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Growth and instability of area, production and productivity of acid lime 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 acid lime in India and Maharashtra. The Compound Annual Growth rate and Cuddy Della Vella Index was used to estimate growth of instability of Acid Lime. The growth rate of area, production and productivity in India was increased positively. The production of acid lime was increased due to both area expansion and productivity improvement for districts viz. Nanded, Amaravati, Yavatmal, Nagpur and Gadchiroli. The production of acid lime was increased due to area expansion in the districts of Jalgaon and Aurangabad. In case of Osmanabad, Gondia and Buldhana districts growth rates of production was positive and significant only due to improvement in productivity. In Maharashtra the area and production of acid lime was highly instable. So, government needs to allocate the substantial funds for public research to stabilize the area and production of Acid lime fruit crop. In India the growth rates of area, production and productivity of acid lime was positive and significant. However, the production of acid lime was increased mainly due to the area expansion and very little due to the production improvement.

Keywords: Acid lime, 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. India is in the first position in case of area and production of the acid lime in the world during 2016-17. India has witnessed increase in horticulture production over the years. Significant progress has been made in area expansion resulting in higher production. Over the last decade, the area under horticulture grew by 2.6% per annum and annual production increased by 4.8%. Gujarat and Andhra Pradesh placed in first position in case of area and production of acid lime during 2019-20 while Karnataka is in first position in case of productivity of acid lime during the year 2019-20. Maharashtra is in third position both in case of area and production of acid lime fruit crop during 2019-20 (Anonymous, 2020) [2]. Highest area and production of acid lime was observed in the Jalgaon district during 2019-20. While highest productivity was observed in Nanded district. Minimum area, production and productivity were observed in Thane, Bhandara and Gondiya district respectively.

Objectives

To examine the trends in growth and instability in area, production and productivity of acid lime in Maharashtra.

Experimental Methods

The present study based on secondary data. The data related to area, production and productivity of acid lime 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

Acid Lime fruit crop was purposively selected for the study.

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Period of Study

The period of the study was considered as per the availability of data. The compound growth rates of area, production and productivity of acid lime fruit crop in India were estimated for the period from 1991-92 to 2018-19 this period was subdivided into three sub periods as Period-I (1991-92 to 1999-00), Period-II (2000-01 to 2009-10) and Period-III (2010-11 to 2018-19). The region wise and district wise compound growth rates and instability index of area, production and productivity of acid lime in Maharashtra were estimated for the period from 2006-07 to 2019-20. The whole period was subdivided into three sub periods as Period-I (2006-07 to 2012-13), Period-II (2013-14 to 2019-20) and overall period (2006-07 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.

$$Y = ab^t e$$

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 acid lime 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:

$$(C.V) = (\text{Standard Deviation} / \text{Mean}) * 100$$

Instability Index: Cuddy-Della Valle Index

The instability in area, production and productivity of acid lime 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:

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

Where,

C.V. was the Coefficient of Variation in per cent, and R² 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 Acid lime

The compound growth rates were estimated to examine the changes in area, production and productivity of acid lime in India and presented in Table 1. The period wise analysis revealed that the maximum growth rate of area and production of acid lime was observed during period II in comparison to other periods. The increase in area and production of acid lime in second period may be due to the implementation of National Horticulture Mission in 2005-06 (10th plan) in India (similar observations were reported by Singh and Nimmy, 2013) [10]. The main aim behind the initiation of National Horticulture Mission (NHM) is to provide holistic growth of horticulture sector in India and to enhance horticulture production. In case of productivity the declining trend was observed during first and second period while during third and overall period yield has increased at the rate of 1.7 and 0.39 per cent per annum, respectively.

