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Studies on growth rates of area, production and productivity of major crops in Nanded district of Maharashtra

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Abstract
The present investigation was undertaken in Nanded district of Maharashtra. The study was focused on examining agricultural development in Nanded district over a period of time for recommending better future policies. Estimating trends in land use and cropping patterns, growth rates of area, production and productivity of important crops, infrastructural development, major variables impacting agricultural production, challenges and suggestions are all incorporated in this section. The district of Nanded comes under Marathwada division of Maharashtra with 8 subdivisions and there are total 16 tehsils in the district. The analysis was based on secondary data collected from several public entities in Nanded and the Maharashtra Government. The secondary data collected for the agriculture years from 1990-91 to 2018-19 was analysed by using simple tabular approach and functional analysis method. The exponential function was used to examine the growth rates of area, production, and productivity of important crops. The growth rates of area of food grains decreased at the rate of 0.3 and 2.15 percent per annum while the production showed non-significant increase during the period under study. The growth rates of area and production of oilseeds were increased with rates of 0.79 percent and 0.56 percent per annum, respectively whereas the growth rates of area and production of cotton are slightly increased at the rate of 0.38 and 1.26 percent per annum for overall period in the district.

Keywords: Nanded, growth rates, area, production and productivity

Introduction
Nanded is one of the eighth districts in Marathwada division of state Maharashtra. It is located in south- east part of Maharashtra at 18°15”-19°55” north and 77°7”-78°15” east. Nanded is surrounded by districts Hingoli and Yavatmal from north, Parbhani from north west, Latur from south west. Adilabad and Nizamabad districts of Telangana state forms south east boundary of Nanded district while Bidar district of Karnataka state forms southern boundary. Total area of the district is 10440sq.km which is 3.41 percent of Maharashtra. Nanded district comes under Marathwada division of Maharashtra and divided into 8 subdivisions for ease of governance *viz.*, Nanded, Bhokar, Biloli, Degloor, Dharmabad, Hadgaon, Kandhar and Kinwat. Total area of the district is 10440 km sq. which is 3.41% of Maharashtra. According to 2011 census, the district had population of 33,61,000 of which rural population was 24,47,000 and urban population was 9,14,000. Out of total population, 17,30,000 were males and 16,31,000 were females. The soils of the districts are light, medium and heavy black cotton soils with hilly area in the northern part of the district. Some areas in Kinwat tehsil shows low quality reservoir of limestone which is mixed with sand. Special quality of soil required for construction work is available in Nanded. The main rivers flowing in Nanded districts are Godavari, Manjara, Manyad, Saraswati, Painganga, Asna, Sita and Lendi. Godavari is an important river in Nanded district which flows from east and enter in Nizamabad district of Andhra Pradesh. Manjra is the tributary of Godavari which flows from south to north and crosses the border of AP. The climate of Nanded district is warm and cool. The major agricultural products in the district are soyabean, cotton, sugarcane, redgram, greengram, blackgram etc. every year a huge chunk of revenue comes from the agricultural products in the district helps in its economy to a great extent. As a result, the study aimed at evaluating agricultural development must examine changes in land use and cropping patterns, area, production and productivity of major crops grown, infrastructural development in terms of provision of critical inputs, markets and value addition systems as well as identify the factors influencing agricultural production.

Materials and Methods

The Nanded district was selected purposively for the present study. Secondary data on various parameters of Agriculture for the period starting from 1990-91 was collected. It was proposed to secure the data for last 29 years i.e.,1990-91 to 2018-19. It was proposed to use both tabular as well as statistical method of analysis. For the study, total period was divided into two sub periods as given below, while the third period was considered as an overall period.

