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RESEARCH ARTICLE

STUDY ON ARRIVALS AND PRICING SITUATION OF MAJOR VEGETABLES IN POKHARA WHOLESALE MARKET, NEPAL

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ABSTRACT

To study the price and volume variability pattern and analyze the relationship of market arrival with the prices of major vegetables, a study was conducted in Pokhara wholesale market, Nepal. The study collected seventeen year's monthly data of the wholesale market starting from 2001/02. Farmgate and retail market prices of major vegetables were collected by market surveys. The results revealed that the mean variability in the arrival of sponge gourd was higher, followed by green peas, tomato, bitter gourd, cucumber, cauliflower, and cabbage. The study reported stability in the price of green peas, bitter gourd, and cucumber compared to the prices of cabbage and tomato. The study confirmed numerous cases of positive relationships, though statistically non-significant, between market arrival and prices in terms of coefficient of correlation across months, although a negative relationship was found over the years in almost half of the cases. Computation of compound annual growth rate revealed a 7.22% growth in price and 13.95% growth in the arrival volume of selected vegetables over the years. Regression analysis confirmed that the volume of cauliflower was affected by the price and quantity of its close substitutes. A comparison between the farmgate, wholesale, and retail prices reveals that the mean price spread of fresh vegetables was 57.33%. The most crucial effect of these price differential was on producers since the mean producer's share was only 42.67%. The study suggested due consideration of the Government of Nepal to enhance market intelligence, stability in price, cold chamber, and cold chain development.

KEYWORDS

Arrival, Compound Growth, Market Intelligence, Price Stability, Variability.

1. INTRODUCTION

Vegetable production is an important agribusiness in Nepal and comes under national priority. The diverse topographic features and climatic conditions in Nepal allow the successful production of a large number of vegetables. According to the report of MOAD, the area, production, and yield of vegetables are in increasing trend (MOAD, 2018). Producers have moved towards commercial vegetable production as they are less risky, fast-growing, and the best source of income in comparison to other cereal crops and fruits. Off-season production technologies for tomato, cucumber, cabbage, and cauliflower have been extensively practiced by the producers for two season production. Although bitter gourd, green peas, and sponge gourd are produced once a year in the hilly region, their consumption is high all over the country. Further, the importance of vegetables in the agricultural economy of Nepal can be well appreciated in terms of their burgeoning domestic demand, providing better employment, and income opportunities to the producers given they are being labor-intensive and more remunerative nature (Mishra, 2012).

Pokhara is the second-largest populated city of Nepal with a population of 0.421 million. Located in the Kaski district of Nepal, Pokhara Wholesale Market (PWM) was established in 2001 AD and includes an area of 2.34 hectares. PWM is one of the important wholesale markets in Nepal where retailers, institutional consumers, and other bulk consumers get their supplies. Nevertheless, the fluctuations in market arrival and prices of vegetables in Pokhara wholesale market has been an important concern in recent years. During the main productive season, vegetable arrival is comparatively high, which reflects negatively on the price of produce. Besides this, the decision of arrival and price are not rational due to the lack of market intelligence. The cheaper imports have also started affecting the market, leading to a price crash. Moreover, Inadequate market infrastructure, lack of cold chain, and too many intermediaries between the producers and consumers lead to high marketing costs, resulting in high price spread and lower share of the producer in the consumer's rupee.

Fluctuations in market arrival largely contribute to the price instability of major agricultural commodities. There is, therefore, a need to have a perfect understanding of the market arrival and price behavior over time and space. The efficient marketing system plays an important role in

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economic development as it stimulates production, avoids unnecessary fluctuation in output and prices, reduces the unfair share of consumer's prices, and contributes to price stability (Khalon and George, 1985). The availability of market intelligence on aspects like the potential markets, the quantum of market arrival, and prevailing and expected prices in different regional, national and international markets during different months of the year shall go a long way in mitigating many of these problems (Kumar et al., 2005). To device appropriate ways and means for reducing price fluctuations of agricultural commodities, various studies were carried out on the global and national levels by focusing on the effective marketing of individual vegetables in single or few stages of the supply chain. Whereas limited study is conducted in concentrating Pokhara wholesale market.