The district wise and region wise compound growth rate of area, production and productivity of acid lime in Maharashtra was estimated and presented in Table 2, 3 and 4. The time series data on area (A), production (P) and productivity (Y) were divided into three sub period as period I (2006-07 to 2012-13), period II (2013-14 to 2019-20) and overall period (2006-07 to 2019-20). For overall period (2006-07 to 2019-20) the growth rates of area, production and productivity were positive and significant. The production of acid lime was increased due to both area expansion and productivity improvement for districts viz. Nanded, Amaravati, Yavatmal, Nagpur and Gadchiroli. While the production of acid lime has positively increased only due to area expansion for Jalgaon and Aurangabad district. In case of Osmanabad, Gondia and Buldhana districts growth rates of production was positive and significant only due to improvement in productivity.

The growth rate of area, production and productivity was negative and non-significant in remaining regions viz. Marathwada, Konkan and Western Maharashtra. Importantly the area under Acid lime was significantly increased during the period-II (2013-14 to 2019-20) in all the regions of Maharashtra. Thus, the area, production and productivity of acid lime have been fluctuating over a period of time in all the districts and regions. Among the regions of Maharashtra and entire Maharashtra state, the production in Vidarbha region recorded positive and significant growth only due to improvement in productivity for the overall period.

Table 1: Compound Growth Rates of Area, Production and Productivity of Acid lime in India

Sr. No.	India											
	Period I (1991-92 to 1999-2000)			Period II (2000-01 to 2009-10)			Period III (2010-11 to 2018-19)			Overall Period (1991-92 to 2018-19)		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1.	8.13***	5.61***	-2.33**	9.74***	9.03***	-0.65 NS	2.69**	4.44**	1.7**	4.76***	5.16***	0.39*

(***, ** and * significant at 1, 5 and 10 per cent, respectively)

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

Sr. No.	District	Period I(2006-07 to 2012-13)			Period II (2013-14 to 2019-20)			Overall Period (2006-07 to 2019-20)		
		A	P	Y	A	P	Y	A	P	Y
1	Jalgaon	-2.46	-2.57	-0.41*	22.85***	29.85	5.7	14.52***	15.38***	0.77
2	Ahmednagar	-1.2*	-5.06	-3.9	2.07**	-3.64	-5.6	-0.99**	-9.44***	-8.53***
3	Pune	3.69***	0.91	-2.68	18.82***	20.2	1.16	5.19***	1.61	-3.4***
4	Solapur	-7.61	-12.37	-5.15	5.8	1.17*	2.23	-0.59	4.92	4.13*
5	Satara	-4.31**	4.69	9.4	-3.33	-0.39***	3.05	-17.54***	-9.72***	9.49***
6	Sangli	1.82**	1.71	-0.1	-35.88***	-34.75	1.78	-15.28***	-14.54***	0.87
7	Jalna	4.23	-18.8	-22.09	-14.08**	-1.58**	14.55	-11.09***	-12.17**	-1.22
8	Beed	-27.01**	-31.48	-6.12	17.52***	34.39	14.36	-0.69	-4.93	-4.27*
9	Aurangabad	69.81***	66.67	-3.06	-1.63	-0.59***	1.85	26.14***	25.89***	0.26
10	Osmanabad	-6.19	48.36	58.14	-4.78	7.54	12.94	0.62	29.74***	28.94***
11	Latur	-17.56**	-24.97	-8.98	-10.94**	7.02	20.17	-18.58***	-24.55***	-7.33
12	Nanded	29.2**	30.31	0.86	30.82***	73.71	32.78	29.25***	47.48***	14.11***
13	Parbhani	6.02***	4.69	-1.26	0.41	-1.03	-1.44	1.38	0.65	-0.72
15	Washim	24.66**	30.49	4.67	2.94***	-3.5	-6.26	-15.89***	-14.73**	1.38
16	Amravati	-3.98**	-7.73	-3.9	-3.87	1.19**	5.27	8.91**	15.07***	5.66***
17	Yavatmal	1.84**	1.5	-0.33**	8.38***	5.99	-2.2	4.93***	14.18***	8.82***
18	Wardha	-0.24	0.08**	0.32	6.2***	4.1	-1.98	-1.41	-3.9**	-2.52**
19	Nagpur	6.54***	3.48	-2.87	0.5	0.5	0.01	9.03***	12.91***	3.56**
20	Bhandara	3.72	1.63*	-2.01	-12.45	-9.67	3.18	-5.84**	-7.4**	-1.66
21	Gondia	-9.92**	45.27	61.27	7.96*	12.15	3.88	-1.44	19.64***	21.39***
22	Gadchiroli	66.7**	60.92	-3.47	0.35**	5.36	4.99	22.06***	29.78***	6.32***
23	Chandrapur	40.59**	45.34	3.38	-16.52*	-13.26	3.91	2.24	4.79	2.49***
24	Buldhana	-0.67	12.87	13.63	10.06**	32.33	20.23	-0.37	12.83***	13.25***
25	Kolhapur	20.08***	21.08	0.83***	1.27	8.28	6.93	4.43**	-7.75*	-11.66***
26	Dhule	2.25*	-1.37	-3.54	2.57***	13.76	10.91	-14.74***	-10.92***	4.49***
27	Nasik	-2.5	5.16	7.85	1.78	-9.93	-11.51	-7.82***	-8.49***	-0.73
28	Sindhudurg	-3.46*	-9.78	-6.55	-0.23	8.19	8.43	-2.01***	-6.81***	-4.9**

