Price trend and integration of wholesale markets for onion in metro cities of India

B.S.Reddy (Corresponding author)
Assistant Professor, College of Agriculture,
Bheemarayanagudi-585287, Yadgir dist, Karnataka, India
Tel: +91 08472 233997 E-mail: bsreddyagecon@gmail.com

Chandrashekhar S.M.
Research Scholar, Department of Economics,
Gulbarga University, Gulbarga, Karnataka, India
Tel: +91 08472 233997 E-mail: bsreddyagecon@gmail.com

A.K.Dikshit
Senior Scientist, Extension Education and Socio-Economics section,
Central Institute for Research on Goats,
Makhdoom 281 122, Uttar Pradesh, India
Tel: +91 9027773507 E-mail: akdixit@cirg.res.in

N.S. Manohar
Associate Professor, Department of Agricultural Economics,
Navsari Agriculture University, Dist. Navsari,Gujarat, India
Tel: +91 9427383049 E-mail: ns_manohar@rediffmail.com

Abstract

Availability of market intelligence on various aspects like the potential markets, quantity arrived and prevailing and expected prices in different regions during different months of the year are important in mitigating many of market related problems. Study reveals that there was high variability in the arrival of onion in the month of March and April in selected markets. Among the markets, the coefficient of variation in both arrivals and prices were found to be higher in Ahmedabad and Kolkata. The zero order correlation matrix between two markets average wholesale prices of onion indicated the high integration among the selected markets except Ahmedabad with Mumbai market. This might be due to the movement of produce from one market area to another depending upon price prevailed in the markets. The competitive conditions prevailing in the selected markets might have influenced the movement of prices in the same direction. The magnitude of regression coefficient revealed that an increase in market arrivals by a MT in a month led to an increase in prices by Rs.6.00/MT and Rs. 0.40/MT in Bangalore and Delhi markets respectively. On the contrary, prices of onion decreased in Ahmedabad (Rs. 6.00), Mumbai (Rs. 10.00) and Kolkata (Rs. 2.00) markets with increase in arrivals by one MT in a month.

Key words: Instability, Market integration, Price behavior

1. Introduction:

Onion is one of the important vegetable crops grown in India. In terms of area, over 8.21 lakh hectares of area was under onion crops during the year 2009-10, accounting for around 10.5 percent of country's vegetable area as well as production. Globally, the country occupies the second position after China in onion production with a production share of around 10 percent during the year. However, onion productivity in India is low at around 12.78 MT/ha, which is about 38% lower than the world average (17.6 MT/ha). Besides India and China, the other major onion producing countries are Turkey, Pakistan, Brazil, United States of America, Iran, Spain and Japan. In India, onion is extensively cultivated over a large area spread all over the country. It is produced for both domestic consumption as well as exports.

1.1 Supply Scenario:

A large variety of vegetables are grown in India. In the agricultural year 2009-10, onion accounted for around 10.5 percent of the total vegetable area and 10.8 percent of the production of vegetables in the country. Although onion is cultivated almost all over the country, the major onion growing states are Maharashtra, Karnataka, Gujarat, Andhra Pradesh, Madhya Pradesh, Tamil Nadu, Haryana and Uttar Pradesh. These eight

states together accounted for over 70 percent of area and 75 percent of production of onion in the country. The area under onion has made rapid stride in the country during recent years; the area has increased from 3.32 lakh ha in 1991-92 to 4.55 lakh ha in 2009-10 with compound growth rate of 0.28 percent per annum. However, production has been increased from 47.06 lakh MT to 60.34 lakh MT with 1.79 percent growth per annum during corresponding period. The onion is cultivated round the year and harvesting is also done in all months in one or other states. Staggered and varied season of onion cultivation results a possibilities of getting fresh onion throughout the year. In the northern part of the country, onion is usually grown in winter *(rabi)* season. However, in the southern and western states of Andhra Pradesh, Karnataka, Tamil Nadu, Gujarat and Maharashtra, it is grown in winter (*rabi*) as well as in the rainy *(kharif)* seasons.

