Market Arrivals and Price Behavior of Onion in India

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Abstract

The price fluctuations in onion are a major concern among farmers, consumers and policy makers. The current study is an attempt to analyze the behavior of prices and arrivals of onion in the major markets of India. The time series data regarding monthly onion prices and arrivals in the major markets of leading producing states were collected from various secondary sources. The prices of onion significantly increased over the last fifteen years in all the sample markets. During this period, the arrival of onion increased significantly in all of the selected markets except in Delhi market in which arrivals decreased over time. The seasonal indices of arrivals revealed the presence of unique pattern in nearby markets and in a same production zone. On the other hand, the seasonal price variation in all selected markets confirmed significant seasonality in price indices, with being lowest in the months of April and May; remained high during the months of August to January and then decrease in later months.

Introduction

Vegetables, mainly low in fat and carbohydrates but high in vitamins, minerals and dietary fiber play an important role in human nutrition. Asia dominates the world in vegetables by accounting of about 60 per cent of global production. India is the second largest producer of vegetables after China with 14 per cent of global production. In India, onion has emerged as one of the important vegetable crops in recent years. After potato, the onion is the highest produced vegetable with share of 12.11 per cent (NHRDF, 2019) in total vegetable production. Major onion growing states are Maharashtra (30.48 %), Madhya Pradesh (16.89 %), Karnataka (11.75 %), Bihar (5.72 %) and Rajasthan (5.55 %). The seasonality of production of onion has major impact on its market arrivals and prices. However, violent onion price variations are observed from year to year as well as in same marketing periods. This high price volatility originates initially from production uncertainties and then changes in the nature of demand (Kumar *et al,* 2005; Saxena and Chand, 2017). Long

term perspectives shows variations in supply and demand causing price rise and trader's cartel groups results in frequent price fluctuation adversely impacting the welfare of both producers and the consumers. On the other hand for the producer, the volatility leads to increased risk and low farm profitability. The current study is an attempt to analyze the behavior of prices and arrivals of onion in the major markets of India.

Data Sources and Methodology

The study constitutes the major onion producing states in India which were selected on the basis of their share in total onion production in the country. In addition, Punjab state was selected purposively. Further markets representing major producing states viz. Lasalgaon (Maharashtra), Bengaluru (Karnataka) and Indore (Madhya Pradesh) were selected on the basis of highest annual arrivals of onion and data availability. In addition, Mumbai and Delhi markets were selected to represent the major consuming centers of the country. Based on highest annuals arrivals and data availability Amritsar, Chandigarh and Patiala markets were taken in order to put emphasize on Punjab region. The data

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on area, production and productivity of onion in the selected states were collected from Indiastat.com for the period of 1980-81 to 2018-19 (Indiastat, 2019a). Monthly data on market arrival and prices for year 2005 to 2019 were taken from National Horticultural Research and Development Foundation.

Growth analysis

The compound annual growth rates (CAGR's) of area, production and productivity of onion in the selected states were estimated using the following growth model:

$$Y_t = AB^t$$

Where Y_t = Area/production/productivity of onion for the year 't'
T=Time variable (1,2…n) for each period.
A=Constant
B=Growth coefficient

Log transformation of above function is:

$$Ln\ Y_t = Ln\ A + t\ (Ln\ B)$$

Where,

$ln\ B = ln\ (1+t)$, and
$t = [antilog\ (ln\ B) - 1]$
$CAGR\ (\%) = [antilog\ (ln\ B) - 1] \times 100$

Variability in area, production and productivity

In order to check the variability in area, production and productivity of onion, Cuddy-Della Valle Index (Cuddy and Della, 1978) was employed. The CDVI is calculated as under

$$CDI = CV\sqrt{1 - \bar{R}^2}$$

Where CV = Coefficient of variation (in per cent)

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

Trend analysis

Growth trends for the price series and the arrivals using the monthly wholesale price and arrivals data were worked out as followings:

$$Y = a + bt$$

Where   Y=Market arrivals/price
a=constant
t=time variable
b=Regression coefficient

The seasonal indices of onion prices were worked out using by using the ratio to trend method

Results and Discussion

India is the second largest producer of vegetables in the world after China and accounts for 14 per cent of production of the world (NHRDF, 2019). Onion, potato, tomato, brinjal, cabbage and cauliflower are among the most important vegetables grown in the country. The triennium averages of area, production and productivity of onion in India has been presented in table 1 and the same is depicted in Fig 1. In addition the CAGR and instability with respect to these variables are given in table 2. The data revealed that the area under onion in India, which was 245.67 thousand hectare in TE 1982-83 increased nearly five times to 1270.33 thousand hectare in TE 2018-19. CAGR of onion area over this period was calculated at 4.99 per cent. The decadal growth rates of area under onion were positive and significant with highest CAGR of 7.76 per cent in 2000s.

