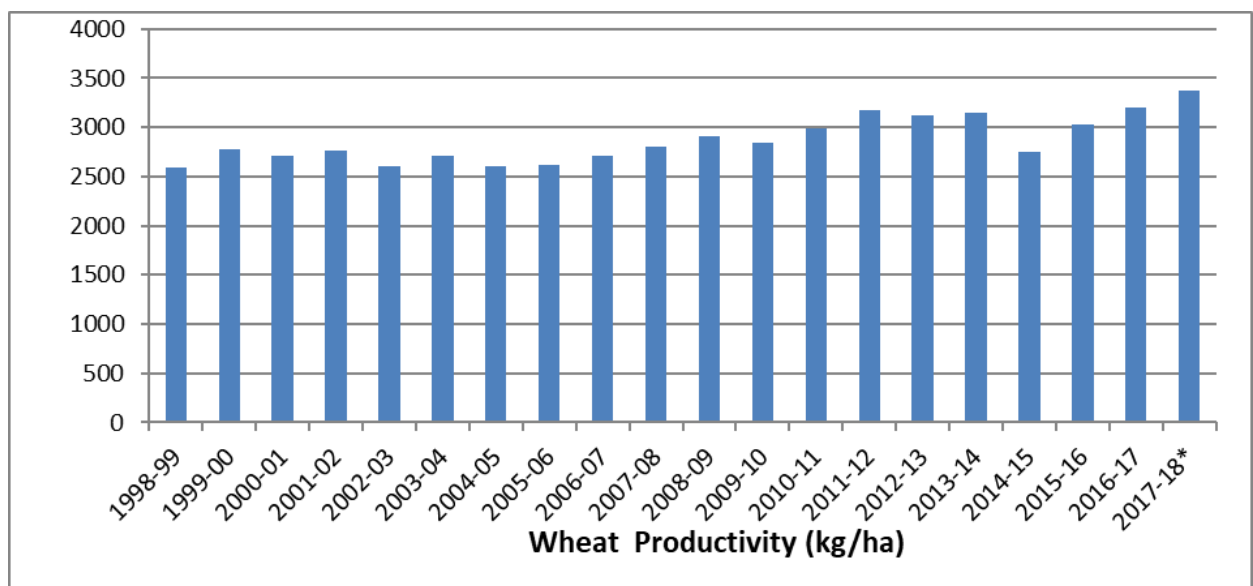


Fig 4: Productivity of wheat in India in 1998-99 to 2017-18

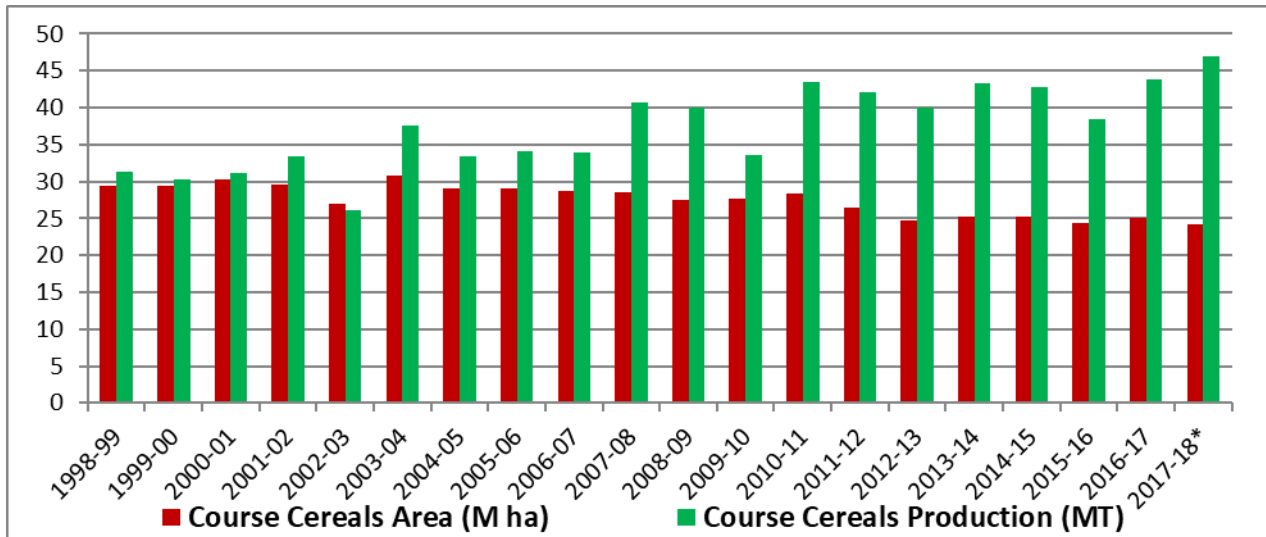