Maharashtra is the highest producer of onion in the country. It contributes about 27.53 percent to the national onion basket followed by Gujarat (16.32 %), Uttar Pradesh (9.31 %), Karnataka (5.08 %), Madhya Pradesh (5.03 %), Haryana (4.26 %) and Tamil Nadu (4.16 %) during the year. Area and production of onion in Maharashtra has increased by 0.06 % and 0.35 % respectively in 2007-08 over 1991-92, whereas, productivity has declined by 0.12 %. Similar trend was noticed in Gujarat, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh and country as a whole. Also, negative growth in production was noticed in Karnataka (-7.22%) and Tamil Nadu (-0.03%) during corresponding period.

1.2 Consumption/Demand for Onion:

As per NSSO consumption survey data, per capita monthly consumption of onion has increased from 0.38 kg to 0.58 kg in rural area and from 0.50 kg to 0.72 kg in urban area over a period of twelve years (1999-00 over 1987-88). Onion consumption has grown at the rate of about 3.59 % during the period from 1997-88 to 1999-2000 in rural area, whereas, it has increased at the rate of 3.09 % per annum in urban area during the same period. During the period 1987-88 to 1999-2000, the total vegetable consumption has improved from 2.64 kg to 4.17 kg in rural area and from 3.17 kg to 4.37 kg in urban area. This shows that more importance is given to onion consumption in rural area as compared to urban area. Onions have natural qualities that make them attractive to consumers, particularly in today's health-conscious market. Research has shown that onions are low in calories, and are a source of dietary fiber. Fresh onions also provide vitamin C, with one medium onion providing 15 to 20 percent of the daily requirement. Additionally, onions are playing a greater role in the diets. Onions can aid in prevention of diseases due to their antioxidant content. Antioxidants can reduce the risk of body degeneration and disease by inhibiting the damage caused by oxidative free-radical chemical compounds to nutritional and bodily lipids, proteins and nucleic acids. Common household cooking and industrial processing methods may decrease the antioxidant capacity of onions. In addition to these factors, increase in population was the major reason for increase in demand for onion. Availability of market intelligence on various aspects like the potential markets, quantity arrived and prevailing and expected prices in different regions during different months of the year are important in mitigating many of market related problems. In the light of the above facts, this paper seeks to evaluate various aspects of marketing of onion in India. The broad objectives of this paper is to comprehensively study and the various components of onion market like variation in arrivals and prices, their relationship and extent of price integration among different wholesale markets of India, price response in relation to arrivals.

2. Data and Methodology:

The data on area, production, productivity, arrivals and prices of onion were collected from different issues of Indian Horticulture Database. To workout the demand for onion, per capita consumption data was collected from Food & Agriculture Organisation website (www.fao.org). The, data on monthly arrivals and monthly prices pertained to the period 1999-2011. The selection of major markets for onion is based on size of market and total arrivals. Finally, markets namely Ahmedabad, Bangalore, Mumbai, Kolkata and Delhi were selected for the study. To explore the instability in market arrivals and prices of onion over a period of 13 years (1999-2011), coefficient of variation techniques were used. Correlation matrix of prices of different markets was worked out to know the integration. Pearson correlation coefficient was computed to find out the degree of relationship between market arrivals and wholesale price of onion in selected markets. To ascertain the response of prices to a given change in arrivals, regression analysis was used.

a. To know the direction and extent of association between arrivals and prices, following formula is used

$$r = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\{N\sum X^2 - (\sum X)^2\}\{N\sum Y^2 - (\sum Y)^2\}}}$$

Where,

r = Correlation coefficient

N = No. of observation

X = Arrivals

Y = Prices

2. 2. Trend Analysis:

To know the trends in arrivals and prices, orthogonal polynomial regression analysis used by Sastry *et al*. (1976), Mundinamani (1993) and Sharanesh (1998) was employed.

The trend function of the following form was employed.