Productivity of onion increased with CAGR of 1.54 per cent from 10380 Kg/ha in TE 1982-83 to 18000 Kg/ha in TE 2018-19. The highest significant growth rate in this regard was observed in 2000s at the rate of 6.47 per cent followed by 2010s with 2.67 per cent. The CAGR of productivity during 1980s and 1990s were negative but non-significant. The production of onion in India has increased from 2549.67 thousand metric tonnes in TE 1982-83 to 22836 thousand metric tonnes in TE 2018-19. Increase of area as well as productivity both contributed towards the increase in production of onion in India throughout the study period. Except for 1990s, the CAGR of onion production was significant in all decades with the highest during the decade of 2000s (14.72%). Overall, the onion production of India increased significantly during the study period with positive CAGR of 6.61 per cent. The area expansion under onion cultivation contributed in a major way towards the increase in onion production in country.

The results of analysis of variability revealed that during the overall study period, onion production remained highly instable in country with estimated variability in this regard at 27.88 per cent (Table 2). Both, the high instability in area (15.52%) as well as in productivity (13.87%) contributed towards this. As evident from the instability index, variability of area under onion was the highest in 2000s (15.04%) followed

Table 1. Trends in area, production and productivity of onion in India, triennium averages 1981 to 2019

Year	Area ('000 ha)	Production ('000 MT)	Productivity (Kg/ha)
1981-83	245.67	2549.67	10380
1984-86	276.33	2889.33	10430
1987-89	278.73	2811.43	10070
1990-92	311.33	3665.63	11700
1993-95	375.43	4582.40	12200
1996-98	381.83	3800.00	9900
1999-01	474.27	5029.10	10600
2002-04	491.43	5171.03	10430
2005-07	605.47	7856.60	12770
2008-10	803.80	13207.90	16430
2011-13	1067.50	16480.60	15430
2014-16	1232.30	19753.37	16030
2017-19	1270.33	22836.00	18000
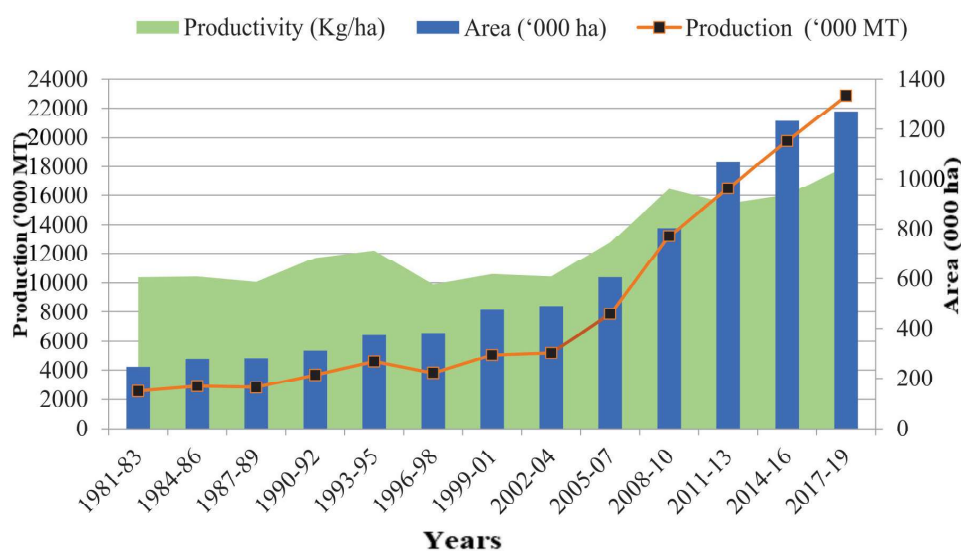
Figure 1. Trends in area, production and productivity of onion in India

Table 2. Compound annual growth rate and variability of area, production and productivity of onion in India, 1981 to 2019