Fig 5: Area and production of coarse cereals in India in 1998-99 to 2017-18

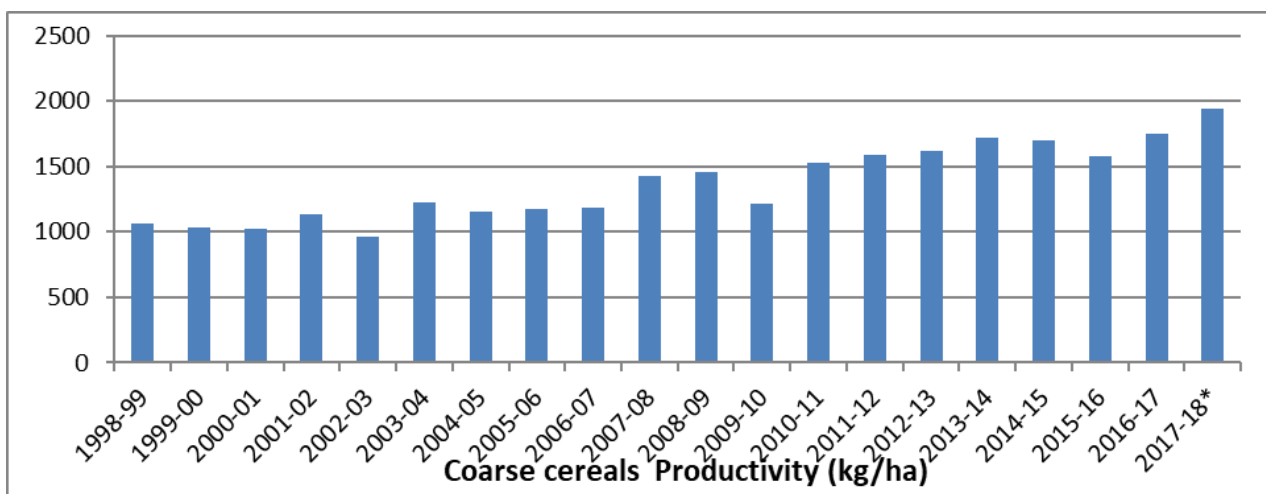


Fig 6: Productivity of Coarse cereals in