

Price Volatility and Major Issues in Demand and Supply Management of Onion in Gujarat

S S Kalamkar and Hemant Sharma

Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar, Anand, Gujarat, India

Abstract

The present study was undertaken in Gujarat to find out the major factors affecting onion price volatility. India is not only the second-largest producer of onion in the world but also the major consumer. Though there is always a surplus production, fluctuating domestic and export demand often creates demand-supply mismatch leading to a spiral effect on the prices of onion. The price spikes of onion in many ways cannot be explained fully by the fundamentals of demand and supply. All the stationary series which is obvious from the fact that calculated values (-5.46 to -5.78) for all the markets were less than the critical value (-4.01) and were free from the consequence of unit root. The results of the Granger Causality Test depicted that most of the markets had bidirectional as well as unidirectional influences on onion prices. These markets are affected by the prices of each other. The high volatility in the price of onion (from Rs. 1025 to Rs. 4525 per Quintal) was observed in all selected markets. Therefore, in order to continue the present system of market integration, there is a need to establish cells to generate market information and market intelligence which would provide a better platform for guiding the farmers in marketing their produce. The high inflation of food commodities cannot always be attributed to risks, exogenous shocks, and mismatch of demand and supply, it can also be caused by market inefficiencies, weak supply chains, and monopolies in the market. Therefore, there is a need for action against hoarders, remove the transportation bottleneck by making available railway wagons for transport and create regional storage to cater to the need of the region as per requirement.

Keywords: Onion market, Agricultural policy, Prices, Volatility, Production, Pricing

JEL Classification: Q02, Q13, Q18, E31, F41, L11

Introduction

Onion is a politically-sensitive commodity as well as closely observed agricultural commodities produced in India. Onion is the only vegetable that can bring down a government from power (Sudhir, 2004), as higher prices of onion have a direct impact on the common man's consumption basket. Though there is always extra/surplus production, demand-supply mismatch resulting due to unstable domestic as well as export demand which often creates a spiral effect on the prices of onion. The prices sometimes fall below the cost of production making it uneconomical for the onion growers. Central Government uses Minimum Export Price as an instrument

to make certain regulated exports so that there is an adequate supply of onion in the domestic market. State Governments with the support of the Government of India have also implemented Market Intervention Scheme as and when required given the possible surplus production conditions in the market. During the year May 2014, due to its highly fluctuating prices, onion was brought under the Essential Commodities Act, 1955 imposing a limit on stock holdings. Despite this step, a wide variation in average wholesale prices of onion was recorded in major markets during the last five years. The prices remained quite high in the year 2015, 2017, and 2018, especially from July to December. Average wholesale prices went down sharply in September 2016 at a far below level of Rs. 1060/qtl. After some

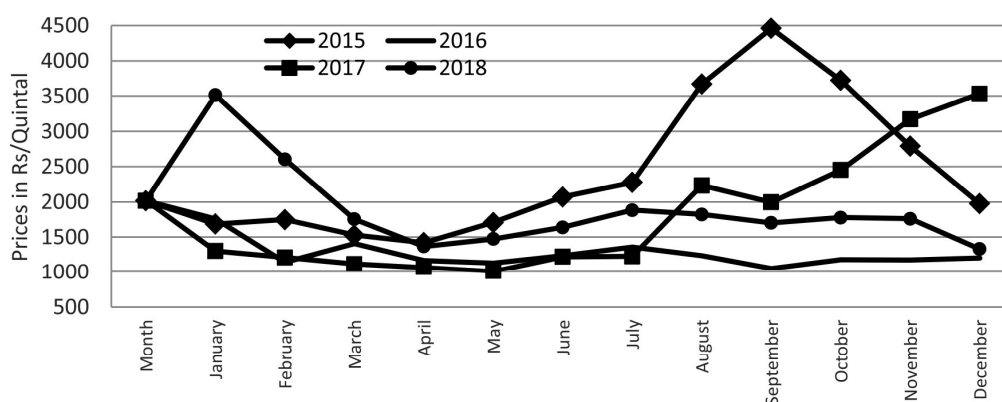
increase in prices during the remaining months of the year 2016 and the beginning of 2017, the onion prices again went down in May 2017 at the lowest level at below Rs. 1010/qtl. The picture is more bothersome when one compares wholesale prices of onion across the regions/states. During January 2018, prices were very high as compared to prices in December 2018 and January 2019, and about 60% variation is recorded during the period from January 2018 to December 2018 (Fig. 1). The deep decline in the prices of onion has led to heavy losses to the farmers. In the whole process, middlemen take advantage of price fluctuations, which also influence farmers and consumers badly. The high variation in prices of onion can be due to hoarding by traders to take advantage of price rise, higher retailers' mark up, change in (Minimum Export Price) and policy by the Government, and lack of proper forecasting system. The GOI has also approved 'Operation Greens' as a Central sector scheme to integrate the development of the value chain for three commodities, viz. tomato, onion, and potato with an aim to stabilize the prices of these commodities.

India ranks second in the production of onion in the world accounting for 23 per cent of the total production which was 24 million metric tonnes in 2017. The onions from India are famous for its strong flavor. India exports around 15-25 lakh tonnes per annum. As onion has no substitutes, demand for it is completely static. Onion is also exported in dehydrated form, canned, and pickle. India is also ranked second in the production of dehydrated onions in the world. The substantive increase in export of quality onion produce and also the foreign exchange earnings was released as onion export was brought under Canalization Scheme

through NAFED in 1974 by the government of India (GOI, 2019). Though India holds premier positions in area and production, the productivity of onion (16 tonnes/ha) is very low compared to other onion-producing countries. The inherent lower productivity in sub-tropical countries vis-à-vis European countries is due to less availability and high prices of quality seeds, high incidence of pests and diseases, moisture stress, or excess/less rains during critical growth stages. India produces onion in one or the other part of the country round the year due to the availability of suitable agro-climatic conditions (Table 1). The top five major onion-producing states in the country are Maharashtra, Madhya Pradesh, Karnataka, Bihar, and Rajasthan.

