Dynamics of Prices and Arrivals of Major Vegetables : A case of Haldwani and Dehradun Markets, Uttarakhand

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Abstract

The study assesses the behavior and relationship between arrivals and prices of potato in Dehradun market and tomato and onion in Haldwani market of Uttarakhand. The statistical tools employed includes, exponential function, coefficient of variation, seasonal indices and linear regression analysis. The empirical analysis showed that the area and production of these vegetables are significantly increasing. The arrival of potato and tomato negatively and significantly influenced their prices while the lagged prices had a significant and positive effect on current prices of all selected vegetables. The variability in price of onion is highest amongst all the vegetables and 92 per cent of this is caused by factors other than market arrivals and lagged year prices.

Introduction

Food, livelihood, nutritional security and health care are considered as the core element for socio-economic development attaining which can lead a society towards path of development. The role of horticultural crops in providing nutrition to human, preventing diseases is well known and thus, are considered to be contributing in nation's development and prosperity. Besides, horticulture crops form a vital part of the Indian agricultural production, adding 30 percent to agricultural GDP, with an area of about 14 percent and nearly 37 percent to total agricultural export. India is the second largest producer of fruits and vegetables in the world with an export of fruits and vegetables of about Rs. 9410.81 crores value in year 2017-18. (APEDA, 2018).The demand for fruits and vegetables will increase to around 540 million tonnes in year 2050 (IIHR, 2014) i.e. nearly double the current production. Keeping in mind the hitches faced by agriculture sector coupled with increased demand and changing consumption pattern the sector needs protection in terms of price support and policies. The price can act as a catalyst in boosting production andthe magnitude of price variation can also adversely affect the production. It has been reported that lack of market intelligence about the potential markets and the pattern of arrivals and prices (Sharma, 2011), inability to obtain fluctuating price information are the major threat for the

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horticultural producers. Thus, there is need for effective and proper market intelligence and price forecast (Kalloo and Pandey, 2002; Rai and Pandey, 2004). The study and knowledge of price behaviour over time and space can guide the planners in deriving the appropriate price regulation measures for the creation of better marketing facilities (Meera, 2016).Therefore, studies related to behaviour of price and arrivals can help policy makers by solving dual purpose of devising sound and appropriate agricultural policies to control price instabilities and giving preview of market condition to the farmers thus enabling them to make informed decision regarding adjustments in cropping pattern, dispose of produce at best place and best time.

In between 2001-02 and 2016-17, the production of potato has been doubled (from 24.46 million tonnes(mt)) to 48.61 mt, for tomato the figures got a spike of three times i.e. from 7.46 mt to 20.71 mt and for onion it has been quadrupled from 5.25 mt to 22.43 mt. Operation Greens has been launched in union budget 2018 on the line of Operation Flood to address the fluctuations in price of these three vegetables and benefitting producer and consumer. Keeping in mind the importance of these crops and need for price and arrival behavior study, the present study was undertaken to study the behavior of prices and arrivals of tomato, onion and potato (TOP) vegetables and to find out the nature of relationship between arrivals and prices in Haldwani and Dehradun markets of Uttarakhand.

Data Sources and Methodology

The study is based on secondary data on wholesale prices and market arrivals of tomato, onion and potato collected from Mandi Bhawan, Rudrapur for the period 2006 to 2017. For potato, the data was collected for Dehradun Mandi and for tomato and onion for Haldwani mandi (selected based on highest arrival). The analysis includes computation of growth rate, seasonal indices and coefficient of variation.

The trend in prices and arrival can be estimated using compound annual growth rate (Bhosale et al 2017) To calculate the growth rate of arrival and prices, following exponential function was assumed,

$$Y_a / Y_p = ab^t$$
$$\text{Or, } \log Y_a / \log Y_p = \log a + t \log b$$

Where,
Y_a = Monthly arrivals
Y_p = Monthly prices
t = Rank given to the concerned year (ascending order)
a = Functional coefficient
b = Compounding coefficient

Then, using compounding coefficient growth rate wascalculated using following formula,

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

The variability in the prices and arrivals is denoted by coefficienct of variation (Kumar 2005, Asmatoddin et al. 2009, Sharma 2011, Reddy et al. 2012, Singh 2017). For calculating cofficient of varitaion following formula was used,

Where,
$$C.V. = \frac{S.D.}{Mean}$$
C.V.= Coefficient of variation
S.D.= Standard Deviation

Seasonal Indices were caculated using Fielder and Osagie ,1985. Following formula was employed.