$\hat{Y} = \bar{Y} + b_1Z_1 + b_2Z_2 + b_3Z_3$ …………………. (1)

Where,

$\hat{Y}$ = the predicted arrivals/prices of vegetables

$\bar{Y}$ = the general mean arrivals/prices of vegetables for any specific year ' 'X' via, 'Z'

Zi' =the orthogonal polynomials.

i. e.
$Z_1 = X - \bar{X} = x$

$Z_2 = x^2 - \left(\dfrac{n^2-1}{12} \right)$

$Z_3 = x^3 - \left(\dfrac{3n^2-7}{20} \right) x$

$Z_4 = x^4 - \left(\dfrac{3n^2-13}{20} \right) x^2 + 3 \dfrac{(n^2-1)(n^2-9)}{560}$

$Z_5 = x^5 - 5 \left(\dfrac{n^2-7}{18} \right) x^3 + \left(\dfrac{15n^4-230n^2+407}{1,008} \right)$

Expressed explicitly in terms of equally spaced original 'X's and b's are the regression co-efficients whose values are to be determined from the sample data.

Since the objective is to find the polynomial of lowest degree that seems an adequate fit for the data, it is necessary to test for the significance of each 'b' co-efficient in successive stages until two successive 'b's turn out to be non-significant or consequently, the reduction in sum of squares will be tested as each successive term is added (Snedecor and Cochran, 1968). At each stage, calculate

$\sum X_iY$, $B_i = \sum X_iY / \sum X_i^2$

For getting the polynomial, the estimated values $\hat{Y}$ for each value of X is computed by using equation. However, only significant values are presented in tables -1. This method is more suitable for the present study because of absence of prior knowledge regarding the exact mathematical form of the trend functions of different vegetables and computational ease with which step-wise forward polynomial regression analysis is facilitated.

2.3.To ascertain the response of prices to a given change in arrivals, simple linear regression equation was used.

$Y_i = a + bX_i$

Where,

Y_i = Prices

X_i =Market arrivals

a = Intercept

b = Regression coefficient

2.4.The co-efficient of variation (CV) was computed to find out the extent of fluctuations in market arrivals and prices of onion in the study markets.

$$C.V. = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

3. Results and Discussion:

A critical analysis of trend in arrivals and prices of onion by orthogonal polynomial regression analysis, in general, showed that there was a marginal increasing trend in arrivals and prices over the years with mild ups and downs in all the selected markets. Mundinamani (1993) reported similar trend in arrivals and prices of oilseeds. However, considerable variations both in prices and arrivals were observed in onion in all the selected markets.

The pattern of trend both in arrivals and prices of onion (Table-1) was observed to be similar in all the markets. Similarly, there was marginal change in arrivals over the period in all the markets except Ahmedabad and Bangalore wherein there was increasing trend over years with ups and downs. In case of prices, there was a marginal increase in trend over the period with mild fluctuations in all the markets except Ahmedabad, Bangalore and Mumbai wherein upward like trend was noticed. Arrivals in Ahmedabad market showed constant trend throughout the year. In Bangalore market arrivals has shown more or less constant trend from the month of January to August, whereas increasing trend was noticed during the month of September to December. This is mainly due to harvesting of onion in Karnataka starts in these months. In case of Mumbai market again constant trend was observed whereas in Delhi and Kolkata markets fluctuations in arrivals were noticed. In Delhi market maximum arrivals was noticed in the month of November-December, however, in Kolkata market it was in the month of March.

The price trend over 13 years from 1999 to 2011 in selected markets showed declining trend from January to May. The decline in price is mainly due to heavy arrival of onion from Nasik, Satar and other parts of Maharashtra where harvesting starts in November-December and supply/feeds to major portion of the country. Whereas, June onwards it starts increasing and reaches maximum in the month of October. The arrival of onion during this period is very less because of heavy rain and uncertainty of crop yield. The stored Nasik onion will be release by big trader who controls the onion market during this period. Further, small quantity of fresh onion will also start arriving from part of Karnataka (Chitradurga, Dharwad and Davanagere districts) during June-October month and is also uncertain.