The state of Gujarat is the eighth largest onion-producing state in India, which accounts for about 2.3 per cent of the production of the country from an area share of around 4.0 percent. It was estimated that during the year 2017-18, total onion production in the state was 14.16 lakh tonnes and major onion producing districts were Bhavnagar, Gir Somanath, Rajkot, Amreli, Junagadh and Jamnagar (Fig. 2).

The review of literature on onion price volatility, supply chain issue and state interventions (Kulkarni and Basargekar, 1997; Mehta and Kamra, 1999; Molla and Atteri, 2000; Kalamkar *et al.*, 2013) indicate that onion prices prevailed in the markets is greatly influenced by production in the previous year, exported quantity in the previous year and export price in the current year, while the pattern of harvesting and market arrivals have a direct bearing on price behavior and its movements. Besides factors likes huge post-harvest losses, non-availability of proper storage structures, and



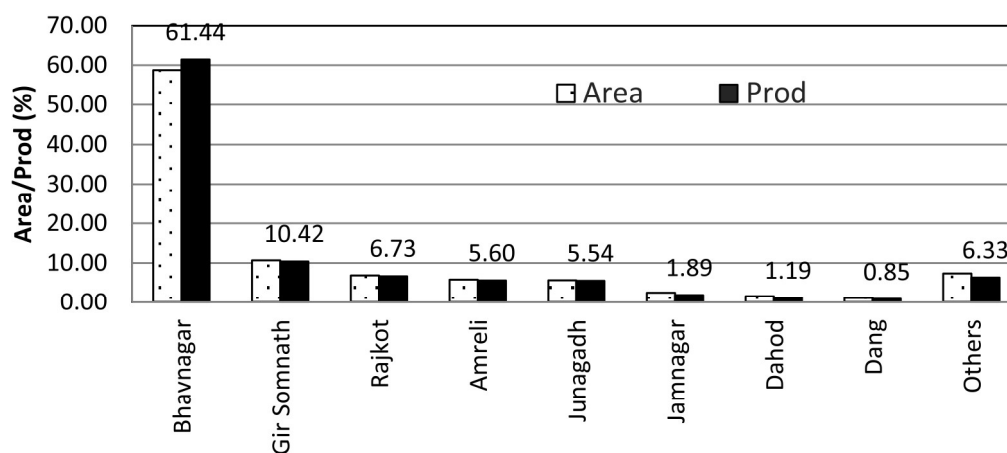
Source: GOI (2019).

Figure 1. All India Monthly Average Wholesale Prices of Onion (2015 to 2018)

Table 1. Season-wise onion production in India

Season	Agriculture Year: July-June		Production in Lakh Tonnes		
	Transplanting	Harvesting Period	2013-14 to 2017-18	2017-18	2018-19
Kharif	July - August	October- December	32 (15.24)	35(15.08)	36 (15.25)
Late Kharif	October November	January- March	42(20.0)	46(19.83)	47(19.92)
Rabi	December - January	End of March to May	136(64.76)	151(65.09)	153(64.83)
Total			210	232	236

Note: Data for 2018-19 are first advance estimates; figures in parenthesis are percentages to the total.
Source: GOI (2019).

**Figure 2. Major Onion Producing districts in Gujarat (2017-18)**

Small practices in trading were highly responsible for onion price fluctuation (Murthy and Subrahmanyam, 2003; Sharma *et al*, 2011; Chengappa *et al*, 2012). Elenchezian and Kombairaju (2003) observed that Farmers Market helped to increase in farmers' share in consumer's rupee and provide fresh vegetables to consumers at relatively low prices. While Shroff (2003) reported that the share of the farmer in retail price was less than half the retail prices in the traditional market, the balance being accounted by marketing costs and margins. Shroff (2004) suggested that the reduction in the length of the marketing channel and also the encouragement of cooperative marketing is needed so that farmers can benefit from scale economies. As far as the traditional chain is concerned, Shorff, 2011 suggested for strengthening and up-gradation of infrastructure in regulated markets is necessary so as to reduce post-harvest losses and benefit the producer and consumer. As part of market reforms, NIAM (2013) advocates for the implementation of market intelligence systems that can help in discovering the right prices for producers as well as consumers. Maity

and Sharangi (2016) mentioned that the supply chain for onion is different from general agricultural produce and suggested that proper planning for production, post-harvest management, and marketing may help growers to get better prices for good quality produce. With this background, the present study was undertaken in Gujarat to find out the major factors affecting onion price volatility.

Data Sources and Methodology

The study is based on both secondary (published sources) as well as field survey data. The secondary data were collected from published sources for the period from 2005-2018. The primary data survey was carried out from one of the largest onion-producing districts of Gujarat (Bhavnagar) for the year 2017-18. Primary data were collected from selected 10 sample farmer households; 2 Traders, 2 commission agents, 2 warehouse owners, and 1 onion processor. Besides data were also collected from 2 commission agents from Sevana APMC of Ahmadabad and 2 APMC Mahuva (Bhavnagar) and Sevana (Ahmadabad) making a total

of 21 households. A focus group discussion with the stakeholders was also held.

Until recently three broad approaches were used to investigate market integration: (i) that devised prior to the use of cointegration techniques, (ii) those using cointegration methods of the Engle-Granger variety, and (iii) those using Johansen maximum-likelihood techniques (Johansen, 1988). To the extent that agricultural prices tested are non-stationary, the latter technique is more appropriate.

To examine the price relation between two markets, the following basic relationship commonly used to test for the existence of market integration may be considered.

$$P_{it} = \alpha_0 + \alpha_1 P_{jt} + \varepsilon_t \quad (1)$$

Where P_i and P_j are price series of a specific commodity in two markets i and j . ε is the residual term assumed to be distributed identically and independently. The test of market integration is straight forward if p_i and p_j are stationary variables.