India in 1998-99 to 2017-18

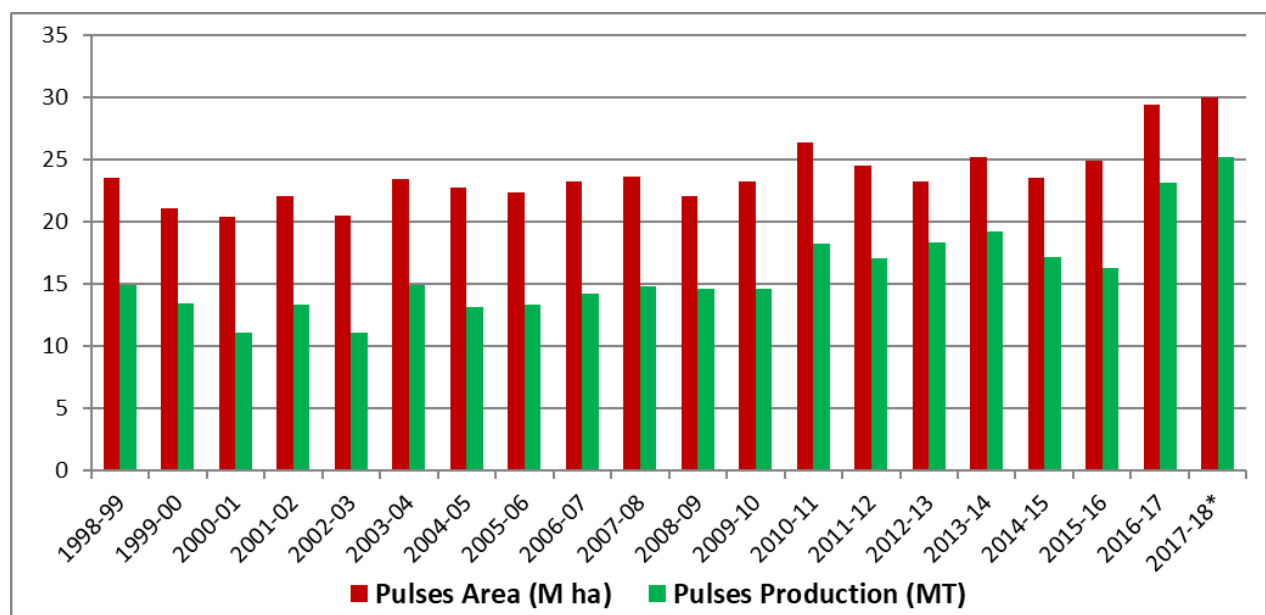
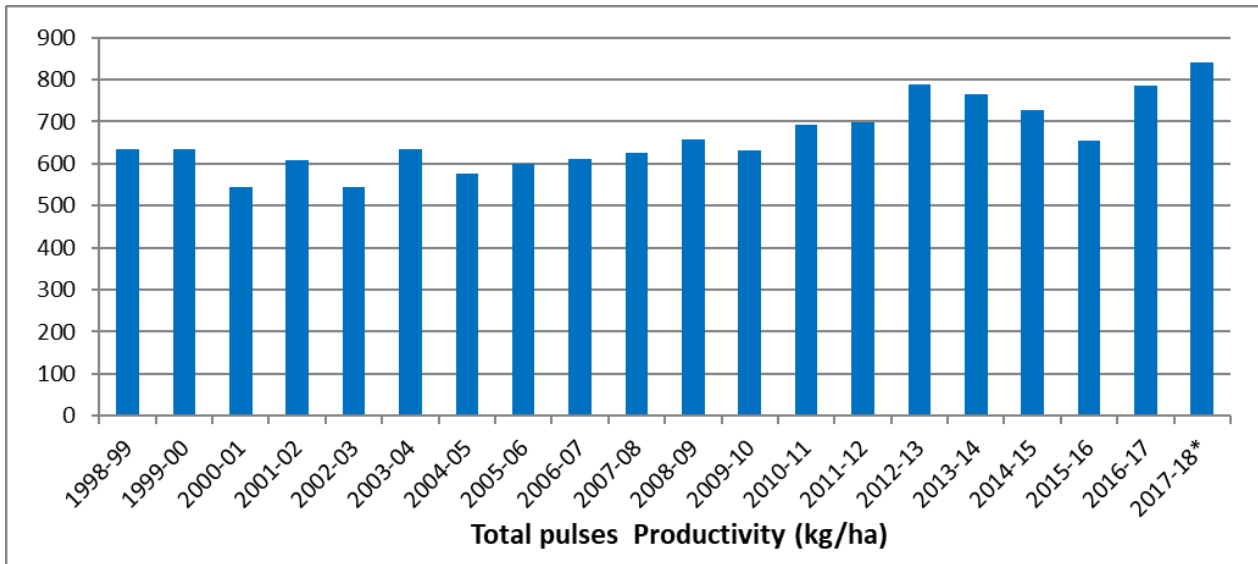
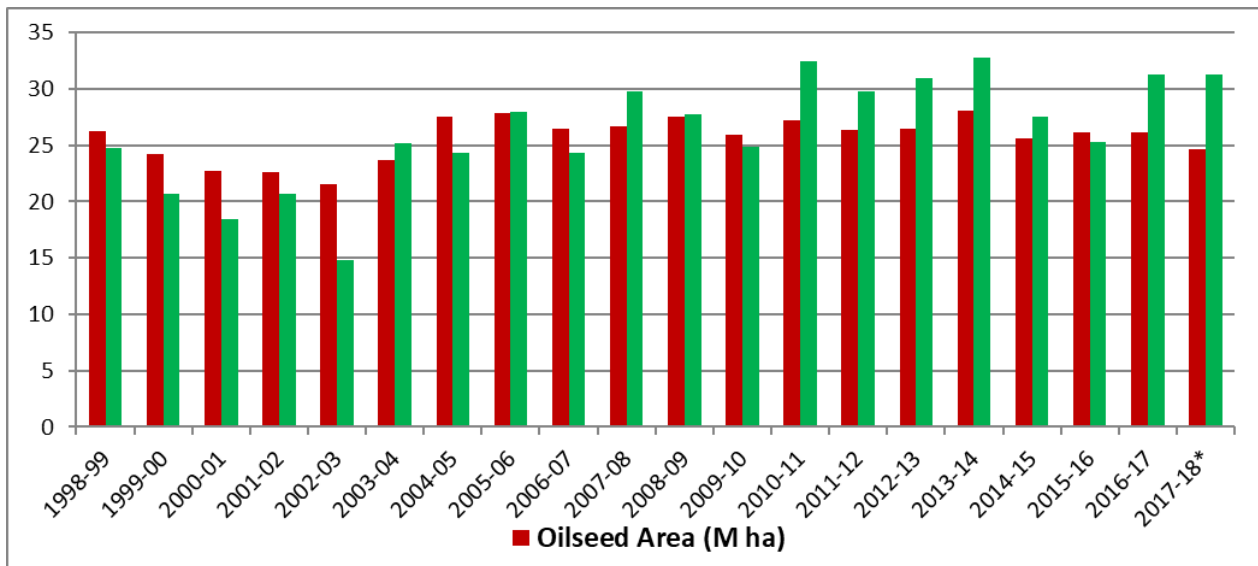


