A STUDY OF THE GROWTH AND INSTABILITY IN AREA AND PRODUCTION OF ONION IN GUJARAT, INDIA

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Abstract: The present study was based on the secondary time series data on various aspects. Total eight regulated markets were selected purposively based on maximum arrivals of onion in the markets. The markets covered under the study were Mahuva (Station road), Ahmedabad (Chimanlal Patel market Vasana), Bhavnagar, Gondal, Vadodara (Sayajipura), Rajkot, Surat and Bharuch market. The secondary data on monthly wholesale prices and arrivals was collected from the website of www.agmarknet.gov.in of selected regulated markets for last ten years (2007 to 2016). For analysis of data several analytical tools were used *viz.,* Compound Growth Rate, Instability Index, Inter year and Intra year price indices, correlation coefficient and Johansen co-integration approach. The findings of the study showed that area, production and productivity of onion were decreased over the years but statistically non-significant. Further, it was observed that the growth rate of arrivals was statistically significant in Mahuva, Bhavnagar and Gondal market. Whereas, the highest growth rate of arrivals was found in Mahuva market. The compound growth rate of wholesale prices of onion in Vadodara market was found positive and significant. The onion arrival and price indices did not continuously increase or decrease uniformly over the years in all the selected markets.

Keywords: Onion, Growth, Instability, Market, Gujarat

INTRODUCTION

India is the fruit and vegetable basket in the world and also a combined home of wide varieties of fruits and vegetables holding a unique position in production figures among other countries. Over 90 per cent of India's exports in fresh products go to West Asia and East European markets. Efficient functioning of markets is an essential prerequisite of a sound marketing system to provide remunerative prices of the produce to the farmer sellers as well as to provide of goods at reasonable prices to the innumerable consumers. One of the common indicators of an efficient functioning of the markets is the existence of high degree of integration in them. The existence of integration in the markets influences the conduct of the firms of the markets and consequently the marketing efficiency. The behavior of a highly integrated market is different from that of dis-integrated market (Singh, 2014). Among vegetables, onion is the third most important crop of the world after potato and tomato and is grown in over 140 countries. The onion (*Allium cepa*), is a vegetable that is most widely cultivated species in India. Onion is cultivated and used around the world and as a food item, usually served cooked, as a vegetable or part of a prepared savory dish, but can also be eaten raw or used to make pickles or chutneys. It is pungent when chopped and contain certain chemical substances which irritate the eyes. (https://en.wikip.org/wiki/Onion). The problems of heart diseases, rheumatism, cancer, digestive disorders, blood sugar and prolonged cough are known to be resolved by regular consumption of onion and garlic (Anonymous, 2013).

India is projected to have population of 1.7 billion by 2050, and there is no possibility of increase in cultivable land. To cater the requirement of this ever increasing population, keeping per capita consumption, export, processing and losses at existing rate (consumption *i.e.* 7.83 kg per person per year, export 9 per cent, processing 6.75 per cent and losses 30 per cent; base year 2011-2012), we will require 24.62 million tons of onion in 2050 against 17.51 million tons in 2011-12. This demands an increase in average productivity from 16.11 to 22.65 ton per hectare, which is about 41 per cent higher than that of in the year 2011-12. Efforts can be made to reduce losses up to20 per cent, increase export up to 25 per cent and processing up to 15 per cent by 2050. With these targets, we have to increase production from 17.51 million tons to 33.39 million tonnes with productivity of 30.72 ton per hectare (Anonymous, 2013). India is at 90th place in onion productivity, although it is the second largest producer of onion in the world. The productivity is high in many European and American countries because they mostly grow long day onions and have congenial climate for bulb making. Non-availability of high yielding hybrid onion varieties, shortage and high cost of quality onion seed, use of old traditional farmers varieties and farmers own onion seed for large-scale production, susceptibility to diseases and pests and their high incidence under tropical conditions and shortage of irrigation water at critical