Year	CAGR (%)			Variability (%)		
	Area	Production	Productivity	Area	Production	Productivity
1981-1990	2.23**	1.95*	-0.26	6.28	9.53	3.97
1991-2000	4.24***	1.19	-2.93	9.78	20.49	14.34
2001-2010	7.76***	14.72***	6.47***	15.04	23.29	9.36
2011-2019	2.46***	5.39***	2.67***	1.67	0.006	0.009
1981-2019	4.99***	6.61***	1.54***	15.52	27.88	13.87

*Note: ***, ** and * significant at 1, 5 and 10 per cent level of significance*

by 1990s (9.78 %) and 1980s (6.28 %). The productivity variability was the highest during 1990s (14.34%) followed by 2000s (9.36 %) and 1980s (3.97%). The production instability of onion was observed to be the highest at 23.29 per cent during 2000s, which was followed by 1990s (20.49%) and 1980s (9.53 %). However, during the recent decade (2011 onwards), on account of negligible instability in productivity and very low instability in area the production of onion in country showed the least instability.

Area, production and productivity of onion in different states

The data on average area, production and productivity of onion along with percentage share of states in area and production in India is presented in table 3 and also depicted graphically in Fig 2 to 4. Maharashtra, Karnataka and Madhya Pradesh are the major onion producing states which contributed about 65 per cent of total area under onion cultivation in India during TE (Triennium Ending) 2018-19. Maharashtra has the highest share in area under onion (37.76 %) followed by Karnataka (15.20 %) and Madhya Pradesh (11.72 %). Rajasthan and Bihar are the other important states accounting for 5.00 and 4.31 per cent of total area under onion cultivation in India respectively. In addition, Punjab, with only 9.27 thousand hectares of its land under onion accounted for less than one per cent (0.73 %) of total area under onion in the country during TE 2018-19.

It was observed that nearly 63 per cent of total onion production of India was contributed by States of Maharashtra (34.50%), Madhya Pradesh (16.19%) and Karnataka (12.54%). The respective contribution of Bihar and Rajasthan was 5.55 and 4.59 per cent respectively. Punjab contributed less than one per cent (0.93 %) towards the national onion production during TE 2018-19.

The average productivity of onion in India during TE 2018-19 was 18 tonnes/ha. Madhya Pradesh ranked first with 24.84 tonne/ha followed by Bihar state at second place with productivity level of 24.78 tonnes/ha. Despite being the top two onion producing states of India, the productivity level in Maharashtra and Karnataka States was significantly low at 16.44 and 14.90 tonnes/ha respectively. Punjab, with less than one per cent share in area and production of onion in country, falls in the high productivity group of states with its productivity level at 22.89 tonnes/ha.

Market arrival and price behaviour

Onion production is seasonal and accordingly its arrivals vary in markets across the months in the year. From policy point of view, it is important to have a perfect understanding about the pattern of prices over time and the factors associated with the same. The behaviour of onion prices in the sample markets represented by trend and seasonal indices is presented and discussed in this section.

The analysis of trend component is to ascertain the general movement of arrivals and prices of onion during 2005 to 2019. To analyze the trend, many functional forms were tried and on the basis of significance of the coefficient, value of R^2 and shape of the function, linear trend model was found to be best in arrivals and

Table 3. Area, production and productivity of onion in major producing states of India

(TE 2018-19)

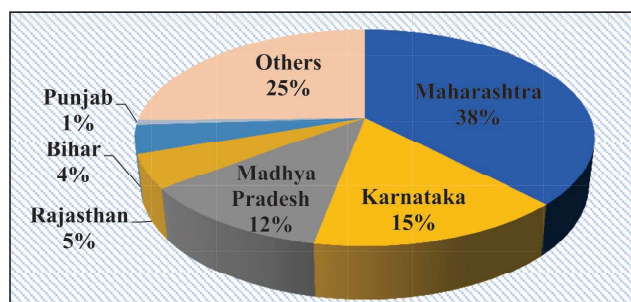| States	Area		Production		Productivity
	('000 ha)	Share in national area (%)	('000 MT)	Share in national production (%)	(Tonnes/ha)
Maharashtra	479.67	37.76	7878.61	34.50	16.44
Karnataka	193.03	15.20	2864.69	12.54	14.90
Madhya Pradesh	148.90	11.72	3698.21	16.19	24.84
Bihar	63.45	05.00	1047.76	04.59	16.53
Rajasthan	54.78	04.31	1267.00	05.55	23.13
Punjab	9.27	00.73	212.30	00.93	22.89
Others	321.23	25.28	5867.43	25.69	18.26
India	1270.33	100.00	22836.00	100.00	18.00