In light of these issues, the present study was undertaken to examine the situation of arrivals and pricing situation of major vegetables (bitter gourd, cauliflower, cabbage, cucumber, green peas, sponge gourd, and tomato) in Pokhara wholesale market. More specifically, the study had four objectives: i) to determine the variability of market arrival and price of major vegetables, ii) to investigate the relationship between market arrival and the price behavior of major vegetables, iii) to determine the market arrival and price growth rate of major vegetables, and iv) to analyze price spread and producers' share in consumer's rupees.

2. Material and Methods

2.1 Selection of study area and commodity

The research was carried out in the Kaski district of Nepal during 2017/18 AD. The study site is located in the geographical latitude of 28.2096° N and longitude of 83.9856° E. Pokhara wholesale market, vegetable retailers, and vegetable producers of Pokhara were selected for the present study. Pokhara wholesale market was selected due to the continuous availability of time series data (e-copy) for the research period. There are 150 stalls in PWM of which 86 stalls are allocated for wholesale vegetable markets. Bitter gourd, cabbage, cauliflower, cucumber, green peas, sponge gourd, and tomato were selected for their importance in the present situation.

2.2 Data types and period of data

Secondary data on market arrival and wholesale prices of different vegetable crops were collected from Pokhara Wholesale Market, Nepal. The time-series data pertained to the period from 2001/02 to 2017/18. Primary data from the producers and retailers were collected for the year 2017/18 by survey method. Simple random sampling was used to select a total of 60 retailers and 60 farmers of Pokhara for the study purpose.

2.3 Statistical analysis of data

MS Excel 2013 was used for the descriptive analysis of the pattern of market arrival and price behavior, growth rate, share, and price spread while SPSS 23 was used to analyze the relationship between market arrival and price as well for cross-price elasticity. The computation of these statistical methods is given below.

2.3.1 Pattern of market arrival and their price behavior

The pattern of market arrival and the price behavior of the selected vegetable crops over the period 2001/02-2017/18 was analyzed in terms of the mean value for each month and the coefficient of variation. The coefficient of variation (CV) is a statistical measure of the dispersion of data points in a data series around the mean. The coefficient of variation depicts the ratio of the standard deviation to the mean, and it is a valuable statistic for comparing the degree of variation from one data series to another.

$$\text{Coefficient of Variation (CV)} = \frac{Standard\ Deviation}{Mean} * 100\%$$

2.3.2 Relationship between market arrival and prices of major vegetables

The Karl Pearson correlation coefficient was computed to determine the degree of relationship between market arrival and prices of major vegetables. Karl Pearson's coefficient of correlation is a broadly used mathematical approach wherein the numerical expression is used to calculate the degree and direction of the relationship between linear related variables. If the relationship between two variables x (market arrival) and y (vegetable prices) is to be ascertained, then the following formula is used:

$$\text{Karl Pearson correlation coefficient } (r) = \frac{\sum(x-\overline{x})(y-\overline{y})}{\sqrt{\sum(x-\overline{x})^2}\sqrt{\sum(y-\overline{y})^2}}$$

Where, $\overline{x}$ = mean of x variable, $\overline{y}$ = mean of y variable.
The value of the coefficient of correlation (r) always lies between ±1. Such as; r=+1, perfect positive correlation, r=-1, perfect negative correlation and r= 0, no correlation.

2.3.3 Growth rate

Compound annual growth rates (CAGR) were worked out to examine the trends in market arrival and prices of major vegetables over the years. The CAGR between given years X and Z, where Z-X = N, is the number of years between the two given years, is calculated as follows:

$$CAGR, \text{year X to year Z} = \left(\frac{\text{value in year Z}}{\text{value in year X}}\right)^{\left(\frac{1}{N}\right)} - 1$$

2.3.4. Cross-price elasticity

Economic relationships are more complicated than the basic bi-variate model as there is usually more than a single effect on the dependent variable. The cross-price elasticity of demand measures the responsiveness of the quantity demanded for a vegetable to a change in the price of another vegetable, ceteris paribus. The study used linear regression to analyze the cross-price elasticity. The following regression equation through the origin was used to ascertain the effect of many predictors on one dependent variable.

$$y = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \cdots + \hat{\beta}_k x_k + e$$

where, y = dependent variable or regressed variable
$\beta_1, \beta_2, \beta_3, \ldots, \beta_k$ = estimated coefficients
$x_1, x_2, x_3, \ldots, x_k$ = independent variable
e = error in the equation or residual

