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Study on growth rates of area, production and productivity of major crops grown in Solapur district of Maharashtra

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Abstract

The study attempted to analyze the growth rates of area, production and productivity of major crops. The study is based on the secondary data collected for the three periods ie. Period I: 1990-91 to 2002-03, Period II: 2003-04 to 2016-17 and overall period: 1990-91 to 2016-17. Production and productivity of selected crops covering the period from 1990-91 to 2016-17 in respect of Solapur district were obtained by referring the socio-Economic Review and District Statistical Abstracts of Solapur district published by Directorate of Economics and Statistics, Planning Department Government of Maharashtra and India and also website of Department of Agriculture, Government of Maharashtra. The information obtained from various sources became useful for studying the land use and cropping pattern and estimation of growth rates of area, production and productivity of selected crops under study in Solapur district. For this study i have selected three periods. Among three Periods, 1990-91 was considered as base period. Comparative study between three periods had done. The data obtained on area, production and productivity of major crops which are grown in Solapur district for the period 1990-91 to 2016-17 was used for estimation of compound growth rates. The data was analysed to have compound growth rates of area, production and productivity of the above said crops for three different periods.

Keywords: Yield, compound growth rates, crop diversification, production function

Introduction

Agricultural Development

The development of agriculture is a process through which the shift takes place from stage of traditional agriculture to the stage of modernized agriculture resulting in increased production and productivity per unit of resources due to use of modern technology. During the process of transformation, the position of original equilibrium changes and production function shifts to a higher level and occupies a new equilibrium position, where the profits are maximum. The process of agricultural development includes use of high yielding varieties, adoption of improved package of practices including use of fertilizers, plant protection measures, irrigation, use of modern machinery etc. for increasing productivity of farm enterprises. The process aims at getting the maximum advantage of the available resources viz; land, labour, capital, etc. On the farm and finally depicts the prominent changes in resource use and allocation, productivity of crops over a period of time. The process of agriculture development is important from the view point of increasing agricultural production in the state as well as in the country.

Agricultural Development in Maharashtra

Agriculture is the mainstay of the state of Maharashtra. Maharashtra's economy is predominantly agrarian. Farming is the main occupation of the people. Both food crops and cash crops are grown in the state. Maharashtra is an important state of India so far it's contribution to the agriculture development is concerned. Maharashtra is the second largest state in India in terms of it's population and the third in respect of area. The state had highest per capita state domestic product among all the Indian states in the year 2011-12. Though, Maharashtra is one of the industrialized states in the country, agriculture and allied activities are still predominant in the state. Agriculture continues to be the major source of income to most of the population. Maharashtra could be considered one of the heterogeneous states in the Indian union as far as the varying agro-climatic conditions are concerned.

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The state comprises of Konkan, Western Maharashtra, Marathwada and Vidarbha regions which represent varying type of natural, physical, social and economic conditions quite distinct from each other. The variabilities in topography, soils and climatic factors bear significant impact on crop and land use pattern, use of production inputs and adoption of technological innovations of crop production among the regions. The inter-regional comparison of the performance of agriculture has revealed that, the technological advances in agriculture could not make much progress in their contribution to increase production and productivities of various crops in different regions. Because of these variability's, there existed significant imbalance and disparities in income level of farm families in the regions.

In Maharashtra all possible efforts have been made for increasing agriculture production and thereby to involve in the national campaign of development of agriculture which commenced during the post independence period. The development scheme viz; CADA, DPAP, SFDA, MFAL, etc, have been launched in the state. Maharashtra is forerunner in respect of many new schemes of agriculture development. Due to development of agriculture higher levels of production of food and other farm products, higher income and better standard of living of farm families have been achieved. When agriculture sector grows, the impact of it's development is felt in other sector of the economy and it accelerates the overall economic development of a region in Maharashtra.