The Augmented Dickey Fuller test (ADF test) is used to determine the stationarity of a variable. The test is based on the Dickey Fuller value statistic of B_1 given by the following equation.

$$\Delta P_t = \beta_0 + \beta_1 P_{t-1} + \sum \delta_k \Delta P_{t-k} + n_t \quad (2)$$

$\sum \downarrow (k=1)^{\wedge} N \equiv$ (Where,

$$\Delta P_t = P_t - P_{t-1}$$

The test statistic is simply the t statistic. However, under the null hypothesis, it is not distributed as student-t, but this ratio can be compared with critical values given in Dickey Fuller Table. In estimating Equation (2), the null hypothesis is $H_0: P_t$ is $I(1)$, which is rejected [in favour of $I(0)$] if β_1 is found to be negative and statistically significant. The above test can also be carried out for the first difference of the variables. That is, we estimate the following regression equation:

$$\Delta^2 P_t = \theta_0 + \theta_1 \Delta P_{t-1} + \sum \downarrow (k=1)^{\wedge} N \equiv (\Phi_k \Delta^2 P_{t-k} + \mu_t) \quad (3)$$

Where the null hypothesis is $H_0: P_t$ is $I(2)$, which is rejected [in favour of $I(1)$] if θ_1 is found to be negative and statistically significant. In general, a series P_t is said to be integrated of order 'd', if the series achieves stationary after differencing d times, denoted $P_t \sim I(d)$. Consequently, if P_t is stationary after differencing once, this we may denote as $P_t \sim I(1)$. Having established that the variables are non-stationary in level, we may

then test for co integration. Only variables that are of the same order of integration may constitute a potential co-integrating relationship.

Engle-Granger causality

An autoregressive distributed lag (ARDL) model for the Granger-causality test was developed following the Engle and Granger (1987) specification provided below:

$$P_t^1 = \alpha + \beta_0 T + \sum_{j=1}^j \beta_j P_{t-j}^1 + \sum_{k=1}^k h_k P_{t-k}^2 + \varepsilon_t$$

where T is the time trend, ε_t is the error term, and other terms are as defined in equation.

Lags for the ADL model were selected to minimize the Akaike's Information Criterion. Granger causality tests were specified as:

$$P_t^1 = \alpha + \beta_0 T + \sum_{j=1}^j \beta_j P_{t-j}^1 + \sum_{k=1}^k h_k P_{t-k}^2 + \varepsilon_t$$

$$H_0 : h_1 = h_2 = \dots = h_k = 0$$

$$P_t^2 = \delta + \phi_0 T + \sum_{j=1}^j \Omega_j P_{t-j}^1 + \sum_{k=1}^k \phi_k P_{t-k}^2 + \nu_t$$

$$H_0 : \phi_1 = \phi_2 = \dots = \phi_k = 0$$

To assess the presence of price fluctuations in different markets for onion and potato ARCH-GARCH analysis was carried out for Ahmadabad, Gondal, Rajkot, Mahuwa, and Surat markets of Gujarat. The sum of alpha and beta values indicated the presence of persistent fluctuation.

Results and Discussion

The per capita onion consumption in India reached an all-time high of 13.5 kg/person in the year 2013, which is subject to fluctuations on account of religious considerations. A section of the society avoids onions totally and a few others leave out onion from their daily diet during observance of religious occasions (Navartras/Pitru Paksh). The month-wise per capita onion consumption as per NSSO survey indicate that consumption of onion during 2011-12 in rural area was relatively lower of 0.84 kg per capita while in the urban area, same was 0.95 kg per capita India produced enough onion and surplus quantity was exported to several other countries. Some authors estimated that onion consumption in the rural area was around 48.10

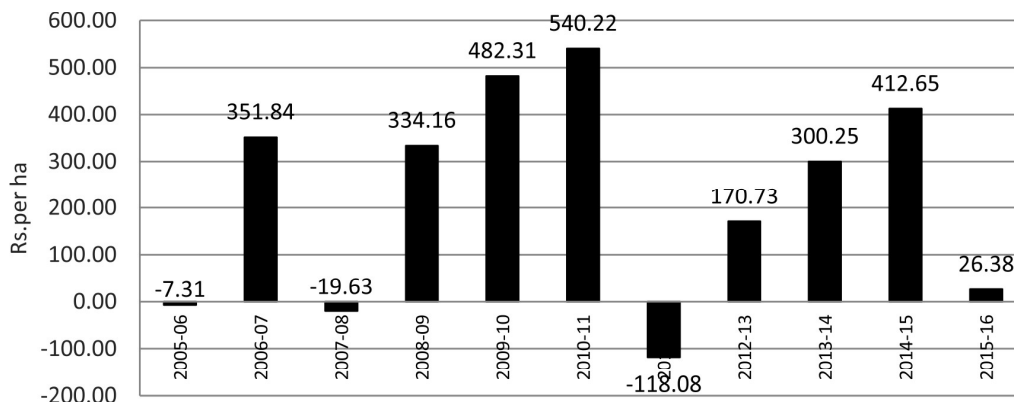


Figure 3. Profit per Quintal (Rs.)

g/person/day while the same was 50.97 g/person/day in the urban area. The cost of cultivation of onion in the state of Gujarat is estimated to be Rs. 125083/ha as C2 cost during 2015-16 while per quintal cost of production is estimated to be Rs. 723/- (Fig. 3). Cost of production varies considerable across the years and thus negative profit per quintal of onion was observed during the year 2005-06, 2007-08 and 2011-12. Cost of labour accounted for the highest share of 37.5 % in the total cost of cultivation followed by seed (27 %).

