Randhir Yadav
Department of Agricultural Economics, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

RR Kushwaha
Department of Agricultural Economics, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

KK Singh
Department of Agricultural Economics, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Supriya
Department of Agricultural Economics, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Arrival of potato: A case of Faizabad, Gorakhpur, Azam Garh and Varanasi market in Uttar Pradesh

Randhir Yadav, RR Kushwaha, KK Singh and Supriya

Abstract
The present study was undertaken to analyse the behaviour of arrivals of potato and to find out the nature of relationship between arrivals in Faizabad, Azamgarh, Gorakhpur and Varanasi markets of Uttar Pradesh. The variations in potato arrivals are mostly caused by these factors, whose magnitudes vary evenly and often. According to the study, potato arrivals peaked in April after beginning at the end of December. A little under half of the potato harvest was marketed from December to March. It was discovered during a market research in Varanasi that potatoes began to arrive at the end of December. The months of December-January (10.99) to April saw the highest concentration of arrivals. There were 10.45%, 8.62%, and 9.85% of these arrivals in the months of January, March, and April, respectively. This makes gluts of produce during these periods in the market which resulted in low prices in these months.

Keywords: Arrival, potato

Introduction
The four main components of socioeconomic development-food, livelihood, nutritional security, and health care-are thought to be essential for guiding a society toward progress. Horticultural crops are widely recognised as playing a role in human nutrition and disease prevention, and as a result, they are seen as having a positive impact on a country's wealth. In addition, horticulture crops contribute 30 percent of the agricultural GDP, 14 percent of the total agricultural export, and roughly 37 percent of the area under cultivation in India. India is the world's second-largest exporter of fruits and vegetables, with a value of around Rs. 9410.81 crores in the 2017-18 fiscal year. (APEDA, 2018). According to the IIHR (2014), by 2050, demand for fruits and vegetables would be over 540 million tonnes, or about twice as much as what is currently produced. Given the challenges the agricultural sector is facing, together with rising demand and shifting consumer behaviour, it need protection in the form of price support and policy. The price can stimulate production, and the degree of price volatility can have a negative impact on it as well. According to reports, the biggest threat to horticulture growers is a lack of market intelligence regarding potential markets, the pattern of arrivals, and prices (Sharma, 2011) [3]. Another problem is a producer's inability to get information on changing prices. Thus, there is need for effective and proper market intelligence and price forecast (Kalloo and Pandey, 2002; Rai and Pandey, 2004) [1]. 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 be marketing facilities. (Meera, 2016) [2].

Potato is an integral part of the global food system and the world's number one non-food grain commodity. The crop plays an important role in ensuring food security of present and future generation. Keeping in view the potential of potato in the food security of developing nations, FAO has rightly declared it as 'Future Food Crop'. Considering its importance, United Nations (UN) had declared 2008 as the International Year of Potato (Sreepriya, 2020) [4]. Globally India stands third in terms of area and second in terms of production (52.58 million tonnes) after China. During 2018-19 potato acreage in India was 21.84 lakh ha with a production of 52.58 million tonnes (Indiastat, 2019). Major potato growing states are Uttar Pradesh (30%), West Bengal (24.31%), Bihar (14.15%), Gujarat (7.31%), Madhya Pradesh (6.30%) and Punjab (5.17%) (Indiastat, 2019).

Keeping in mind the importance of potato crops and need for arrival behaviour study, the present study was undertaken to study the behaviour of arrivals of potato and to find out the nature of relationship between arrivals in Faizabad, Azamgarh, Gorakhpur and Varanasi markets of Uttar Pradesh.

Corresponding Author
Randhir Yadav
Department of Agricultural Economics, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Material and Methods

The study is based on monthly data on arrivals of the potato crops pertaining to the time period 2005-06 to 2019-2020 were collected from the secondary sources from the Directorate of Agriculture Marketing, U.P., Rajya Krishi Utpadan Mandi Parishad and related market official records.

