



TRENDS AND VARIABILITY IN AREA, PRODUCTION AND PRODUCTIVITY OF VEGETABLES IN GUJARAT, INDIA

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Abstract

During the few decades the horticultural production increased in India. In diverse agro climatic condition of Gujarat different horticultural crops are cultivated in which vegetables are major source of income and employment. The demand for vegetables is increasing in the state. The present investigation focus on trends and variability in area, production and productivity of vegetables in Gujarat. The secondary data pertain to area, production and productivity of total vegetable crops grown in Gujarat state was collected from the report of Directorate of Horticulture, Government of Gujarat for the period from 1996-97 to 2015-16 and divided into Period I, Period II and Overall period and analysed with simple statistical tools like mean and percentage. To study growth trend linear and exponential trend equations fitted and LGR and CAGR were worked out, whereas coefficient of variation was worked out to study variability. The results of present study showed that during Period I except productivity and during Period II and overall period the area, production and productivity increased significantly. The productivity of vegetables in Gujarat recorded less growth which was below 3 per cent per annum during overall and II period. The values of coefficient of variation showed that there was variability in area and production, whereas lower variability recorded in productivity over the period of time.

Key words : Trends, variability, vegetables, CAGR, LGR.

Introduction

Horticulture is a part of agriculture. As the state and the whole country is moving towards modernization, the agricultural sector also changed from traditional to modern agriculture. The changing dietary pattern of the population made diversification in agriculture. The cropping pattern changed from traditional to high valued crops and the horticultural crops got prime importance in cropping pattern. During the few decades the horticultural production increased in India. Directorate of Economics and Statistics, Government of India has mentioned in their report 'State of Indian agriculture 2015-16' that horticulture and livestock sectors have emerged as major drivers of agriculture in India. Over a last decade, the area under horticulture grew by 2.7 per cent per annum and production increased by 5.5 per cent per annum. The production of vegetables increased from 585.32 lakh MT to 1666.08 lakh MT from 1991-92 to 2015-16. India

ranks second in production of fruits and vegetables. Apart from health benefits, production of vegetables is a good source of income and employment of the farming community of country. As compare to other horticulture crops vegetables have maximum production in the country (Ministry of Agriculture and Farmers Welfare, 2016).

Gujarat state having diverse agro climatic conditions, which permit the farmers to cultivate the different types of agricultural crops. The horticultural crops in the Gujarat state includes the fruits like mango, sapota, banana and papaya, vegetables like okra, tomato, potato, brinjal, onion, cabbage, cauliflower, cucurbits and other leafy vegetables, flowers and spices. Vegetables production is one of the major source of income which provide income through out the year. Vegetable production provide employment to the mass population in the state. The area under vegetable crops during the year 2015-16 was 6.26 lakh hectare which was 40.86 per cent of total area under horticultural crops in the state, whereas the production

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was 126.82 lakh MT, which was 57.11 per cent of total production of horticultural crops in the state. During the year 2015-16, Gujarat state rank 5th in vegetables production with share in production of vegetables in the country was 7 per cent.

The demand for vegetables is increasing in the state. To cope up the increasing demand of vegetables, it is necessary to decide the appropriate strategies to increase the production. The study on growth in area, production and productivity will helpful in deciding such strategies. The effective planning can be done by measuring the progress of any particular sector. The present investigation focus on trends and variability in area, production and productivity of vegetables in Gujarat, India.

Materials and Methods

The study was done for Gujarat state. The secondary data pertain to area, production and productivity of total vegetable crops grown in Gujarat state was collected from the report of Directorate of Horticulture, Government of Gujarat for the period from 1996-97 to 2015-16. The data divided in to two period viz. Period I (1996-97 to 2005-06) and Period II (2006-07 to 2015-16). The data collected was analysed for Period I, Period II and Overall period with simple statistical tools like mean and percentage.

To study the growth trend of vegetables in respect of area, production and productivity the linear and exponential trend equations were fitted. Linear and compound growth rates of area, production and productivity of vegetables were worked out with help of linear and exponential trend equations, respectively.