There is a lot of demand for Indian Onion in the world, the country had exported fresh onion worth Rs. 3089 crores (15.89 lakh metric tonnes) during the year 2017-18 to Bangladesh, Malaysia, Sri Lanka, United Arab Emeritus, and Nepal. During the period from January to September 2017, India had exported fresh onion worth US\$ 216.95 million which accounted for 70.29 per cent of the total onion exports while dehydrated onion export was to the tune of US\$72.49 million (23.49%). The major five onion exporting states are Maharashtra, Gujarat, Tamil Nadu, Karnataka, and West Bengal. Two Western states of India, viz. Maharashtra and Gujarat together account for about 80 percent of the total value of the onion export. Dehydrated Onion export in the form of powder, flakes, and grits is gaining demand. There are about 75 onion dehydration units in the state of Gujarat and mostly located in the Mahuva of Bhavnagar district. In the export market, India faces tough competition from Turkey and China. Due to unstable prices of onion, raw material prices go up, making onion processing unprofitable. During the year 2014-15, more than 75% of onion dehydration units remained closed due to high raw material prices. As the domestic demand for dehydrated onion is very low and limited (Datta and

Mandan, 2020), the growth of the onion dehydration industry is moving at a snail's pace¹.

The seasonal indices of market arrivals and prices of onion in the selected markets are present in Table 2 and line graph of arrivals and price indices are depicted in Fig. 4 to 8 of selected markets. Monthly seasonal indices were calculated in order to ascertain the long run seasonal variations in arrivals and prices of onion. The results revealed the existence of seasonality in all the markets. Higher indices of market arrivals of onion were noticed immediately after harvest in the selected markets arrivals reached peak during April (262.72) in Mahuva which decrease to 6.05 in October and relatively shoot up in March. In Gondal market the peak indices was found in February (172.41) followed by March (169.77). Ahmadabad market showed lowest arrivals in September (75.87) while it peaked during March (116.30). Surat market witnessed the lowest arrivals in October (70.12) and highest during May (135.19). Arrivals reached a peak during December (151.90) in Rajkot market while they were the lowest in August (69.87). The higher market arrival indices were observed (more than 100) in the months of to December to April and lower arrival indices was found during July to October (less than 100).

The pattern of market prices showed slight differences among the selected markets. The price index in Mahuva market was the highest in the month of December (127.76) and relatively higher during the months of August to January. Gondal market witnessed peak price during October (152.81). The indices in other months varied from 57.18 to 121.95. A peak of 135.56 in index was observed during December in Ahmadabad market followed by October (134.96) and November

Table 2. Seasonal Indices of monthly arrivals & prices of onion in major markets of Gujarat

Month	Seasonal Indices of Monthly Arrivals					Seasonal Indices of Monthly Prices				
	Mahuva	Gondal	Ahmada- bad	Surat	Rajkot	Mahuva	Gondal	Ahmada- bad	Surat	Rajkot
January	184.53	160.77	106.59	103.66	121.88	105.90	121.95	96.03	102.15	104.80
February	261.37	172.41	109.68	103.54	90.59	94.25	101.94	99.27	95.08	82.99
March	262.34	169.77	116.30	94.43	91.66	85.38	70.71	76.96	76.87	69.60
April	262.72	147.88	108.39	103.91	95.43	73.50	61.63	63.97	66.13	67.04
May	122.85	99.24	112.46	135.19	100.14	70.24	57.18	58.41	61.54	60.19
June	12.27	34.09	106.29	134.17	80.34	78.41	79.70	81.36	73.96	78.67
July	6.49	35.58	94.61	113.71	81.36	96.73	89.50	99.01	101.10	90.73
August	6.28	47.78	87.93	73.89	69.87	108.46	114.53	108.26	119.99	111.87
September	7.49	69.29	75.87	80.78	74.77	109.73	109.80	113.22	118.38	131.22
October	6.05	54.39	80.80	70.12	104.94	124.69	152.81	134.96	143.61	157.13
November	10.77	65.71	93.03	81.84	137.11	124.94	119.55	133.00	122.56	136.80
December	56.85	143.11	108.07	104.76	151.90	127.76	120.70	135.56	118.62	108.97

Source: Office of the Selected APMC.

(133.0). However, the price index of other months was between in 61.54 to 143.61. Surat market witnessed highest price index of 143.61 in October month. The market prices of onion in Rajkot found to be the highest in October (157.13). The lowest index was seen in May (60.19). Price index was between in 67.04 to 136.80 during other period. Price indices were more than 100 in the months of August to January. Lower indices were observed during May. The majority of the produce was sold soon after the harvest probably for want of cash or lack of storage facilities. However, farmers who are financially sound can store for longer time to look forward for advantageous period and higher prices.

To analyze the arrivals pattern of onion during different months of the year and their impact on price, seasonal indices were computed adopting 12 months moving averages. Onion crop were sown in the month of October to December. It comes to harvest from Feb to April. Thus, fluctuation in the monthly indices of onion arrivals was more than the monthly indices of prices in selected markets during the study period. The price movement also demonstrates significant seasonal fluctuations in the selected markets. As a short-term fluctuation, one will notice a general finding that the price is low when the arrivals were large and the price being high when the arrivals were low.

The selected farm households had put around one-third of total cultivated land under onion cultivation.

There are several reasons for the cultivation of onion crop as it is short duration crop, the best suitable land for onion cultivation, better price gain in onion crop other than competitive crops, and the number of onion processing units is also high. About half of selected farmers had the market as a major source of planting material and had homemade seedlings used with good quality planting material. Only 20 per cent of farmers had received training or information about marketing practices of onion crops. About 80 per cent of selected households have received price information from commission agents, APMC, and wholesalers for deciding production and marketing of Onion produces and about 90 per cent of households had sold their produce immediately after harvest due to perishable nature of the crop, lack of storage facility, and hot climatic conditions in these producing area of Gujarat. Among the selected sample farmers households, the highest average quantity of onion was sold by large land-holding size group house followed by medium and small farmers. In case of season-wise trade, the highest share of 80.81 per cent onion was traded in rabi season followed by sales in early rabi (9.26), summer (7.64) season and remaining 2.29 per cent in kharif season. About 80 per cent of the selected household has immediately sold after harvest due to lack of storage facility and perishable nature of the product (Table 3).