Moving average is a method used for the measurement of trend by smoothing out the fluctuation in the data. Moving average of extent 'n' is a series of successive average (Arithmetic mean) of n terms at a time, starting with the 1st, 2nd, 3rd etc. Thus the first average is the mean of 'n' terms, the second is the mean of the n terms from 2nd to $(n + 1)$th term, the third is the mean of n terms from 3rd to $(n + 2)$th term, and so on.

Since in the case of the 12-month moving average($n = 12$), n is even, the moving average is placed between the two middle value of the time interval, i.e., between $t = 6$ and $t = 7$. Thus, to synchronize the moving average arid the original data, a moving average of the extent 2 of these moving averages is taken, putting the first of these values against $t = k + 1, i.e., t = 7$.

Numerically, let the total number of months be n and the wholesale price index be WPI_i, for month i. Hence the formula for 12 month moving average are given below:

$$MA_j^{12} = \left(\frac{1}{12}\right) \sum_{j=i-5}^{i+6} WPI_j$$

Where, $j = 6,7, \dots, (n - 6)$ as $MA_j^{12}=0$ for $j = 1,2, \dots 5$ and $i = (n - 5), \dots, n$

And 2 month moving average

$$MA_j^2 = \left(\frac{1}{2}\right) \sum_{j=i-1}^{i+1} MA_j^{12}$$

Where, $j = 7,8, \dots, (n - 6)$ as $MA_j^2=0$ for $j = 1,2, \dots 6$ and $i = (n - 5), \dots, n$

Result and Discussion

The seasonal behaviour of arrivals of potato was studied for selected four markets included in the study. The fluctuations in the arrivals of potato are mainly the results of such factors which uniformly and regularly fluctuate in magnitude. These variations are periodic and regular. From the study, it was found that in Faizabad market, potato started arriving towards the end of December. Table 1 indicates that the concentration of arrivals was highest in the month of February and March. Arrivals in December, January, February and March were 12.13 per cent, 10.66 per cent, 9.38 per cent and 11.38 per cent, respectively which accounted for 43.55 per cent of arrivals during the year, the remaining year accounted for 56.45 per cent. It indicated that potato marketing was seasonal. In the months of December to March, a little less than half of the potato crop was marketed. There was glut of produce during these months in the market which resulted ruling low prices in these months.

From the study of Gorakhpur market, it was found that potato started arriving towards the month of January. Table 2.2 indicates that the concentration of the arrivals was the highest in the months of April (11.36). Arrivals in January, February and March were 9.95 per cent, 10.06 per cent and 10.11 per cent, respectively which accounted for 41.48 per cent of the arrivals during the year, the remaining year accounted for 58.52 per cent. It indicated that in the months of January, February and March, more than one -third of the potato crop was marketed in the Gorakhpur market. This makes gluts of produce during these periods in the market which resulted in low prices in these months.

From the study of Varanasi market it was found that potato started arriving towards the end of December. Table 2.3 indicates that the concentration of the arrivals was the highest in the months of December-January (10.99) to April Arrivals in these January, March and April months were 10.45 per cent, 8.62 per cent and 9.85 per cent respectively which accounted for 40.45 per cent of the arrivals during the year, the remaining year accounted for 59.55 per cent. It indicated that in the months of January to March, a little less than one third of the potato crop was marketed, prevailed low prices in these months.

From the study of Azamgarh market it was found that potato started arriving towards the end of December. Table 2.3 indicates that the concentration of the arrivals was the highest in the months of December-January (9.32) to January Arrivals in these January, February months were 11.06 per cent, 11.05 per cent respectively which accounted for 31.43 per cent of the arrivals during the year, the remaining year accounted for 68.57 per cent. It indicated that in the months of January to March, a little less than one third of the potato crop was marketed, prevailed low prices in these months.

