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Growth Performance of Major Vegetable Crops in Gujarat State§

Daya Suvagiya, V.C. Shilpa, Shah Parth and N.J. Ardeshna

Department of Agricultural Economics, Junagadh Agricultural University, Junagadh-362 001, Gujarat

Abstract

The study has examined the growth performance of major vegetable crops in the state of Gujarat across its districts and regions. The study has revealed that the growth performance of major vegetable crops was significant in area (9.45% / annum), production (14.03% / annum) and yield (4.18 % / annum). The growth performance of vegetable crops was found to be highest in South Gujarat, followed by the North Gujarat region. The highest rate of increase in area and production of vegetables was observed in Dahod district, whereas the highest yield of vegetables was noticed in Porbandar district. The values of instability indices for area (11.52), production (8.36) and yield (10.71) were comparatively lower, indicating their stability in the state.The area and production of vegetables in the Saurashtra region were more unstable vis-a-vis other regions of the state.

Key words: Compound growth rate, instability index, regional disparity, vegetables, Gujarat

JEL Classification: Q10, Q16

Introduction

India is the second largest vegetables producing country in the world, next to China. The horticulture sector accounts for about 13.08 per cent of gross cropped area (192 million hectares) in the country and contributes around 30 per cent to agricultural GDP of India. Its share is about 37 per cent of the total exports of agricultural commodities. The area under horticultural crops which was 12.77 million hectares during 1991-1992 increased to 23.69 million hectares during 2012-13 (Ardeshna *et al*., 2014). The total vegetables production during this period increased by nearly 2.8-times and the productivity increased 1.5-times. The total horticultural production was 268.9 million tonnes as compared to 257.1 million tonnes of food grain production during 2012-13. The share of vegetables production in total horticultural production was higher (60.3 %) vis-a-vis other horticultural crops (NHB, 2012-13). In 2012-13, the total horticultural production was highest in West Bengal (292 lakh tonnes), followed by Andhra Pradesh (289 lakh tonnes). The production of vegetables was also highest in West Bengal (15.7%), followed by Uttar Pradesh (12.1%) in the year 2012-13. The calorie intake from fruits and vegetables has increased from 6.9 per cent in 2004-05 to 7.0 per cent in 2009-10 in the rural areas and from 7.2 per cent to 8.0 per cent in the urban areas during same period.

The state of Gujarat has a variety of soils, rainfall pattern, temperature regimes, and irrigation facilities. This diverse agro-climatic situation across the state holds potential for development of the horticulture sector in a big way. However, the wide annual variations in rainfall affects the productivity of crops.

* Author for correspondence
Email: pateldaya1993@gmail.com

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The investment in fruit and vegetable processing units has increased in the state which shows a bright future for horticulture sector in Gujarat. Considering the importance of horticulture sector in the Gujarat state, the present study was undertaken with the following specific objectives:

- Compute the district-wise compound growth rates and instability indices of area, production and productivity of major vegetable crops in Gujarat, and
- Study the regional disparity in growth performance of major vegetable crops in Gujarat.

Data and Methodology

The district-wise time series data on area, production and yield of major vegetable crops of the state were collected from the Directorate of Horticulture, Government of Gujarat, Gandhinagar, for the period 1994-95 to 2012-13. The district-wise and region-wise compound growth rates (CGRs) of area, production and productivity of major vegetable crops were computed using the following formula:

$$CGR\ (\%) = (\text{Anti log of log } b - 1) \times 100$$

where, b is the regression coefficient

The level of instability was computed from Cuddy Della Valle index (Cuddy and Della, 1978):

$$\text{Instability Index (I I)} = CV * \sqrt{(1 - R^2)}$$

where, CV is the co-efficient of variation and R^2 is the co-efficient of determination from a time trend regression adjusted by the number of degrees of freedom.

Results and Discussion

The results of district-wise and region-wise compound growth rates as well as instability indices of area, production and yield of total vegetables and individual vegetable crops, namely potato, onion, brinjal, cabbage, okra, tomato and clusterbean, are presented and discussed in this paper.

Vegetable Crops

The compound growth of area, production and yield as well as instability indices of vegetables are presented in Table 1. The CGRs and I.I. of individual vegetable crops are given in Tables 2 to 8.