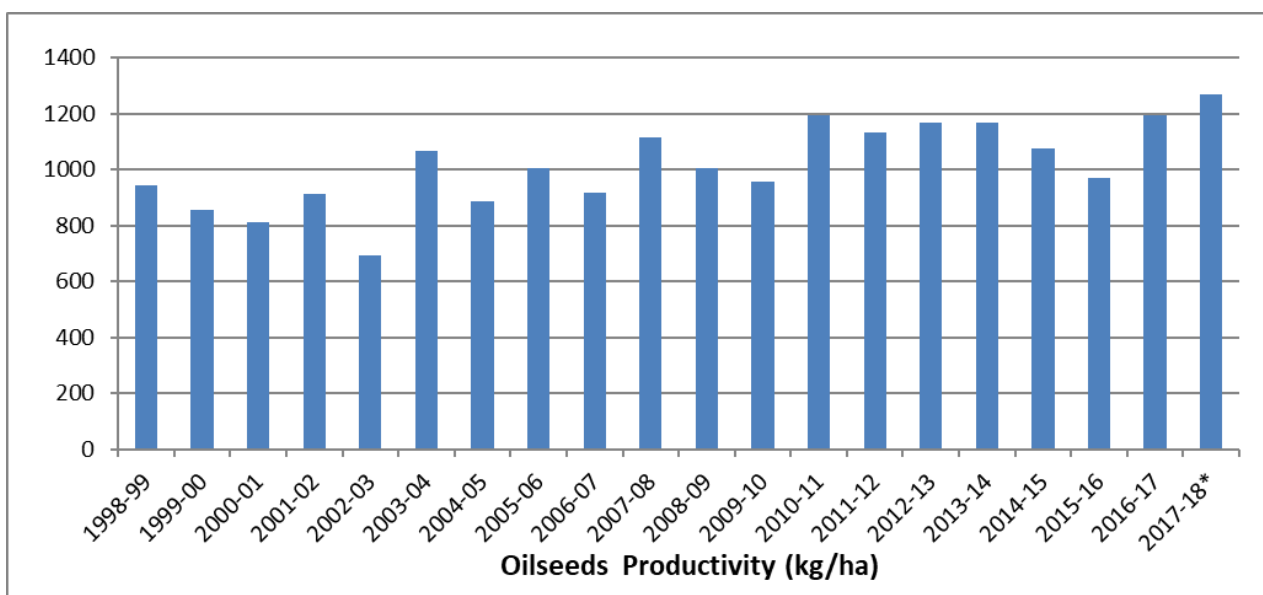
Fig 7: Area and production of Total pulses in India in 1998-99 to 2017-18