The total food grain production in the state was 9.472 million tonnes in 1980-81, which increased to 15.79 million tonnes in 2016-17. The agricultural production in the states is highly subjected to the regularity of monsoon. The area under sugarcane, which is a prominent cash crop, has increased from 3.19 lakh hectares in 1980-81 to 10.22 lakh hectares in 2012-13 and which is decreased in 2016-17 up to 6.33 lakh hectares. It has been noted that the gross area irrigated showed an increase from 24.15 lakh hectares to 40.89 lakh hectares during the period from 1980-81 to 2012-13. The gross area irrigated increased upto 49.62 lakh hectares in 2016-17. The state's agricultural and allied sector has recorded a growth of 12.5 percent, which had dipped to minus 5.3 percent in the previous fiscal, propelled by policy reforms coupled with a good monsoon, according to the state Economic survey Report 2016-17. Maharashtra ranks first in GDP contribution to Indian economy. Agriculture sector has 11.9 percent GDP (10 percent for India) in 2016-17. Agriculture serves 51 percent employment directly and indirectly in Maharashtra.

Solapur district, which seems to be Agro-climatically representative of western Maharashtra, has been purposively selected for present study. The Solapur is situated in south-east edge of Maharashtra. There was that the finding of the study may, indicates the overall trend of agriculture in western Maharashtra. Therefore, the Solapur district has specifically selected for present study. The farmers in the district agriculturally conscious and have made sincere efforts for agricultural development since the inception of green revolution in the country. Solapur district is geographically one of the largest District in Maharashtra State. It is well defined to its west as well as to its east by the inward looking scraps of Phaltan ranges and Osmanabad plateau respectively. There are no prominent hill ranges in the district. The western foot hill regions in the parts of Malshiras and western Sangola. It is one of the identified drought prone district in India. Solapur district occupies 4.83 percent of area and

contains 4.10 percent of population of Maharashtra State. The total Geographical area of Solapur is of 15.055 lakh ha. Gross cropped area is near about 11.77 lakh ha. The net sown area of the district is of about 9.90 lakh ha. (i.e. 65.76%). Cropping intensity is 118.93 percent, the forest area is 33100 ha. (2.19%). It is believed that agricultural development in a specific region cause significant changes in the yield, production and productivity of major crops due to rational attitude of the farmers to make investment in land development, mechanization and to allocate their resources for high rewarding enterprises.

Methodology

It was concluded that the process of agricultural development had pronounced effects on the productivity of agriculture and as a result, higher level of agriculture production achieved per unit of available resources. In order to present an overall picture of average productivity, production and area under major crops, their relative growth rates examined. The annual compound growth rates (interval wise as well as overall basis) were computed for area, production and productivity of major crops viz., paddy, jowar, bajra, maize, sunflower, groundnut, cotton, Sugarcane for 27 years from 1990-91 to 2016-17 in Solapur district. For the purpose of scientific assessment of the agricultural development, compound growth rates of the above crops were separately estimated for area, production and productivity for 3 different periods viz., 1990-91 to 2002-03, 2003-04 to 2016-17 and 1990-91 to 2016-2017. This attempt also made to identify major factors influencing agricultural production during the study period. The compound growth rates were worked out by fitting exponential function of the following type to the data for three periods explained above

$$Y = ab^t$$

i.e in logarithmic form

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

Where

Y = Area in 00' hectares, production in 00' tonnes and productivity in Kg per hectare.

a = Intercept

b = Regression coefficient

t = Time period in year

Finally, the annual rates of compound growth of area, production and productivity of the crops was worked out by using the formula.

$$r = (\text{Antilog } b - 1) \times 100$$

Where

r = Compound growth rate

The significance of the estimated compound growth rates was tested with the help of student's 't' test

Results and Discussion

Production of Major Crops in Solapur District

Changes in production of major crops in the Solapur district is showed in Table 1.

It is concluded from table that, in case of cereals the production of paddy, kharif jowar and bajra were decreased in study period. The production of maize had increased from

25400 tonnes to 75780 tonnes in overall study period, where as, it was decreased in 2003-04 from 25400 tonnes to 4900 tonnes. It was recorded an increase by 198.34 percent over the base year. The production of total cereals had decreased from 474300 tonnes to 51100 tonnes in 2003-04, later on it was increased to 526230 tonnes in 2016-17. Production of cereals was increased by 10.94 percent in 2016-17. The production of

total pulses was also decreased in 2003-04 from 34500 tonnes to 7800 tonnes, it was increased to 69400 tonnes in 2016-17. It showed an increase about 101.15 percent.

Over the base year. Among the pulses production of red gram had increased from 6700 tonnes to 16798 tonnes in study period, while, in 2003-04 it was decreased up to only 700 tonnes.