Table 1. Compound growth rates for area, production and yield of vegetables in Gujarat: 1994-95 to 2012-13

District / Region	Compound growth rates (% p.a.)		
	Area	Production	Yield
Ahmedabad	06.96	07.31	00.33#
Amreli	**11.70**	10.70	-0.90#
Banaskantha	10.23	13.70	03.15
Bharuch	03.70	08.60	04.72
Narmada	12.71	**18.75**	**05.36**
Bhavnagar	04.22 *	05.83 *	01.55 *
Dang	**18.54**	**22.21**	03.09 *
Gandhinagar	11.46	**17.87**	**05.75**
Jamnagar	07.99	08.29	00.27#
Junagadh	07.40	08.22	00.76#
Porbandar	02.70#	10.39 *	**07.48**
Kutchh	06.58	12.67	**05.72**
Kheda	02.49#	04.10	01.58#
Anand	04.50 *	09.73	05.00
Mehsana	05.64	05.63	-0.01#
Patan	10.90	14.02	02.81#
Panchmahal	04.28 *	03.42#	-0.82#
Dahod	**23.70**	**27.20**	02.83#
Rajkot	09.82	12.08	02.06#
Sabarkantha	10.71	15.13	**03.99**
Surat	08.09	11.21	02.89
Surendranagar	**13.61**	**16.98**	02.96
Vadodara	07.79	10.47	02.49
Valsad	03.27 *	07.93	04.52
Navsari	07.38	14.04	**06.21**
Tapi	**15.78**	**18.34**	02.21#
Gujarat	07.93	10.62	02.49
Regions			
Saurashtra	07.47	08.50	00.96*
North Gujarat	09.44	12.81	03.08
South Gujarat	09.45	14.03	04.18
Middle Gujarat	06.68	09.05	02.22

Source: Authors' calculations
Note: * indicates significance at 5 per cent level and # indicates non-significant. The remaining CGRs are significant at 1 per cent level.

The acreage under vegetable cultivation and production of vegetables increased throughout the state

at the rate of 7.93 per cent and 10.62 per cent per annum, respectively during 1994-95 to 2012-13. These results are in conformity with the findings of Mehta (2012) who observed high growth of vegetable crops in Gujarat during 2001 to 2010. Region-wise, the rate of increase in area (9.45% / annum), production (14.03% / annum) and yield (4.18 % / annum) was observed highest in South Gujarat region, followed by North Gujarat region. Many districts in the state registered non-significant growth which was reflected by lower productivity growth in Gujarat state (2.49 % / annum) and in all the four regions of the state. The highest rate of increase in area and production of vegetables was observed in the Dahod district while the Porbandar district depicted the highest growth in yield of vegetables.

The instability indices for area, production and productivity of vegetables in Gujarat are presented in Table 2. The instability indices of area (11.52), production (8.36) and yield (10.71) were lower indicating their stability in the state. The area and production of vegetables in the Saurashtra region showed more instability as compared to other regions of the state.

Table 2. Instability index for area, production and yield of vegetables in Gujarat: 1994-95 to 2012-13

District / Region	Instability Index (I.I.)		
	Area	Production	Yield
Ahmedabad	32.17	**49.00**	13.68
Amreli	**46.55**	**50.85**	22.35
Banaskantha	14.00	11.21	09.40
Bharuch	20.23	31.47	20.02
Narmada	20.48	25.34	11.04
Bhavnagar	36.71	42.25	13.44
Dang	**61.93**	**54.08**	**30.10**
Gandhinagar	27.11	27.06	16.52
Jamnagar	25.82	34.94	17.83
Junagadh	31.16	34.43	**29.52**
Porbandar	**63.75**	**74.65**	24.61
Kutchh	31.39	29.30	**27.96**
Kheda	**55.13**	25.76	23.77
Anand	23.14	26.13	21.54
Mehsana	20.79	21.21	11.44
Patan	30.21	38.61	23.14
Panchmahal	41.40	46.93	18.31
Dahod	31.75	43.20	**25.14**
Rajkot	**50.61**	**56.62**	21.42
Sabarkantha	16.89	23.92	11.90
Surat	25.15	26.25	11.63
Surendranagar	28.48	28.75	17.20
Vadodara	16.55	21.42	09.20
Valsad	29.14	32.38	**27.65**
Navsari	15.92	16.20	14.51
Tapi	09.24	16.24	07.42
Gujarat	11.52	08.36	10.71
Regions			
Saurashtra	27.07	31.23	10.88
North Gujarat	08.10	08.47	09.09
South Gujarat	13.67	14.84	11.62
Middle Gujarat	21.33	14.87	16.17