Figure 2. Share of different states in total area of onion in India
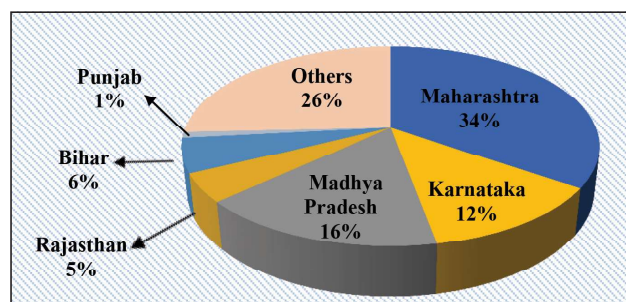

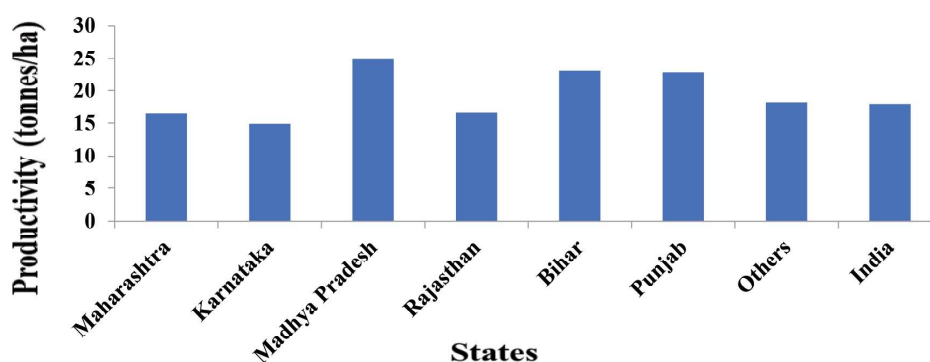**Figure 3. Share of different states in total production of onion in India**

Figure 4. Productivity of onion in different states of India

wholesale prices of onion. The results of the same are represented in table 4. The prices ofonion significantly increased over the last fifteen years in all the selected markets. The per-annum increase in prices of onion was found to be the highest in Amritsar market (Rs102.96/qtls) followed by Mumbai (Rs. 95.96/qtls), Bengaluru (Rs.92.15/qtls) and Chandigarh (Rs.85.92/qtls) and the lowest was seen in Indore market (Rs.57.44/qtls).

The annual arrivals of onion in most of the selected markets was observed to be increasing significantly in Amritsar, Patiala, Chandigarh, Indore and Mumbai; non-significantly in Lasalgaon and Bengaluru, on the contrary the arrivals declined in Delhi market over the years. The highest per-annum increase in arrivals was observed in Indore market at the rate of 136.39 thousand quintals. The onion arrivals in Delhi market declined at the rate of 101.66 thousand quintals per annum and decline was found to be significant. The reason may be the emergence of other market centres in the National Capital Region (NCR). According to Bhat *et al* (2015), negative shift in arrivals of onion, tomato and potato was observed in the New Delhi markets after delisting with the introduction of APMC Act.

The seasonal variations are the similar patterns that occur at specific regular intervals every year and have their origin within the year. The factors that affect the extent of seasonality in prices comprise the degree of perishability of the commodity and seasonality in consumption, the extent of seasonal concentration in production, the cost and storage infrastructure available to farmers or traders and restrictions on storage. So, it is necessary for organizations to identify and measure seasonal variations within their market to help them to plan for the better price. The seasonal indices worked out through ratio to trend method are presented in table 5 to 7 and in Fig 5 to 12.

The seasonal variation indices confirmed that the selected markets of Punjab region had shown an inconsistent pattern in seasonal indices of arrivals but similar pattern in case prices of onion. It may be due to the fact that the regional markets are well connected to the major national markets which influence the arrivals and prices (Kumar *et al,* 2009). The presence of weak inverse relationship between arrivals and prices of onion points out that Punjab being net importer of onion, the traders are arranging its supply in advance from major