Table 1: Production of Major Crops. (Production in '00' tonnes)

Sr. No	Crops	1990-91 (Base Year)	2003-004	2016-17	Percent change in production over the base year.	
					2003-004	2016-17
1	Paddy	44.00	1.00	0.4	-97.72	-99.09
2	Wheat	520.00	133.00	777.8	-74.42	49.57
3	Kharif jowar	51.00	1.00	0.8	-98.03	-98.43
4	Rabi jowar	3752.00	286.00	3617.9	-92.37	-3.57
5	Bajra	113.00	37.00	94.00	-67.25	-16.81
6	Maize	254.00	49.00	757.8	-80.70	198.34
7	Other cereals	9.00	4.00	13.6	-55.55	51.11
	Total cereals	4743.00	511.00	5262.30	-89.22	10.94
9	Red gram	67.00	7.00	167.98	-89.55	150.71
0	Chick pea	89.00	51.00	381.00	-42.69	328.08
11	Green gram	8.00	6.00	51.95	-25.00	549.375
12	Black gram	3.00	13.00	86.94	333.3	2766.6
13	Other pulses	178.00	1.00	299.00	-99.43	67.97
14	Total pulses	345.00	78.00	694.00	-77.39	101.15
15	Total food grains	5088.00	589.00	5956.30	-88.42	17.06
6	Groundnut	159.00	9.00	56.9	-94.33	-64.21
17	Sunflower	520.00	28.00	129.3	-94.61	-75.13
18	Safflower	33.00	11.00	19.00	-66.66	-42.42
19.	Soybean	5.00	7.00	101.7	40.00	1934.00
20.	Other pulses	161.00	3.00	12.1	-98.13	-92.48
21	Total oilseeds	556.00	58.00	319.00	-89.56	-42.62
22	Cotton	25.00	15.00	13.7	-40.00	54.8
23	Sugarcane	33877.00	28315.00	47620.7	-16.41	40.56

Source: Socio- Economic Review and District Statistical abstract of Solapur district: 1990-91 to 2017-18

Production of red gram had increased by 150.11 percent in study period. Production of gram (chick pea) also increased from 8900 tonnes to 38100 tonnes. It increased by 328.08 percent over the base year. Production of green gram also increased in study period. In fact, production of total pulses decreased in 2003-04, but later on it increased from 34500 tonnes to 69400 tonnes in study period. The production of total food grains increased from 50880 tonnes to 595630 tonnes but it decreased from 508800 tonnes to 58900 tonnes in 2003-04. The production of total oilseeds had decreased continuously from 55600 tonnes to 31900 tonnes in study period. It decreased by 42.62 percent over the base year. The production of cotton decreased from 2500 tonnes to 1370 tonnes in study period but it is decreased to 1500 tonnes in 2003-04. It was decreased by 54.8 percent in study period. The production of sugarcane was increased from 3387700 tonnes to 4762070 tonnes in study period. It was increased by 40.56 percent over the base year.

Productivity of Major Crops in Solapur District

It could be concluded from the Table.2. That the productivity of most of the crops had increased over the base year. The critical observations showed that the productivity of crops mostly increased during over all period (1990-91 to 2016-17).

The major reason for this might be the use of improved technology and high yielding varieties of crops. Among different crops, the average productivity of wheat was increased from 1165.92 Kg to 1338 Kg in study period but it was noticed that productivity of wheat was decreased to 433 Kg in 2003-04. Average productivity of rabi jowar was declined from 533.94 Kg to 47 Kg in 2003-04 but later it was increased to 549 Kg in 2016-17. It was recorded an increase by 2.82 percent over the base year. In case of maize, there was same situation, average productivity of maize was decreased in 2003-04 and it was increased in 2016-17 from 1176 Kg to 1762 Kg over base year. However, the overall productivity of total cereals had decreased from 610 Kg to 76 Kg in 2003-04 later it was increased to 685 Kg in 2016-17. It recorded an increase by 12.29 percent over the base year. The average productivity of pulses had increased from 397 kg to 613 Kg in overall period but it was drastically declined up to 190 Kg in 2003-04. Among the pulses, red gram, chick pea (gram) and green gram had shown increase in productivity by 242.07 percent, 84.42 percent and 105.59 percent respectively over the base year. The average productivity of oilseeds was increased from 521 Kg to 534 Kg in total study period but it was drastically decreased in 2003-04.