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growth stages reduce productivity in India. Fluctuations in market prices disturb the attitude of farmers towards adoption of input intensive production techniques and good management practices (Anonymous, 2013). India occupies first position in area of onion (1.20 Million hectares) in the world and in production ranks second (19.42 Million tonnes) next to China. However, the productivity of onion (16.18 t/ha) is far lower as compared to USA, Iran, Egypt, Turkey and many other countries. India is a country with varied agro climatic condition for growing large number of vegetable crops. It has fortunate to have a wide range of vegetable crops grown in different agro climatic zones and has a pride of place in the production of vegetables. In India onion occupies 12.85 lakh hectares area with a production of 232.62 lakh tonnes which accounted as 12.49 per cent and 12.62 per cent of the total vegetable crops area and production in the year 2017-18, respectively. In India, Gujarat state has accounted about 2.35 per cent of total onion production from 1.75 per cent area of the country and its ranks eighth in production of onion among different states in the country during the year 2017-18. The area and production of onion in Gujarat was about 44.33 thousand hectares and 1111.09 thousand metric tonnes, respectively, during the year 2018-19. Indian governments announce operation green and idea behind is to double the income of farmers by end of 2022. In this operation farmers are on "TOP" priority, where T is for tomatoes, O for onions and P for potatoes. Moreover, the seasonality and dependency on rain are more pronounced situation in production and arrival of commodity in Gujarat. As such, the producers have little control over prices which ultimately causes the price uncertainty. Therefore, the study on behavior of arrival and prices would be useful to take decision "when to grow and when to sell" on the part of farmers and "when, where and how to store and dispose off" on the part of businessmen. Market integration reflects the degree of competitiveness of the marketing system as a whole. Therefore, the present study is devoted to a study growth and instability in area and production of onion in Gujarat.

METHODOLOGY

This study has been carried out in Gujarat state and total eight regulated markets were selected purposively based on maximum arrivals of onion in the markets during TE 2017-18. The present study was pertained to the year 2007-2016 but the markets selected on the basis of maximum arrivals in TE 2017-18, because the study was proposed in the year 2016 under distance mode but analysis was carried out in the year 2019. Therefore, for selection of markets the data considered for the year average of TE 2017-18. To achieve the stipulated objectives of the study the secondary and time-series data over the last ten years (2007 to 2016) of onion was collected from various issues of Directorate of Agriculture, Agriculture & Cooperation Department, Government of Gujarat, National Horticulture Board, etc. The secondary data on monthly wholesale prices and arrivals was collected from the website of www.agmarknet.gov.in of selected regulated markets for the last ten years (2007 to 2016). The data collected from various APMCs is being systematically arranged, organized and finally subject to tabular analysis for drawing inferences to assess growth and instability.

Compound Annual Growth Rate (CAGR) and Instability Index (II)

The CAGR and Instability Index were calculated by using the following methods.

The CGR was calculated by fitting the exponential function given below:

$$Y = a\, b^t \qquad (1)$$

Where, Y = area/production/productivity/annual index number of wholesale prices

a = constant

b = regression co-efficient

t = time variable

Thus, natural log on both the sides of eq (1) was taken to convert it in to linear form.

$$\text{Log } Y = \log a + t \log b \qquad (2)$$

And, CGR (%) was worked out using following formula:

CGR (%) = (antilog of b-1) x 100

The simple co-efficient of variation (CV) often contains the trend component and thus estimates the level of instability in time series data characterized by long-term trends. To overcome this problem, the Cuddy Della Valle Index was used to correct the CV.

Instability Index (II) = CV x $\sqrt{(1-R2)}$

Where, CV = co-efficient of variation and

R^2 = co-efficient of determination from a time trend regression adjusted by the number of degrees of freedom.

The significant CGRs was classified in two groups *i.e.* negative and positive CGR.

The high growth and low instability are prerequisites for sustainable agricultural performance. Since the magnitude of growth and instability in crop production has serious implications for policymakers, the growth and level of instability in the area and production of the onion of the Gujarat state are being estimated.

RESULTS AND DISCUSSION

An attempt has been made in this chapter to study the pattern of arrivals and wholesale prices of onion during 2007 to 2016 to understand general behaviour in arrivals and wholesale prices for the selected markets.

Compound annual growth rate and instability index of area, production and productivity

Table 1 represents the results of Compound Annual Growth Rate (CAGR) and Instability Index (II) of area, production and productivity of onion in Gujarat. It is revealed from the table that the growth rate of area, production and productivity was found negative and non-significant for last ten year (2007-2016). This showed that the area, production and productivity of onion were decreased over the years but statistically non-significant. Further, the result shows that the instability index of area, production and productivity was 26.56, 28.54 and 2.61, respectively. This indicated that the variability in productivity was very less as compared to area and production.

Table 1. Compound growth rate and instability index of area, production and productivity of onion in Gujarat.

Sr. No.	Particulars	Compound Growth Rate (CGR %)	Instability Index (II)
1.	Area	-3.06	26.56
2.	Production	-3.12	28.54
3.	Productivity	-0.06	2.61

In India area of spices was found negative growth rate may be due to diversification of agricultural field crops (Devi and Jadav, 2018). Kondal (2014) studied growth rate of area, production and productivity of onion crop in Andhra Pradesh. It was observed that the compound annual growth rate of onion in terms of productivity is negative (-1.84%) during the 2007-08 to 2011-12 period, even though the area under the cultivation of onion crop and its production was positive. Acharya *et al.* (2012) conducted research on growth in the area, production and productivity of different crops in Karnataka by using the compound growth function. Growth rates showed a significant positive growth in area under pulses, vegetables, spices, fruits and nuts while cereals showed significant negative growth.