Multicollinearity occurs when independent variables in a regression model are highly correlated. Multicollinearity is a problem because it undermines the statistical significance of an independent variable. To detect multicollinearity problems for continuous variables, Variance Inflation Factor (VIF) for each coefficient in regression as a diagnostic statistic is used. R^2 represents the coefficient of determination. As a rule of thumb, if the VIF value of a variable exceeds 10, which will happen if R^2 exceeds 0.90, then, that variable is said to be highly collinear. Therefore, for this study, VIF was used to detect the multicollinearity problem for continuous variables.

$$Variance\ Inflation\ Factor\ (VIF) = \frac{1}{1-R^2}$$

2.3.4 Price spread and Producers' share

Price spread refers to the difference between price paid by the consumer and price received by the producer for an equivalent quantity of the farm product. This price spread consists the proportion of consumer's rupee that is shared by the market functionaries as their margin including the marketing cost and charges. It gives fair idea about relative efficiency of various marketing system and channels.

$$\text{Price Spread} = \frac{Price\ paid\ by\ consumer - price\ received\ by\ producer}{Price\ paid\ by\ consumer} * 100\%$$

Producers' share was computed to estimate the amount received by producers from consumer's rupee. It is the ratio of net price received by producer to the price paid by consumer and can be calculated as:

$$\text{Producers' share} = \frac{Net\ price\ received\ by\ farmer}{Price\ paid\ by\ consumer} * 100\%$$

3. Results and Discussion

3.1 Pattern of market arrivals and their price behavior

The arrival of selected vegetables in PWM rose from 340.61 thousand tones in 2001/02 to 14094.38 thousand tones in 2017/18, while their share in total arrival has decreased from 63.6 percent in 2001/02 to 32.99 percent in 2017/18. It will be hard to sustain the significant increase in the arrival of vegetable crops unless remunerative prices are ensured to the producers. And it is in this context that an understanding of the pattern of market arrivals and the price behavior of vegetables, both over the years and across months, assumes significant importance. The pattern of market arrivals and the price behavior of the selected vegetable crops from 2001/02 to 2017/18 was examined using the mean value and the coefficient of variation for each of the twelve months.

3.1.1 Market arrivals and price variability in bitter gourd

The market arrivals and price variability analysis in bitter gourd across the different months have been worked out in Table 1. The variability in market arrival of bitter gourd was low (83% < CV < 89.3%) during winter and spring, except February/March (CV = 118.2%); these were high in monsoon and autumn. The variability in market arrivals was lowest (CV = 77.8%) in March/April and highest (CV = 167.3%) in September/October. The variability in the price of bitter gourd was high (CV > 100%) in early summer and early monsoon, which was the main season. The price indices are low during summer and monsoon months because the main harvesting period of bitter gourd in hill regions is May/June to August/September.

Table 1: Market arrival and price variability of bitter gourd in PWM

	Variability in market arrivals of bitter gourd		Variability in price of bitter gourd	
Months	Mean (kg)	CV (%)	Mean (Rs/kg)	CV (%)
Apr/May	1348.1**	83	42.4	57.2
May/Jun	1111.3	105.9	25.4	122.7
Jun/Jul	961.1	92.5	22.9*	44.2
Jul/Aug	856.1	107	32.8	173.8**
Aug/Sep	720.5*	108.2	32.5	48.9
Sep/Oct	753.5	167.3**	44	83.4
Oct/Nov	834.7	104.4	51.1	83.9
Nov/Dec	963.7	101.8	46.8	43.2*
Dec/Jan	1288.1	89.3	57.5	80.3
Jan/Feb	1215.3	83.8	85.2	105.3
Feb/Mar	1271	118.2	98.1**	58.4
Mar/Apr	1150.4	77.8*	62.2	52.7
Note: * lowest value and ** highest value				