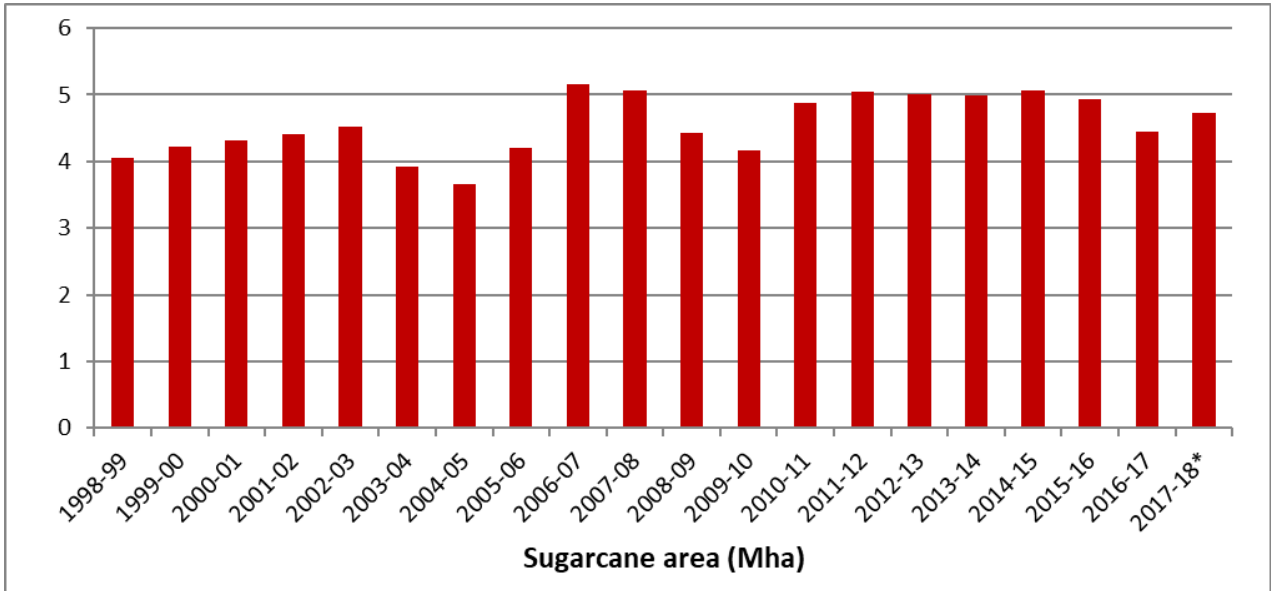
**Fig 8:** Productivity of total pulses in India in 1998-99 to 2017-18



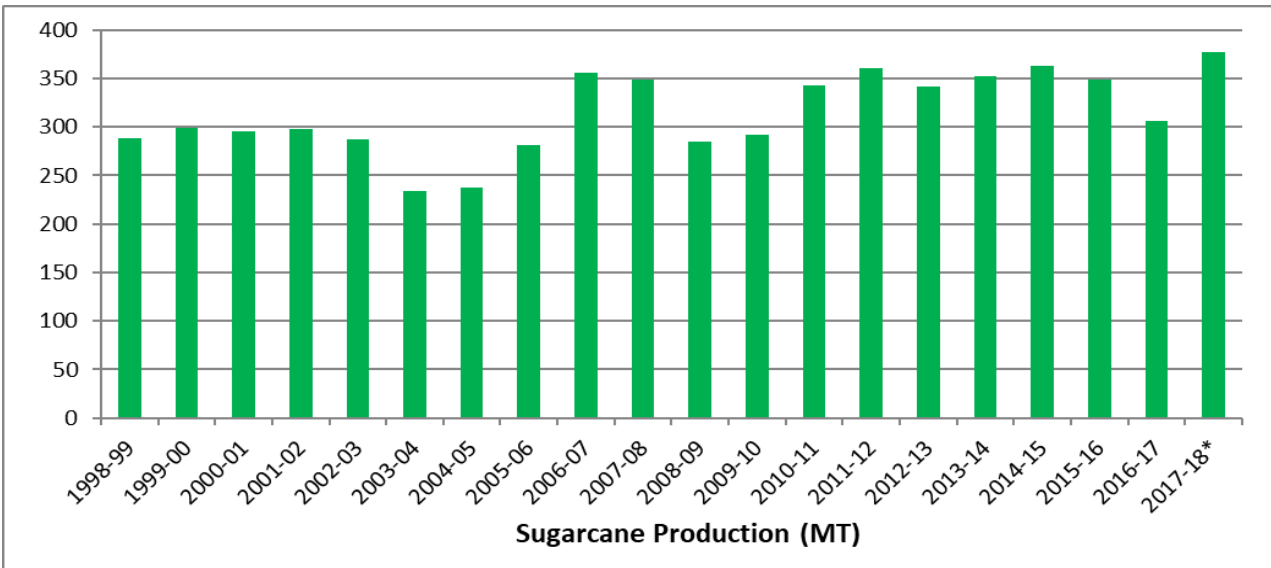
**Fig 9:** Area and production of oilseeds in India in 1998-99 to 2017-18