Where,
$$SI_{ij} = \frac{Y_{ij}}{(Y_i - (6-j) b)} \times 100$$
SI_{ij}= Monthly Index for j^{th} month of i^{th}year
Y_{ij}= arrival/prices for j^{th}month of i^{th}year

Y_i = average arrival/prices of ith year
j = number assigned to month
b = trend coefficient

Prices of current year is dependent not only on market arrivals but also on lagged year prices. Therefore, current year prices is assumed as a linear function of current year market arrival and prices of lagged year. Linear regression analysis was used to estimate the coefficients. Similar relationship has been assumed by Molla and Atteri, 2000 and Sharma, 2011.

$$P_t = f(Y_t, P_{t-1})$$
Where, P_t = current price
    P_{t-1} = lagged price
    Y_t = current arrival

Results and Discussion

Tomato, Onion and Potato: Status in India and Uttarakhand

There is strong and significant association in current year production and state market arrival of next year indicating stock of current year is converting into supply for next year showing appropriate storage capacity (Saxena and Chand, 2017). Therefore, it is important to get an insight of the area and production of the slected vegetables in the study area. The details of area, production and compound growth rate of tomato, onion and potato over 2006-07 to 2017-18 in India and in the state is presented in table 1. The results shows that there is positive and significant growth in the area and producion of tomato,onion and potato in India. The area under onion is growing at a rate of 5.7 per cent per annum while the growth rate of its production is 6.52 per cent. The gowth rate in area and production of tomato is 3.23 percent and 7.38 percent, respectively. While area and production of potato is found to be increasing with a rate of 5.65 and 7.94 per cent repec- tively.

The state level data was collected from Uttarakhand Horticulture Department, Dehradun. The data was available till 2016-17 and for potato the data was recorded from 2009-10 onwards. Therefore, using the given information the trend was calculated and presented. The area under tomato onion and potato was found to be increasing with a rate of 1.56 percent,1.9 percentand 1.4 percent/ per annum respectively.

Behaviour of Prices and Arrivals

A study of past trend helps one to understand the current scenario and facilitate the forecasting of future. The trend in the annual market arrivals and average wholesale prices are presented in figure 1 and 2, respectively. In the year 2017, potato was the highest arrived vegetable amongst all selected vegetables followed by tomato. The highest arrival of tomato was seen in year 2012 touching 786991 quintal. The state witnessed the highest production of tomato during year 2012-13 and 2013-14 explaining this unexpected hike in market arrivals. The arrival of onion has an increasing trend being highest at 91015 quintal in the year 2017. The trend in market arrival of potato is fluctuating though the highest arrival was in 2017.

The trend in the prices was quite interesting. The price of tomato moved in opposite direction as of the market arrival. But even after such huge market arrival in the year 2012, the market prices did not show wide variation. However, after the year 2012, the price hiked from Rs. 652 /quintal in year 2012 to Rs. 1011/quintal in 2013 and revolved around these figures with Rs. 1040/quintal in 2017. The variation showed by onion is unanticipated as though the market arrival

Table 1. Area and Production of Tomato, Onion and Potato in India and Uttarakhand