3.1.2 Market arrivals and price variability in cabbage

The market arrivals and price variability analysis in cabbage across the different months have been worked out in Table 2. The variability in the market arrival of cabbage was low during monsoon (CV <= 60%). The result of the present study can be correlated with Kumar et al. (2005), where the variability in market arrival of cabbage was low during monsoon in the Kolkata market. The mean market arrival was highest in August/September because of the higher supplies of cabbage during the festive period in Nepal. The price variability, measured in terms of coefficient of variation, was more pronounced (CV > 150%) during summer and winter months which happened to be the main season of production; these were low (CV > 52.6%) during the lean season of autumn. Similar results in market arrival variability of cabbage were shown by Kumar et al., (2005) in Bangalore, Kolkata, and Delhi markets. The mean market price varied from Rs 12.6 per kg in April/May to Rs 31.5 per kg in July/August. The market prices were lower than the average during the periods of winter, spring, and summer (< Rs 18 per kg) which are the main season for cabbage in mid-hills; these were above the average (> Rs 26 per kg) during the off-season months of monsoon and autumn. Mishra and Kumar support the price of cabbage in hill regions of Nepal is below average during winter, spring and summer because of being the main productive season and above-average during off-season months of monsoon and autumn (Mishra and Kumar, 2012).

Table 2: Market arrival and price variability of cabbage in PWM

	Variability in market arrivals of cabbage		*Variability in price of cabbage*	
Month	Mean (kg)	CV (%)	Mean (Rs/kg)	*CV (%)*
Apr/May	1866.1	75.7	12.6*	*109.1*
May/Jun	2134.1	104.4	17.2	*187.6*
Jun/Jul	2823.5	86.6	26.2	*179.4*
Jul/Aug	4106.8	60.0	31.5*	*151.0*
Aug/Sep	4147.6**	52.3*	27.6	*121.1*
Sep/Oct	3514.6	91.6	30.5	*118.8*
Oct/Nov	1919.9	97.6	29.3	*52.6**
Nov/Dec	1589.8*	79.7	29.1	*213.0*
Dec/Jan	2176.4	151.8**	15.8	*99.1*
Jan/Feb	2500.4	80.1	15.2	*225.5*
Feb/Mar	2638.0	77.4	15.7	*351.2***
Mar/Apr	1951.1	70.1	13.1	*99.0*
Note: * lowest value and ** highest value				

3.1.3 Market arrivals and price variability in cauliflower

The market arrivals and price variability analysis in cauliflower across the different months have been worked out in Table 3. The variability in market arrival was high (CV = 180.3%) during summer and autumn. The mean market arrival ranged from 1758.4 kg in October/November to 3348.8 kg in July/August. The variability in the price of cauliflower was high (CV > 165%) during spring. The main harvesting period of cauliflower in hill regions is November/December to March/April. Consequently, the price indices are low during these months. The mean market price was highest during early autumn and lowest during late winter. Mishra and Kumar have shown that the highest price in the mid-hills of Nepal prevailed during autumn, and the lowest price prevailed during winter months (Mishra and Kumar, 2012).

Table 3: Market arrival and price variability of cauliflower in PWM

	Variability in market arrivals of cauliflower		Variability in price of cauliflower	
Month	Mean (kg)	CV (%)	Mean (Rs/kg)	*CV (%)*
Apr/May	2221.0	93.2	44.3	*169.4*
May/Jun	2115.8	102.1	40.2	*43.2*
Jun/Jul	2308.9	101.2	42.5	*34.0*
Jul/Aug	3348.8**	79.2	50.8	*68.5*
Aug/Sep	3140.6	72.0	55.7	*61.0*
Sep/Oct	2586.4	180.3**	57.9**	*26.7**
Oct/Nov	1758.4*	101.5	46.2	*46.0*
Nov/Dec	2073.0	65.8*	30.3	*90.6*
Dec/Jan	2424.7	72.2	25.9	*142.9*
Jan/Feb	2805.7	77.4	18.2*	*50.9*
Feb/Mar	3039.9	83.9	19.8	*260.5***
Mar/Apr	2374.4	65.8*	24.4	*181.6*
Note: * lowest value and ** highest value				

3.1.4 Market arrivals and price variability in cucumber

The market arrivals and price variability analysis in cucumber across the different months have been worked out in Table 4. The market arrival of cucumber revealed high variability (CV >90%) during the autumn and winter season and the variability in market arrival was low in the remaining months. The mean arrival ranged from 936.2 kg in November/December to 1666 kg in April/May. The magnitude of variability in the market arrivals with values of coefficient of correlation varies from 72.9% in August/September to 187.8% in February/March. The variability in the price of cucumber was highest in January/February and lowest in December/January. The main harvesting period of cucumber in hill regions is April/May to August/September. Consequently, the price indices are low (below 30 Rs/kg) during these months. The high price (above 30 Rs/Kg) of cucumber during winter months is due to the off-season production.