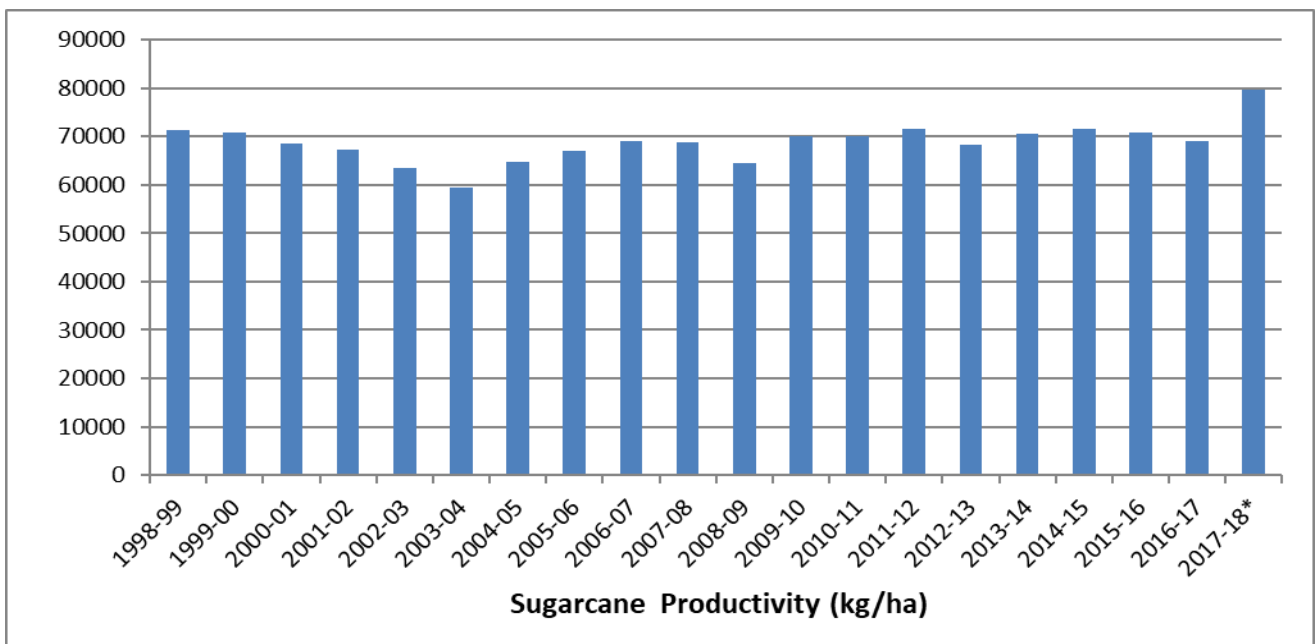
**Fig 10:** Productivity of oilseeds in India in 1998-99 to 2017-18