(***, ** and * significant at 1, 5 and 10 per cent, respectively)

Table 3: District wise Compound Growth Rates of Area, Production and Productivity of Acid lime

Sr. No.	Particulars (For entire period (2006-07 to 2019-20))	Districts
1	The production of Acid lime was increased by both area expansion and productivity improvement	Nanded, Amaravati, Yavatmal, Nagpur and Gadchiroli
2	The production of Acid lime was increased mainly due to the area expansion	Jalgaon and Aurangabad
3	Production of Acid lime was increased due to improvement in productivity only	Osmanabad, Gondia and Buldhana and Vidarbha Region
4	Production of Acid lime was decreased by both due to decline in area and productivity	Ahmednagar, Jalna, Beed, Latur, Wardha, Bhandara, Nasik and Sindhudurg
5	Production of Acid lime was decreased due to decline in area	Satara, Sangli, Washim and Dhule
6	Production of Acid lime was decreased mainly due to decline in productivity	Kolhapur

Table 4: Region wise Compound Growth Rates of Area, Production and Productivity of Acid lime in Maharashtra State

Sr. No.	Region	Period I (2006-07 to 2012-13)			Period II (2013-14 to 2019-20)			Overall (2006-07 to 2019-20)		
		A	P	Y	A	P	Y	A	P	Y
1	Marathwada	-12.5**	-16.6	-4.68	8.51***	18.02	8.77	-0.43	-0.93	-0.51
2	Vidarbha	27.47***	35.21	6.07	22.96***	33.14	8.28	4.44	10.76**	6.06***
3	Western Maharashtra	-1.74*	-2.35	-0.62	8.35***	6.59	-1.63	-1.32	-2.15	-0.85
4	Maharashtra State	-0.3NS	-1.95	-1.65	10.01***	9.7	-0.29	-0.71	-1.23	-0.52

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

Instability in Area, Production and Productivity

Coefficient of variation and Cuddy Della Valle Index of area, production and productivity of acid lime was estimated and presented in the Table 5 a), 5 b) and 5 c) for the period 2006-07 to 2019-20 for district, region and entire Maharashtra. The fluctuations in area, production and productivity were

measured by using the Coefficient of Variations (CV) and Cuddy-Della Valle Index. The time series data on area (A), production (P) and productivity (Y) were divided into three sub periods as period I (2006-07 to 2012-13), period II (2013-14 to 2019-20) and overall period (2006-07 to 2019-20).