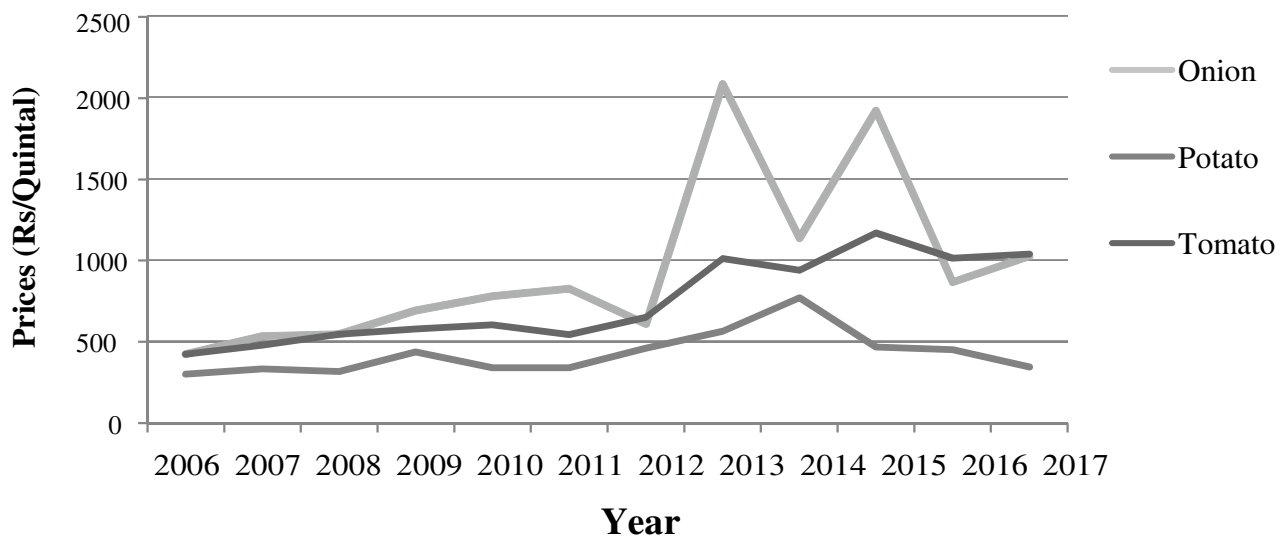| Year | Tomato | | | | Onion | | | | Potato | | | |
| | India | | Uttarakhand | | India | | Uttarakhand | | India | | Uttarakhand | |
	A	P	A	P	A	P	A	P	A	P	A	P
2006-07	596	10055	7997	86879	768	10847	3399	34761	297	2402	--	--
2007-08	566	10303	7606	92094	821	13900	3614	40199	313	2491	--	--
2008-09	599	11149	7808	95833	834	13565	3674	40725	348	2916	--	--
2009-10	634.4	12433.2	7886	95602	756.2	12158.8	3812	39732	364.9	3029.4	24331	432236
2010-11	865	16826	8783	97077	1064	15118	3779	37993	370	3517	24275	424344
2011-12	907.1	18653.3	8788	102395	1087.2	17511.1	3813	39267	408.2	3744.8	25034	433821
2012-13	879.6	18226.6	8951	111625.6	1051.5	16813	3939.6	40682.5	420.9	4006.2	25733.17	446913.4
2013-14	882	18735.9	8990.9	111668.6	1203.6	19401.7	3951.8	40740.2	433.6	3868.6	25742.8	4446959
2014-15	767	16385	9458.31	115413.4	1173	18927	4378.29	41277.33	476	4652	28359.6	452495.2
2015-16	774	18732	8550.15	93223.49	1320	20931	4066.81	41587.06	498	4811	25889.76	358244.2
2016-17	797	20708	8626.81	94005.13	1306	22427	4117.02	41770.07	530	5345	26038.19	360370.5
2017-18*	801	22337	--	--	1315	22071	--	--	543	5430	--	--
Growth rate	3.23**	7.38***	1.56	1.33	5.7***	6.52***	1.9***	1.1**	5.65***	7.94***	1.4*	0.36