Table 4. Trend component in prices and arrivals of (Rs/qtls) in onion markets

Market	Equation	R^2	t-value
	Prices		
Amritsar	y = 511.92+ 102.96x	0.58	4.20***
Patiala	y = 617.07 + 76.65x	0.51	3.70***
Chandigarh	y = 530.74 + 85.92x	0.54	3.90***
Lasalgaon	y = 472.43 + 79.17x	0.37	2.77**
Bengaluru	y = 458.88 + 92.15x	0.51	3.70***
Indore	y = 431.29 + 57.44x	0.38	2.82**
Mumbai	y = 490.36 + 95.96x	0.44	3.20***
Delhi	y =581.87 + 70.47x	0.37	2.78**
Arrivals			
Amritsar	y = 166.22 + 28.29x	0.57	4.18**
Patiala	y = 292.84 + 7.22x	0.45	3.29***
Chandigarh	y = 5.80 + 29.70x	0.85	8.85***
Lasalgaon	y = 2860.3 + 61.34x	0.17	1.64
Bengaluru	y = 5441.1 + 135.20x	0.18	1.69
Indore	y = 840.26 + 136.39x	0.74	6.05***
Mumbai	y = 2302.1 + 66.48x	0.56	4.04***
Delhi	y = 4159.5 - 101.66x	0.60	-4.40***

*Note: *** and ** significant at 1 and 5 per cent level*

Table 5. Seasonal indices of arrivals and prices of onion in Punjab region markets

(Per cent)

Months	Amritsar		Patiala		Chandigarh	
	Arrival	Price	Arrival	Price	Arrival	Price
January	130.47	116.25	98.67	108.64	101.62	110.88
February	98.51	92.21	102.50	93.42	99.31	96.72
March	109.53	74.43	110.96	79.69	96.46	83.16
April	102.27	69.87	100.69	71.14	90.39	75.06
May	110.92	63.78	98.10	64.90	109.61	67.13
June	86.14	66.15	103.73	72.34	113.48	68.86
July	92.69	88.24	99.93	86.37	108.71	88.19
August	75.82	111.48	94.34	111.84	89.25	108.57
September	105.42	122.10	90.11	127.49	86.74	126.57
October	88.05	134.27	103.81	132.07	112.71	126.94
November	93.29	130.62	105.74	122.77	91.37	121.85
December	103.27	114.05	89.32	111.55	98.30	112.33

Table 6. Seasonal indices of onion arrivals in major national markets

(Per cent)

Months	Markets				
	Lasalgaon	**Bengaluru**	**Indore**	**Mumbai**	**Delhi**
January	158.08	82.88	121.33	118.60	86.09
February	144.15	65.40	73.62	100.78	90.57
March	109.84	71.59	62.89	112.24	108.65
April	97.69	70.97	112.41	105.34	101.88
May	116.33	75.31	104.60	101.16	106.00
June	92.01	72.01	125.45	98.74	110.79
July	87.24	64.19	63.03	93.73	104.38
August	78.88	73.12	65.28	84.10	92.82
September	68.69	127.49	53.49	87.04	91.83
October	60.13	214.08	104.83	90.21	89.06
November	60.12	169.74	183.77	95.58	113.24
December	124.27	116.82	143.65	110.24	105.54

Table 7. Seasonal indices of onion prices in major national markets (Per cent)

Months	Markets				
	Lasalgaon	**Bengaluru**	**Indore**	**Mumbai**	**Delhi**
January	104.03	114.66	116.37	104.46	111.54
February	80.18	92.82	88.60	80.81	91.32
March	60.66	70.87	69.44	63.95	77.67
April	57.57	62.68	55.88	61.06	69.22
May	59.27	65.96	51.48	63.15	62.59
June	78.93	84.38	70.11	77.48	69.64
July	94.47	101.73	89.22	90.87	88.81
August	121.09	120.51	113.32	115.49	114.65
September	123.71	112.48	124.90	120.67	126.29
October	138.04	117.96	136.45	135.61	134.54
November	138.69	123.38	134.69	139.88	124.60
December	118.81	113.81	123.58	123.28	112.00

producing states (particularly Maharashtra), store it locally (being semi-perishable) and release in markets as per local demand and price scenario.