Period I : 1990-91 to 2005-06

Period II : 2005-06 to 2018-19

Overall Period : 1990-91 to 2018-19

Compound growth rates

The compound growth rates in area, production and productivity of major crops were worked out by fitting exponential function,

$$Y=ab^t$$

Where,

Y = Area (00' ha), production (00' metric tons) and productivity (Kg/ha).

a = Intercept

b = Regression coefficient

t = Time period in year

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

CGR = (Antilog b-1) x 100

Results and Discussion

Changes in cropping pattern of Nanded

The data on land use and cropping patterns in Nandurbar district were analysed using a simple tabular method. Table 1 provides detailed information on the changes in cropping pattern of Nanded.

Changes in production of major crops in Nanded

The data on changes in production was helpful in determining how the performance of the major crops changed over time in Nanded district. The information on the changes in production of major crops in Nanded is depicted in Table 2.

Changes in productivity of major crops in Nanded

In Table 3, an effort has been made to evaluate per hectare productivity of major crops in the Nanded district to analyse the trends in output which in turn used to know which factors affected the average productivity of major crops to improve future policies in terms of productivity.

Annual compound growth rates of area, production and productivity of cereals, pulses, oilseeds and commercial crops in Nand

The Exponential function was used to examine the annual compound growth rates of area, production and productivity of crops like cereals, pulses, oilseeds and commercial crops. The significance of the estimated compound growth rates was tested with the help of student's 't' test. The detailed information regarding exponential function analysis is given in Table 4 and Table 4.

Table 1: Change in cropping pattern of Nanded district, (Area in '00'ha)

Sr. No	Crops	Triennium average			Percent change over base year	
		Period I (1990 to 93) Base year	Period II (2003 to 06)	Period III (2016 to 19)	Period II	Period III
1	Paddy	11.04 (0.17)	10.15 (0.16)	9.21 (0.13)	-8.06	-16.57
2	Wheat	180.00 (2.83)	144.6 (2.35)	211.00 (3.18)	-19.66	17.22
3	*Kharif* Jowar	140.00 (2.20)	116.3 (1.89)	100.45 (1.51)	-16.92	-28.25
4	*Rabi* Jowar	155.34 (2.83)	190.55 (3.10)	215.00 (3.24)	22.66	38.40
5	Maize	115.00 (1.81)	90 (1.46)	84.00 (1.26)	-21.73	-26.95
6	Other cereals	60.39 (0.95)	51 (0.38)	30.00 (0.45)	-15.54	-50.32
7	Total Cereals	661.77 (10.42)	602.6 (9.81)	649.66 (9.80)	-8.94	-1.82
8	Gram	632.00 (9.95)	700 (11.40)	780.00 (11.77)	10.75	23.41
9	Red Gram	281.00 (4.42)	146.5 (2.38)	170.00 (2.56)	-47.86	-39.50
10	Green Gram	320.00 (5.04)	230.75 (3.75)	168.00 (2.53)	-27.89	-47.50
11	Black Gram	246.50 (3.88)	135.8 (2.21)	156.00 (2.35)	-44.90	-36.71
12	other pulses	24.40 (0.83)	20.17 (0.32)	18.00 (0.27)	-17.33	-26.22
13	Total Pulses	1503.90 (23.69)	1233.22 (20.09)	1292.00 (19.48)	-17.99	-14.09
14	Total Food grains	2165.67 (34.12)	1835.82 (29.91)	1941.66 (29.28)	-15.23	-10.34

15	Groundnut	175.64 (2.76)	119.23 (1.94)	192.00 (2.89)	-32.11	9.31
16	Soyabean	1323.90 (20.86)	1430.98 (23.31)	1600.00 (24.15)	8.08	20.85
17	Sesamum	78.94 (1.24)	48.79 (0.79)	26.00 (0.39)	-38.19	-67.06
18	Other oilseeds	14.13 (0.45)	13.64 (0.27)	11.00 (0.16)	-3.46	-22.15
19	Total oilseeds	1592.61 (25.09)	1612.64 (26.27)	1829.00 (27.60)	1.25	14.84
20	Sugarcane	114.31 (1.80)	96.00 (1.56)	120.00 (1.81)	-16.01	4.97
21	Cotton	2400.84 (37.86)	2520.00(41.08)	2666 (40.28)	4.96	11.04
22	Fruits and vegetables	25.46 (0.40)	30.66 (0.49)	37.00 (0.56)	20.42	45.32
23	Fodder crops	46.69 (0.73)	42.68 (0.69)	31.00 (0.47)	-8.58	-33.60
24	Gross cropped area	6345.58 (100.00)	6137.80 (100.00)	6624.66 (100.00)	-3.28	4.39

