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Growth and instability of area, production and productivity of sweet orange in India and Maharashtra

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Abstract
The present analysis was undertaken to estimate the growth and instability of area, production and productivity of sweet orange in India and Maharashtra. The Compound Annual Growth rate and Cuddy Della Vella Index was used to estimate growth of instability of sweet orange. The growth rate of production of sweet orange in India was increased positively and significantly due to the expansion in area. The production of sweet orange was increased significantly and positively in the Wardha district because of both area expansion and productivity improvement. While the growth rate of output in the Aurangabad, Nagpur, and Akola districts was positive and significant during the time, this was attributable to the expansion of the sweet orange area. The production in the districts of Nagpur and Akola was found to be significant yet negative. The growth rates of area, production, and productivity was significant but negative in the districts of Nasik, Osmanabad, and Satara. Medium level of instability in area, production and productivity of sweet orange was observed in the regions of Maharashtra and similar results were observed for the state of Maharashtra. So, government needs to allocate the substantial funds for public research to stabilize the area and production of sweet orange fruit crop.

Keywords: Sweet orange, growth, area, production, productivity, instability, etc.

Introduction
The study area is confined to the state of Maharashtra. Maharashtra is the third largest state of India in both area and population. Food, horticultural crops and cash crops are grown in the state. The main crops of Maharashtra are mango, grapes, banana, orange, acid lime, sweet orange, wheat, rice, jowar, bajra, pulses, groundnut, cotton, sugarcane, turmeric tobacco, *etc.* Andhra Pradesh is in first position both in area and production of sweet orange in India during the year 2019-20. Rajasthan is in first position in productivity of Sweet Orange during 2019-20. Maharashtra is in second placed both in area and production of Sweet Orange during the year 2019-20 (Anonymous, 2020) [2]. During 2019-20, the districts of Aurangabad, Jalna, and Nanded had the highest area, production, and productivity under the sweet orange fruit crop, respectively. While Thane district recorded smallest area, production, and productivity were found under sweet orange.

Objectives
To examine the trends in growth and instability in area, production and productivity of sweet orange in India and Maharashtra

Experimental Methods
The present study based on secondary data. The data related to area, production and productivity of sweet orange for the state of Maharashtra and India was collected from various secondary sources i.e. Department of Horticulture, Government of Maharashtra, Pune, and Horticulture Statistics at a glance**,** Pocket Book of Agricultural Statistics, Government of India, Department of Agriculture and Cooperation, Horticulture Statistics Division, New Delhi, Socio Economical Statistical Information about India (India Stat), etc.

Crop Covered
Sweet Orange fruit crop was purposively selected for the study.

Period of study
The compound growth rates of area, production and productivity of sweet orange fruit crop in India were estimated for the period from 1994-95 to 2018-19 this period was divided into two

sup periods i.e. Period-I (1994-95 to 2005-06) and Period-II (2006-07 to 2018-19). The region wise and district wise compound growth rates and instability index of area, production and productivity of sweet orange in Maharashtra were estimated for the period from 2000-01 to 2019-20 this period was divided into two sub period as period-I (2000-01 to 2009-10) and period-II (2010-11 to 2019-20).

Analytical Tools and techniques

A) Compound annual growth rate

Compound annual growth rates were estimated to study the percentage increase or decrease in the selected parameter. The following exponential type of function was used

$Y = ab^te$

Where,

Y = Dependent variable for which growth was estimated i.e. area (ha), production (tonnes) and productivity (tonne/ha).

a = Intercept or constant

b = Regression/trend coefficient

t = Periods in years (1, 2, 3…n)

e = Error terms

Instability Analyses

Instability in area, production, productivity of sweet orange was examined by using two different measures of instability such as Coefficient of Variation and Cuddy-Della Valle Index.