Table 2: Productivity of major crops. (Productivity in Kg/ha)

Sr. No.	Crops	1990-91 (Base Year)	2003-04	2016-17	Percent change over the base year	
					2003-04	2016-17
1	Paddy	880.00	500.00	248.00	-43.18	-71.81
2	Wheat	1165.92	433.00	1338.00	-62.86	14.75
3	Kharif Jowar	850.00	164.00	495.00	-80.70	-41.76
4	Rabi Jowar	533.94	47.00	549.00	-91.19	2.82
5	Bajra	366.00	381.00	349.00	4.09	-4.64
6	Maize	1176.00	331.00	1762.00	-71.85	49.82
7	Total cereals	610.00	76.00	685.00	-87.54	12.29
8	Red Gram	164.00	64.00	561.00	-60.97	242.07
9	Gram	366.00	181.00	675.00	-50.54	84.42
10	Green Gram	268.00	466.00	551.00	73.88	105.59
11	Black Gram	176.00	565.00	570.00	221.022	223.86
12	Total pulses	397.00	190.00	613.00	-52.14	54.40
13	Total food grains	600.00	82.00	676.00	-86.33	12.66
14	Groundnut	638.00	1106.00	1338.00	73.35	109.71
15	Sunflower	645.00	130.00	657.00	-79.84	1.86
16	Safflower	286.66	84.00	579.00	-70.69	101.98
17	Soybean	555.56	1106.00	367.00	99.07	-33.94
18	Total oilseeds	521.00	152.00	534.00	-70.82	2.49
19	Cotton	1042.00	231.00	265.00	-77.83	-74.56
20	Sugarcane	85332.49	58000.00	74213.00	-32.03	-13.03

Source: Socio- Economic Review and District Statistical abstract of Solapur district: 1990-91 to 2017-18

Average productivity of groundnut had increased from 638 Kg to 1338 Kg in study period. It was increased by 109.71 percent over the base period. Average productivity of Soybean had recorded increasing trend in productivity which was 1106 Kg in 2003-04 but it was decreased in 2016-17 up to 367 Kg. It was decreased by 33.94 percent in over the base year. The average productivity of cotton was also decreased from 1042 Kg to 231 in 2003-04, later it was increased to 265 Kg in 2016-17. Average productivity of sugarcane was decreased in study period from 85332.49 Kg to 74213 Kg in study period. The changes in productivity of major crops in Solapur district during 1990-91 to 2016-17 is depicted in Table.

Annual Compound Growth Rates of Area, Production and Productivity of major crops In Solapur District

In the previous section an attempt had been made to study the agricultural development in terms of changes in the production, productivity during the last 27 years in Solapur district. It was concluded that the process of agricultural development had pronounced effects on the productivity of agriculture and as a result, higher level of agriculture production achieved per unit of available resources. In order to present an overall picture of average productivity, production and area under major crops, their relative growth rates examined.

The annual compound growth rates (interval wise as well as overall basis) were computed for area, production and productivity of major crops viz., paddy, jowar, bajra, maize, sunflower, groundnut, cotton, Sugarcane for 27 years from 1990-91 to 2016-17 in Solapur district. For the purpose of scientific assessment of the agricultural development, compound growth rates of the above crops were separately estimated for area, production and productivity for 3 different periods viz., 1990-91 to 2002-03, 2003-04 to 2016-17 and 1990-91 to 2016-2017. This attempt also made to identify major factors influencing agricultural production during the study period. The period wise annual compound growth rates of area, production and productivity of cereals, pulses, oilseeds and commercial crops for the period 1990-91 to

2016-17 presented in table. 3. and table. 4. The annual compound growth rates of area, production and productivity of all cereals, pulses, oilseeds, cotton and sugarcane fluctuated widely during the period.