3.1 Variation in arrivals and prices:

The analysis of price movement of commodity in the corresponding and liked markets helps in judging of the extent of efficiency of the marketing system in the country for the selected commodity. It has been noticed that when major portion of the produce reaches the market during peak season, the price generally rule low which depress the farmers income to a great extent. Seasonal variations are the results of such factors, which uniformly and regularly rise and fall in the magnitude. The variation can be per hour, per week or per month but for our study we have considered per month variations. The coefficient of variation (Table-2) in arrivals of onion was found to be higher in the month of March (59.82%) and lower in May (10.40%) in Ahmedabad market. Similarly, high variation in April (31.76%) and low variation in February (7.34%) was noticed in Bangalore market. Market arrivals of onion revealed that high variability was noticed in the month of March in Mumbai, Kolkata and Delhi markets indicating higher variations in March and April months in selected markets. In case of prices (Table-3), coefficient of variation was found to be higher in Ahmedabad (57.27%) followed by Bangalore (56.17%), Delhi (55.15%), Kolkata (48.35%) and Mumbai (47.44%) markets. This clearly implied that the variations in arrivals as well as prices over the years were found relatively higher. Among the markets, the coefficient of variation in both arrivals and prices were found to be higher in Ahmedabad and Kolkata. This clearly indicates that although there was a steady increase in arrivals and prices over a period of time, their fluctuation from year to year were very high. Similar results were observed for vegetables by Mali *et al.* (1999) and Nawadkar *et al*. (1999). The higher fluctuations in arrivals might have resulted in wide variations in prices of onion.

3.2. Relationship between monthly arrivals and wholesale prices:

To study the overall relationship between monthly arrivals and average wholesale prices of onion in selected markets, the correlation coefficient between arrivals and prices of corresponding months as well as subsequent months were worked out. It is clear from the Table-4 that negative relationship between arrivals and prices were noticed in Ahmedabad, Mumbai, Kolkata and Delhi markets in corresponding months indicating the increase in arrival leads to decline in onion price and vice versa. In case of Bangalore market positive relationship was noticed indicating increase in arrivals leads to increase in price and vice versa. This might be due to good demand for consumption of onion by local consumer as well as neighboring states (Andhra Pradesh, TN and Kerala). Whereas in case of arrivals and subsequent month prices, positive relationship was noticed in Bangalore, Kolkata and Delhi markets which indicates that the arrival of onion in a month is positively influenced by the previous month price. However, in Ahmedabad and Mumbai markets previous month prices are not influencing on current month arrivals.

3.3. Market integration for onion:

In an integrated market, prices of a commodity are responsive to price changes of the same quality products in other markets. The analysis of price movement of the commodity in the corresponding and linked markets helps in judging the extent of efficiency of the marketing system in the country for the onion crop. In this section an attempt has been made to examine the extent of price integration of onion in the selected markets. The zero order correlation matrix (Table-5) between average wholesale prices of onion clearly indicated the integration among the selected markets except Ahmedabad with Mumbai market. However,the magnitude of integration was found to be higher and significant between Ahmedabad and Kolkata (0.908), Bangalore and Kolkata (0.898), Ahmedabad and Bangalore (0.871), Bangalore and Mumbai (0.863), Mumbai and Kolkata (0.840), Kolkata and Delhi (0.840), Ahmedabad and Delhi (0.819), Bangalore and Delhi (0.796) and Mumbai and Delhi (0.774) markets. Arya (1991) and Nawadkar et. al. (1999) also found similar findings. This clearly indicated that the prices of onion was governed not only based on arrivals and other factors in the given market but also prices and other factors prevailing in other markets like varieties, appearance, moisture content, colour, size and shape and of the produce. This might be due to the movement of produce from one market area to another depending upon price prevailed in the markets. The competitive conditions prevailing in the selected markets might have influenced the movement of prices in the same direction.

3.4. Response of price to the change in arrivals:

The study on response of price to the change in arrival depicts (Table–6) the regression equations computed to study the relationship between monthly market arrivals and wholesale prices of onion in different markets. The regression coefficients between monthly arrivals and prices in Bangalore (0.006) and Delhi (0.0004) markets were found positive but not significant. This clearly revealed the influence of other factors other than arrivals, which were not considered. A negative relationship between arrivals and prices was noticed in Ahmedabad (0.006), Mumbai (0.010) and Kolkata (0.002) markets as evidence by their negative regression coefficients. The magnitude of regression coefficient revealed that an increase in market arrivals of one tonnes led to an increase in prices by Rs.6.00/MT and Rs. 0.40/MT in Bangalore and Delhi markets respectively (not significant). On the contrary, prices of onion decreased in Ahmedabad (Rs. 6.00), Mumbai (Rs. 10.00) and Kolkata (Rs. 2.00) markets with increase in arrivals by a one tonnes in a month.