Linear Trend Equation : Let the straight line trend between the given time series value (y) and time (t) be given by

$$\hat{y} = a + bt$$

Where,

\hat{y} = estimated area / production / productivity

a = intercept

b = regression coefficient

t = time variable in years

By obtaining regression coefficient (b) from trend equation linear average annual growth rate was obtained.

$$\text{Linear growth rate (LGR)} = \frac{b}{\bar{Y}} \times 100$$

The compound growth rates have been computed by fitting exponential trend equation

$$\hat{Y} = ab^t$$

Where,

\hat{Y} = estimated area/production /productivity

a = constant

b = regression coefficient

t = time variable in year

After transforming in to a linear form by taking logarithms.

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

Put A = log a B = log b & Y = log y this becomes

$$Y = A + Bt$$

Annual per cent compound growth rate (CGR) was obtained by following formula.

$$\text{CGR} = (\text{anti log } b^t - 1) \times 100$$

The significance of linear and compound growth rate was tested with help of correlation coefficient (r) by using 't' test.

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

To study variability with respect to area, production and productivity of vegetables Coefficient of Variation (CV) was worked out over a period of time. CV is percentage variation in mean, standard deviation considered as total variation in the mean.

$$CV = \frac{\sigma}{\bar{X}} \times 100$$

Where,

σ = standard deviation

\bar{X} = mean

Results and Discussion

From table 1, it is observed that the area and production of vegetables in Gujarat increased over the period 1996-97 to 2005-06. The percent change for area and production of vegetables was worked out to be positive for most of years, which implied that there was increasing trend in area and production of vegetables in Gujarat during the period 1996-97 to 2005-06. The highest positive per cent change in productivity was observed during 1997-98 (65.46%), which indicated that the productivity of vegetables crops raised at large extent during this year. This was attributed to decline in area under vegetables by 37.83 per cent. The highest decline

in productivity of vegetable crops was recorded by 26.44 per cent during 1999-2000, which attributed to decline in production in this year.

Table 1 further showed that the compound growth rate of area and production of vegetable crops in Gujarat state were positive and significant implied that the area and production in the state increased significantly at the rate of 8.63 per cent and 11.34 per cent per annum during the period of 1996-97 to 2005-06. The compound growth rate for productivity of vegetables showed non significant positive growth indicated that the productivity was stable during the study period. Similar results were obtained by Ramchandra *et al.* (2013). They found in their study that the growth in area and production of vegetables in Karnataka was positive and significant while the productivity performance was poor over the period 1982-83 to 2007-08. The linear growth in area and production of vegetables achieved at the rate 8.40 per cent and 10.98 per cent per annum. Planning Commission, Government of India (2001) reported that higher production and productivity of vegetable crops during period 1991-92 to 1998-99 in India was largely contributed by adoption of high yielding cultivars, F_1 hybrids and disease and pest resistant varieties and a sound seed production programme with suitable production technologies. The coefficient of variation for area and production of vegetables showed that the variability in area was 29.13 per cent and variability in production was 36.08 per cent, implied that there was variation in area and production of vegetables while lower variability (8.82 per cent) was

recorded for productivity of vegetables during 1996-97 to 2005-06.

Table 2 showed the positive percent change in area and production of vegetables during the period 2006-07 to 2015-16 indicated the increasing trend in area and production of vegetables in Gujarat over the period of time. The productivity of vegetables showed increasing trends except year 2008-09, which attributed to decline in area and production of vegetable crops during the year in the state.

The significant and positive compound growth rate of area and production of vegetables was observed during 2006-07 to 2015-16 implied that the area and production was significantly increased at the rate 6.44 per cent and 8.79 per cent per annum. Significantly positive but less growth (2.20 per cent per annum) in productivity of vegetables was observed during the study period. The linear growth rate of area, production and productivity were positive and significant and worked out to 6.13, 8.17 and 2.16 per cent per annum. The coefficient of variation for area and production of vegetables was worked out to 19.09 per cent and 25.30 per cent, implied that there was variability in area and production of vegetables while lower variability (5.34 per cent) was recorded for productivity of vegetables during 1996-97 to 2005-06.

The trends in area production and productivity of vegetables in Gujarat during the period 1996-97 to 2015-16 presented in Figs. 1, 2 and 3, respectively. The figures

Table 1 : Trends and variability in area production and productivity of vegetables during period 1996-97 to 2005-06 in Gujarat.