Annual compound growth rates of area, production and productivity of cereals, pulses and total food grains

a. Growth rates of area, production and productivity of paddy

It can be noted from Table. 3. that the performance of paddy during the entire study period was not good. During overall period, paddy had recorded negative growth rates in area and production and productivity. In period II, growth rate of area, production and productivity were negative with tunes of 0.71 percent, 5.91 percent and 6.87 percent respectively. In overall period, growth rates of area, production and productivity were 12.54 percent, 18.54 percent and 6.69 which were negatively significant at one percent level of significance. From that, it was revealed that, In over all period area, production and productivity of paddy drastically decreased.

b. Growth rates of area, production and productivity of wheat

In case of wheat, Period I had recorded positive growth rates for area, production and productivity. In case of period I, growth rate of area was recorded 3.51 percent which was highly significant and growth rate of production was recorded 4.26 percent which was significant 5 percent level of significance. Growth rate of productivity was 0.72 percent. In period II, growth rates of area and production and productivity were negative with tunes of 1.85, 0.71 and 1.16 percent respectively. Overall period had recorded positive growth rates of area, production and productivity with tunes of 0.78, 0.66 and 0.12 percent respectively. It was showed increase in area, production and productivity of wheat in study period.

c. Growth rates of area, production and productivity of kharif jowar

Period I recorded negative growth rates for area, production

and productivity of kharif jowar with tunes of 14.66 percent, 16.79 percent and 3.55 percent respectively. Also period II recorded negative growth rates for area with a tune of 2.33 percent and growth rates of production and productivity were positive with tunes of 4.3 percent and 2.93 percent respectively. Over all period had recorded negative significant growth rates in area, production and also for productivity with tunes of 12.53 percent, 11.56 percent and 4.33 percent respectively.

d. Growth rates of area, production and productivity of rabi jowar

Rabi jowar is very important crop in Solapur district. Although, period I recorded negative growth rates in area, production and productivity with tunes of 0.12 percent, 1.04 percent and 0.92 percent respectively. Period II recorded negative growth rate of area, with a tune of 1.17 percent and production and productivity are recorded positive with tunes of 3.02 percent and 4.2 percent.

Over all period recorded negative growth rates for area, production and productivity with tunes of 0.56 percent which is negatively significant and 0.64 percent, 0.08 percent respectively.

e. Growth rates of area, production and productivity of Bajara

In period I, growth rates of area, production and productivity were recorded positive with tunes 1.83 percent, 1.36 percent and 0.52 percent respectively. Period II recorded negative growth rates for area, production and productivity with tunes of 2.82 percent, 4.3 percent and 3.2 percent per annum. In over all period, negatively significant growth rates for area, production and productivity were recorded with tunes of 5.69 percent, 7.09 percent and 1.27 percent per annum respectively

f. Growth rates of are, production and productivity of maize

Maize had recorded positive significant growth rates for area, production and productivity in period I. Growth rates of area was 5.04 percent with 10 percent level of significance, growth rate of production was 5.61 percent with 10 percent level of significance and for productivity it was 0.54 percent. Period II, showed significant increase in growth rates of area, production and productivity with tunes of 4.46 percent significant at 5 percent level of significance, 11.94 percent significant at 5 percent level of significance and 7.15 percent per annum significant at 5 percent level of significance. Over all period also recorded highly significant positive growth rates in area, production and productivity with tunes of 4.01 percent, 6.33 percent and 2.23 percent respectively per annum.

g. Growth rates of area, production and productivity of total cereals

Period I recorded positive growth rates for area, production and productivity with tunes of 0.39 percent, 0.08 percent and 0.05 percent per annum respectively. In period II, growth rate of area was decreased with negative growth rate with tune of 0.9 percent, where as growth rates of production and productivity showed positive with tunes of 2.89 percent and 0.13 percent per annum. In over all period, growth rates of area, production and productivity were negative with tunes of 0.38 percent, 0.17 percent and 1.45 percent per annum respectively. Productivity shows positive annual growth rate

with a tune of 1.45.

h. Growth rates of area, production and productivity of gram (chikpea)

In period I, growth rates of area and production positively increased with tunes of 3.12 percent and 5.63 percent where as growth rate of productivity is positive with a tune of 2.44 percent. In period II recorded positive growth rates for area, production and productivity but slightly decreased with tunes of 1.06 percent, 2.66 percent and 1.61 percent per annum respectively. Over all period had recorded highly significant positive growth rates both in area and production with tunes of 1.81 percent and 3.1 percent. Productivity had showed positive growth rate of 1.27 percent per annum

i. Growth rates of area, production and productivity of red gram

Red gram had showed highly significant but negative growth rate for area with a tune of 6.67 percent and production, productivity showed negative growth rates with tunes of 4.92 percent and 3.09 percent per annum respectively in period I. But, period II, had recorded positive growth rates for area, production and productivity with tunes of 4.21 percent, 8.36 percent and 4.99 percent per annum respectively. In over all period, growth rate of area was negative with a tune of 2.55 percent and growth rate of production and productivity is positive with tunes of 0.18 percent and 2.43 percent per annum respectively.