4. Conclusion:

The study reveals that arrivals in Ahmedabad and Mumbai markets are showing constant trend. Whereas in Bangalore, Delhi and Kolkata markets some fluctuations were noticed. In Bangalore and Delhi markets, maximum arrivals were noticed in the month of November-December, however, in Kolkata market it was in the month of March. Among the markets, the coefficient of variation in both arrivals and prices were found to be higher in Ahmedabad and Kolkata. This clearly indicates that although there was a steady increase in arrivals and prices over a period of time, their fluctuation from year to year were very high. The magnitude of regression coefficient revealed that an increase in market arrivals by a MT in a month led to an increase in prices by Rs.6.00/MT and Rs. 0.40/MT in Bangalore and Delhi markets respectively. On the contrary, prices of onion decreased in Ahmedabad (Rs. 6.00), Mumbai (Rs. 10.00) and Kolkata (Rs. 2.00) markets with increase in arrivals by one MT in a month. The development of warehousing facilities at primary markets and provision of credit to the farmers against warehouse receipt would go long way in reducing the variation in arrivals and prices. Further, in order to continue the present system of market integration, there is a need to establish cells for

fruits and vegetables to generate market information and market intelligence which would provide a better platform for guiding the farmers in marketing of their produce.

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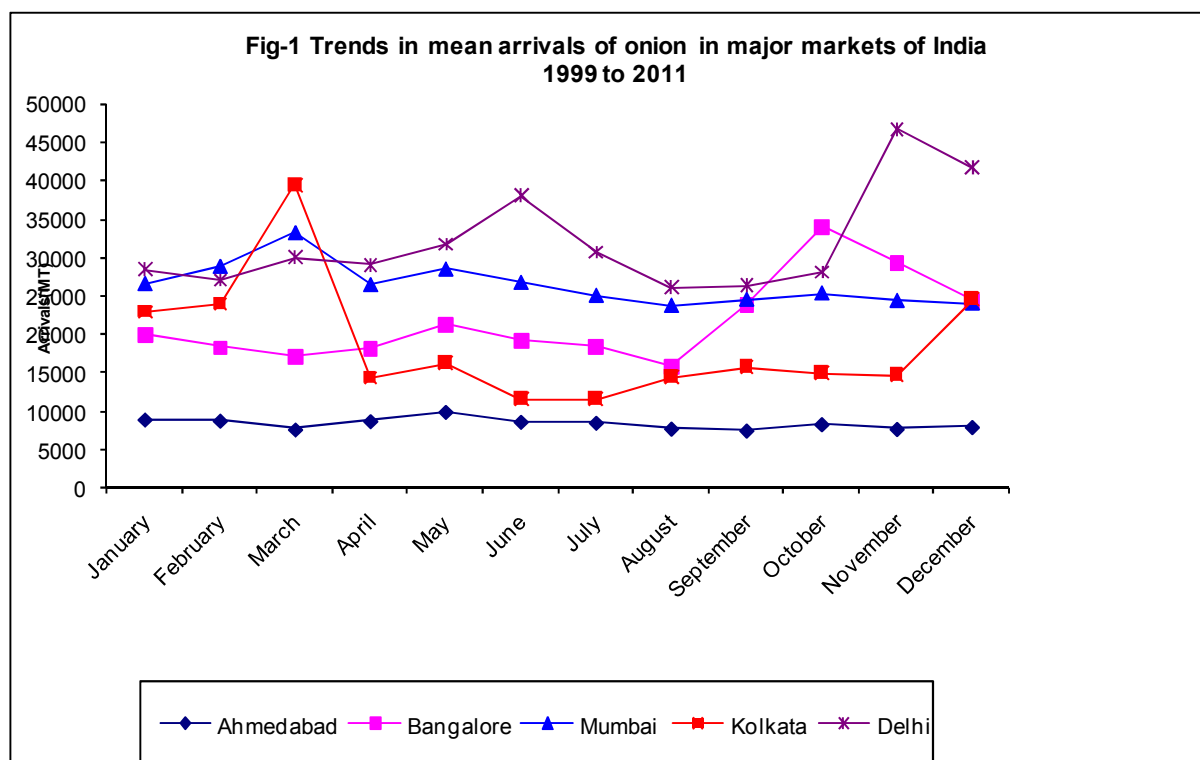
Table 1 : Estimates of trend functions of arrivals and prices for onion in selected markets (1999 to 2011)