Table 5 a: District wise Instability in Area, Production and Productivity of Acid lime in Maharashtra

Sr. No.			Districts	
1	Area	Consistent	Ahmednagar, Parbhani, Yavatmal, Wardha, Nagpur, Sindhudurg,	
		Fluctuating	Jalgaon, Solapur, Satara, Jalna, Beed, Aurangabad, Washim, Amaravati, Gadchiroli, Chandrapur and Dhule	
2	Production	Consistent	Parbhani	
		Fluctuating	Jagaon, Pune, Solapur, Satara, Jalna, Beed, Aurangabad, Osmanabad, Latur, Nanded, Washim, Amravati, Bhandara, Gondia, Gadchiroli, Chandrapur, Buldhana, Kolhapur and Dhule	
3	Productivity	Consistent	Jalgaon, Ahmednagar, Pune, Satara, Sangli, Parbhani, Wardha and Chandrapur	
		Fluctuating	Jalna, Osmanabad, Latur, Nanded, Gondia and Kolhapur	

Instability in Area, Production and Productivity of Acid lime

It was found that at the overall period the area under acid lime was highly consistent and stable for the districts viz. Ahmednagar (5.53), Parbhani (12.49), Yavatmal (7.76), Wardha (11.58), Nagpur (13.51) and Sindhudurg (6.28) except the districts which were highly instable such as Jalgaon (32.85), Solapur (49.12), Satara (31.41), Jalna (31.57), Beed (51.70), Aurangabad (52.14), Washim (75.55), Amaravati (48.99), Bhandara (37.26), Gadchiroli (37.36), Chandrapur (68.04) and Dhule (37.14).

Among the region, in Western Maharashtra (14.16) region the area under acid lime crop was found more stable and consistent while highly instability in area and production under the acid lime was found in Vidarbha and Marathwada region. In Vidarbha (6.83) and Western Maharashtra (14.1) region the productivity of acid lime was found more stable and consistent. While in case of entire Maharashtra, area (15.68) and production (20.66) of acid lime was found highly instable while more stability was found in case of productivity (11.47) under acid lime.

Table 5 b: Region wise Instability in area, production and productivity of Acid lime in Maharashtra

Sr. No.	Period		Region								
			Marathwada			Vidarbha			Western Maharashtra		
			A	P	Y	A	P	Y	A	P	Y
1	Period I	CV (%)	30.7	36.67	15.3	51.43	60.14	13.77	5.09	9.33	7.19
		CDVI	14.98	36.84	15.3	22.5	60.14	13.77	3.41	9.33	7.19
2	Period II	CV (%)	20.68	37.95	19.18	48.49	61.02	17.24	18.04	27.71	20.32
		CDVI	8.9	37.95	19.18	19.04	61.02	17.24	4.84	27.71	20.32
3	Overall	CV (%)	25.19	36.17	17.09	48.92	60.24	25.67	15.07	21.54	14.56
		CDVI	25.13	35.99	16.98	45.82	46.47	6.83	14.16	19.61	14.1

Table 5c: Instability in Area, Production and Productivity of Acid lime in Maharashtra

Sr. No.	Period		Maharashtra		
			A	P	Y
1	Period I	CV (%)	4.68	9.22	6.54
		CDVI	4.63	9.22	6.54
2	Period II	CV (%)	21.29	29.16	15.98
		CDVI	4.6	29.16	15.98
3	Overall	CV (%)	15.92	21.29	11.69
		CDVI	15.68	20.66	11.47

Conclusions

The present study depicted that the compound annual growth rates of area, production and productivity of acid lime during the overall period in India was increased positively and significantly due to both area expansion and improvement in productivity. Among the four regions of Maharashtra the production of acid lime in Vidarbha region was found positive and significant only due to the improvement in Productivity. At the overall period, among the four regions of Maharashtra, in Marathwada and Vidarbha region the growth rate of production of acid lime was found positive and significant which was due to the area expansion. Similar results were found for the state of Maharashtra during the entire period of study. In case of instability, the area and production of acid lime in Maharashtra was found highly instable and consistency in productivity acid lime was observed during the study period.

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