Source: Socio- economic Review and Statistical abstract of Nanded district (1990-91 to 2018-19)

Table 2: Change in Production of major crops in Nanded, (Production in '00' MT)

Sr. No	Crops	Year			Percent change over base year	
		1990 to 91 (Base year)	2005 to 06	2018 to 19	2005-06	2018-19
1	Paddy	4.36	3.21	2.67	-26.37	-38.76
2	Wheat	446.30	350.00	517.33	-21.57	15.91
3	*Kharif* Jowar	150.66	123.19	135.00	-18.23	-10.39
4	*Rabi* Jowar	300.02	453.56	350.00	51.17	16.65
5	Maize	25.05	12.50	7.89	-50.09	-68.50
6	Other Cereals	9.78	4.33	2.45	-55.72	-74.94
7	Total Cereals	936.17	946.79	1015.34	1.13	8.45
8	Gram	1160.00	1043.59	1462.00	-10.03	26.03
9	Red Gram	400.00	200.00	240.00	-50.00	-40.00
10	Green Gram	128.98	90.46	62.45	-29.86	-51.58
11	Black Gram	105.20	120.61	115.30	14.64	9.60
12	Other Pulses	7.07	5.34	2.60	-24.46	-63.22
13	Total Pulses	1801.25	1460.00	1882.35	-18.94	4.50
14	Total Food grains	2737.42	2406.79	2897.69	-12.07	5.85
15	Groundnut	945.36	990.65	895.30	4.79	-5.29
16	Soyabean	2545.00	2966.00	3190.00	16.54	25.34
17	Sesamum	16.44	9.88	5.15	-39.90	-68.67
18	Other oilseeds	8.33	7.13	5.60	-14.40	-32.77
19	Total oilseeds	3515.13	3973.66	4096.05	13.04	16.52
20	Sugarcane	2459.72	1964.33	2754.91	-20.14	12.00
21	Cotton	1060.00	1230.00	1460.80	16.03	37.81

Source: Socio- economic Review and Statistical abstract of Nanded district (1990-91 to 2018-19)

Table 3: Change in average productivity of major crops in Nanded, (Productivity in Kg/ha)

Sr. No	Particulars	Year			Percent change over base year	
		1990 to 91 (Base year)	2005 to 06	2018 to 19	2005-06	2018-19
1	Paddy	394.92	316.25	289.90	-19.92	-26.59
2	Wheat	2503.66	2420.47	2464.45	-3.32	-1.56
3	*Kharif* Jowar	1076.14	1059.24	1343.95	-1.57	24.88
4	*Rabi* Jowar	1931.37	2397.11	1627.90	24.11	-15.71
5	Maize	217.82	138.88	93.92	-36.24	-56.88
6	Total Cereals	1421.23	1576.50	1566.98	10.92	10.25
7	Gram	1835.44	1490.84	1874.35	-18.77	2.11
8	Red Gram	1423.48	1365.18	1411.76	-4.09	-0.82
9	Green Gram	403.06	392.02	371.72	-2.73	-7.77
10	Black Gram	426.77	888.14	739.10	108.10	73.18
11	Total Pulses	1197.71	1183.89	1456.92	-1.15	21.64
12	Total Food grains	1266.01	1255.56	1493.75	-0.82	17.98
13	Groundnut	5382.37	8308.73	4663.02	54.36	-13.36
14	Soyabean	1922.35	2072.70	1993.75	7.82	3.71
15	Sesamum	208.25	202.50	198.07	-2.76	-4.88
16	Total oilseeds	2207.15	2464.07	2239.50	11.64	1.46
17	Sugarcane	21517.97	20461.77	22957.58	-4.90	6.69
18	Cotton	441.51	488.09	547.93	10.55	24.10

