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Research Article

Market Behaviour and Economic Analysis of Arrivals and Prices of Potato in Fruit and Vegetable Market Okara (Punjab), Pakistan

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Abstract: The present study was conducted to analyze the behaviour of arrivals and wholesale price of potatoes in the Fruit and Vegetable (F and V) Market of Okara City, Pakistan. Time series data for the last seven years was collected on market arrivals and prices of potatoes from the government department. The Compound Annual Growth Rate (CAGR) was found to be positive (30%) regarding prices, and negative (-7%) for arrivals of potatoes. The variation in prices and arrivals differed across the months. The findings revealed that the highest (211.3%) arrivals variation occurred during the month of November, and the highest (25.89%) price variation took place during the month of February. The results of the Cuddy-Della-Valle Index showed medium instability (24.38 %) in case of prices, and low instability (4.76%) regarding the arrivals. The Karl Pearson Correlation Coefficient method indicated that mostly across the months, there exists a positive relationship between market arrivals and prices of potatoes with the exception of a few months. The study confirmed the highest seasonal arrivals index (338.11%) for the month of February and the highest seasonal price index (136.98%) for the month of November. In order to get maximum benefit from marketing of potatoes, it is suggested that all the concerned stakeholders should look timely and properly at the trend of market prices and market arrivals of potatoes in the F & V markets. Proper management along with market intelligence of arrivals and prices would increase the welfare of farmers, consumers and other stakeholders which involved in the agri-food supply chain of potato.

Keywords: Potato, Market Arrival, Prices, Variation, Instability, Relationship, Farmers, Consumers.

1. INTRODUCTION

The majority of the vegetables are the most important element in the human diet, which play a vital role in supplying vitamins, minerals, fiber, iron, calcium, etc. to the human body. Globally, Potato (*Solanum tuberosum* L.) is one of the largest non-cereal foods and also widely consumed as a tuberous crop. It is globally recognized as fourth most important food crop following rice, wheat and maize crops. The potato comprises various components, including dry matter, edible protein, and edible energy contents, and such composition makes it superior to other vegetables. It plays an important role regarding nutritional balance. Mainly it is consumed as staple food in Pakistan. Further, it is one of important domestic vegetable which is available throughout the year. The estimated production of potato in Pakistan is 76575 thousand quintals [1]. Moreover, production of potato in Punjab province is 74661 thousand quintals [2]. The Punjab province is a major producer of potato in Pakistan. The district Okara is one of highest potato producing district in Punjab. According to the Crop Reporting Service (Government of the Punjab), production of potato in Okara district is 2.21 million tonns in 2023-24, it is sown on an area of 83275 hectares and its yield is 269 (Mounds/Acre) [2] (Table 1).

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Table 1. Area, production and yields of Potato in Okara District.

Year	Area (Ha)	Production (Tonns)	Yield (Mounds/acre)
2017-18	57997	1400444	261.81
2018-19	58678	1555427	290.48
2019-20	54239	1460663	291.98
2020-21	63547	1595425	254
2021-22	79336	2218140	282.86
2022-23	88259	2255805	258.6
2023-24	83275	2214827	269

Source: Crop Reporting Service, Government of the Punjab [2].

The fluctuation in prices of potato impacts production, consumption and it is one of major factor affecting the income of potato's farmers. Prices of potato show fluctuation both within the year and across the years. Chaudhary *et al*. [3] noted that the stable prices play a key role regarding the determination of farmer's income in agriculture sector. Therefore, it is necessary to consider behaviour of prices regarding growing, storing and selling of the agricultural produce in the agriculture produce markets. Gholap *et al.* [4] emphasized that it is vital to assess the interrelationship between the arrivals of potato and the prices of potato for analyzing price fluctuations and arrival fluctuations in the agricultural produce market. According to the study of Bera *et al*. [5], formulation of effective agricultural price policy regarding stabilization of prices and regulation of supply requires to study interrelationship between farm output prices and arrivals of agricultural commodity. The Thakur *et al*. [6] pointed out that the research studies regarding the price behaviour and market arrivals can assist the agricultural policy makers for devising instructions for ensuring stability in prices and to intimate properly to the producers regarding market conditions so that they make efficient decisions regarding disposal of their agricultural produce at suitable place and time. Although various studies have been undertaken abroad to analyze the behaviour of market arrivals and prices, no such study has been conducted so far in the case of potatoes related to the Okara district (Punjab, Pakistan). In order to fill this gap, the present study was conducted with the aim to properly investigate the extent of relationship between arrivals and market prices of potato so that it can assist concern stakeholders regarding understanding of dynamics of market prices and arrivals of potato in the Agricultural marketing domains of Okara City. This research study would assist not only policy makers but also provide important information to other allied agriculture subsectors for making timely decisions related to potato production and supply chain network for ensuring sustainability. Moreover, consumers would also get critical knowledge regarding when and how much to purchase potato from the F and V Market Okara, it would also assist them to increase their socioeconomic welfare status. The present agricultural marketing study was conducted with reference to F and V Market (Okara), Okara City with the aims to compute the Compound Annual Growth Rate (CAGR), Variability, concerning Instability Value (by using Cuddy-Della- Valle Index), Seasonal indices and extent of relationship between arrivals and market prices of potato.