Table 1: Index of Seasonal variation in Arrivals of potato in market of eastern Uttar Pradesh (Faizabad) 2005-06 to 2019-20

Year	January	February	March	April	May	June	July	August	September	October	November	December
2005	-	-	-	-	-	-	74.79492	60.26552	66.50466	104.2101	75.44427	227.5283
2006	101.2392	110.5862	147.0455	60.14468	71.02846	99.82412	57.8771	74.35558	78.40618	80.23502	145.8765	152.2128
2007	148.836	102.2548	102.8928	69.81211	62.44661	65.44105	58.19006	85.89737	130.7323	106.5365	97.05707	129.3131
2008	136.1376	83.6519	128.1489	115.3291	77.43495	78.35004	81.99048	83.35558	107.2948	99.52481	116.4465	116.3617
2009	94.60572	94.08607	103.5565	107.181	104.7108	91.95869	100.1971	84.63255	85.89	61.09649	83.26313	121.633
2010	117.826	142.4046	193.0047	92.36736	60.81715	57.60281	81.75229	105.6388	94.45737	122.2424	127.0271	129.0788
2011	15.7536	117.6094	106.8836	101.5409	79.52163	106.5288	97.5792	127.8401	88.71479	88.59187	91.82317	117.568
2012	100.6527	113.6876	100.6734	101.3178	73.71664	62.48759	45.85255	38.07042	50.48219	63.05549	56.72573	182.3951
2013	263.9779	188.012	171.2182	51.52521	49.66803	48.37803	52.41149	78.16792	80.48786	15.73779	76.85927	82.70086
2014	99.5612	126.3149	149.8167	134.8424	128.5953	118.8667	101.3342	65.20823	62.41359	87.63312	92.08921	108.5742
2015	92.86475	133.4579	133.6136	106.552	115.3564	106.355	50.67026	68.15818	106.0423	162.8464	94.91426	120.3265
2016	118.7366	82.46217	120.7944	67.38331	59.30899	56.23647	68.92498	79.06828	85.57525	153.5463	129.7166	143.6633
2017	125.3804	77.31259	155.2831	75.9185	52.39443	69.49324	100.4692	90.4009	82.75119	109.5788	127.6097	133.826
2018	127.4879	100.7829	173.5276	63.23272	50.96745	67.41407	70.18739	69.73297	55.36541	64.45799	35.96242	206.4035
2019	203.0803	97.72298	132.0431	84.91361	62.49496	61.65606	82.64835	93.32358	82.27556	118.1108	127.9131	191.7147
2020	154.9463	102.5566	111.752	63.23991	73.84719	50.79951	-	-	-	-	-	-
Average	126.7391	111.5268	135.3503	86.35337	74.8206	76.09282	74.99197	80.2744	83.82623	95.82693	98.58187	144.22

Table 2: Index of seasonal variation in Arrivals of potato in market of eastern Uttar Pradesh (Gorakhpur) 2005-06 to 2019-20