Source: For India, http://agricoop.nic.in/; For state, Directorate of Horticulture Uttarakhand, Dehradun, Uttarakhand
Note: A representing area, P representing production, 2017-18* indicates figures as per 3rd advance estimate; *, ** and *** indicates significance at 10, 5 and 1 per cent level
Area in 000'ha and Production is in 000'MT
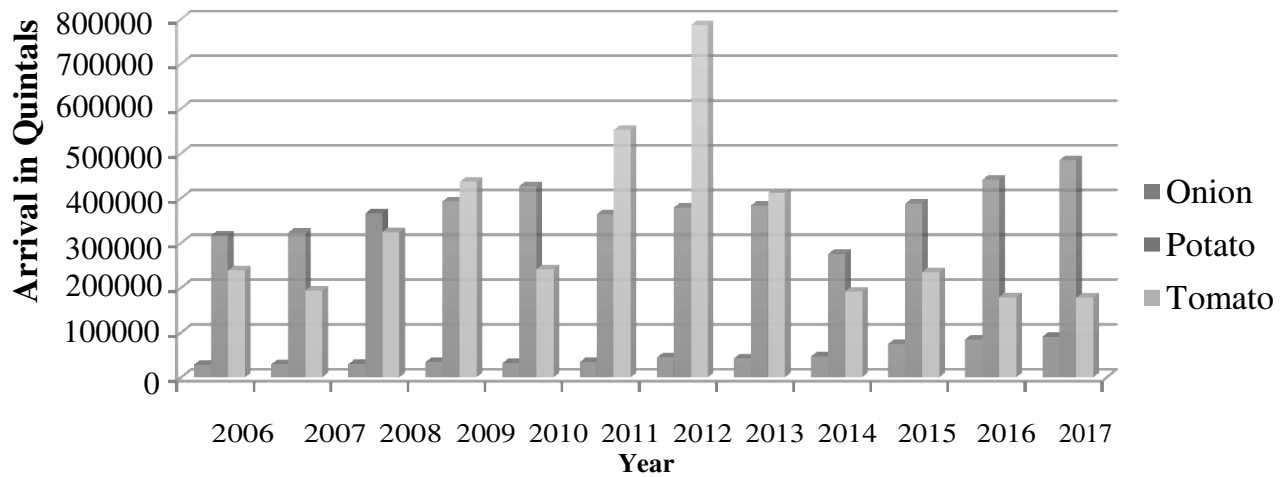
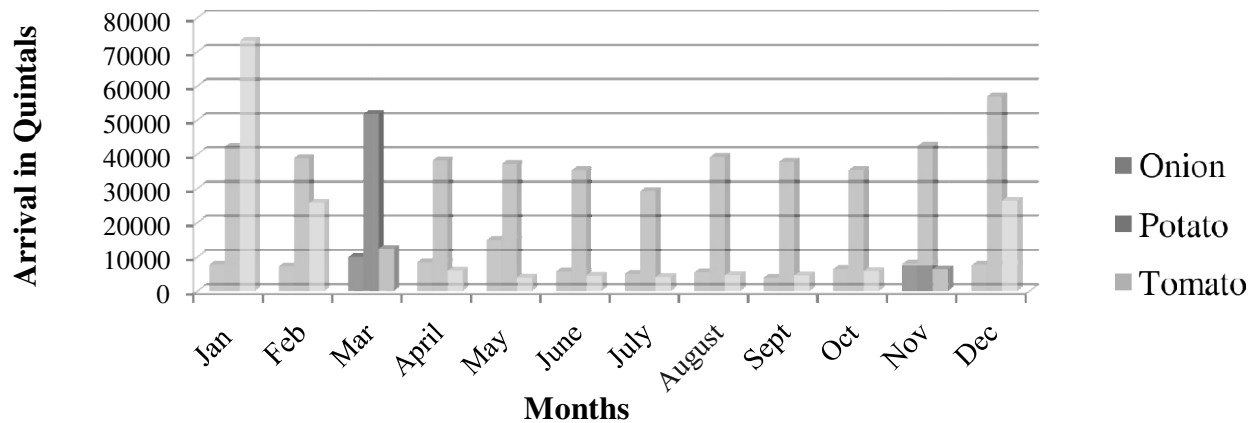**Figure 1. Annual market arrival of Tomato, Onion and Potato**