All the onion producer respondents had sold onion

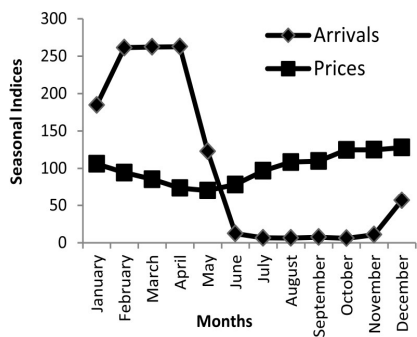


Figure 4. Seasonal Indices of monthly arrivals and prices of Onion in Mahuva

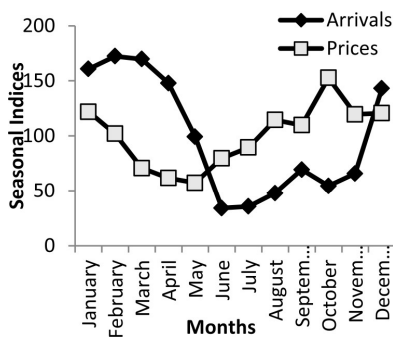


Figure 5. Seasonal Indices of monthly arrivals and prices of Onion in Gondal

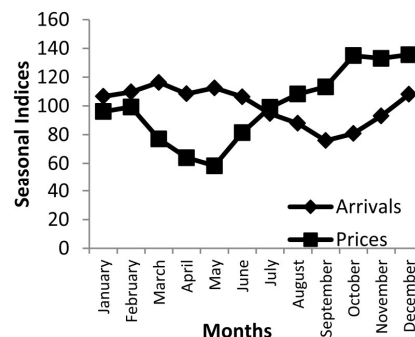


Figure 6. Seasonal Indices of monthly arrivals and prices of Onion in Ahmedabad

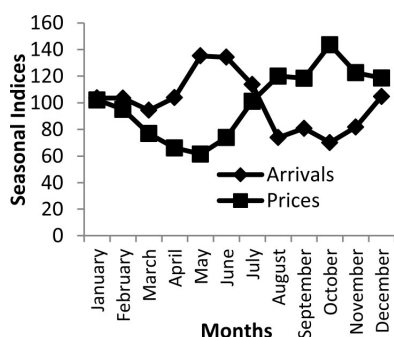


Figure 7. Seasonal Indices of monthly arrivals and prices of Onion in Surat

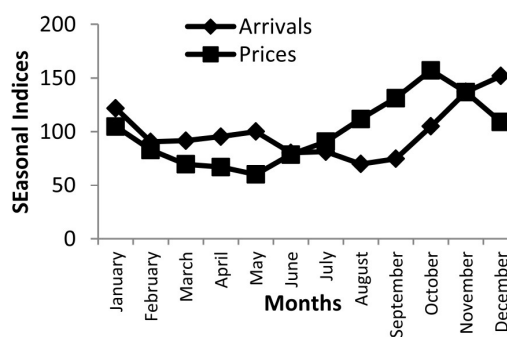


Figure 8. Seasonal Indices of monthly arrivals and prices of Onion in Rajkot

in local markets of Mahuva and Bhavnagar district. On average, 36 kilometers distance was traveled for the marketing of onion by spending an average time of around 1.27 hours by road. About Rs. 496/tonne cost was incurred by respondent farmers on transportation of produce. On average 80 per cent of respondents had sold their onion produce in the local market and the rest sold within the state. The average operational cost incurred by the household (including loading and unloading) was estimated to be Rs. 89.58 per quintal. The major reasons for preference of the market by respondent farmers were to get a better price, low cost of transportation and near to the village. About 10 per cent of the farmers had the storage facilities, with a capacity of 25 tonnes. The onion crop is perishable and has 1-2 months of shelf-life. During the months of June-July, almost all selected respondents required a storage facility with a capacity of 25 tonnes. Around 5-10 per cent loss occurs during the storage of onion. As per the selected respondent farmers, the major reason for not having their own onion storage units were high-cost storage construction, being small farmers, lack of

space, high labor cost, weight loss and spoilage. None of the respondents was aware of the market charges prescribed by the rule (such as Commission, Hamali/Handling, weight men, and market fees).

The major problems faced by the farmers in the marketing of onion were high transportation costs, high marketing costs, and lack of infrastructure facilities like market sub-yard and storage facilities. About 90 per cent of selected farmer households had opined that they did not see any cartel and collusive behavior of traders and commission agents in the market. At the time of sowing, farmers had an expected price of Rs. 2500 per quintal but the actual price received by the onion farmer was less than expected at any time, i.e. Rs. 2366.25 per quintal only (Table 4).

In the selected markets, out of the total procured quantity of onion, 90 per cent onion was procured from the local market of the Mahuva area and the rest of 10 per cent was purchased within the state (Bhavnagar and Rajkot) and out of state (Nasik, Maharashtra) procured by traders (Table 5). The average maximum

Table 3. Extent of onion marketed in Gujarat

Particulars	Extent of onion marketed				
	Small	Medium	Large	Average	
Average quantity of onion sold annually (qtls)	288.25	481.25	540	436.5	
Quantity sold during previous year (qtls)	190.63	472.5	300	321.04	
Details of season wise trade (qtls)	Kharif	30.00	0.00	0.00	10.00 (2.29)
	Early Rabi	38.75	82.50	0.00	40.42 (9.26)
	Rabi	209.50	318.75	530.00	352.75 (80.81)
	Summer	10.00	80.00	10.00	33.33 (7.64)
Out of total production storage	% Immediately sold	100.00	90.00	90.00	80.00
	% of total sold	0.00	10.00	10.00	20.00

Note: Figures in parentheses presents percentage to total sale.