Year	January	February	March	April	May	June	July	August	September	October	November	December
2005	-	-	-	-	-	-	88.88588	71.76744	100.9331	85.35563	86.28918	110.2088
2006	153.5488	88.12268	135.2809	174.8248	110.4198	19.48852	76.82287	13.60918	99.14461	87.03403	88.13842	149.6986
2007	151.3562	155.4742	142.6921	91.66008	60.70871	81.3683	43.77351	61.73467	73.50748	90.11338	120.9006	118.3669
2008	201.4745	115.4891	74.35675	108.4242	125.6948	56.87545	54.35421	88.5015	92.0739	120.0971	137.4232	154.4035
2009	100.9283	93.39788	121.4377	63.1546	105.8094	86.00751	77.42609	57.1288	59.19809	67.39712	62.96852	81.87918
2010	161.5474	190.6007	160.8183	89.86414	59.72357	71.50639	74.87209	88.19221	96.16076	116.4304	71.59386	129.1021
2011	138.2495	9.982197	124.1133	160.1633	134.1413	108.6917	8.023625	56.15409	66.07675	59.9334	82.25284	121.0934
2012	136.6019	321.6659	191.3758	49.92366	44.07646	57.76072	32.45251	59.79022	90.46496	130.7286	205.7589	21.67449
2013	125.8089	115.7687	97.26915	23.58076	27.11414	161.8215	139.6538	148.9519	110.9362	71.95508	49.62287	59.07101
2014	34.14599	76.39006	83.18709	576.2831	66.92676	49.9304	42.29039	49.0418	38.68251	46.88877	55.07719	85.17672
2015	153.8301	131.786	128.774	132.9855	149.6861	100.109	97.92573	58.2176	58.95564	23.584	96.881	96.82893
2016	127.9796	120.4917	192.7727	119.0757	62.14628	99.72711	110.9421	71.06771	90.28222	68.93719	61.3391	96.73746
2017	71.50408	98.04475	97.67159	155.4199	120.0098	110.9662	133.9629	111.5433	84.70673	89.72625	167.0352	77.33739
2018	58.83907	46.57576	52.62325	146.4955	125.5487	121.5982	82.015	69.8577	111.9508	81.67818	110.2407	136.1758
2019	33.34777	127.6378	106.0472	83.36677	96.82367	71.44431	103.4534	96.96692	95.21983	95.94798	82.35999	128.7092
2020	140.0409	117.6651	110.2016	67.75065	112.0111	98.11514	-	-	-	-	-	-
Average	119.2802	120.6062	121.2414	136.1982	93.38937	86.3607	77.79027	73.50168	84.5529	82.38714	98.52544	104.4309

Table 3: Index of seasonal variation in Arrivals of Potato in market of Varanasi 2005-06 to 2019-20

Year	January	February	March	April	May	June	July	August	September	October	November	December
2005	-	-	-	-	-	-	38.155	35.785544	45.474	68.427781	99.625	10.91712
2006	275.12	124.245	41.548	101.173	98.256	78.6803	75.61	71.009087	78.001	69.764885	77.184	227.423
2007	214.03	92.115	86.558	85.5056	57.69	67.446	86.476	93.739785	119.68	105.52434	24.602	145.0375
2008	122.97	86.9125	97.585	112.212	108.24	87.0398	102.86	104.3332	98.555	101.36603	103.81	120.1141
2009	112.32	82.0988	100.68	56.9696	100.22	80.2164	128.39	105.89729	75.598	98.086599	120.99	120.1414
2010	114.06	96.5064	95.913	82.5314	92.568	102.858	103.05	93.128926	93.362	96.565859	127.35	134.717
2011	115.85	123.948	12.301	107.979	108.84	90.1319	91.432	98.145603	86.717	90.972368	89.691	199.3288
2012	99.777	94.8881	88.319	78.5308	86.333	95.0822	94.555	92.280999	79.499	104.03537	94.287	94.02964
2013	163.95	92.5486	90.56	91.9095	96.582	83.5039	89.815	80.53571	76.79	86.373212	166.73	116.7599
2014	160.42	131.553	82.913	61.0862	63.884	96.2234	85.009	166.54406	106.38	16.466097	17.072	103.7202
2015	136.66	119.814	12.834	176.363	147.19	115.498	118.22	102.77111	59.454	82.109011	75.871	83.57673
2016	95.032	70.9139	112.54	114.539	344.35	12.1915	97.766	72.412484	73.702	63.932745	93.95	156.5385
2017	61.671	102.876	90.085	102.089	83.689	80.4978	66.087	73.733941	74.112	105.57933	126.72	153.5305
2018	137.67	143.784	121.13	85.3201	59.868	58.0556	77.929	76.79912	111.01	130.27689	120.96	173.5121
2019	6.8334	5.90286	5.4889	148.784	138.44	137.66	157.58	141.19205	131.4	92.837052	88.515	116.0977
2020	41.741	43.024	34.559	129.661	165.83	145.33	-	-	-	-	-	-
Average	123.87	94.0753	71.534	102.31	116.8	88.6943	94.196	93.887261	87.316	87.487838	95.157	130.3629