2. MATERIALS AND METHODS

Monthly data comprising arrivals and prices of potato for Financial Years (FY) 2018 to 2024 was collected from secondary source (Agriculture Marketing Information Service, Government of the Punjab). Furthermore, various analytical techniques were used for estimating growth rate of market arrivals and market prices, extent of variability in prices and arrivals, instability in prices and arrivals, seasonal indices and degree of relationship between market prices and market arrivals of potato in the F and V Market of Okara City.

In order to investigate the trends in market prices and market arrivals of potato concerning F and V Market (Okara) of Okara City, the Compound Annual Growth Rate (CAGR) method is used in this study. This method was also considered by Timilsina and Bhandri [8] regarding study of pricing and arrival behaviour of main trading vegetables in Pokhara market (wholesale) of Nepal. The CAGR calculated between years X and Z (Z-X = N (No. of years between X and Z)) as below:

$$CAGR = \left(\frac{Final\ Value(Year\ Z)}{Initial\ Value(Year\ X)}\right)^{1/N} - 1 \quad (1)$$

For analyzing extent of variability between market arrivals and market prices of potato, the Coefficient

of Variations (C.V) was computed. This method has used by many researchers, including Thakur *et al.* [6] and Chandra *et al*. [7], among others by using the following statistical formula:

$$CV = \frac{Standard\ Deviation}{Mean} \times 100 \qquad (2)$$

The Cuddy-Della-Valle Index is worked out in this study for computing instability level related to prices and market arrivals of potatoes in the F and V market of Okara City. Following formula is used for estimation of C-D-V Index:

$$C - D - V\ Index = CV * \sqrt{(1 - R2)} \qquad (3)$$

Where,
CV = Coefficient of Variation
R^2 = Coefficient of Determination

The Simple Average Approach is used for calculating seasonal prices and arrivals indices of potato. An Index is constructed by dividing each year average price/arrival by the overall seven years average and multiplying by 100.

The statistical measure (Karl Pearson correlation coefficient) is broadly used for computation of degree and direction of relationship existing between the variables which are related in linear form. The relationship between market arrivals and market prices of potato is estimated by using Karl Pearson correlation coefficient for different years from 2018 to 2024. Thakur *et al.* [6] used same methods for studying relationship between market arrivals and concerning prices of potato. The following formula is used:

$$Karl\ Pearson\ correlation\ coefficient\ (r) = \frac{\sum (x - \bar{x})\,(y - \bar{y})}{\sqrt{\sum (x - \bar{x})2 \sum (y - \bar{y})2}} \qquad (4)$$

Where, $\bar{x}$= Mean of variable x,
$\bar{y}$= Mean of variable y

Generally, value of the correlation coefficient (r) ranges from 0 to ± 1. The value of r equal to zero indicates no correlation between two variables, r = 1 depicts perfect positive correlation and r = -1 revealed perfect negative correlation between two variables.

3. RESULTS AND DISCUSSION

It has been observed by many researchers that there is a widespread fluctuation in the output of potato because of its perishability and seasonality nature. Resultantly, such variations lead to cause fluctuations in the prices of potato. Saha *et al.* [9] observed that despite the fact that there are various factors that are responsible for creating such variations in the prices of potatoes, market arrival plays an important role in determining prices in the agricultural produce markets. Therefore, it is important to study the relationship of prices and market arrival for ensuring better understanding of agricultural marketing system concerning to specific crop (potato).

3.1. Growth Rate of Market Prices and Arrivals of Potato

Over the span of seven years there is a positive CAGR value (30%) in the prices of potato. It is mainly due to rising population, increase in awareness regarding health and market inflation. However, there is a negative CAGR value (-7%) in case of arrivals of potato in F and V market of Okara City. The reason could be due to access of local producers to other F and V Markets of Pakistan, the supply to F and V market of Okara City has shown negative trend because such farmers received higher profit margin by selling potato in other F and V Markets. The findings are in consistent with the study of Chandra *et al.* [7] regarding arrivals of potato in Nagpur Agriculture Produce Market.