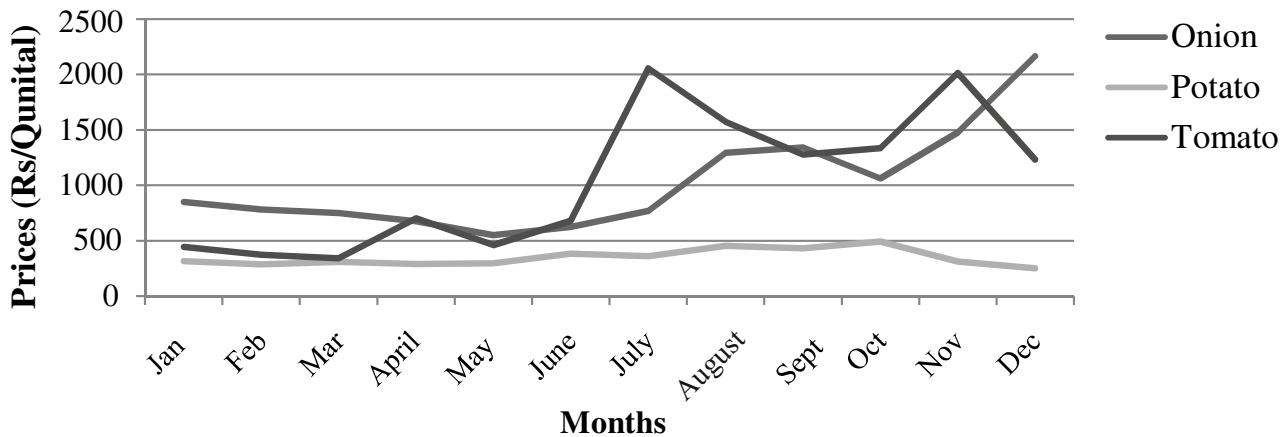**Figure 2. Average annual prices of Tomato, Onion and Potato**

showed a constant increase, the prices were fluctuating in a wide range. In year 2013 the price jumped to Rs. 2087/quintal from Rs. 608/quintal in year 2012. Then take a drop and stood Rs. 1137/quintal in year 2014 after which again hiked to Rs. 1923/quintal. The prices of potato were fluctuating within a small range except for the years 2012 to 2014.

To get a clearer picture of trend, monthly arrival and prices for year 2017 is observed and presented through figure 3 and 4. The highest arrival of potato and tomato was observed in the month of December and January,

respectively though the arrival of onion was highest for the month of May. Like annual trend, the prices of potato did not fluctuate much and varied within a small range. On the other hand, the monthly prices of onion and tomato showed high fluctuations. The prices of onion started to shoot up from August and reached maximum in December. Similarly, in case of tomato, the prices increased from Rs. 678/quintal in June to Rs. 2056 quintal in July than started to fall but again touched Rs. 2015/quintal in November.

Figure 3. Monthly arrival of Tomato, Onion and Potato during 2017

Figure 4. Average monthly prices of Tomato, Onion and Potato during 2017

Variability

The average annual arrival and prices along with the variability in them during the study period is presented in table 2. There is round the year arrival of the selected vegetables indicating whole year demand and import from other states. The average annual arrival of tomato is 330990.08 quintal with highest arrival of 87839.42 quintal in the month of January (harvesting season in the state) and lowest in the month of August (2742.83 quintal). For onion, the average annual arrival is 47803.83 quintal and the arrival ranges from 2410 quintal in September to 7197.17 quintal in the month of May. Potato has the highest average annual arrival amongst all (378894.50 quintal), have lowest variability in the annual arrival (15 %) and with highest average arrival 46652.58 quintal in the month of December. Overall, potato has low arrivals in between June to November and high between December to May. Similar results were obtained by Singh *et al*. 2017 for Agra market.