Markets	Intercept	X	X^2	X^3	X^4	X^5	R^2	F value
1. Arrivals								
Ahmedabad	5240.80	252.87**	-	-	-	-	0.26	8.38
Bangalore	711981.15	-12069.99**	1816.03**	125.14**	-15.76	-24.31***	0.76	15.05
Mumbai	-	-	-	-	-	-	-	-
Kolkota	63211.95	1665.40**	-113.22	-46.65**	-2.57	15.27*	0.46	4.56
Delhi	4246.95	-83.92	-72.04**	4.94*	3.13	-2.35*	0.86	6.49
2. Prices								
Ahmedabad	331.65	-4.06	-3.06**	0.15*	0.04	-0.09*	0.80	5.22
Bangalore	-	-	-	-	-	-	-	-
Mumbai	-	-	-	-	-	-	-	-
Kolkota	-	-	-	-	-	-	-	-
Delhi	347.75	-7.52***	-	-	-	-	0.19	6.42

*** Significant at 1 per cent level
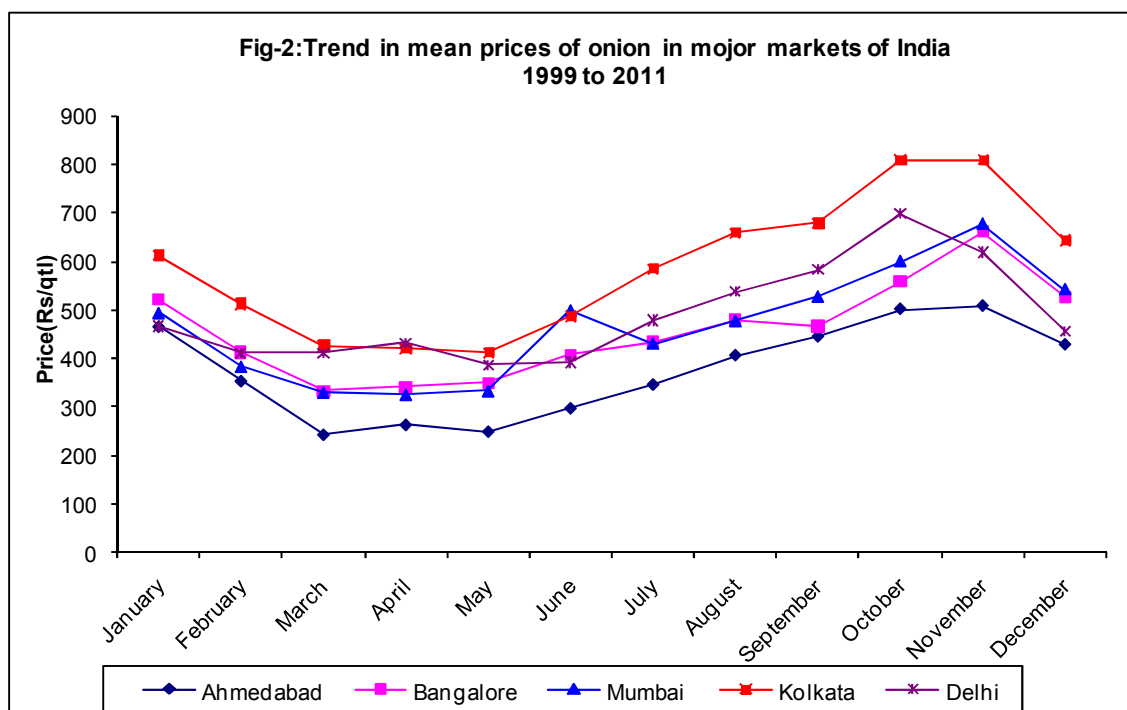** Significant at 5 per cent level
* Significant at 10 per cent level