Coefficient of Variation

Although Coefficient of Variation (C.V) is the simplest measure of instability, it over-estimates the level of instability in time series data which are characterized by long-term trends. CV can be calculated as follows:

(C.V) = (Standard Deviation /Mean)* 100

Instability Index: Cuddy-Della Valle Index

The instability in area, production and productivity of sweet orange fruit crop was examined by using the Cuddy – Della Valle Index. The Cuddy-Della Valle Index corrects the coefficient of variation in long term trend.

The Cuddy Della Valle Index de-trends shows the exact direction of the instability. Therefore, it is a better measure to capture instability in agricultural production. A low value of this index indicates low instability in area, production, productivity and vice-versa. The Cuddy-Della Valle Index corrects the CV as:

Cuddy - Della Valle Instability Index (%) = $CV\sqrt{(1-R^2)}$

Where,

C.V. was the Coefficient of Variation in per cent, and R^2 was the coefficient of determination from a time trend regression adjusted for its degrees of freedom.

The ranges of CDVI are given as follows:

- Low instability = 0 to 15
- Medium instability = 15 to 30
- High instability = 30 and above

Results and Discussion

Compound annual growth rates of area, production and productivity of Sweet Orange

Table 1 shows the compound growth rates of sweet orange in terms of area, production, and productivity in India. The entire period was split up into two sub periods i.e. period I (1994-95 to 2005-06), period II (2006-07 to 2018-19) and overall period (1994-95 to 2018-19). The analysis by time period revealed that during first period the production has positive and significantly increased only due to the area expansion however in the case of second period the production of sweet orange was discovered to be positive and significantly increased due to only productivity improvement. Throughout the period, output was positive and increased significantly due to the expansion of the area.

In Maharashtra, the compound growth rates of area, production, and productivity of sweet orange were estimated and given in Tables 2 and 3, respectively.The time series data on area (A), production (P) and productivity (Y) were divided into three sub period as period I (2000-01 to 2009-10), period II (2010-11 to 2019-20) and overall period (2000-01 to 2019-20).

During the entire period, sweet orange output in Wardha district was favorable and significant, thanks to both area growth and productivity development. While the growth rate of output in the Aurangabad, Nagpur, and Akola districts was positive and significant during the time, this was attributable to the expansion of the sweet orange area. The production in the districts of Nagpur and Akola was found to be significant yet negative. The growth rates of area, production, and productivity was significant but negative in the districts of Nasik, Osmanabad, and Satara.

Among the regions of Maharashtra, Vidarbha and Marathwada region the production growth rate during the overall period was found positive and significant which was mainly due to the area expansion. As a result, the productivity, area, and production of sweet orange have varied throughout time in all districts and regions. Similar trends were found in case of entire Maharashtra during the overall period.

Instability in Area, Production and Productivity of Sweet Orange

For the period 2000-01 to 2019-20, the coefficient of variation and Cuddy Della Valle Index of sweet orange area, production, and productivity were calculated and given in Tables 4 a, 4 b and 4 c for districts, regions, and Maharashtra as a whole.

It was observed that area under sweet orange was highly consistent and stable for the Yavatmal (7.76) district while medium level of consistency and stability was found in the districts like Jalna (26.4), Latur (29.70), Nagpur (21.55) and Wardha (22.55) and other districts were found more instable. Medium level of consistency and stability in production of sweet orange was found in Nagpur (28.62) district and other districts were found highly instable. In case of productivity highly consistency and stability was found in Akola (9.46) and Washim (12.44) district while medium level of consistency and stability was found in Osmanabad (17.58) and Amravati (29.55) districts and highly instability was found in other districts.

In Marathwada (17.57) region medium level of stability and consistency in area under sweet orange crop was observed while in case of other region highly stability was observed. Highly instability in production of sweet orange was found in Vidarbha, Marathwada and Western Maharashtra regions of Maharashtra. While medium level of stability and consistency was observed in productivity of sweet orange in Vidarbha

(29.62), Marathwada (22.60) and Western Maharashtra (21.17) region.

In case of entire Maharashtra state medium level of stability and consistency was observed in area (18.88), production (26.56) and productivity (17.94) of sweet orange.