Similarly, in national markets the arrival indices (Table 6) varied from each other due to different growing seasons in the respective states. In Lasalgaon and Mumbai market, seasonal arrival indices remained high during December to May with the highest value in January at 158.08 and 118.60 per cent, respectively. In these markets, the lean period of arrivals was observed in the months of August to November. Due to start of arrivals of kharif season crop the seasonal indices of arrivals of onion in Bengaluru market were very high during the months of October (214.08) and November (169.74) while the lowest arrival indices were seen in the month of July (64.19). Further, the seasonal indices in Indore and Delhi market were similar in most of the months. This might be due to location and distance between them. The highest arrival indices in these markets were observed during November with indices of 183.77 and 113.24 per cent, respectively. Overall, a
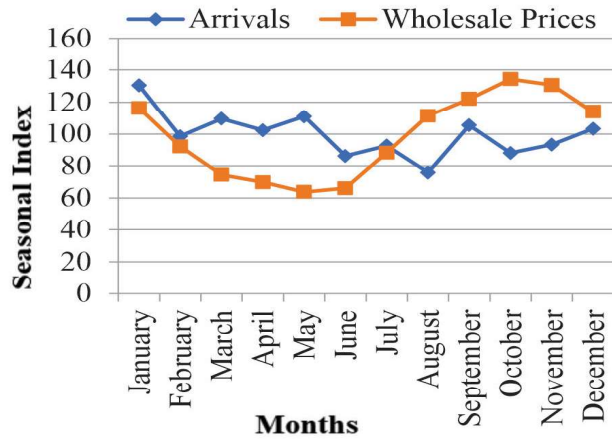
Figure 5. Seasonal indices of onion arrivals and prices in Amritsar market

Figure 6. Seasonal indices of onion arrivals and prices in Patiala market

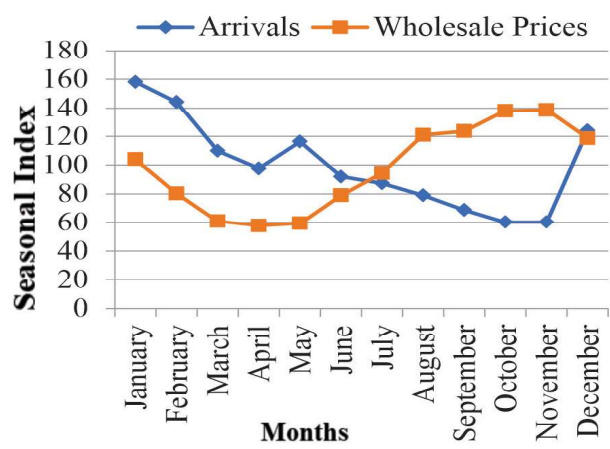**Figure 7. Seasonal indices of onion arrivals and prices in Chandigarh market**

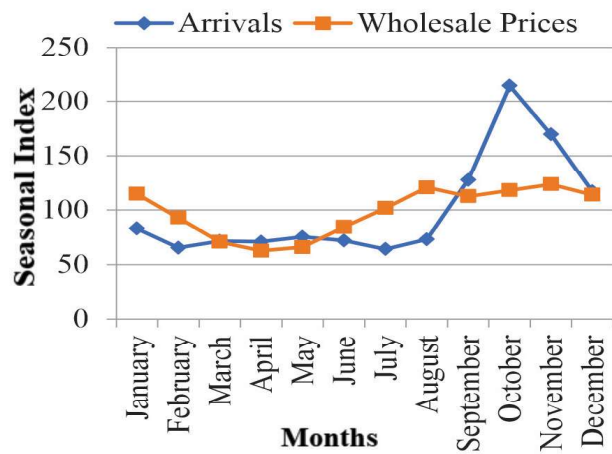**Figure 8. Seasonal indices of onion arrivals and prices in Lasalgaon Market**

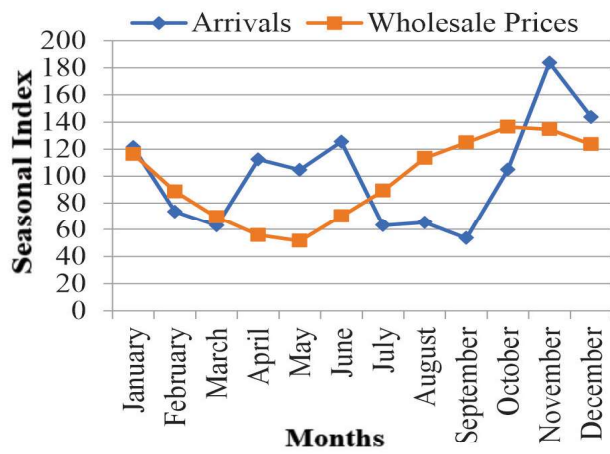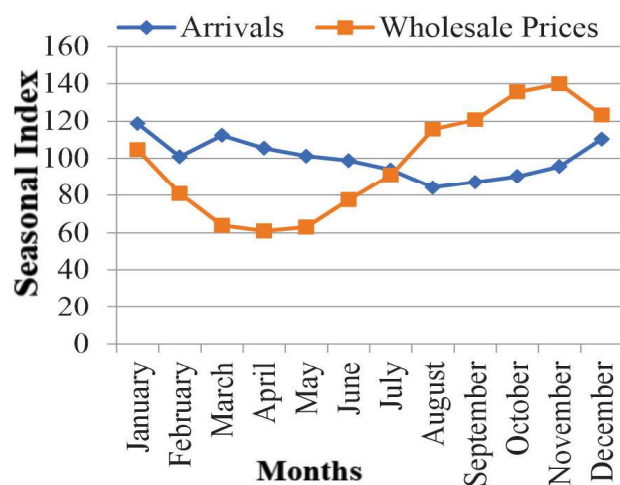**Figure 9. Seasonal indices of onion arrivals and prices in Bengaluru market**