Fig-1 Trends in mean arrivals of onion in major markets of India 1999 to 2011

Fig-2:Trend in mean prices of onion in mojor markets of India 1999 to 2011

Table-2: Variability in market arrivals of onion in major markets of India (MT):1999-2011

Month	Ahmedabad		Bangalore		Mumbai		Kolkata		Delhi	
	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)
January	8967	21.70	20046	19.52	26643	19.13	22963	24.53	28458	16.00
February	8807	18.45	18341	7.34	28885	22.13	24039	31.33	26994	41.24
March	7658	59.82	17104	20.34	33272	23.43	39571	107.04	30042	56.01
April	8750	36.49	18144	31.76	26506	22.01	14432	23.31	29069	18.19
May	9971	10.40	21330	15.61	28538	16.04	16377	26.02	31752	14.32
June	8669	25.52	19133	17.88	26800	13.30	11610	13.67	38113	13.08
July	8540	23.88	18383	28.08	25113	18.51	11692	16.68	30686	14.08
August	7778	26.93	15826	19.77	23803	22.67	14566	25.33	26064	12.88
September	7513	10.51	23821	19.93	24613	20.83	15822	31.90	26357	8.08
October	8343	34.45	33981	25.65	25413	16.92	14987	31.08	28097	12.14
November	7729	51.22	29270	15.79	24448	10.28	14787	12.31	46866	13.66
December	7989	33.38	24355	14.61	24107	11.94	24610	18.95	41770	15.08

Table-3: Variability in market prices of onion in major markets in India (Rs/qtl): 1999-2011

Month	Ahmedabad		Bangalore		Mumbai		Kolkata		Delhi	
	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)
January	463	48.17	520	47.69	493	43.71	612	43.25	465	43.49
February	351	57.27	411	56.17	382	45.93	512	48.35	411	55.15
March	242	55.75	332	33.21	328	29.30	426	22.52	409	30.11
April	262	12.91	340	29.82	324	25.22	420	17.77	430	17.60
May	248	16.82	348	33.15	332	33.93	412	16.95	386	19.11
June	296	22.57	406	27.75	498	47.44	486	16.65	392	13.88
July	345	24.44	433	22.70	430	19.36	585	12.65	478	18.46
August	405	21.69	477	20.44	477	16.97	659	17.36	536	20.37
September	444	18.76	465	17.81	527	22.51	679	14.44	581	14.36
October	500	20.28	558	28.03	600	29.51	809	17.95	696	16.79
November	506	19.66	661	31.02	678	21.03	809	28.95	617	14.06
December	427	33.85	526	32.36	542	29.11	644	30.93	455	26.55

Table-4: Correlation coefficient between monthly arrivals and wholesale prices of onion in major market during 1999-2011

Particulars	Correlation Coefficient				
	Ahmedabad	Bangalore	Mumbai	Kolkata	Delhi
Correlation coefficient between monthly arrivals and wholesale prices of onion in the corresponding months	-0.099	0.220	-0.292*	-0.126	-0.023
Correlation coefficient between monthly arrivals and wholesale prices of onion in the previous months	-0.107*	0.225*	-0.225*	0.051	0.204

Note: * indicate correlation coefficient is significant at 5 percent level

Table-5: Correlation coefficient in monthly wholesale prices of onion in major markets of India: 1999-2011

Markets	Ahmedabad	Bangalore	Mumbai	Kolkata	Delhi
Ahmedabad	1.00	0.871**	0.285**	0.908**	0.819**
Bangalore	--	1.00	0.863**	0.898**	0.796**
Mumbai	--	--	1.00	0.840**	0.774**
Kolkata	--	--	--	1.00	0.840**
Delhi	--	--	--	--	1.00

Note: ** indicate correlation coefficient is significant at 1 percent level

Table-6: Regression coefficient between monthly arrivals and average wholesale prices of onion in major market during 1999-2011

Sl.No.	Markets	Regression coefficient
1.	Ahmedabad	-0.006
2.	Bangalore	0.006
3.	Mumbai	-0.010*
4.	Kolkata	-0.002
5.	Delhi	0.0004

Note: * indicate regression coefficient is significant at 5 percent level