**Fig 11:** Area of sugarcane in India in 1998-99 to 2017-18



**Fig 12:** Production of sugarcane in India in 1998-99 to 2017-18



**Fig 13:** Productivity of sugarcane in India in 1998-99 to 2017-18



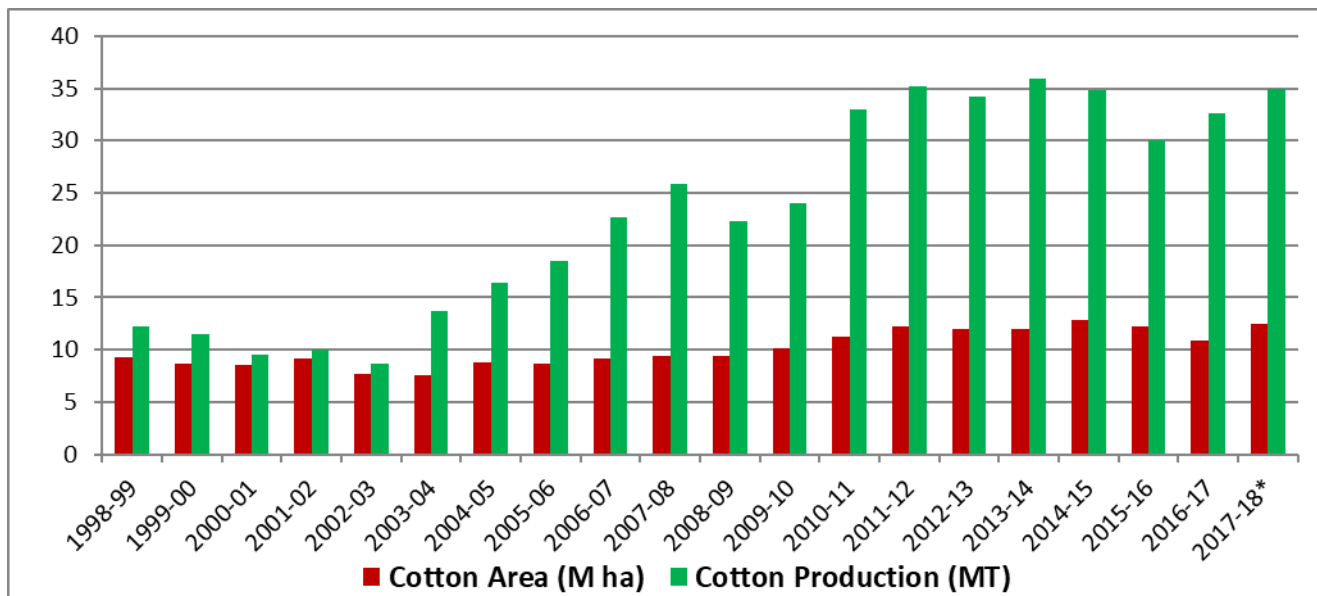


Fig 14: Area and production of cotton in India in 1998-99 to 2017-18

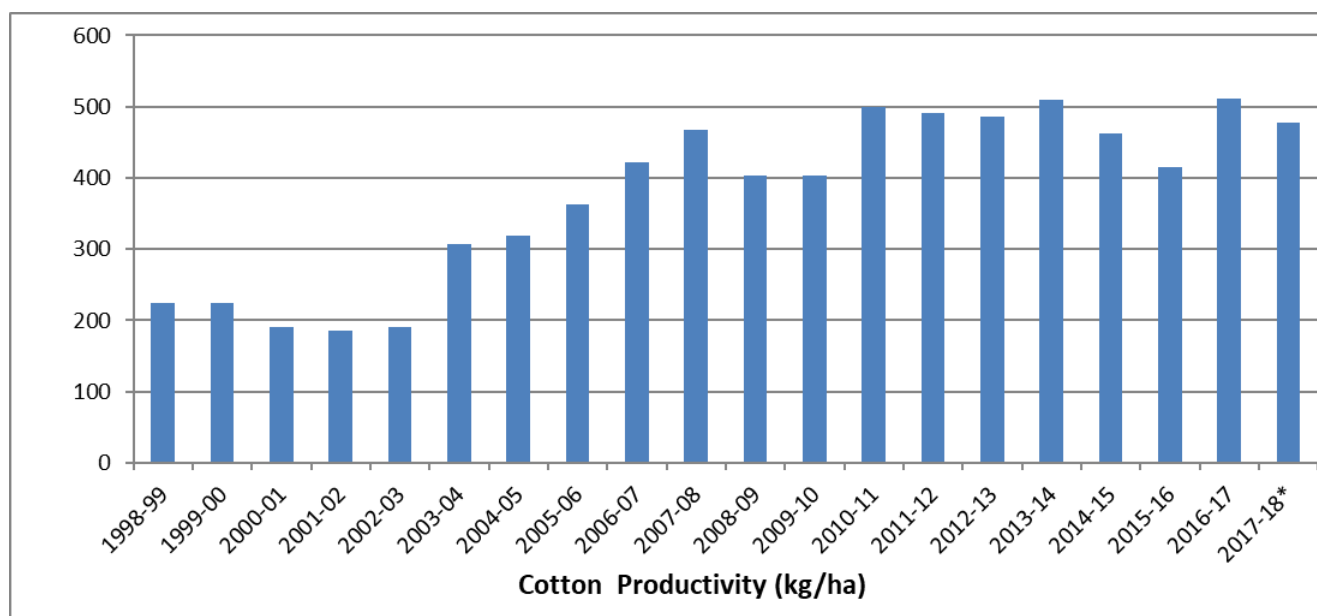


Fig 15: Productivity of cotton in India in 1998-99 to 2017-18

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