Table 4: Market arrival and price variability of cucumber in PWM

	Variability in market arrivals of cucumber		*Variability in price of cucumber*	
Month	Mean (kg)	CV (%)	Mean (Rs/kg)	*CV (%)*
Apr/May	1666.0**	80.7	27.8	*61.3*
May/Jun	1558.1	81.1	24.7*	*64.3*
Jun/Jul	1585.6	80.2	24.8	*132.8*
Jul/Aug	1654.2	73.6	25.7	*47.9*
Aug/Sep	1499.9	72.9*	27.8	*49.5*
Sep/Oct	1607.8	125.8	30.1	*117.1*
Oct/Nov	1099.8	91.0	35.2	*112.2*
Nov/Dec	936.2*	98.8	37.4	*124.6*
Dec/Jan	1006.6	112.9	32.3	*31.5**
Jan/Feb	1229.8	103.8	45.4**	*138.1***
Feb/Mar	1291.3	187.8**	41.1	*37.8*
Mar/Apr	1246.2	87.7	32.0	*45.4*

Note: * lowest value and ** highest value

3.1.5 Market arrivals and price variability in green peas

The market arrivals and price variability analysis in green peas across the different months have been worked out in Table 5. The market arrival of green peas revealed high variability (CV >141%) during autumn and pre-winter season, except October/November (CV = 108.7%). The mean arrival of green peas was highest (1401.1 kg) in April/May; these were lowest (897.4 kg) in October/November, the off-season month. The study depicted low variability (CV < 96.6%) in the arrivals of peas during the summer and monsoon months. Regarding price variability of green peas, it remained high during winter and spring season expect in March/April. The remaining season showed low variability in price. The mean price of green peas was volatile throughout the year.

Table 5: Market arrival and price variability of green peas in PWM

	Variability in market arrivals of green peas		*Variability in price of green peas*	
Month	Mean (kg)	CV (%)	Mean (Rs/kg)	*CV (%)*
Apr/May	1401.1**	104.6	59.3	*97.9*
May/Jun	1201.9	105.3	58.3	*103.4*
Jun/Jul	1294.8	94.4*	42.7	*33.4**
Jul/Aug	1123.1	96.5	36.3	*37.9*
Aug/Sep	994.8	99.8	89.9**	*62.4*
Sep/Oct	1039.4	141.8	89.2	*51.0*
Oct/Nov	897.4*	108.7	77.0	*57.7*
Nov/Dec	903.2	165.6**	72.4	*116.9*
Dec/Jan	1002.0	146.4	46.6	*87.1*
Jan/Feb	1162.1	99.4	37.8	*140.9***
Feb/Mar	1292.1	109.8	33.6*	*111.6*
Mar/Apr	1171.4	99.0	40.6	*41.3*

Note: * lowest value and ** highest value

3.1.6 Market arrivals and price variability in sponge gourd

The market arrivals and price variability analysis in sponge gourd across the different months have been worked out in Table 6. The variability in the market arrival of sponge gourd was high (CV > 162%) during the autumn; these were low (CV < 42%) during winter. The mean arrival of sponge gourd ranged from 483.1 kg in November/December to 1000.9 kg in February/March. The variability in the price of sponge gourd was high (CV > 155%) during summer, monsoon, and autumn, except July/August (CV = 52.0%). The price indices are low during these summer and monsoon months because the main harvesting period of sponge gourd in hill regions is May/June to August/September.

Table 6: Market arrival and price variability of sponge gourd in PWM

	Variability in market arrivals of sponge gourd		Variability in price of sponge gourd	
Month	Mean (kg)	CV (%)	Mean (Rs/kg)	*CV (%)*
Apr/May	794.6	143.7	48.4	*86.6*
May/Jun	743.7	109.6	36.6	*172.3*
Jun/Jul	846.5	108.7	29.5	*155.2*
Jul/Aug	814.5	111.2	27.8	*52.0*
Aug/Sep	736.8	189.1**	25.4*	*185.8***
Sep/Oct	522.6	162.6	34.8	*157.7*
Oct/Nov	616.9	117.9	41.5	*51.1*
Nov/Dec	483.1*	124.2	40.7	*51.5*
Dec/Jan	709.5	113.2	43.1	*29.7**
Jan/Feb	963.3	40.4*	38.6	*80.5*
Feb/Mar	1000.9**	88.6	77.2**	*76.2*
Mar/Apr	664.9	101.2	55.2	*64.0*