The average annual price of onion was Rs. 954.43/ quintal with a variability of 55.89 per cent. The monthly price of onion was lowest in

Table 2. Variability in the monthly market arrivals and wholesale prices of Tomato, Onion and Potato in selected market from 2006 to 2017

Crop	Tomato				Onion				Potato			
	Arrivals		Prices		Arrivals		Prices		Arrivals		Prices	
Month	Mean	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.
January	87839.42	63.31	591.08	49.31	4215.75	49.41	930.08	52.25	36513.67	30.39	253.75	25.57
February	74308.17	66.73	476.50	39.26	4316.42	33.76	875.25	50.54	35151.50	20.95	238.67	25.74
March	51582.92	67.09	473.58	56.53	5496.17	52.87	735.75	47.39	42612.00	23.72	292.08	19.22
April	8524.92	70.54	585.75	47.49	5283.33	33.71	656.08	50.47	39560.42	17.18	334.08	33.13
May	5537.25	88.81	478.25	39.41	7197.17	62.51	536.42	29.40	31140.92	18.73	334.92	33.38
June	3152.25	30.30	609.92	32.57	3360.75	43.36	627.75	40.25	27249.58	23.34	489.42	46.36
July	2841.33	27.22	1107.08	46.42	3563.17	30.57	927.25	57.90	25597.92	24.14	562.33	48.52
August	2742.83	56.46	1101.17	45.39	2639.92	56.72	1316.86	88.70	30355.17	19.78	613.58	47.66
September	3287.42	61.73	914.00	45.39	2410.00	41.35	1445.50	92.60	26707.33	30.42	600.58	52.97
October	4069.00	41.13	936.83	41.17	2807.25	58.43	1324.08	82.31	27005.75	48.38	614.08	34.79
November	19977.25	87.61	1020.83	54.48	3493.92	75.90	1176.42	58.45	26716.50	21.85	550.42	45.35
December	80812.58	84.33	816.08	49.68	3875.75	53.96	1090.33	52.11	46652.58	16.26	285.83	33.43
Annual	330990.08	56.52	750.65	34.97	47803.83	47.61	954.43	55.89	378894.50	15.07	429.33	31.18

the month of May (Rs. 536.42/ quintal) and highest in September (Rs. 1445.50/ quintal). For potato and tomato, the average annual prices were Rs. 429.33/ quintal and Rs. 750.65/quintal with a variability of 31.18 percent and 34.97 per cent. The price of potato was observed to be lower during January to March while high during August to October. The price of tomato shoot up to Rs. 1107.08/quintal and Rs. 1101.17/quintal during July and August.

Growth rate

The compound annual growth rate of arrivals and prices in tomato, onion and potato during the study period is presented in table 5. The annual arrival of the onion is found to be increasing at rate of 11.68 per cent (significant at 1 per cent level). However the growth in annual arrival of potato and tomato were insignificant. For onion, April to November

months showed significant increase in arrivals and prices. May, August and Septmber month showed significant increase in arrivals of potato. In case of tomato, significant increase in arrivals is observed during July to October and May while same month are aslo experencing significant increase in the wholesale prices. Overall, from Arpil to November months there is significant rise in prices of tomato.

Seasonal Indices of Prices and Arrivals of Selected Vegetables

The seasonality in the arrival and prices of horticulture commodities is a well-known phenomenon. The seasonal production and uneven distribution due to various structural constraint soften leads the glut, yielding low prices to the farmers and lean period marked by hiked prices faced by the consumers in the markets. The seasonal indices for prices and arrivals are presented in table 4.

Table 3. Compound annual growth rates of arrivals and prices from 2006 to 2017

Month	Tomato		Onion		Potato	
	Arrivals	Prices	Arrivals	Prices	Arrivals	Prices
January	4.82	7.33	13.35	10.43	0.84	6.62
February	-12.15	6.83	8.22	11.35	4.25	6.29
March	-15.58	8.62	13.69	10.55	3.95	0.44
April	-0.46	12.99*	6.28***	12.7***	0.75	4.76*
May	10.31*	8.1***	13.69***	6.85***	4.93***	4.59*
June	2.52	7.19***	11.99***	8.8***	3.09	6.57**
July	7.6***	10.95***	6.4***	8.76**	0.07	5.64*
August	12.43***	8.82***	13.31***	11.66**	4.92***	6.91**
September	16.21***	11.12***	10.38***	11.33**	8.91***	4.52
October	13.34***	11.32***	13.21***	8.27*	-4.15	1.11
November	4.27	10.32***	23.04***	11.24***	0.78	1.04
December	4.39	7.26	15.41	11.97	4.61	2.63
Annual	-2.88	9.55	11.68***	10.3	2.06	4.1