Figure 10. Seasonal indices of onion arrivals and prices in Indore market
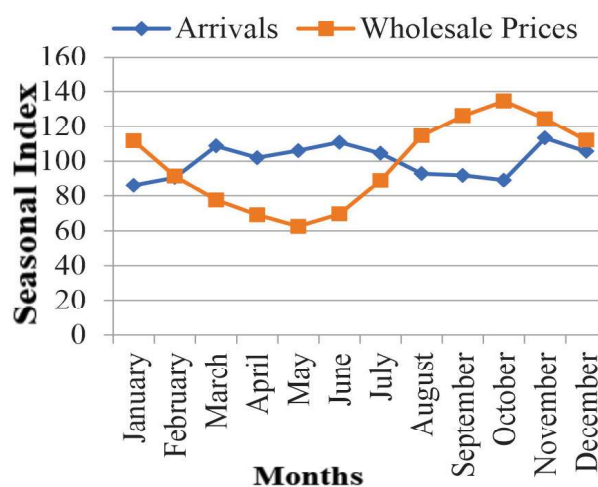
Figure 11. Seasonal indices of onion arrivals and prices in Mumbai market

Figure 12. Seasonal indices of onion arrivals and prices in Delhi market

look into seasonal indices in markets arrivals revealed the presence of similar pattern in nearby markets and in a same production zone.

The seasonal price indices (Table 5 to 7) in all selected markets confirmed significant seasonality in onion prices. In Punjab region markets, it has been clearly observed that after touching the lowest level in the month of May, in all the selected markets the price started rising in the month of June, remained high during the months from August to January and then declined in the onward months. Similarly in national markets, i.e. Lasalgaon, Bengaluru and Mumbai markets showed similar pattern of price indices, with being the lowest in the month of April, remained high during the months from August to January and then decreased in later months. In Indore and Delhi market, the prices were observed to be the lowest during month of May and the highest price levels were observed in October. However, analysis did not confirm the significant inverse relationship between the market arrivals and prices a commonly observed relationship in most of the agricultural commodities. It points towards the fact that onion prices significantly depend upon a number of factors like EXIM policy, speculations, demand scenario, etc. Overall, the seasonal price indices of onion in most of the selected markets are similar, thus, indicating the presence of price integration among markets (Reddy *et al,* 2012). Further, the arrivals and prices of onion in some markets showed positive relation due to availability of cold storage units (Bera, 2017).

The seasonal fluctuations are the results of such factors, which regularly increase or decrease in the magnitude and the variations can be per day, per month or annually. Inter-year coefficients of variation for onion prices were worked out for the period 2005 to 2019 and presented in table 8. The results of coefficient of variation reveal the presence of significant variation in prices. It was observed that in Lasalgaon and Indore markets, during 8 years (out of 15 years) the inter-year onion price variations remained more than 50 per cent. In case of Mumbai market prices varied more than 50 per cent during 7 years, whereas in Bengaluru, Delhi, Amritsar, and Patiala such huge onion price variations were observed in 5 out of 15 years of study. Further, during 2019 price variation of onion was highest in all markets ranging from the lowest in Patiala at 67.69 per cent to the highest in the Bengaluru market at 105.76 per cent. Production of onion and the seasonality in production are the two important factors responsible for huge instability in prices of onion. Apart from this many other factors like weather irregularities, pest and disease attacks, marketing aspects like transportation, storage, inadequate and costly cold chain facilities which affect the prices of onion. About 50-60 per cent of onion in India is produced in rabi season hence, storage plays an important role in distributing supply over the remaining months of the year (GoI, 2019b). Shortage of cold storage space in many states of India and erratic electricity supply create problems for onion marketing. According to Mission for Integrated Development of Horticulture, the existing low-cost onion storage