Table 1: Compound Growth Rates of Area, Production and Productivity of Sweet Orange in India

Sr. No.	India								
	Period I (1994-95 to 2005-06)			Period II (2006-07 to 2018-19)			Overall Period (1994-95 to 2018-19)		
	A	P	Y	A	P	Y	A	P	Y
	12.28***	8.91***	-3	-3.11	9.99*	13.52**	6.1***	7.29***	1.13

*, ** and*** indicate significance at 10, 5 and 1 % level

Table 2: District wise Compound Growth Rates of Area, Production and Productivity of Sweet Orange in Maharashtra

Sr. No.	District	Period I (2000-01 to2009-10)			Period II (2010-11 to 2019-20)			Overall Period (2000-01 to 2019-20)		
		A	P	Y	A	P	Y	A	P	Y
1	Jalgaon	-3.82	-6.72	-3.02	16.64 ***	7.61 **	-7.75 ***	2.57	3.19 *	0.6
2	Nasik	-	-	-	-	-	-	-41.13***	-49.68***	-14.53***
3	Ahmednagar	-23.91 **	-10.88	17.13	-20.61 **	-24.17 ***	-4.49	-3.49	0.26	3.88
4	Pune	-18.41 ***	-14.62 *	4.64	-12.23 ***	-18.38 ***	-7.01 ***	-12.02 ***	-11.38 ***	0.73
5	Solapur	-	-	-	-	-	-	-10.7	-13.34	-2.95
6	Aurangabad	-13.07 **	-9.97 **	3.57 *	23.84	22.01	-1.48	8.32 *	9.49 *	1.08
7	Jalna	7.36 *	10.31 *	2.75	-2.66	10.74	13.77	6.05 ***	3.64	-2.27
8	Beed	14.7 **	25.66 ***	12.96 ***	6.26 **	10.42 **	4.02	2.49	2.86	0.32
9	Latur	-	-	-	-	-	-	-9.76 **	-16.05 ***	-6.86
10	Osmanabad	-	-	-	-	-	-	-27.19 ***	-31.3 ***	-5.65 ***
11	Nanded	-18.83 ***	-28.64 ***	-12.09	28.55 **	34.09 ***	4.31	-8.67 **	-2.8	6.43**
12	Parbhani	-5.47	-37.15 *	-33.51 **	-4	-19.47	-16.07 ***	0.39	-4.71	-5.08
13	Hingoli	6.01	-20.16 *	-3.18	-30.67 ***	21.44	5.99	-12.89 ***	-16.08 *	0.08
15	Amravati	6.49 **	11.64 **	4.84	-0.39	-1.32	-0.93	1.51	2.17	0.65
16	Satara	-	-	-	-	-	-	-60.2 ***	-46.65 ***	34.05 ***
18	Nagpur	19.9 ***	23.02 ***	2.6	8.83 ***	9.02 **	-0.01	13.01 ***	9.83 ***	-2.81 **
19	Buldhana	-	-	-	-	-	-	-6.31	-13.35***	0.45
20	Akola	-	-	-	-	-	-	34.38 ***	30.82 ***	-2.6 **
21	Washim	-	-	-	-	-	-	-14.3 **	-12.7 *	1.79
22	Yavatmal	-	-	-	-	-	-	0.84 ***	-0.26	-1.08
23	Wardha	-	-	-	-	-	-	5.84 *	39.75***	24**

Table 3: Region wise Compound Growth Rates of Area, Production and Productivity of Sweet Orange in Maharashtra State

Sr. No.	Region	Period I			Period II			Overall		
		A	P	Y	A	P	Y	A	P	Y
1	Marathwada	1.17	0.8	-0.36	2.57	5.43	2.79	5.19 ***	5.54 ***	0.33
2	Vidarbha	17.22	22.85 **	4.8	4.09 ***	6.42 *	2.24	10.79 ***	9.07 ***	-1.55
3	Western Maharashtra	-7.6	-3.17	4.79 *	-14.54 ***	-13.32 ***	1.43	-2.9	-2.98	-0.09
4	Maharashtra	1.34	2.45	1.09	0.62	2.49	1.86	4.32 ***	4.35 ***	0.04