Year	Period I (1996-97 to 2005-06)					
	Area('000' ha.)	% change	Production('000' MT)	% change	Productivity(MT/ha.)	% change
1996-97	230	—	2153	—	9.38	—
1997-98	143	-37.83	2214	2.83	15.52	65.46
1998-99	189	32.17	3253	46.93	17.17	10.63
1999-2000	216	14.29	2730	-16.08	12.63	-26.44
2000-01	206	-4.63	3067	12.34	14.92	18.13
2001-02	237	15.05	3299	7.56	13.94	-6.57
2002-03	248	4.64	3515	6.55	14.17	1.65
2003-04	325	1.05	4580	30.30	14.07	-0.71
2004-05	331	1.85	4867	6.27	14.68	4.34
2005-06	380	14.80	6308	29.61	16.59	13.01
Mean	250.5		3598.6		14.307	
LGR	8.40***		10.98***		2.00	
CGR	8.63***		11.34***		2.47	
SD	72.97		1298.42		1.40	
CV	29.13		36.08		8.82	

Note: *** indicate significant at 1% level of probability.

Source: Director of Horticulture, Government of Gujarat.

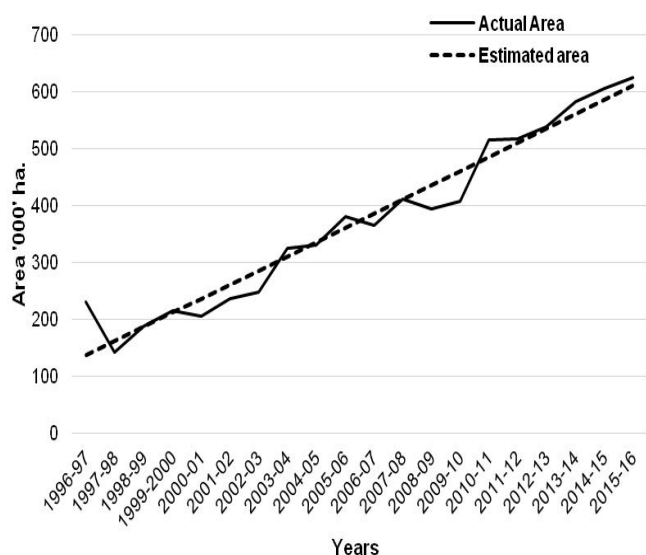


Fig. 1 : Trends in area of vegetables in Gujarat.

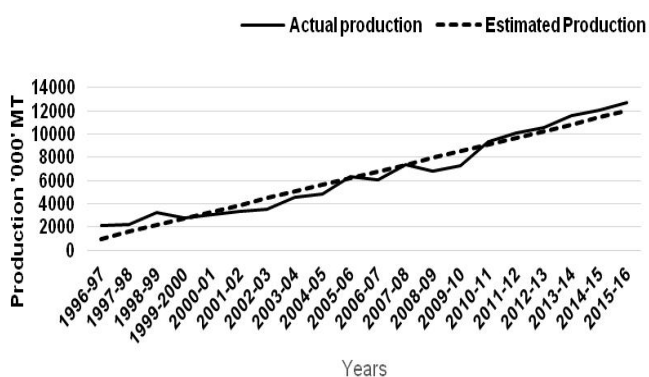


Fig. 2 : Trends in production of vegetables in Gujarat.

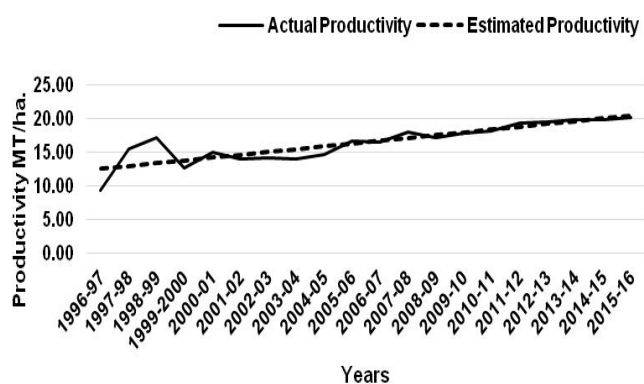


Fig. 3 : Trends in productivity of vegetables in Gujarat.