Source: Field survey data.

Table 4. Place & Percentages of onion produce sold in the markets of Gujarat

Particulars	Small	Medium	Large	Average
Places of Destination				
On farm	0.00	0.00	0.00	0.00
Local	100	75.00	50.00	80.00
Within State	0.0	25.00	50.00	20.00
Outside State	0.00	0.00	0.00	0.00
Major markets & places	Mahuva	Mahuva, Bhavnagar	Mahuva, Bhavnagar	Mahuva, Bhavnagar
Approximate distance (km)	13.75	45.50	50.40	36.55
Time (hours)	1.13	1.25	1.45	1.27
Mode of transporter				
Rail				
Road	100.00	100.00	100.00	100.00
Transportation cost per Bag (Rs)	14.75	15.00	16.50	15.42
Transportation cost per ton (Rs)	460.00	502.50	525.00	495.83
Transportation cost per quintal (including loading and unloading)	79.25	83.50	106.00	89.58
Expected Average price (Rs.)				
at the time of Sowing	2375.00	2750.00	2375.00	2500.00
Before harvesting	2637.50	2537.50	2500.00	2558.33
After harvesting	2937.50	3312.50	3125.00	3125.00
Actual Price	2316.25	2390.00	2392.50	2366.25
Farmers having (own) storage unit for onion				
Yes	0.00	25.00	0.00	10.00
No	100.00	75.00	100.00	90.00

Source: Field Survey

transportation cost was Rs. 3.5 per kg for procuring from outside of state followed by Rs. 3.0 per kg within the state and Rs 1.5 per kg onion procure from the local market. The traders have then targeted the local area. This happens due to the availability of onion at a low cost. The road was the major mode of transportation for procurement and sale of the onion by traders in the Mahuva market. Overall 85 per cent of the traders had sold the product outside the state; whereas only 5 per cent of them had sold within the state and rest was local market sale. The transportation cost incurred by the trader for trading outside the state was estimated to be between Rs. 3.0 to 5.5 per kg (road and railway) as per location and mode of transport. The major targeted consumer markets were in the states of Delhi, Punjab, Haryana, Rajasthan, Assam, Bihar, and Bengal. Most traders preferred to purchase onion from the local market because onion produce is generally available at a low price with good quality. Most of the traders had preferred to sell their produce in the state due to good prices and less storable products. Traders have faced major problems such as of lack of efficient transportation facility and high transportation costs.

The selected commission agents have reported that they adjusted their purchase and sale pattern in times of very high or low prices. The commission agents at Vasana APMC as well as at Ahmadabad APMC were well equipped with information and were connected with other markets. Quantities transacted by the commission agent of Vasana were quite high in volumes that were sold outside the state while the

commission agents of the Mahuva market had traded the onion within the state.. High price fluctuation and lack of storage facility are the major problems faced by the commission agents during marketing and transport of produce.

From table 6 It can be seen that the details of the onion processing unit in the Mahuva market indicated that the processor had purchased only three varieties of onion for processing and on average, about 75 MT of onion is processed annually. Processor has a storage facility and the storage capacity is 250 MT. The current facility of onion storage is not enough for the processor because of huge market arrives in December to May and it requires high storage facilities with high storage capacity. The processor had faced problems regarding marketing and storage of onion. The area of the market yard and auction place is very small and all functionaries of marketing face problems in peak arrival. The majority of the respondents had suggested increasing the infrastructure facility like market yard, auction place, and storage facility in Mahuva market to overcome problems in marketing of onion.

Unit root test

From the table 7 it could be inferred that Augmented Dickey Fuller test values are less the critical value (1 %) given by MacKinnon statistical tables at levels implying that the series are stationary at their levels indicating the free from the consequence of unit root. All the stationary series which is obvious from the fact that calculated values (-5.462 to -5.783) for all the

Table 5. Detail of procure & sale of onion

Place of Origin	Received (%)	Approximate distance (km)	Time (hrs)	Major markets & places	Mode of transport	Transportation cost (Rs per kg)
Place of Procure						
Local	90	20	1	Mahuva	Road	1.5
Within State	5	300	7	Bhavnagar, Rajkot	Road	3.0
Outside State	5	600	12 to 15	Nasik(Maharashtra)	Road	3.5
Place of Sale						
Local	10	20	1	Mahuva	Road	1.5
Within State	5	300	7	Bhavnagar, Rajkot	Road	3.0
Outside State	85	1800	18 to 36	Delhi, Punjab, Haryana, Rajasthan, Assam, Bihar and Bangal	Road & Rail	3.0-5.5

Source: Field Survey

Table 6. Primary details of onion processing by processor

Particulars	Quantity (MT)	
Varieties of Onion stored	Local	Yes
	Red	Yes
	White	Yes
Quantity of onion purchased annually (on an average during last five years(MT))		75
	Capacity (metric tons)	250
Quantity of onion stored during last one year(MT)		50 (100)

Source: Field Survey

Table 7. ADF unit root test for prices of onion

Market	Augmented Dickey-Fuller (ADF) test value	
	Level	Critical value (1%)
Ahmadabad	- 5.763	-4.019
Gondal	-5.718	
Rajkot	-5.783	
Mahuva	-5.462	
Surat	-5.604	

markets were less than the critical value (- 4.019) and were free from the consequence of unit root. Sharma and Burark (2016) also found similar findings. The price series of onion were stationary at level, and then we cannot proceed for Johanson co-integration methodology.