Table 4 a.: District wise Instability in Area, Production and Productivity of Sweet Orange in Maharashtra

Sr. No.	Period	District																	
		Jalgaon			Nashik			Ahmednagar			Pune			Solapur			Aurangabad		
		A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1	**Period I**																		
	CV (%)	59.56	39.15	31.53	45.04	41.03	20.68	75.01	127.94	72.61	55.28	74.38	49.72	-	-	-	37.44	32.39	18.95
	CDVI	58.52	34.03	30.74	35.12	34.79	18.25	57.64	125.36	68.65	25.58	58.29	48.16	-	-	-	24.59	25.08	15.64
2	**Period II**																		
	CV (%)	41.05	25.88	31.48	157.19	160.76	59.2	107.79	104.17	60.35	42.18	69.13	30.12	-	-	-	45.29	60.81	36.03
	CDVI	24.00	18.97	18.10	57.50	49.25	27.95	71.04	45.00	59.50	21.61	32.2	17.41	-	-	-	40.17	55.99	35.96
3	**Overall**																		
	CV (%)	49.22	35.95	33.25	88.65	87.8	42.36	96.02	112.58	64.68	83.14	93.85	39.64	79.78	156.75	98.81	74.31	94.25	32.41
	CDVI	47.62	32.34	33.1	44.84	48.55	38.36	94.29	112.57	63.48	32.59	55.07	39.44	75.45	142.06	97.85	67.69	84.99	32.16

Sr. No.	Period	District																	
		Jalna			Beed			Latur			Osmanabad			Nanded			Parbhani		
		A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1	**Period I**																		
	CV (%)	43.82	57.35	26.5	66.77	97.99	53.23	-	-	-	-	-	-	56.19	75.81	46.78	65.78	65.27	168.16
	CDVI	34.06	46.63	25.13	44.89	50.52	31.25	-	-	-	-	-	-	28.87	48.48	42.24	65.32	52.42	111.39
2	**Period II**																		
	CV (%)	17.51	50.75	52.93	24.62	46.18	29.65	-	-	-	-	-	-	65.76	84.23	243.35	79.71	124.56	62.21

	CDVI	15.43	49.41	50.46	16.27	33.53	27.94	-	-	-	-	-	-	45.13	52.66	242.05	79.27	109.38	31.28
3	**Overall**																		
	CV (%)	41.76	56.67	39.79	51.85	87.32	47.35	40.89	64.1	36.3	94.66	103.45	25.96	81.57	77.89	314.07	71.83	116.12	153.33
	CDVI	26.45	55.37	39.38	48.67	84.27	47.3	29.7	42.9	31.11	50.76	57.07	17.58	71.14	77.84	287.95	71.82	114.8	148.34

Sr. No.	Period	District														
		Hingoli			Amravati			Satara			Nagpur			Buldhana		
		A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1	**Period I**															
	CV (%)	53.49	51.3	33.24	25.85	43	35.89	-	-	-	55.12	57.59	32.49	-	-	-
	CDVI	46.33	39.82	31.64	18.4	31.87	33.21	-	-	-	23.89	29.21	31.74	-	-	-
2	**Period II**															
	CV (%)	134.82	194.54	147.47	55.27	74.57	23.98	-	-	-	27.58	28.93	6.96	-	-	-
	CDVI	84.55	191.6	146.95	55.27	74.53	23.79	-	-	-	17.27	20.52	6.96	-	-	-
3	**Overall**															
	CV (%)	88.2	105.33	150.61	51.95	69.59	29.79	140.18	202.15	67.01	60.94	48.77	36.62	79.53	76.43	36.34
	CDVI	65.43	97.34	150.61	51.67	68.94	29.55	75.32	104.52	45.18	21.55	28.62	31.66	75.95	76.4	35.64