Source: Authors' calculations

Individual Vegetable Crops

Potato

The area, production and yield of potato increased at the rate of 5.95, 6.99 and 2.45 per cent per annum, respectively in Gujarat during 1994-95 to 2012-13 (Table 3). Mehta (2012) has also observed that the area and production of potato increased at the rate of 6.00 per cent and 5.56 per cent per annum, respectively in Gujarat state during 2001 to 2010. Region-wise, the area and production of potato significantly increased in Saurashtra and North Gujarat, while significant increase in yield of potato was found in the North Gujarat region (1.2 % / annum) only. The districts of Banaskantha, Gandhiagar, Jamnagar, Kutch, Panchmahal and Sabarkantha registered a significant and positive growth in area and productivity of potato. The highest stability of area (25.24) and production (36.20.) was observed in Kheda while highest stability of yield of potato was found in the Sabarkantha district.

Onion

The acreage under onion cultivation increased at the rate of 6.62 per cent per annum and production at the rate of 6.55 per cent per annum in Gujarat during 1994-95 to 2012-13 (Table 4). The region-wise growth in area and production was also found significant in all the four regions, but the productivity growth was non-significant in the state as well as in Saurashtra and South Gujarat regions. Ardeshna *et al.* (2014) have also observed that the area and production of onion in Gujarat increased at the rate of 9.53 per cent and 8.74

Table 3. Compound growth rates and instability index for area, production and yield of potato in Gujarat: 1994-95 to 2012-13

District / Region	Compound growth rates (% p.a.)			Instability Index (I.I.)		
	Area	Production	Yield	Area	Production	Yield
Ahmedabad	-26.16	-25.89	00.37#	80.38	84.12	15.17
Banaskantha	08.49	08.73*	00.22#	49.20	60.03	14.53
Gandhinagar	14.93	17.28	02.05 *	58.34	68.41	16.59
Jamnagar	12.64	09.45 *	-2.84 *	79.43	72.90	28.29
Kutchh	05.62 *	4.66	-0.91#	45.52	41.87	27.70
Kheda	-1.92#	-3.89#	00.79#	25.24	36.20	37.76
Anand	01.05#	06.23#	05.22#	35.00	65.63	46.05
Mehsana	-0.53#	-0.21#	00.32#	34.14	41.86	14.03
Patan	06.90#	07.71#	00.76#	74.07	82.97	17.22
Panchmahal	09.04 *	05.63	-3.12	58.37	50.78	12.80
Dahod	09.97#	11.44#	01.28#	131.26	114.79	32.23
Sabarkantha	08.95	10.89	01.78	41.82	48.54	13.52
Gujarat	05.95	06.99	02.45 *	29.49	40.28	18.69
Regions						
Saurashtra	16.14	13.01	-02.69	79.31	84.66	27.69
North Gujarat	07.15	08.45	01.20	41.76	51.56	10.41
South Gujarat	-4.47#	01.40#	06.15 *	228.35	223.63	09.45
Middle Gujarat	00.61#	-0.07#	-0.68 #	22.93	38.44	29.5

Source: Authors' calculations
Note: * indicates significance at 5 per cent level and # indicates non-significant. All remaining CGRs are significant at 1 per cent level.

Table 4. Compound growth rates and instability indices for area, production and yield of onion in Gujarat: 1994-95 to 2012-13

District / Region	Compound growth rates (% p.a.)			Instability Index (I.I.)		
	Area	Production	Yield	Area	Production	Yield
Ahmedabad	-4.08#	-2.92#	01.09#	69.46	65.19	32.73
Amreli	08.15 *	07.82 *	-0.30#	68.96	69.15	20.37
Banaskantha	04.75#	06.07*	01.26#	42.99	41.99	21.96
Bharuch	08.86*	09.56	00.02#	51.64	51.97	23.28
Narmada	15.09	18.33 *	03.01	75.64	74.41	13.98
Bhavnagar	04.38#	04.80#	00.40#	53.88	55.49	9.72
Dang	05.24#	09.32#	03.43	88.17	109.09	16.74
Jamnagar	10.79	08.86	-1.75#	53.76	61.64	21.54
Junagadh	06.27#	06.39#	00.11#	57.49	60.38	12.47
Porbandar	10.83#	16.83#	05.42	98.35	97.40	8.86
Kutchh	03.11#	02.08#	-1.00#	179.54	165.08	16.79
Kheda	-3.55#	-5.21#	-1.77 *	54.10	48.48	16.04
Anand	06.32 *	-0.99#	-6.69	34.24	35.16	31.35
Mehsana	02.09#	-0.68#	-2.71	40.12	48.33	17.37

Contd...