Compound annual growth rate of arrival and wholesale price indices

The estimates of compound annual growth rate of arrivals of onion were depicted in Table 2 and the results disclosed that the compound growth rate of arrivals of onion was found statistically significant at one per cent level of probability in Mahuva (13.02 %) followed by Vadodara (10.14 %), Rajkot (9.72 %) and Ahmedabad (5.31 %) market. The highest significant growth rate of arrivals was found in Mahuva market with 13.02 per cent, whereas the arrivals of onion in Bhavnagar, Gondal and Bharuch markets increased but statistically non-significant. In case of Surat market, the CGR was found negatively non-significant. This may be due to that these markets are nearer to the main production centers' of onion in Gujarat.

Table 2. Estimates of compound growth rate of arrival indices of onion in selected markets (2007-2016).

Sr. No.	Markets	Intercept(a)	Estimates of Coefficient (b)	Compound Growth Rate (CGR) in %	R^2	AdjustedR^2
1.	Mahuva	1.89	0.05	13.02**	0.76	0.73
2.	Ahmedabad	1.95	0.02	5.31**	0.88	0.87
3.	Bhavnagar	1.90	0.02	5.19	0.19	0.09
4.	Gondal	1.86	0.02	5.20	0.05	-0.06
5.	Vadodara	1.91	0.04	10.14**	0.63	0.58
6.	Rajkot	1.89	0.04	9.72**	0.82	0.80
7.	Surat	2.06	-0.01	-2.87	0.22	0.12
8.	Bharuch	1.95	0.03	6.08	0.36	0.28

** Significant at 1 per cent probability level

The estimates of compound annual growth rate of wholesale price of onion were depicted in Table 3. The results disclosed that the compound rate of wholesale prices of onion in all the selected markets were found positive but statistically non-significant except in Vadodara market, the CGR was found positive and significant (10.16 %) at 5 per cent level of probability. This may be due to the demand and supply gap, more distance from the main production centers' results into the more marketing cost, market intelligence etc.

Table 3. Estimates of compound growth rate of wholesale price indices of onion in selected markets (2007-2016).

Sr. No.	Markets	Intercept(a)	Estimates of Coefficient (b)	Compound Growth Rate (CGR) in %	R^2	Adjusted R^2
1.	Mahuva	1.97	0.03	6.47	0.17	0.07
2.	Ahmedabad	1.96	0.04	8.47	0.28	0.19
3.	Bhavnagar	1.95	0.03	8.18	0.32	0.23
4.	Gondal	1.98	0.01	3.04	0.05	-0.07
5.	Vadodara	1.94	0.04	10.16*	0.42	0.35
6.	Rajkot	1.99	0.02	5.56	0.19	0.08
7.	Surat	1.96	0.03	6.97	0.23	0.14
8.	Bharuch	1.99	0.02	4.40	0.17	0.07

*Significant at 5 per cent probability level

Instability in annual arrivals and wholesale prices
The coefficient of variation in arrivals and prices of onion as a measure of instability in different markets was analyzed for the period from 2007 to 2016. The results are presented in Table 4. It is inferred from the table that among the selected markets, the instability index in arrivals was highest in Gondal (97.54), followed by Vadodara (28.61) and Bharuch (25.47). It was found lowest in Ahmedabad (5.77) and Rajkot (14.85) market. The instability index of prices was high magnitude in Gondal (43.77), followed by Ahmedabad (42.60) and Surat (42.29).

Table 4. Instability in annual arrivals and wholesale prices of onion in the selected markets

Sr. No.	Markets	Arrivals				Wholesale prices			
		Mean	SD	CV %	II	Mean	SD	CV %	II
1.	Mahuva	33080	13266	40.10	19.50	919	403	43.84	39.91
2.	Ahmedabad	12400	2092	16.87	5.77	1194	601	50.35	42.60
3.	Bhavnagar	14631	4708	32.18	29.01	928	447	48.17	39.86
4.	Gondal	14557	14605	100.33	97.54	971	435	44.83	43.77
5.	Vadodara	3526	1648	46.74	28.61	1111	579	52.10	39.56
6.	Rajkot	2606	918	35.22	14.85	916	350	38.24	34.51
7.	Surat	3711	689	18.56	16.40	1246	601	48.26	42.29
8.	Bharuch	1180	376	31.86	25.47	1168	398	34.09	31.05