Table 8. Inter-year variability in the prices of onion in selected markets, (2005 to 2019)

(Rs/qtls)

Years	Lasalgaon		Bengaluru		Indore		Mumbai		Delhi		Amritsar		Chandigarh		Patiala	
	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)
2005	516.00	71.43	628.75	38.19	381.17	68.40	623.17	62.17	650.25	43.30	648.42	55.02	715.17	41.26	649.67	42.17
2006	348.00	46.29	430.42	16.33	261.08	37.73	422.58	38.46	471.00	19.97	465.67	24.13	518.08	17.53	471.83	17.59
2007	851.33	40.17	898.33	21.11	780.42	36.84	928.75	34.87	908.83	37.82	1028.33	33.99	979.83	24.81	1015.92	38.51
2008	535.58	54.57	633.75	34.65	594.75	56.45	644.50	40.11	657.92	38.81	745.42	42.52	683.58	26.47	737.33	43.11
2009	889.00	40.46	970.92	36.67	804.50	38.53	1033.00	42.35	1008.50	32.38	1129.83	36.70	849.92	23.15	1136.58	35.39
2010	1409.08	67.61	1096.08	59.19	956.67	49.73	1287.50	62.25	1131.33	51.02	1313.42	48.53	1033.08	42.90	1257.42	51.05
2011	885.42	57.77	1066.08	52.53	808.58	68.94	1048.58	52.91	982.33	58.59	1191.75	62.27	1102.67	54.41	1200.75	60.01
2012	581.25	49.72	830.33	41.01	506.25	47.29	730.25	37.92	722.33	30.95	801.00	24.26	844.25	22.17	834.17	29.84
2013	2159.00	62.60	2025.17	44.93	1645.58	60.62	2307.17	59.99	2175.67	60.13	2208.83	56.87	2153.00	48.86	1987.67	51.90
2014	1250.67	28.39	1390.75	40.12	999.33	29.71	1439.92	32.47	1396.25	25.79	1469.50	25.12	1403.67	19.95	1343.83	23.29
2015	2065.83	55.08	1950.83	31.25	1605.00	51.53	2378.42	51.40	1980.92	44.50	2173.92	43.61	2001.67	49.11	1996.50	47.06
2016	761.33	23.80	896.67	22.47	568.17	32.31	827.58	20.83	785.00	22.45	1033.75	16.00	1022.58	16.85	980.25	13.92
2017	1249.83	76.08	1478.42	63.96	1105.08	70.89	1495.92	73.37	1258.50	58.29	1746.92	63.58	1408.33	50.93	1513.92	64.80
2018	1104.83	55.36	1164.50	53.90	940.33	56.96	1321.75	45.16	1175.33	47.96	1588.83	44.71	1459.83	34.92	1391.92	42.47
2019	1979.25	82.31	2479.58	105.76	1404.92	80.70	2381.00	95.59	1879.92	88.14	2488.83	83.12	2095.25	87.30	1925.42	67.69

CV: Coefficient of variation (%)

structures in the country cannot store even half the of total onion production. Also, transportation cost is very high in India as compared to developed countries. Rail transport is quite cheap but less priority was given for railway transport in onion industry for marketing.

Conclusion and Policy Implications

The price of agricultural commodities form the basis of income to the producers to allocate the resources in the marketing activities and allocation of goods and services among the prospective buyers and thus it is the deciding factor of growth of a particular crop in the country. From 1980-81 to 2018-19, the area, production and productivity of onion in India increased significantly at CAGR of 4.99, 6.61 and 1.54 per cent respectively. During this period, the arrival of onion increased significantly in all of the selected markets except in Delhi market in which arrivals decreased over time. The seasonal indices of arrivals revealed the presence of unique pattern in nearby markets and in the same production zone. The seasonal price variation in all selected markets confirmed significant seasonality in price indices, with being lowest in the months of April and May; remained high during the months of August to January and then decreased in later months. There is huge inter-year instability in prices of onion and production of onion and the seasonality in production are the two important factors affecting the same. Policy makers should emphasize on price stabilization strategies to safeguard the interest of all stake holders associated with the onion industry.

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