Table 4 Contd.

District / Region	Compound growth rates (% p.a.)			Instability Index (I.I.)		
	Area	Production	Yield	Area	Production	Yield
Patan	02.94#	01.53#	-1.36#	27.97	27.95	2.65
Panchmahal	05.88#	03.82#	-1.97 *	51.09	51.33	18.60
Dahod	13.55	09.06#	-3.83	61.12	69.20	16.14
Rajkot	10.04 *	09.87 *	-0.16#	69.91	68.33	22.08
Sabarkantha	10.37	08.26	-1.91#	49.07	44.31	21.69
Surat	-2.70#	-3.06#	-0.22#	77.42	76.77	19.85
Surendranagar	10.89 *	10.37 *	-0.47#	63.25	61.11	18.25
Vadodara	14.43	13.54	-0.77#	58.21	57.21	24.99
Valsad	-6.02#	-9.23 *	-3.50 *	58.31	69.72	26.62
Gujarat	06.62	06.55	-0.07 #	42.77	42.82	8.73
Regions						
Saurashtra	06.22 *	06.37 *	00.14#	49.93	49.58	8.22
North Gujarat	06.45	04.99 *	01.37	34.25	34.91	15.28
South Gujarat	08.39	09.18	00.73#	30.84	35.09	13.11
Middle Gujarat	08.72	05.82	-02.60	30.58	32.20	16.89

Source: Authors' calculations

Note: * indicates significance at 5 per cent level and # indicates non-significant. All remaining CGRs are significant at 1 per cent level.

per cent per annum in Gujarat during 2001-02 to 2011-12. They also observed the non-significant growth of productivity of onion in the state of Gujarat as well as in Saurashtra region during 2001-02 to 2011-12. All the districts of major onion-growing Saurashtra region registered non-significant growth of yield, except Porbandar district (5.42% /annum). The district of Narmada registered the highest rate of increase in area (15.09 % / annum) and production (18.33% / annum) of onion. The instability indices of area and production of onion ranged from 30.58 to 49.93 and 32.30 to 49.58, respectively, indicating that the area remained less stable which in turn was responsible for fluctuations in onion production. Very high fluctuations in onion prices affect the acreage of onion. The lowest instability indices of area, production and yield of onion were observed in the Patan district.

Brinjal

The cultivation of brinjal increased at the rate of 8.18 per cent per annum along with significant growth in production (10.47% / annum) and yield (2.12% / annum) in Gujarat during 1994-95 to 2012-13 (Table 5). The lower instability indices of area, production and yield of brinjal to the tune of 10.98, 10.94 and 6.19, respectively in Gujarat indicated its stability. It is observed that the growth of area, production and productivity were significant in all the four regions of the state, except in case of Saurashtra in productivity. The positive and significant growth of area, production and productivity of brinjal in South Gujarat region were also observed by Saraswat *et al*. (2014). The region-wise highest growths in area (8.37% / annum), production (12.03% / annum) and yield (3.99% / annum) were observed, respectively in Middle and North Gujarat regions. Among the four regions of the state, Middle Gujarat registered the highest stability in area, production and yield of brinjal. Most of the districts in Gujarat registered a positive and significant growth in area and production, among which the district of Dang topped the list while Banaskantha district remained at the top in growth of brinjal productivity.