Granger causality test

In order to know the direction of causation between the markets, Granger Causality test was employed in table 8. It was observed that there was a bidirectional influence on onion prices of Gondal and Ahmadabad, Gondal and Mahuwa, Surat and Gondal, Surat and Rajkot. Ahmadabad onion price shows unidirectional causality with Surat and Rajkot. Mahuwa market price influenced Surat and Rajkot market prices. Thus, different markets of onion in the state of Gujarat were closely linked with each other for the movement of Onion prices

Price volatility

To assess the presence of price fluctuations in the different markets for onion ARCH-GARCH analysis was carried out for the following wholesale price series viz., Ahmadabad Surat, Mahuwa, Rajkot and Gondal

onion markets. The sum of Alpha and Beta values indicated the presence of persistent fluctuation. The value close to 1 indicates the persistence of volatility in the market. The results presented in table 9 confirmed that there was high volatility in onion prices in these markets as the sum of Alpha (A) and Beta (B) values ranged from 1.13 to 1.28 in prices of onion. These values were above to one. Similar results were obtained by Burark *et al.* (2012) while studying the market integration of Coriander.

Conclusion and Policy Implications

The present study was undertaken in Gujarat to find out the major factors affecting onion price volatility. Onion production has shown a steady upward trend, with a few exceptions, in response to increase in planted area and to a lesser account due to improvement in productivity. Per capita onion consumption has shown a significant growth in recent years. Onion prices typically exhibit a seasonal trend peaking during the lean season of September- October and falling during April – May coinciding with the peak arrival season of the major rabi season crop. The onion retail mark up in the past has ranged from 50 per cent to 200 per cent

Table 8. Pair wise granger causality tests results for onion wholesale prices

Null Hypothesis is	Obs	F-Statistic	Prob
MH does not Granger cause ADI	154	1.209	0.301
ADI does not Granger cause MH		2.228	0.111
GNDL does not Granger cause ADI	154	4.521	0.012
ADI does not Granger cause GNDL		6.551	0.002
SRT does not Granger cause ADI	154	8.668	0.000
ADI does not Granger cause SRT		1.351	0.262
RJK does not Granger cause ADI	154	13.648	4.E-06
ADI does not Granger cause RJK		2.773	0.066
GNDL does not Granger cause MH	154	3.120	0.047
MH does not Granger cause GNDL		4.419	0.013
SRT does not Granger cause MHI	154	7.148	0.001
MH does not Granger cause SRT		0.906	0.406
RJK does not Granger cause MH	154	9.866	9.E-05
MH does not Granger cause RJK		1.896	0.154
SRT does not Granger cause GNDL	154	9.664	0.000
GNDL does not Granger cause SRT		3.305	0.039
RJK does not Granger cause GNDLI	154	13.003	6.E-06
GNDL does not Granger cause RJK		0.861	0.425
RJK does not Granger cause SRT	154	7.039	0.001
SRT does not Granger cause RJK		3.18	0.044

Table 9. ARCH- GARCH results for selected onion markets

Variable	Ahmadabad	Surat	Mahuwa	Rajkot	Gondal
Alpha(A)	1.358	1.502	1.297	1.349	1.353
Beta (B)	-0.135	-0.245	-0.158	-0.073	-0.067
Sum of A & B	1.223	1.257	1.139	1.276	1.285

- the mark up per cent is high when wholesale prices are low and vice versa. Besides fulfilling the increasing demand of domestic population, India has emerged as a major exporter of onion. One of the reasons for the high domestic onion prices is believed to be increasing exports. Onion production has shown a steady upward trend, with a few exceptions, in response to increase in planted area and to a lesser account due to improvement in productivity. Per capita onion consumption has shown a significant growth in recent years. Onion prices typically exhibit a seasonal trend peaking during the lean season of September- October and falling during April – May coinciding with the peak arrival season of the major *rabi* season crop. The onion retail mark up in the past has ranged from 50 per cent to 200 per cent-the mark up per cent is high when wholesale prices are low and vice versa. Besides fulfilling the increasing

demand of domestic population, India has emerged as a major exporter of onion. The high volatility in price of onion was observed in all selected market. Uncertainty in weather conditions, heavy/low rains and temperature effect the crop production, low stocks facility and delayed shipments is the source of high prices.

- The available regulated markets are inefficient to handle the buffer produce of onion. Also inadequate facilities at market and inappropriate steps at APMC level for efficient marketing of produce are the major difficulties for farmers to sell out their produce. Therefore, the appropriate policy decision and arrangement should be made for remunerative prices to onion growing farmers in order to safeguard their interest in production of onion. NAFED or any other notified procurement

agency/ies should procure onion at least 5 per cent of produce from open market and should store it.

- Onion dry product needs to be promoted in the market. The adequate number of processing/dehydration units needs to be created/installed to increase the onion demand in market. The awareness about use of dried/dehydrated onion among the consumer needs to be made through consumer awareness programme.
- Policies need to be developed to control the volatile nature of onion prices, which is directly affecting the low income group. Therefore, in order to continue the present system of market integration, there is need to establish cells to generate market information and market intelligence which would provide a better platform for guiding the farmers in marketing their produce.

Notes

¹There are nearly 115 onion dehydration plants in Mahuva of Bhavnagar district and 40 units in Amreli and Rajkot districts. These plants dehydrate nearly 70,000 tonne of onion every year.

Acknowledgement

This is abridged version of research project carried out for the Ministry of Agriculture and Farmers Welfare, GOI.