j. Growth rates of area, production and productivity of green gram

In period I, area showed negative growth rate with a tune of 1.87 percent and production and productivity showed positive growth rates with tunes of 0.1 percent and 1.61 percent per annum respectively. In period II, area, production and productivity had recorded negative growth rates with tunes of 2.51 percent, 0.67 percent and 3.38 percent per annum respectively. In Over all period growth rates of area, production and productivity with tunes of 2.5 percent, 0.57 percent and 0.07 percent per annum respectively.

k. Growth rates of area, production and productivity of black gram

In period I, growth rates of area, production and productivity was recorded positive with tunes of 1.68 percent, 1.98 percent and 0.28 percent per annum respectively. In period II, had recorded growth rates of area, production and productivity had increased up to 4.55 percent, 2.24 percent and 1.62 percent per annum respectively. In over all area, production and productivity shows highly significant positive growth rates with tunes of 4.07 percent, 5.64 percent and 1.49 percent per annum respectively.

l. Growth rates of area, production and productivity of total pulses

Period I had recorded negative growth rates for area, production and productivity with tunes of 0.35 percent, 2.43 percent and 0.22 percent respectively. Where as period II showed positive growth rates with tunes of 2.00 percent, 3.3 percent and 1.3 percent per annum respectively. Overall period had showed negative growth rate of area with tune of 0.35 percent where as production and productivity showed positive growth rate with tunes of 0.51 percent and 1.32 percent per annum respectively.

m. Growth rates of area, production and productivity of total food grains

Total food grains had showed highly significant negative growth rate in case of production with a tune of 0.31 percent where as area and productivity showed negative growth rates with tunes of 0.19 percent and 0.83 percent respectively. In period II, area showed negative growth rate with a tune of

0.63 percent where as production and productivity showed positive growth rates with tunes of 3.82 percent and 4.49 percent per annum respectively. Over all period had recorded positively increased growth rates with tunes of 0.27 percent, 0.5 percent and 0.69 percent per annum respectively under consideration in Solapur district.

Table 3: Annual compound growth rates of cereals and pulses in Solapur

Sr. No	Crops	Period I 1990 – 91 to 2002 -03			Period II 2003 – 004 to 2016 – 17			Overall period 1990 – 91 to 2016 – 17		
		A	P	Y	A	P	Y	A	P	Y
1	Paddy	-13.1***	-11.68**	-1.63	-0.71	-5.91	-6.87	-12.54***	-18.54***	-6.69***
2	Wheat	3.51***	4.26**	0.72	-1.85	-0.71	-1.16	0.78	0.66	0.12
3	Kharif jowar	-14.66***	-16.79***	-3.55*	-2.33	4.3	2.93	-12.53***	-11.56***	-4.33***
4	Rabi jowar	-0.12	-1.04	-0.92	-1.17	3.02	4.2	-0.56*	-0.64	-0.08
5	Bajra	1.83	1.36	0.52	-2.82	-4.3	-3.2	-5.69***	-7.09***	-1.27
6	Maize	5.04*	5.61*	0.54	4.46**	11.94**	7.15**	4.01***	6.33***	2.23**
7	Total cereals	0.39	0.08	0.05	-0.9	2.89	0.13	-0.38	-0.17	-1.45
8	Gram	3.12**	5.63*	2.44	1.06	2.66	1.61	1.81***	3.1**	1.27
9	Red gram	-6.67**	-4.92	-3.09	4.21	8.36	4.99	-2.55*	0.18	2.43
10	Green gram	-1.87	0.1	1.61	-2.51	-0.67	-3.38	-2.5	-0.57	-0.07
11	Black gram	1.68	1.98	0.28	4.55	2.24	1.62	4.07***	5.64**	1.49
12	Total pulses	-0.35	-2.43	-0.22	2.00	3.3	1.3	-0.35	0.51	1.32*
13	Total food grains	-0.19	-0.31***	-0.83	-0.63	3.82	4.49	0.27	0.5	0.69

(***, **, * indicates at 1, 5 and 10 percent level of significance respectively).