Cabbage

The positive and significant CGRs of area (10.60% / annum), production (12.91% / annum) and yield (2.09%/ annum) of cabbage were observed in Gujarat during 1994-95 to 2012-13 (Table 6). The area,

Table 5. Compound growth rates and instability index for area, production and yield of brinjal in Gujarat: 1994-95 to 2012-13

District / Region	Compound growth rates (% p.a.)			Instability Index (I.I.)		
	Area	Production	Yield	Area	Production	Yield
Ahmedabad	03.92	06.72	02.70	38.22	42.16	11.12
Amreli	11.17	11.70	00.48#	43.73	49.24	11.83
Banaskantha	10.17	16.40	05.65	19.32	31.16	23.96
Bharuch	04.25	09.99	05.50 *	20.80	44.15	36.35
Narmada	12.11	17.66	04.95	20.19	27.79	14.16
Bhavnagar	04.67 *	08.51	03.67	31.48	33.86	12.48
Dang	31.91	25.81	-4.62	31.33	26.92	17.62
Gandhinagar	09.96	13.29	03.03 *	32.86	27.94	34.51
Jamnagar	02.72#	02.00#	-0.70#	30.00	35.73	19.18
Junagadh	09.24	09.93	00.63#	41.04	38.75	43.77
Porbandar	-2.02#	00.21#	02.28#	49.53	44.22	35.68
Kutchh	15.73	13.35	-2.24#	38.39	44.59	32.99
Kheda	01.85 *	03.42	01.54	18.04	18.99	09.65
Anand	12.03	12.75	00.64#	18.46	36.40	13.59
Mehsana	05.35 *	03.69 *	-1.57 *	45.56	38.20	13.00
Patan	08.48	10.15	01.54#	14.06	16.18	06.35
Panchmahal	01.91#	01.34#	-0.56#	35.65	38.04	15.50
Dahod	23.80	26.82	02.44	37.48	38.51	09.14
Rajkot	04.23#	06.22	01.91 *	43.57	39.55	15.65
Sabarkantha	07.39	11.89	04.19	26.50	25.54	22.68
Surat	05.35	07.83	02.34	23.49	26.52	15.42
Surendranagar	16.49	17.18	00.59#	28.75	34.54	13.51
Vadodara	12.24	14.66	02.15	19.53	20.76	12.95
Valsad	01.96#	04.83 *	02.81#	32.57	41.92	41.68
Navsari	01.82#	03.23#	01.39	24.01	26.73	07.72
Tapi	05.59	00.78#	-4.56#	05.33	11.75	10.68
Gujarat	08.18	10.47	02.12	10.98	10.94	06.19
Regions						
Saurashtra	08.05	09.12	00.99#	23.58	19.11	20.39
North Gujarat	07.73	12.03	03.99	15.90	18.55	10.59
South Gujarat	07.79	10.95	02.93	14.31	20.05	14.66
Middle Gujarat	08.37	10.52	01.99	11.25	10.10	03.14

Source: Authors' calculations

Note: * indicates significance at 5 per cent level and # indicates non-significant. All remaining CGRs are significant at 1 per cent level.

production and yield of cabbage increased significantly in all the regions, the highest rate of increase in area (13.37% /annum), production (17.44%/annum) and yield (3.59% / annum) was observed in North Gujarat region. The area and production of cabbage remained more stable in the Middle Gujarat region while productivity remained more stable in the North Gujarat region. The district of Gandhinagar registered the highest rate of growth in area, production and yield of cabbage. The lowest instability indices of area (4.47), production (7.14) and yield (3.55) indicated its stability in the Tapi district.

Table 6. Compound growth rates and instability index for area, production and yield of cabbage in Gujarat: 1994-95 to 2012-13