Sr. No.	Period	District											
		Akola			Washim			Yavatmal			Wardha		
		A	P	Y	A	P	Y	A	P	Y	A	P	Y
1	**Period I**												
	CV (%)	-	-	-	-	-	-	-	-	-	-	-	-
	CDVI	-	-	-	-	-	-	-	-	-	-	-	-
2	**Period II**												
	CV (%)	-	-	-	-	-	-	-	-	-	-	-	-
	CDVI	-	-	-	-	-	-	-	-	-	-	-	-
3	**Overall**												
	CV (%)	96.61	92.39	13.25	83.93	89.38	13.43	2.68	46.33	47.81	27.72	64.05	504
	CDVI	30.00	33.93	9.46	59.4	71.77	12.44	0.96	46.33	47.81	22.55	47.34	46.76

Table 4b: Regions wise instability in area, production and productivity of Sweet Orange in Maharashtra

Sr. No.	Period	Region								
		Marathwada			Vidarbha			Western Maharashtra		
		A	P	Y	A	P	Y	A	P	Y
1	**Period I**									
	CV (%)	16.29	26.39	18.95	148.31	127.62	29.25	59.51	82.86	23.48
	CDVI	15.79	26.27	18.92	124.79	94.86	26.01	55.47	81.97	18.9
2	**Period II**									
	CV (%)	15.00	33.11	26.66	15.55	27.62	17.65	56.57	61.61	16.78
	CDVI	13.32	30.99	25.74	9.63	22.73	16.85	25.84	36.38	16.44
3	**Overall**									
	CV (%)	34.24	46.08	22.67	80.72	79.18	31.02	56.65	74.01	21.18
	CDVI	17.57	34.43	22.6	54.14	59.13	29.62	54.09	70.55	21.17

Table 4c: Instability in Area, Production and Productivity of Sweet Orange in Maharashtra

Sr. No.	Period	Maharashtra		
		A	P	Y
1	**Period I**			
	CV (%)	27.05	33.04	16.64
	CDVI	26.66	32	16.33
2	**Period II**			
	CV (%)	8.07	23.85	19.99
	CDVI	7.87	23	19.34
3	**Overall**			
	CV (%)	29.79	35.88	17.94
	CDVI	18.88	26.56	17.94

Conclusions

The present study depicted that the compound annual growth rates of area, production and productivity of sweet orange during the overall period in India the production of sweet orange was increased positively and significantly due to expansion in area. Among the regions of Maharashtra, Vidarbha and Marathwada region the production growth rate during the overall period was found positive and significant which was mainly due to the area expansion. As a result, the productivity, area, and production of sweet orange have varied throughout time in all districts and regions. Similar trends were found in case of entire Maharashtra during the overall period. In case of instability, the medium level of stability was found in area, production and productivity of sweet orange for the state of Maharashtra for the overall period.

References

1. Adhale PM, Pokharkar VG, Gulve CM, Khade SD. Growth and instability of area, production and productivity of sugarcane in Maharashtra. Journal of Pharmacognosy and Phytochemistry. 2019;8(5):703-706.
2. Anonymous. Socio Economical Statistical Information about India, 2019. Available at: https://www.indiastat.com/agriculture-data/2/horticulture/118/stats.aspx. Accessed on: 9th December 2019.
3. Bhat HA. Trends and Growth in Area, Production and Productivity of Apples in India from 2001-02 to 2017-18. An International Multidisciplinary e-Journal. 2019;4(1):15-23.
4. Immanuelraj TK, Dastagiri MB, Sajesh VK. Growth and Instability of Onion Production in Maharashtra, India. Journal of Global Economics. 2014;2(1):69-71.
5. Jain R, Chand R, Singh A. Total Factor Productivity Growth in Indian Crop Sector. Indian Journal of Agricultural Economics. 2017;72(4):535-554.
6. Kadam MM, Rathod VJ, Phalke SH. Growth and performance of horticulture in India. International Journal of Commerce and Business Management. 2015;8(2):207-217.
7. Kashish R, Dhawan V. A Study on Production and Trade Performance of Fruits in India. Agricultural Research Journal. 2017;54(1):108-113.