Note: * lowest value and ** highest value

3.1.7 Market arrivals and price variability in tomato

The market arrivals and price variability analysis in tomato across the different months have been worked out in Table 7. The variability in market arrival of tomato was highest (CV = 127.0%) in March/April and the lowest (CV = 86.1%) in April/May. The difference of magnitude of variability across different seasons was found lower than other crops because of its all-round production throughout the year. The price variability in tomato was high (CV > 154%) during the winter and spring season. The result of the present study can be correlated with Kumar et al. (2005), where the price variability in tomato was high during the winter period in the Delhi, Bangalore, and Mumbai markets. The magnitude of price variability in tomato ranged from 48.5% in June/July to 220.1% in February/March. The mean market price started increasing in summer and peaked to 40.5 Rs/kg in autumn (October/November); these start decreasing from pre-winter as the tomato from plain starts coming in the market and reaches the lowest price in winter (January/February= 22.7 Rs/kg).

Table 7: Market arrival and price variability of tomato in PWM

	Variability in market arrivals of tomato		Variability in price of tomato	
Month	Mean (kg)	CV (%)	Mean (Rs/kg)	*CV (%)*
Apr/May	5892.1	86.1*	30.3	*173.0*
May/Jun	6371.9	88.9	28.2	*119.4*
Jun/Jul	4461.3	121.4	29.8	*48.5**
Jul/Aug	3916.2	116.9	39.3	*111.0*
Aug/Sep	3858.4	105.6	39.3	*106.3*
Sep/Oct	3698.4*	116.5	38.4	*94.6*
Oct/Nov	4125.9	118.8	40.5**	*133.5*
Nov/Dec	4431.2	122.1	33.0	*108.8*
Dec/Jan	5957.7	108.3	25.3	*103.0*
Jan/Feb	6714.3**	124.6	22.7*	*154.1*
Feb/Mar	6073.0	113.0	24.8	*220.1***
Mar/Apr	5282.4	127.0**	31.3	*166.8*

Note: * lowest value and ** highest value

3.2 Relationship in market arrivals and prices

Market arrivals and prices follow an inverse relationship in a typical market equilibrium. Nonetheless, factors such as the availability of cold storage facilities, enhanced possibilities for export, integration between the hill and plain markets, value-addition through agro-processing, availability of new poly house technologies, etc. not only undermine this negative relationship but may even turn it positive. The degree of relationship between market arrivals and prices of selected vegetable crops was studied for different years from 2001/02 to 20017/18 by computing correlation coefficients. The relationship was also studied for different months over different years. This was required because of the seasonality in vegetable production. The negative relationship may be more pronounced during the peak season and it may be positive for other months. Furthermore, given the scope for varying the cropping pattern, the relationship between market arrivals and prices in different months may be more useful because it encourages farmers to adjust their cropping pattern and market at a time when prices are reasonably high. The results of correlation analysis, given in Table 8, Table 9, reveal that the negative relationship between market arrivals and prices was not universally true for all the crops and all years.

With bitter gourd, cabbage, cauliflower, cucumber, sponge gourd, and tomato, the year-wise correlation coefficient between arrival and prices were positive in most of the years, albeit non-significant in most of the cases. The correlation coefficients between market arrival and prices of green peas were negative for majority years (eleven out of seventeen), in other crops, these were negative for about half of the years (seven-eight out of seventeen). The correlation coefficient between market arrival and prices was significant and negative in 2017/18 for bitter gourd and 2003/04 for cauliflower indicating the increase in arrival leads to decline in price and vice versa. The month-wise correlation coefficients between arrivals and prices for major vegetables were positive, though statistically non-significant, for most of the months. A positive and significant correlation coefficient in November/December for bitter gourd, May/June and June/July for cauliflower, and February/March and March/April for sponge gourd, may be attributed to the fact that the Pokhara Wholesale market receives off-season supplies of these vegetables from India as well as Terai region of Nepal. The positive and significant relationship between market arrival and prices indicates that the increase in arrival leads to increase in price and vice versa.

The relationship between arrival and price of tomato and cabbage were statistically non-significant for all months, showing the arrivals of tomato and cabbage did not affect their prices. The correlation coefficient between market arrival and prices, whether positive or negative, was statistically non-significant practically for most of the years and months in the Pokhara wholesale market.