District / Region	Compound growth rates (% p.a.)			Instability Index (I.I.)		
	Area	Production	Yield	Area	Production	Yield
Ahmedabad	07.44	08.12	00.63#	22.27	19.85	10.56
Amreli	07.97	08.57	00.55#	32.78	33.48	07.94
Banaskantha	14.57	15.74	01.02 *	28.30	29.22	11.08
Bharuch	09.40	11.02	01.48#	38.38	44.25	20.17
Narmada	08.80	11.42	02.35	26.10	26.06	11.14
Bhavnagar	01.43#	06.13#	04.62	56.04	62.04	15.02
Gandhinagar	25.54	34.73	07.32	36.74	38.93	23.30
Jamnagar	04.71 *	04.42 *	-0.28#	32.07	40.19	17.75
Junagadh	24.93	30.17	04.20#	29.71	31.97	31.96
Porbandar	-27.54	-26.59	01.30	58.55	58.53	02.83
Kutchh	15.67	14.44	-1.25#	31.08	29.89	33.20
Kheda	05.97	09.69	03.51	31.17	23.52	19.48
Anand	09.89	08.68	-1.10 *	12.07	14.75	06.61
Mehsana	04.43#	03.14#	-1.24#	67.30	44.34	17.21
Patan	-2.55#	00.16#	02.78	61.60	60.94	05.80
Panchmahal	06.49	04.80 *	-1.59 *	33.33	31.73	18.04
Dahod	04.28	06.89	02.51 *	07.27	10.54	07.05
Rajkot	19.20	19.83	00.53#	51.04	49.59	05.63
Sabarkantha	18.00	22.86	04.11	27.51	21.98	21.62
Surat	-0.27#	-0.71#	-0.44#	51.55	53.33	12.84
Surendranagar	21.65	22.68	00.85#	46.57	51.26	21.29
Vadodara	01.37#	00.81#	-0.55#	28.65	34.61	09.15
Valsad	10.23	10.39	00.15#	18.34	18.69	00.62
Navsari	-4.29#	-0.72#	03.73#	85.51	85.19	14.22
Tapi	15.03	16.46	01.25#	04.47	07.14	03.55
Gujarat	10.60	12.91	02.09	10.05	08.03	06.16
Regions						
Saurashtra	10.49	11.93	01.30	24.48	27.03	12.31
North Gujarat	13.37	17.44	03.59	19.96	17.62	06.35
South Gujarat	09.92	11.18	01.15*	34.05	37.09	09.68
Middle Gujarat	08.16	09.16	00.93*	11.44	09.34	07.77

Source: Authors' calculations

Note: * indicates significance at 5 per cent level and # indicates non-significant. All remaining CGRs are significant at 1 per cent level.

Okra

The production of okra increased at the rate of 15.74 per cent per annum as a result of positive and significant increasein area (11.80% / annum) and yield (3.52 % / annum) in Gujarat during 1994-95 to 2012-13 (Table 7). The results of region-wise CGRs showed a similar pattern of growth with highest rate of increase in area and production of okra being in South Gujarat region, while the rate of increase in yield (5.24% per annum) was highest in North Gujarat region. The lowest instability indices of area, production and yield were observed in the Middle Gujarat region, while those in the district of Narmada indicated stability of okra crop. The highest rate of increase in area (36.56%

Table 7. Compound growth rates and instability index for area, production and yield of okra in Gujarat: 1994-95 to 2012-13

District / Region	Compound growth rates (% p.a.)			Instability Index (I.I.)		
	Area	Production	Yield	Area	Production	Yield
Ahmedabad	08.10	09.52	01.32#	66.47	74.82	27.45
Amreli	13.50	13.64	00.12#	57.80	65.90	43.02
Banaskantha	10.16	18.74	07.79	31.28	30.12	37.24
Bharuch	06.09	10.40	04.07 *	29.23	35.86	33.89
Narmada	10.29	14.21	03.56	17.98	17.92	07.65
Bhavnagar	03.12#	07.83	04.57	36.31	39.64	28.01
Dang	36.56	46.59	07.35	26.65	21.55	25.56
Gandhinagar	11.78	14.62	02.54 *	33.70	33.97	24.40
Jamnagar	11.44	09.80	-1.47#	27.70	25.66	44.30
Junagadh	11.95	13.73	01.59#	37.37	49.29	92.08
Porbandar	-2.88#	00.81#	03.81 *	66.29 *	59.16	19.76
Kutchh	14.84	15.09	00.56#	33.75#	40.49	32.89
Kheda	12.64	16.10	03.07 *	27.98	36.61	24.03
Anand	07.59	13.66	05.64	20.67	18.05	12.05
Mehsana	16.06	19.57	03.03	30.52	35.20	20.79
Patan	27.86	29.10	00.97#	18.69	19.03	05.32
Panchmahal	07.96	07.47	-0.45#	40.81	59.94	38.11
Dahod	21.96	30.37	06.90	32.91	34.93	14.82
Rajkot	09.55	11.86	02.12#	58.60	64.56	35.72
Sabarkantha	10.29	16.19	05.34#	35.97	45.64	63.51
Surat	11.95	16.68	04.23	34.02	38.28	21.51
Surendranagar	13.86	19.42	04.88	25.45	24.03	15.20
Vadodara	11.68	15.29	03.24 *	26.79	25.81	27.27
Valsad	05.45	08.14	02.55#	30.72	32.64	36.66
Navsari	07.99	16.62	07.99	36.47	34.44	09.85
Tapi	22.43	27.29	03.96	16.92	16.52	00.72
Gujarat	11.80	15.74	03.52	19.81	22.09	23.98
Regions						
Saurashtra	10.68	12.73	01.86#	24.15	26.13	29.12
North Gujarat	10.48	16.27	05.24	22.76	23.64	29.75
South Gujarat	12.93	17.73	04.24	23.78	28.83	24.47
Middle Gujarat	12.18	15.37	02.84*	20.04	23.54	21.42