3.2. Forecasting of Arrivals and Prices of Potato

It is important to forecast the future trend of arrivals and prices to inform concerned stakeholders in making decisions regarding input purchase and allocation of land for growing of suitable crop. Figure 1 shows the arrival data from 2018 to 2024 and a linear trend is forecasted for the future time period (2025 to 2027). These results confer that arrivals trend shows decreasing behaviour. Figure 2 shows a comparative trend of price from 2018 to 2024, these results show an increasing trend; the price forecast for 2025 to 2027 shows a linear increase in the price.

3.3. Average Monthly Variability in Market Arrivals and Prices of Potato in F & V Market Okara

Variability on monthly basis regarding the market

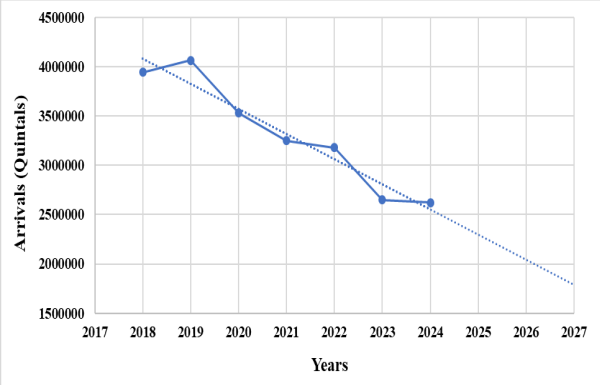

Fig 1. The year wise arrivals of potato (symbols and solid line show data used in the study, while dotted line is the linear fit for future trend).

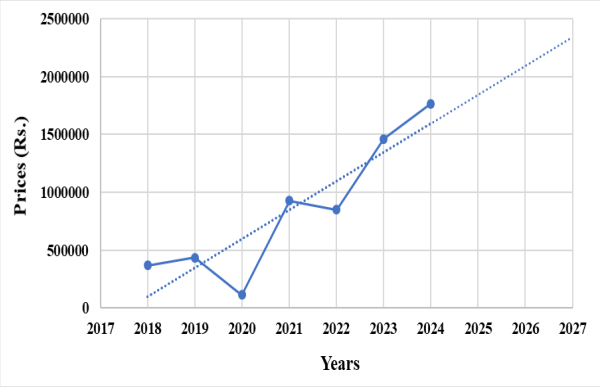

Fig. 2. The year wise prices of potato (symbols and solid line show data used in the study, while dotted line is the linear fit for future trend).

arrivals and prices of potato is shown in Table 2. There is a significant variation in arrival of potato across the months. Highest monthly mean arrivals were observed during February (225770 quintals) and lowest monthly mean arrivals were noted during August (269.67 quintals) over the span of seven years. Likewise, prices also show variations from month to month. The Highest mean monthly prices were noticed during November (Rs.26435 per quintal) and lowest mean monthly prices were noticed during February (Rs.11260.240 per quintal). Similar pattern was observed by Singh *et al.* [10] in Agra Market (India) who concluded that there were highest monthly mean prices in November and it was noticed lowest level during February. Moreover, highest considerable variation in arrivals relative to the mean value was observed during November (211.3 percent) and value of lowest variation in arrivals relative to the mean value was noticed during January (21.5 percent). These results are consistent with the findings of Thakur *et al.* [6], who stated that there were the highest variations in arrivals relative to the mean during the month of November and the lowest variation in arrivals relative to the mean during the months of January and February in the Delhi Market of India. As far as variations in prices were concerned, highest substantial variation in prices relative to the mean were observed in the month of February (25.89 percent) and lowest variations noticed in the month of October (12.77 percent).

Table 2. Average monthly variability in arrivals and prices of Potato in Okara Market.

Months (FY-2018 to 2024)	Arrivals		Prices	
	Mean (Quintals)	C.V %	Mean (Rs.)	C.V %
Jan	154816.5	21.5	13925.45	14.42
Feb	225770	24	11260.24	25.89
Mar	180016.7	25.86	13521.94	18.49
Apr	94277.07	35.71	15817.4	20.26
May	25623.71	64.45	18392.74	22.29
Jun	851.43	101.7	19598.4	19.18
Jul	293.09	41.43	20058.68	17.76
Aug	269.67	29.32	20278.06	21.83
Sep	327.8	20.17	21500.83	12.86
Oct	395.9	21.64	22140.32	12.77
Nov	2471.86	211.3	26435	16.66
Dec	82198.84	47.72	24592.74	18.94

Source: Author's own calculations.