Table 4: Annual compound growth rates of oilseeds and commercial crops in Solapur

Sr. No	Crops	Period I 1990 –91 to 2002 -03			Period II 2003 –04 to 2016 –17			Overall period 1990 –91 to 2016 –17		
		A	P	Y	A	P	Y	A	P	Y
1	Groundnut	2.58***	7.34***	8.51***	-4.9	-1.21	-0.65	-6.98***	4.37**	5.93***
2	Sunflower	0.62	2.46***	1.6	-6.41***	-3.55	-3.09	3.67***	2.31***	0.14
3	Safflower	4.22	10.74**	6.28*	-17.03***	-12.77**	-5.26	7.31***	3.29	4.42***
4	Soybean	0.24	2.94	2.32	24.33***	15.65***	6.9	13.59***	12.77***	0.94
5	Total oilseeds	-2.2*	-3.96**	-0.45	-3.19	-0.34	-2.94	-3.9***	-2.39***	-1.64*
6	Sugarcane	6.05***	6.69***	0.66	7.18**	7.64*	0.7	6.5***	6.49***	0.13
7	Cotton	4.64***	6.24*	12.27**	-3.22	-2.78	-1.2	-8.54***	-7.31***	-7.47***

(***, **, * indicates 1, 5 and 10 percent level of significance respectively).

Annual Compound Growth Rates of Area, Production and Productivity of oilseeds crops

The close observation of period wise growth rates of oilseeds revealed that, the growth rates of area and production and productivity in period I recorded highly significant negative with tunes of 2.2 percent, 3.96 percent and 0.45 percent per annum respectively. In period II, also recorded negative growth rates with tunes of 3.19 percent, 0.34 percent and 2.94 percent respectively. In overall period, growth rates of area and production and productivity recorded highly negatively significant growth rates with tunes of 3.9 percent, 2.39 percent and 1.64 percent per annum respectively.

Annual Compound Growth Rates of Area, Production and Productivity of Commercial Crops

a. Growth rates of area, production and productivity of sugarcane

Sugarcane had recorded highly significant positive growth rates of area, production and productivity with tunes of 6.05 percent, 6.69 percent and 0.66 percent per annum respectively. In period II, growth rates of area and production and productivity had increased to 7.18 percent, 7.64 percent and 0.7 percent respectively. Overall period, growth rates of area, production and productivity were positive with tunes of 6.5 percent, 6.49 percent and 0.13 percent per annum respectively.

b. Growth rates of area, production and productivity of cotton

Period I had recorded highly significant positive growth rates for area, production and productivity with tunes of 4.64 percent, 6.24 percent and 12.27 percent respectively. Both period II and overall period had recorded negative growth rates for area, production and productivity. Over all period depicted highly significant negative growth rates of area, production and productivity with tunes of 8.54 percent, 7.31 percent and 7.47 percent per annum respectively.

Conclusions

In case of production and productivity of major crops, it was observed that, production of paddy, kharif jowar, bajara had decreased during the study period. Where as, production of maize and wheat was increased in study period. Production of total cereals was increased by 10.94 percent over the base year. In case of pulses, production of red gram, gram, green gram, black gram was increased during study period. In case of oilseeds, the production of groundnut, sunflower, safflower had decreased where as, production of soybean has increased drastically during the study period. Production of cotton and sugarcane has increased over the base year.

The changes in productivity of major crops showed that except paddy, kharif jowar, bajra, soybean, sugarcane and cotton the productivity of all other crops had increased over the base year 1990-91. It might be due to increase in HYV's

of respective crops. The productivity of maize had declined during II period and again it was increased in period III. Growth rates indicated that, the area, production and productivity of maize increased significantly during the period under study. The area, production and productivity of wheat showed significant increase. The area, production and productivity of total cereals recorded negative growth rates. In case of total pulses growth rate of area recorded negative growth rate. where as growth rates of production and productivity are positive. The growth rates of area, production and productivity of total oilseeds decreased significantly. In case of sugarcane, growth rates of area and production increased significantly where as growth rate of productivity was 0.13 percent per annum during the study period. Cotton also recorded negatively significant growth rates of area, production and productivity in study period.

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