Source: Socio- economic Review and Statistical abstract of Nanded district (1990-91 to 2018-19)

Table 4: Annual compound growth rates in area, production and productivity of major crops in Nanded district

Sr. No	Crop	Period I 1990-91 to 2004-05			Period II 2005-06 to 2018-19			Overall period 1990-91 to 2018-19		
		A	P	Y	A	P	Y	A	P	Y
1	Paddy	-0.66 ***	-2.56 ***	-1.91 ***	-0.34 NS	-0.37 NS	-0.04 NS	-0.47 ***	-1.88 ***	-1.41 ***
2	Wheat	-1.47 ***	-2.35 ***	-0.46 ***	2.61 ***	3.59 ***	0.55 ***	0.09 NS	0.03 NS	-0.12 **
3	*Kharif* jowar	-1.23 ***	-1.63 ***	-0.4 ***	-1.34 ***	0.77 ***	2.15 ***	-1.17 ***	-0.33 **	0.85 ***
4	*Rabi Jowar*	1.3 ***	2.63 ***	1.31 ***	0.76 ***	-1.41 ***	-2.16 ***	1.37 ***	0.8 ***	-0.56 ***
5	Maize	-1.72 ***	-3.81 ***	-2.12 ***	-0.72 ***	-3.56 ***	-2.86 ***	-1.28 ***	-5.08 ***	-3.85 ***
6	Total cereals	-0.7 ***	-0.4 ***	0.03NS	0.64 ***	0.71 ***	0.08 NS	-0.14 **	0.32 ***	0.46 ***
7	Gram	0.45 ***	-0.45 NS	-0.89 ***	0.83 ***	2.49 ***	1.64 ***	0.81 ***	0.97 ***	0.16 NS
8	Red Gram	-3.73 ***	-4.17 ***	-0.46 NS	1.6 ***	1.22 ***	-0.37 NS	-2.35 ***	-1.77 ***	0.6 ***
9	Green gram	-2.55 ***	-2.72 ***	-0.18 NS	-2.54 ***	-2.97 ***	-0.45 **	-2.29 ***	-2.47 ***	-0.18 **
10	Black gram	-3.2 ***	0.12 NS	3.43 ***	1.24 ***	-0.36 NS	-1.57 ***	-1.83 ***	0.28 **	2.15 ***
11	Total pulses	-1.66 ***	-1.56 ***	0.1 NS	0.39 ***	2.18 ***	1.79 ***	-0.64 ***	0.03 NS	0.67 ***
12	Total food grains	-1.06 ***	-1.25 ***	-0.19 NS	0.65 ***	2.04 ***	1.38 ***	-0.3 ***	0.11 NS	0.41 ***
13	Groundnut	-2.14 ***	0.1 NS	2.29 ***	4.15 ***	-1.27 ***	-5.2 ***	-0.17 NS	-0.32 ***	-0.16 NS
14	Soyabean	0.53 ***	1.16 ***	0.63 ***	0.76 ***	0.28 NS	-0.48 **	0.69 ***	0.91 ***	0.22 **
15	Sesamum	-3.33 ***	-2.94 ***	0.4 NS	-5.26 ***	-4.07 ***	1.26 **	-3.99 ***	-3.72 ***	0.28 *
16	Total oilseeds	-0.02 NS	0.89 ***	0.91 ***	1.11 ***	0.38 **	-0.72 ***	0.79 ***	0.56 ***	-0.22 *
17	Sugarcane	-1.11 ***	-1.71 ***	-0.61 **	1.71 ***	2.83 ***	1.1 ***	0.08 NS	0.53 **	0.45 ***
18	Cotton	0.28 **	0.83 **	0.55 **	0.52 ***	1.55 ***	1.03 ***	0.38 ***	1.26 ***	0.88 ***