Similarly, Vedamurthy and Pandey (2010) studied the performance and competitiveness of India's onion exports and found significant positive growth in the area, production, and productivity. The increase in productivity may be attributed to improved efficiency in production at the farm level. National Institute of Agricultural Marketing, Jaipur (Rajasthan) studied the trend in marketing and export of onion in India and found that an increase in onion production results in the rise in market arrivals (Anonymous, 2012-13). Dhakre and Bhattacharya (2013) also observed the growth and instability analysis in vegetables at West Bengal, India. They found that the growth of the area, production, and productivity for all vegetables registered are positive and statistically significant and instability index for all the vegetables is also positive which indicates that there is less risk for cultivation in the state. Also, Mishra *et al*. (2013) conducted a research on instability and forecasting using the ARIMA model in the area, production, and productivity of onion in India. The results found high instability in the period 1993 to 2008 in area, production, and productivity. The study also focused on forecasting the cultivated area and production of onion in India using Autoregressive Integrated Moving Average (ARIMA) model. The forecast of onion production for the year 2020 to be about 23.02 million tonnes. Immanuelraj *et al*. (2014) conducted a study on growth and instability of onion production in Maharashtra and found that period wise compound annual growth rate of the area, production and yield

which were improved consistently over the periods. An increase in the area allocation that ranged from 1 to 10 per cent was the main reason for production rather than any technological breakthrough, as indicated by the growth rate of land productivity, which was often less than two per cent or negative. In Rajasthan state similar work was conducted by Boyal et al. (2015) on growth and instability in the area, production and productivity of fenugreek and authors concluded that the magnitude of instability in the production of fenugreek crop was higher compared to area and productivity in the selected districts.

Dinesha and Sriramappa (2015) have undertaken the study on vegetables and fruits in India with special reference to Karnataka in terms of growth in area, production and productivity. They found compound growth rate for the period 2001-02 to 2010-11 indicated that area and production under fruits registered significant positive growth rates about 5.80 per cent and 6.70 per cent, respectively. The growth of productivity was 0.80 per cent which is positive but not significant. Ganesan (2015) also examined the growth and instability in turmeric production in India for a period of 32 years. It is found that all the selected states registered significant growth in the area, production and yield of Turmeric. It is also found that the instability in the area was reduced in Andhra Pradesh, production instability was reduced in Andhra Pradesh and Tamil Nadu, yield instability was reduced in Tamil Nadu and Karnataka.

Growth rates and decomposition analysis of major pulses in Gujarat were also studied and explored the trend in area, production and productivity of major pulse crops (chickpea and pigeon pea) (Changela and Devi, 2018). The results showed that the CGRs of area, production and yield over sixteen years (2001-02 to 2016-17) were positive and significant for total pulses in India while, in Gujarat production and yield was increased significantly. Further it was observed that the CGR of area, production and yield of chickpea was positive and significant, whereas in case of pigeon pea the CGR of production and yield was positive and significant in Gujarat. The decomposition analysis concluded that increasing area of chickpea, pigeon pea and total pulse play an important role in increasing production of these crops in India but in Gujarat increasing in yield was increased total production of pulses.

Devi and Jadav (2018) also studied the growth performance in area, production, productivity and export of spices in India. It was found that the positive and significant growth rate of productivity (3.04 %) of spices in India was observed during the study period whereas, the positive and statistically non-significant growth rate in production (1.79 %) was found over the years. It also indicates that increasing trend in productivity leads to increase in production. In case of area, the negative but non-significant growth rate was found over the years. This may be due to diversification of agricultural field crops. Further, it was observed that the spices crops recorded positive higher growth in export as compared to import over last years in terms of value earned. Kamble and Tiwari (2019) performed the study on instability production and marketing of onion in Maharashtra and revealed that there was a high growth rate with high instability observed in the area, production and yield.

CONCLUSION

The study found that the area, production and productivity of onion were decreased over the years but statistically non-significant. Further, it was noticed that the variability in productivity was very less as compared to area and production. The growth rate of arrivals of onion was found statistically significant at one per cent level of probability in Mahuva, Ahmedabad, Vadodara and Rajkot market. The highest growth rate of arrivals was found in Mahuva market, whereas the arrivals of onion in Bhavnagar, Gondal and Bharuch markets increased but statistically non-significant. In case of Surat market, the CGR was found negatively non-significant. The results disclosed that the compound rate of wholesale prices of onion in all the selected markets were found positive but statistically non-significantexcept in Vadodara market, the CGR was found positive and significant at 5 per cent level of probability. Among the selected markets, the instability index in arrivals was highest in Gondal (97.54), followed by Vadodara (28.61) and Bharuch (25.47). It was found lowest in Ahmedabad (5.77) and Rajkot (14.85) market.

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