Source: Authors' calculations
Note: * indicates significance at 5 per cent level and # indicates non-significant. All remaining CGRs are significant at 1 per cent level.

per annum) and production (46.59 % / annum) of okra was observed in the Dang district while the district of Navsari registered the highest rate of growth in yield of okra.

Tomato

Tomato is an important vegetable cultivated throughout the state with a significant increase at the rate of 8.56 per cent, 14.10 per cent and 5.10 per cent

per annum, respectively in area, production and yield during 1994-95 to 2012-13 (Table 8). The lower instability indices of 10.21 in yield, 12.42 in production and 15.29 in area indicated its stability in the state. It is due to the fact that demand for tomato remains almost stable throughout the year. The highest rate of growth in area, production and yield of tomato was observed in the North Gujarat region, followed by the Saurashtra region in case of area and production, while in yield, it was followed by well-known tomato-growing Middle Gujarat region. The highest stability in area, production and yield of tomato was also found in the Middle Gujarat, followed by South Gujarat in case of area and production and by North Gujarat in case of yield. The result of district-wise CGRs showed that the highest rate of increase in area (18.39 % / annum), production

Table 8. Compound growth rates and instability index for area, production and yield of tomato in Gujarat: 1994-95 to 2012-13

District / Region	Compound growth rates (% p.a.)			Instability Index (I.I.)		
	Area	Production	Yield	Area	Production	Yield
Ahmedabad	05.36 *	10.42	04.81	41.10	33.42	17.75
Amreli	16.76	22.12	04.58#	55.72	78.28	37.25
Banaskantha	16.64	29.03	10.62	29.63	31.12	36.02
Bharuch	-1.64#	-3.96#	-2.36	50.51	59.48	17.77
Narmada	07.25	07.69 *	00.41#	34.22	39.40	22.63
Bhavnagar	05.84 *	11.18	05.04	37.45	35.62	27.03
Gandhinagar	15.25	29.85	12.67	69.07	85.16	29.34
Jamnagar	09.54	11.98	02.23	33.93	36.41	15.97
Junagadh	08.24#	09.10#	00.78#	126.05	132.34	90.19
Porbandar	-4.21#	01.84#	06.32	50.28	46.96	23.56
Kutchh	18.39	22.32	03.03#	28.57	30.21	36.06
Kheda	10.21	12.74	02.29#	29.43	34.33	34.16
Anand	11.38	18.61	06.49	22.73	17.82	12.19
Mehsana	15.13	20.37	04.55	34.20	30.81	16.61
Panchmahal	-1.70#	01.30#	03.06#	70.23	68.34	26.50
Dahod	05.66#	05.72#	00.06#	35.34	37.92	18.24
Rajkot	07.07 *	15.15	07.55 *	59.43	45.87	24.57
Sabarkantha	09.33	15.24	05.40	25.47	24.81	14.78
Surat	03.42 *	03.90 *	00.49#	31.43	34.54	12.36
Surendranagar	13.86	17.92	03.57	39.21	42.47	19.33
Vadodara	05.03	12.99	07.58	32.09	44.56	19.61
Valsad	00.52#	03.48 *	02.94 *	35.42	29.28	34.17
Navsari	-0.62#	02.73 *	03.37	16.73	21.27	12.02
Tapi	-2.11#	04.39#	06.64 *	06.53	14.01	09.96
Gujarat	08.56	14.10	05.10	15.29	12.42	10.21
Regions						
Saurashtra	09.69	13.96	03.89	28.37	19.37	17.57
North Gujarat	14.23	23.22	07.86	20.93	22.18	22.07
South Gujarat	03.68	05.61	01.86	16.59	18.79	09.55
Middle Gujarat	07.53	13.30	05.36	15.16	14.24	09.33

Source: Authors' calculations

Note: * indicates significance at 5 per cent level and # indicates non-significant. All remaining CGRs are significant at 1 per cent level.