***, **, * indicates 1, 5, 10 percent level of significance respectively

Conclusion

The analysis was mostly concerned with the percent change over base year and growth rates by fitting exponential function. Among the different cereals, area under, paddy, *kharif* jowar, maize and others cereals were declined for the study period except wheat and rabi *jowar*. Area under paddy and maize was slightly decreased. Area under total pulses decreased over base year by 17.99 percent in period II and 14.09 percent in period III. In case of oilseeds, the farmers in Nanded district have taken soybean crop on large scale. The area under soybean was increased from to 132390 ha in period I to 160000 ha in period III i.e., 20.85 percent over the base year and area under sesamum and other oilseeds were decreased during the study period. The area under cotton was increased from 240084 ha in period I to 266600 ha in period III Production of total cereals and pulses were declined in the year 2005-06 and then increased in 2018-19 over the base year. Total food grain production was increased from 2737.42 MT in 1990-91 to 2897.69MT in 2018-19. Production under paddy and maize were declined in the year 2018-19 while the production of wheat was increased 15.91 percent over base year. Overall production of oilseeds was found to be increased from 3515.13MT in 1990-91 to 4096.05MT in 2018-19 i.e., 16.52 percent change over the base yea. Production of cotton was tremendously increased from 1060 MT in 1990-91 to 1460.80MT in period 2018-19. The average productivity of total cereals was increased from 1421.23 kg/ha in the year 1990-91 to 1566.98 kg/ha in 2018-19. Productivity of total pulses was 1197.11 kg/ha in base year which was increased to 1456.92 kg/ha in 2018-19 i.e., 21.64 percent over base year. Total food grains showed minor decline in 2005-06 and increase in 2018-19. In case of oilseeds, average productivity was increased to 2239.50 kg/ha in 2018-19 from 2207.15 kg/ha in base year but not more than in year 2005-06. The productivity of major crops like cotton and soyabean were increased by 24.10 and 3.71 percent over the base year, respectively. Among the different period, during the Period I, the area and production of total cereals, total pulse and total food grains were negatively significant except total oilseeds and productivity were positively significant of except total food grain. But productivity of total cereals and total pulses were positive and non-significant during the study period. Among period, the production of paddy, wheat, *kharif* jawar and maize crops has declined both by area expansion and productivity improvement in Nanded district whereas, the production of *rabi* jawar, soybean and cotton had increased due to both area expansion and productivity improvement in the district. In the Period II the area and production of total cereals, total pulses, total food grains, total oilseeds, sugarcane and cotton had positively significantly, whereas the productivity of total pulses, total food grains, sugarcane and cotton were positive and significant except total oilseeds. The growth rate of productivity of total pulses, total food grains, sugarcane and cotton had increased significantly at the rate of 1.79, 1.38, 1.1 and 1.03 percent per annum, respectively for the Period II. The productivity of total cereals was positive but non-significant and the productivity of total oilseeds was negatively significant during the study. Among the period, the performance of area, production and productivity of cotton was quite satisfactory in Period I and II in Nanded districts except other crops. The performance with regard to productivity of major crops was quite satisfactory in Period II as compared to Period I and overall period in the districts. It is interesting to note that the area of paddy has declined during all period due to shifting of area to other substitute crops. It can be concluded form the CAGR analysis of major crops in Nanded district that during the study period of 29 years, growth of major crops like cotton and soyabean was satisfactory. But growth rates of minor crops like maize, paddy, red gram, green gram and sesamum was not much satisfactory. These crops need to be promoted for better agricultural production.

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