Table 8: Yearly correlation coefficients of market arrivals and wholesale prices in PWM

Fiscal Year	Bitter Gourd	Cabbage	Cauliflower	Cucumber	Green Peas	Sponge Gourd	Tomato
2001/02	0.244	-0.035	-0.116	0.124	-0.095	-0.031	-0.016
2002/03	0.323	0.147	0.026	0.083	-0.007	0.162	-0.078
2003/04	0.022	-0.042	-0.506*	-0.120	0.014	0.178	-0.140
2004/05	0.251	0.093	0.008	0.275	-0.005	-0.047	0.029
2005/06	0.059	-0.029	0.031	-0.042	-0.013	0.282	0.096
2006/07	0.114	0.058	0.075	-0.268	-0.015	0.246	-0.012
2007/08	-0.144	0.067	-0.199	-0.050	0.059	-0.179	0.000
2008/09	0.121	0.652*	0.388	0.032	-0.216	0.006	-0.068
2009/10	-0.028	-0.287	-0.021	0.04	-0.147	-0.077	-0.203
2010/11	0.005	0.063	0.010	0.018	0.204	-0.122	0.011
2011/12	-0.074	-0.055	-0.013	0.014	-0.060	0.081	0.006
2012/13	0.244	-0.210	-0.069	-0.167	-0.358	0.137	0.016
2013/14	-0.208	0.127	0.039	0.155	0.105	0.381	0.066
2014/15	-0.049	0.271	-0.166	0.143	0.024	-0.263	-0.099
2015/16	0.041	-0.019	0.273	-0.088	0.035	0.353	0.013
2016/17	-0.086	-0.055	0.119	-0.269	-0.105	0.286	0.037
2017/18	-0.524*	0.146	-0.174	-0.123	-0.020	-0.087	-0.051

Note: * and ** denote significance at 0.01 and 0.05 levels of probability, respectively

Table 9: Monthly correlation coefficients of market arrivals and wholesale prices in PWM

Months	Bitter Gourd	Cabbage	Cauliflower	Cucumber	Green Peas	Sponge Gourd	Tomato
Apr/May	0.227	0.287	0.165	0.113	-0.006	0.281	0.125
May/Jun	0.097	0.081	0.514*	0.078	-0.007	0.102	0.050
Jun/Jul	0.057	0.270	0.620*	0.190	0.026	0.147	0.214
Jul/Aug	0.147	0.207	0.176	0.347	0.177	0.147	0.157
Aug/Sep	0.341	0.270	0.031	0.403	0.017	0.015	0.110
Sep/Oct	0.159	0.122	0.105	0.034	-0.125	0.080	0.099
Oct/Nov	-0.012	0.074	-0.008	-0.037	0.091	0.070	0.152
Nov/Dec	0.582*	0.017	0.160	0.071	0.017	0.247	0.083
Dec/Jan	0.366	0.134	0.304	0.288	0.016	0.253	0.011
Jan/Feb	0.373	0.026	0.290	0.155	0.073	-0.981**	-0.021
Feb/Mar	0.460	0.149	0.069	0.075	0.035	0.923**	0.072
Mar/Apr	-0.081	0.165	0.160	0.086	-0.041	0.761**	0.034

Note: * and ** denote significance at 0.01 and 0.05 levels of probability, respectively

3.3 Compound Annual Growth Rate

The analysis of arrival and prices of major vegetables over seventeen years shows an increasing trend in Pokhara wholesale market. A positive mean compound annual growth rate (CAGR) of 13.95%, shown in table 10, reveals that the arrival of selected vegetables in PWM has increased from 2001/02 to 2017/18. The study showed the highest increment of arrival volume in green peas and the lowest increment of arrival volume in tomato. The price of vegetables in the Pokhara wholesale market, from 2001/02 to 2017/18, has increased over the years as the calculated mean compound annual growth rate is positive (6.70%). The study of vegetable price 2001/02 to 2017/18 found the highest price growth rate in cabbage and the lowest price growth rate in sponge gourd.