(29.03 % / annum) and yield (12.67 % / annum) was in Kutch, Banaskantha and Gandhinagar districts, respectively. So far as the district-wise stability was concerned, the district of Tapi registered the highest stability in acreage, while the district of Anand registered the same in production and yield of tomato.

Cluster bean

The area, production and yield of cluster bean increased in Gujarat at the rate of 7.33 per cent, 10.68 per cent and 3.17 per cent per annum, respectively (Table 9). The rate of increase in area, production and yield was observed highest in traditionally cluster bean-growing region of North Gujarat. The area and production of cluster bean was more stable in North Gujarat while yield was more stable in the Middle Gujarat region. The Mehsana district registered the highest rate of increase in area and production, but the yield was declining at the rate of 4.56 per cent per annum. The highest stability in area was observed in

Table 9. Compound growth rates and instability index for area, production and yield of cluster bean in Gujarat: 1994-95 to 2012-13

District / Region	Compound growth rates (% p.a.)			Instability Index (I.I.)		
	Area	Production	Yield	Area	Production	Yield
Ahmedabad	04.42#	01.86#	-2.59 *	142.018	161.03	23.72
Amreli	14.16	15.31	01.04#	92.20	107.11	40.20
Banaskantha	04.83	13.50	08.35	12.46	31.92	34.95
Bharuch	00.47#	11.02	10.90	51.72	47.04	25.28
Narmada	00.81	00.78	00.96	49.00	40.00	81.00
Bhavnagar	01.35#	09.14 *	07.81 *	39.59	58.40	48.43
Gandhinagar	-0.18#	04.82#	04.81 *	76.56	63.78	25.19
Jamnagar	07.97	05.32	-2.52	35.23	25.80	17.19
Junagadh	07.59	10.85	03.18#	44.16	83.77	46.87
Porbandar	-0.71#	01.09#	01.81#	45.92	50.06	25.86
Kutchh	04.03#	09.89	05.63	37.22	47.19	09.07
Kheda	10.20	15.44	04.77	28.81	37.48	17.01
Anand	05.20 *	03.36#	-1.76	73.22	77.74	07.79
Mehsana	22.46	16.77	-4.56 *	28.11	34.72	121.05
Patan	05.11#	07.39	01.53	18.95	17.94	02.25
Panchmahal	06.57 *	06.46#	00.03#	59.85	70.12	16.46
Dahod	14.01	17.33	02.91	25.74	22.43	12.81
Rajkot	04.47#	07.76 *	02.94#	53.95	55.90	21.10
Sabarkantha	-3.66#	01.57#	05.67	68.47	73.77	12.48
Surat	00.07#	01.16#	01.03 *	56.41	61.12	10.10
Surendranagar	05.34#	06.68#	01.20#	46.23	52.19	23.45
Vadodara	06.22	07.29	01.05#	19.56	29.63	21.30
Navsari	06.85#	16.33#	07.43	100.54	119.84	08.98
Gujarat	07.33	10.68	03.17	08.99	15.34	12.19
Regions						
Saurashtra	06.83	09.14	02.16*	17.31	30.29	23.54
North Gujarat	06.86	12.44	05.22	13.15	18.69	24.71
South Gujarat	06.75	10.87	03.66	32.09	36.04	12.19
Middle Gujarat	08.36	10.06	01.56	17.67	22.98	07.50

Source: Authors' calculations

Note: * indicates significance at 5 per cent level and # indicates non-significant. All remaining CGRs are significant at 1 per cent level.

Banaskantha district, while the highest stability in production and yield was observed in Patan district.

Conclusions

The study has found that the area of vegetables significantly increased (at the rate of 7.93%), while their production increased at the rate of 10.62 per cent per annum, in Gujarat during 1994-95 to 2012-13. But, the yield of vegetables increased at a lower rate of 2.49 per cent per annum. The rate of increase, in area, production and yield of vegetables was observed to be significant (7.47%, 8.50% and 0.96% per annum, respectively) in the Saurashtra region. The region of South Gujarat remained at the top among the four regions of the state in the rate of increase in area and production of vegetables. The rate of increase in yield was the highest in South Gujarat region in vegetables. The production of vegetables was found to be more stable as compared to area and yield in Gujarat. The stagnation in productivity of crops like onion in Gujarat needs appropriate technological support.

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