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

Table 4. Seasonal Indices of arrivals and prices of Tomato, Onion and Potato from 2006 to 2017

Month	Tomato		Onion		Potato	
	Arrivals	**Prices**	**Arrivals**	**Prices**	**Arrivals**	**Prices**
January	308.40	86.44	108.51	112.35	111.49	63.28
February	250.44	67.25	117.74	99.50	107.22	58.29
March	182.11	64.34	136.72	85.54	129.64	73.69
April	32.77	76.49	142.15	74.93	121.88	79.28
May	20.07	64.93	171.26	65.16	94.32	78.45
June	14.62	82.68	83.49	72.81	82.67	111.41
July	12.64	143.08	94.84	100.12	77.35	127.19
August	13.10	142.58	63.57	132.69	91.59	138.21
September	15.36	115.55	58.50	135.68	79.69	133.15
October	17.90	117.90	64.15	129.67	83.22	142.13
November	64.48	126.91	72.24	121.29	80.91	123.62
December	268.13	102.31	86.83	57.79	140.03	66.35

For onion, the highest arrival seasonal index was found for May (171.26 %) attached with low price seasonal index (65.16 %) and the lowest arrival seasonal index is for September (58.5 %) with corresponding high price seasonal index of 135.58 per cent. For potato, December is associated with the highest arrival (seasonal index is 140.03 %) though the lowest price index was observed in the month of February (58.29%). In case of tomato, lowest arrival was in month of July i.e. 12.64 percent with price seasonal index of 143.08 per cent

Relationship between arirvals and prices

Results obtained while studying the nature of relationship between arrival and prices are presented in table 5.The fitted models were found to explain about 41 percent, 33 percent and 8 percent of variation the prices of tomato, potato and onion, respectively. Indicating about 92 percent of the variaion in onion prices is unexplained by arrival and lagged year prices. However, the finding confirms the inverse relationship between arrivals and prices as the regression coefficient is found to be negative and significant for potato and

Table 5. Correlation between arrivals and prices during 2006-17

S. No.	Commodity	Regression Coefficient			R^2
		Constant	**Arrival**	**Lag prices**	
1.	Tomato	383.52***	-0.002***	0.626***	0.411
2.	Onion	836.27***	-0.021	0.285***	0.083
3.	Potato	358.61***	-0.003***	0.485***	0.333

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

tomato. The relationship of current price and lagged year prices showed that for all the crops, the lagged year prices positively and significantly affected the current year prices. Similar findings were reported by Sharma (2011) and Molla and Atteri (2000).

Conclusion and Policy Implications

The area and production of the TOP vegetables is increasing in India as well as in Uttarakhand state. Among the three vegetables studied, fluctuations in the average annual prices were highest for onion and lowest for potato. The current year market arrivals lagged prices explained only 92 percent of the variation in the onion prices, indicating various other factors responsible for the price fluctuation in onion. Appropriate pricing policy measures are needed to regulate prices in case of onion. For tomato, the prices are significantly increasing during the months of July to October even though the arrivals are also increasing during the same period. The variability in the prices during this period is also low. Similar trend has been observed for onion and potato. This may be indicating lack of response of arrival on prices and incompatibility in the marketing system for self-adjustment. Efficient marketing system is needed to check this. However, overall the arrival of tomato and potato is negatively and significantly affecting the prices, while for all three, the lagged prices have positive and significant effect on current prices. It is better to include the lagged prices in the model as it automatically considers effects of most of the dropped variables as those were reflected in the lagged prices.

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