Table 3 : Growth and variability in area production and productivity of vegetables during period 1996-97 to 2015-16 in Gujarat.

Particulars	Area	Production	Productivity
Mean	373.45	6489.15	16.497
LGR	6.66***	8.92***	2.51***
CGR	7.36***	10.25***	2.69***
SD	94.79	2373.33	1.11
CV	25.38	36.57	6.72

Note: *** indicate significant at 1% level of probability.

showed the increasing trends in area, production and productivity of vegetables in Gujarat during the study period.

Table 3 depicted that the linear and compound growth rate of area, production and productivity of vegetables were positive and significant at 1% level of probability.

Table 2 : Trends and variability in area production and productivity of vegetables during period 2006-07 to 2015-16 in Gujarat.

Year	Period II (2006-07 to 2015-16)					
	Area('000' ha.)	% change	Production('000' MT)	% change	Productivity(MT/ha.)	% change
2006-07	366	-3.68	6063	-3.88	16.56	-0.18
2007-08	412	12.57	7403	22.10	17.98	8.57
2008-09	395	-4.13	6807	-8.05	17.24	-4.12
2009-10	407	3.04	7256	6.60	17.84	3.48
2010-11	516	26.78	9379	29.26	18.18	1.91
2011-12	517	0.19	10049	7.14	19.42	6.82
2012-13	538	4.06	10521	4.70	19.57	0.77
2013-14	582	8.18	11588	10.14	19.91	1.74
2014-15	605	3.95	12049	3.98	19.92	0.05
2015-16	626	3.47	12682	5.25	20.25	1.66
Mean	496.40		9379.70		18.69	
LGR	6.13***		8.17***		2.16***	
CGR	6.44***		8.79***		2.20***	
SD	94.79		2373.33		1.11	
CV	19.09		25.30		5.34	

Note: *** indicate significant at 1% level of probability.

Source: Director of Horticulture, Government of Gujarat.

During the overall study period (1996-97 to 2015-16) the area and production of vegetable crops in the state increased significantly at the rate 7.36 per cent and 10.36 per cent per annum where as significant increase in productivity was observed at the lower rate of 2.69 per cent per annum indicated that productivity of vegetables was not increased at large extent. The linear growth rate were worked out to 6.66, 8.92 and 2.51 per cent per annum, respectively during the period 1996-97 to 2015-16. The increasing trends in area and production of vegetables in the state might be due to increase in demand for vegetables in daily consumption, improved production technology and remunerative prices of vegetables. These results are in conformity with the findings of Suvagiya *et al.* (2017) who observed that the area and production of vegetables in Gujarat state increased at the rate 7.93 per cent and 10.63 per cent per annum during 1994-95 to 2012-13 whereas productivity of vegetables increased at lower rate of 2.49 per cent per annum. Rai (2013) studied the production and growth of horticultural crops in West Bengal and found that the area and production of fruits and vegetables increased during the study period where as the productivity growth rate was lower and range between 0.24 to 3.4 per cent in different districts under study. The coefficient of variation was higher and worked out to 25.38 and 36.37 per cent for area and production of vegetable crops whereas lower variability was observed for productivity of vegetables during study period in Gujarat state indicated that the productivity of vegetable crops was stable during the overall study period. Similar results found by Prem Chand (2007), Mehta (2012), Dastagiri *et al.* (2013) and Agrawal *et al.* (2016).

Conclusion

The results of present study showed that during Period I except productivity and during Period II and overall period the area, production and productivity increased significantly. The growth in area was 8.63, 6.44 and 7.36 per cent per annum while the growth in production was 11.34, 8.79 and 10.25 per cent per annum for Period I, Period II and overall period, respectively. The productivity of vegetables in Gujarat recorded less growth which was below 3 per cent per annum during overall and II period. The values of coefficient of variation

showed that there was variability in area and production whereas lower variability recorded in productivity over the period of time. Large demand of vegetables indicate that still there is scope to increase the production of vegetables in the state. Appropriate strategies should be adopted to increase productivity of vegetable crops.

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