Table 4: Index of seasonal variation in Arrivals of potato in market of eastern Uttar Pradesh (Azamgarh) 2005-06 to 2019-20

Year	January	February	March	April	May	June	July	August	September	October	November	December
2005							88.46903	60.60811	137.0852	150.8721	54.9075	134.3027
2006	171.1375	113.0354	98.79777	46.59183	53.95843	102.1385	124.2307	140.6623	103.3222	70.78926	52.24715	172.9525
2007	182.6729	92.44031	140.9491	65.1646	56.31384	61.95944	85.6548	78.38795	64.31935	63.91002	78.93588	58.73796
2008	66.87235	148.5484	166.9234	142.0373	122.3432	119.7886	53.52662	82.34881	70.61078	109.3022	86.44368	100.3448
2009	142.9712	106.8341	119.022	89.87646	116.8095	79.233	93.25395	82.53461	81.86828	120.3911	10.4227	117.0924
2010	132.0153	113.8873	117.862	135.5007	91.79508	85.9556	111.5033	95.30813	86.30885	113.1247	90.93131	121.0735
2011	102.966	100.1846	13.01223	147.6673	103.7272	99.08491	110.4326	86.82425	97.41499	74.28814	77.14645	110.1508
2012	77.41431	135.872	128.1965	97.68452	107.8399	114.0547	84.20462	94.35229	56.30421	43.8839	41.07787	33.02621
2013	41.69019	124.8897	156.9097	123.8208	136.7842	109.4245	107.0819	113.6769	96.43645	84.66701	115.6145	87.80142
2014	123.4362	99.04921	96.04176	102.2124	109.5201	95.59186	76.416	71.7608	59.60303	86.00528	77.53569	127.7147
2015	167.8478	155.4778	118.7556	81.33707	96.63332	67.97579	102.1166	83.32403	75.947	120.9187	88.59301	95.87899
2016	138.8461	122.955	83.20942	100.4741	67.05486	58.41488	73.31337	66.08667	105.9056	97.17313	128.6728	221.5115
2017	134.8984	110.0524	126.3173	76.86517	2.82379	52.29944	80.85279	107.1422	94.54037	96.87732	101.0616	125.2113
2018	145.3351	130.3647	145.8796	56.66029	115.498	87.30079	71.06559	61.55902	74.17359	88.19041	76.73477	120.5543
2019	122.5159	142.4585	165.3842	103.8406	100.644	88.20624	77.0776	50.54056	48.81238	46.54142	45.24792	45.1692
2020	234.6086	287.0499	105.9462	66.80843	110.7763	101.6118						
Average	132.3485	132.2066	118.8804	95.76944	92.83477	88.20267	89.27996	85.00777	83.51016	91.12899	75.03819	111.4348
Adj Index	132.8309	132.6885	119.3137	96.11848	93.17312	88.52414	89.60535	85.31759	83.81452	91.46112	75.31168	111.8409
k=	1.003645											

Conclusion

The fluctuations in the arrivals of potato are mainly the results of such factors which uniformly and regularly fluctuate in magnitude. From the study, it was found that potato started arriving towards the end of December and reached peak arrival in April. In the months of December to March, a little less than half of the potato crop was marketed. In the study of Varanasi market it was found that potato started

arriving towards the end of December. It indicates that the concentration of the arrivals was the highest in the months of December-January (10.99) to April. Arrivals in these January, March and April months were 10.45 per cent, 8.62 per cent and 9.85 per cent respectively. As a result, there are surpluses of produce at these times on the market, which leads to lower pricing throughout these months.

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