3.4. Measurement of Instability in Arrivals and Prices of Potato by using C-D-V- Index

The level of instability related to arrivals and prices in F and V Market Okara was estimated by using C-D-V-Index. Table 3 shows that there is a low instability (4.76 %) in case of arrivals of potato over the period of seven years in the Okara F and V Market. Moderate instability was observed in case of prices of potato over the seven years because of various factors which are linked with formulation of prices in the market. Such moderate instability had an unfavorable impact on farmers and consumers.

3.5. Seasonality of Market Arrivals and Prices of Potato

The monthly seasonal indices of market arrivals and market prices of potato concerning F and V Market (Okara) for the period of last seven years were shown in Table 4. These findings indicated that market arrivals of potato observed as low from the month of June to November and it is in consistent with the findings of Singh *et al.* [10]. The minimum arrival index (0.43) was noted in August. However, increase in arrival index were observed from November to May. The arrival index (maximum) was noticed during the month of February reaching value of 338.11. These results of arrivals are in agreement with the findings of Chandra *et al.* [7] and Patel *et al.* [11] who stated that pattern of market arrivals of potato was maximum during January to March in Nagpur and Deesa Markets. The price index (56.40) was lowest during February and highest price index was noticed in November and these findings were consistent with the results of Singh *et al.* [10], Chandran and Pandey [12], Dhakre and Bhattachrya [13], and Noonari *et al.* [14] with reference to their studies in Delhi (India), Agra (India) and Hyderabad (district of Pakistan) Markets.

3.6. Relationship between Arrivals and Prices of Potato in F and V Market (Okara)

The degree and direction of relationship is analyzed between market arrivals and market prices of potato in F and V Market (Okara) over the period of seven years by using Karl Pearson correlation coefficient. The monthly correlation coefficients were shown in Table 5 and mostly the value of correlation coefficient is positive because of various reasons including off season supply of potato to the market and availability of cold storages, among others. This

Table 3. Instability index of potato in F and V Market (Okara) over the period of 2018 to 2024.

Variable	C.V	Instability Index (%)	Inference
Arrival	17.18	4.76	Low Instability
Price	51.39	24.38	Moderate Instability

Source: Author's own calculations.

Table 4. Seasonal monthly indices of market arrivals and prices of Potato in Okara market.

Months	Arrival Index (%)	Price Index (%)
January	247.84	74.56
February	338.11	56.40
March	288.18	72.40
April	146.05	81.96
May	41.02	98.48
June	1.31	101.55
July	0.46	107.40
August	0.43	108.58
September	0.50	111.41
October	0.63	118.55
November	3.82	136.98
December	131.59	131.68

Source: Author's own calculations.

Table 5. Correlation coefficients between market arrivals and market prices of potato.

Month	Potato
January	-0.11
February	0.58
March	0.40
April	-0.19
May	0.21
June	0.13
July	0.23
August	0.19
September	0.18
October	-0.009
November	0.41
December	-0.40

Source: Author's own calculations.

result is in consistent with the findings of Thakur *et al.* [6]. Moreover, the study of Areef *et al.* [15] also showed parallel results in which most of the months revealed positive correlation coefficients and value of coefficient of correlation is also highest during the month of February (harvesting season) as far as their study concerned with the Bangalore Market. On the other hand, there were inverse relationship between market arrivals and prices during the month of January, April, October and December regarding the present study in F and V market Okara.

4. CONCLUSIONS

This study has examined the behaviour and economic analysis of market arrivals and market prices of potatoes in the F and V market (Okara) of Punjab province of Pakistan over the period of seven years. The findings show that there is an increase in growth rate in the prices and reduction in the growth rate in the market arrivals of potato. The variability in the market arrivals was highest in the month of November, and the variability in the case of prices was highest in the month of February. The mean monthly market arrival of potato significantly increased for January and attained highest value for the month of February (225770 quintals) and resultantly lowest mean price was noticed during the month February. Moreover, the C-D-V index indicates low instability in case of arrivals and moderate instability as far as prices were concerned. The seasonal indices indicate that arrival index was low during the period of June to November and Price index shows low value during December to May which is consistent with theoretical economic approach. Most of the months showed positive relationship between market arrivals and market prices of potato. It is suggested that all the stakeholders engaged in the supply chain of potato must collaborate timely and efficiently with each other in transparent manners so that overall welfare of all the concern stakeholders would be increased in an efficient way. The effective management of market arrivals and prices of potato would increase the welfare for farmers, consumers and for all other stakeholders which are engaged in agri-food supply chain network of potato. There is a need to study consumer demand of potato related to their preferences.

5. CONFLICT OF INTEREST

The authors declare that they have no conflict of interest

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