References

- Chengappa P G, Manjunatha AV, Dimble V, and Shah K 2012. Competitive Assessment of Onion Markets in India. A report prepared for Competition Commission of India, ISEC, Bengaluru. <https://www.cci.gov.in/sites/default/files/AO.pdf>
- Dickey D A and Fuller W A 1981. Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica* **49**:1057-1072. <http://www.u.arizona.edu/~rlo/readings/278800.pdf>
- Dutta Subrata and Mandan Richa 2020. Onion dehydration industry in Gujarat state of India: Issues of Competitiveness, Expansion and Diversification. *International Journal of Economics and Business Research* **20**:192-216 DOI:10.1504/IJEBR.2020.109148
- Elenchezian T and Kombairaju S 2003. Comparing Marketing Efficiency of Farmer Market with Central Vegetable Market. *Indian Journal of Agricultural Marketing*, **17**: 45-51.
- Engle R F and Granger CWJ 1987. Co-integration and Error Correction: Representation, Estimation and Testing. *Econometrica*, **55**:251-276. <https://ideas.repec.org/a/ecm/emetrv/v55y1987i2p251-76.html>.
- Government of India (GOI) 2019. *Monthly Onion Report-January*, Department of Agriculture, Cooperation and Farmers Welfare, Government of India. <https://agricoop.gov.in/horticulture-reports>.
- Granger, C W J 1988. Some Comments on Econometric Methodology, *Economic Record. The Economic Society of Australia*, **187**:327-330. DOI: 10.1111/j.1475-4932.1988.tb02071.x.
- Johansen, S 1988. Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control*, **12**: 231-254. [https://doi.org/10.1016/0165-1889\(88\)90041-3](https://doi.org/10.1016/0165-1889(88)90041-3)
- Kalamkar S S, Ojha M K and Parihar T B 2013. Evaluation of Price Support and Market Intervention Scheme in Rajasthan. *AERC Research Report*, Sardar Patel University, Vallabh Vidyanagar, April. https://old.spuvvn.edu/academics/academic_centres/agro_economic_centre/research_studies/R.%20No.%20149%20PSS%20&%20MIS%20in%20Raj.pdf
- Kalamkar S S, Shroff S and Dimble V 2012. Study on Competitive Assessment of Onion Markets in India: A Case of Maharashtra (part of ISEC study on Competitive Assessment of Onion Markets in India), *Research Report*, Gokhale Institute of Politics and Economics, (Deemed to be University), Pune, Maharashtra. https://dspace.gipe.ac.in/xmlui/bitstream/handle/10973/47663/GIPE-FP_333.pdf?sequence=3&isAllowed=y
- Kulkarni A P and Prema Basargekar 1997. Factors influencing Onion Prices in India. *Journal of Indian School of Political Economy* **9**: 463-489. <http://ischolar.info/index.php/JISPE/article/view/174606>
- Kumar Anil and Arora V P S 2003. An Analysis of Marketed Surplus and Marketing Cost of Vegetables in Uttaranchal. *Indian Journal of Agricultural Marketing* **17**:63-74. <http://www.agrilmktg.org>
- Maity T K and Sharangi A B (2016). Supply Chain Management of Onion in India: Status, Issues and Scope. *Research Gate*. DOI:10.17660/ActaHortic.2013.1006.29

- Mehta R and Kamra K 1999. Analysis of Price Variability of Onion Statistical Model for Price Variation Alert. *Agricultural Situation in India*, **56**:457-459. <https://eands.dacnet.nic.in/publications.htm>
- Molla Alemayehu and Atteri B R 2000. Analysis of Price Behavior of Vegetables in Delhi Wholesale Market: The Case of Potato and Onion. *Agricultural Economics Research Review*. **13**:144-150. <http://aeraindia.in/index.php>
- Murthy D. Sreenivasan and Subrahmanyam K V 2003. Demand and Supply Analysis of Onion under Uncertain Production Situations. *Indian Journal of Agricultural Marketing*, **17**:75-84. <http://www.agrilmktg.org>
- National Horticultural Research and Development Foundation (NHRDF) 2017. *38th Annual Report 2015-16*. National Horticultural Research and Development Foundation, New Delhi. <http://nhrdf.org/pdf/NHRDF%20Annual%20Report%202015-16.pdf>
- National Institute of Agricultural Marketing (NIAM) 2013. Trends in Marketing and Export of Onion in India (prepared by Dr. K. C. Gummagolmath, Assistant Director) Research Report 2012-13, *National Institute of Agricultural Marketing, Jaipur, Rajasthan*. https://mail.ccsniam.gov.in/images/research/2013_report_onion_final.pdf
- Sharma Hemant and Burark S S 2016. Extent of Market Integration of Wheat in Rajasthan. *Indian Journal of Economics and Development*, **12**:445. <http://dx.doi.org/10.5958/2322-0430.2016.00160.8>
- Burark S S, Sharma Hemant, Meena G L 2012. Market Integration and Price volatility in Domestic Market of Coriander in Rajasthan. *Indian Journal of Agricultural Marketing*, **27**:121-131. <http://www.agrilmktg.org>
- Sharma Hemant, S S Kalamkar and M C Makwana M C 2018. Management of Market Risk through Market Integration: Study of Price Volatility in Domestic Market of Onion in Gujarat. *Indian Journal of Agricultural Marketing*, **32**: 40-48, <https://www.indianjournals.com/ijor.aspx?target=ijor:ijam&volume=32&issue=3s&article=004>
- Sharma Hemant and Burark, S S 2015. Market Integration of Gram in Major Domestic Markets of Rajasthan. *Journal of Progressive Agriculture*, **6**:11-17. 10.5958/0976-4615.2015
- Sharma Purushottam, Gummagolmath K C and Sharma R C 2011. Prices of Onions: An Analysis. *Economic and Political Weekly*, **46**(2):22-25 <https://www.epw.in/journal/2011/02/commentary/prices-onions-analysis.html>.
- Shroff Sangeeta 2003. Building Up of an Efficient Marketing System to obviate the need for a Large Scale State Intervention in Maharashtra. *AERC Report*, GIPE, Pune. <file:///C:/Users/INDIA/Downloads/GIPE-FP-323.pdf>
- Shroff Sangeeta 2004. Marketing of Onion in Maharashtra. *Indian Journal of Agricultural Marketing*. **18**: 45-58. <http://www.agrilmktg.org>

Received: October 3, 2021 Accepted: December 5, 2021