Over the years, a positive growth rate in price and arrival volume of selected vegetables was seen in Pokhara wholesale market. Health awareness, bourgeoning population, market inflation, and off-season production of vegetables are some causes of increased growth rate in price and arrival volume of vegetables. Vegetables are great sources of energy, protein, vitamins, and minerals. They are considered as protective food since they contain a greater amount of vitamins and minerals. However, in Nepal, cereals provide a major volume of the daily diet which provides a higher amount of energy. Due to the nutritive value of vegetables and the health consciousness of the consumer, the consumption of vegetables in Nepal has risen. The swelling middle class, expanding population, and stagnant local agricultural production are driving up the market arrival and prices of vegetables in PWM.

Table 10: CAGR of selected vegetables in PWM

Vegetable	CAGR of arrival volume (%)	*CAGR of price (%)*
Bitter Gourd	13.05	*7.69*
Cabbage	14.59	*8.69***
Cauliflower	12.11	*7.85*
Cucumber	15.95	*5.97*
Green Peas	19.06**	*8.6*
Sponge Gourd	16.12	*4.12**
Tomato	6.78*	*7.64*
Mean	13.95	*7.22*

Note: * lowest value and ** highest value

3.4 Cross-Price Elasticity

A key goal of regression analysis is to isolate the relationship between each independent variable and the dependent variable. The interpretation of a regression coefficient is that it represents the mean change in the dependent variable for each unit change in an independent variable when you hold all the other independent variable constant.

a. Dependent variable: Quantity of cauliflower

b. Predictors: Price of cauliflower, Quantity of cabbage, Price of bitter gourd, Price of green peas, Price of sponge gourd, and Price of tomato
Table 11 depicts the following regression model for the quantity of cauliflower arrival.

$$y = 15.804x_1 + 0.305x_2 + 10.523x_3 + 10.528x_4 + 10.257x_5 + 7.241x_6 + e$$

Where,

y = Monthly supply quantity of cauliflower between 2001/02 to 2017/18
x_1 = Price of cauliflower (in Rs/Kg)
x_2 = Quantity of cabbage (in Kg)
x_3 = Price of bitter gourd (in Rs/Kg)
x_4 = Price of green peas (in Rs/Kg)
x_5 = Price of sponge gourd (in Rs/Kg)
x_6 = Price of tomato (in Rs/Kg)

The quantity of cauliflower depended on the above predictors. An increase in the price of cauliflower by Rs 1 could increase the quantity of cauliflower supply by 15.804 kg, ceteris paribus. While keeping other predictors constant, the quantity of cauliflower could increase by 0.305 kg when the quantity of cabbage increases by 1 kg. An increase in the bitter gourd's price by Rs 1 could increase the quantity of cauliflower by 10.523 kg, ceteris paribus. Quantity of cauliflower could increase by 10.528 kg when the price of green peas increases by Rs 1, ceteris paribus. Similarly, remaining other variables constant, the quantity of cauliflower could change in the same direction by 10.257 kg when the price of sponge gourd changes by Rs 1. Quantity of cauliflower could increase by 7.241 kg when the price of tomato increases by Rs 1, ceteris paribus.

The adjusted R square value was 0.574. It means that the predictors explain 57.4% of the regressand variability. A large f-value (336.226) showed that the model was highly significant at a 1% level. This implies the predictors were highly compatible to explain independent variables.

Cross price elasticity indicates the relationship between two commodities, i.e., whether the commodities are compliment or substitutes. A negative cross-price elasticity shows that the two products so considered are compliments and positive cross elasticity shows that the two products are

substitutes (Anwarul Huq and Arshad, 2010). The positive cross-price elasticity observed between the vegetables considered in the model indicates that they are substitutes. Cauliflower can be substituted by the bitter gourd, cabbage, green peas, and sponge gourd in terms of use. The construct of cross-price elasticity is important from a policy perspective in that relative shifts in prices through taxation or subsidies can affect demand for other commodities not regulated by policies (Andreyeva et al., 2010).

Table 11: Regression analysis on effect of price and quantity of major vegetables

Coefficients a, b						
	Unstandardized Coefficients		t	Sig.	Collinearity Statistics	
	B	Std. Error			Tolerance	VIF
Price of Cauliflower	15.804	2.154	7.337	0	0.547	1.829
Quantity of cabbage	0.305	0.023	12.998	0	0.518	1.932
Price of Bitter Gourd	10.523	1.83	5.751	0	0.496	2.015
Price of Green Peas	10.528	1.659	6.344	0	0.536	1.866
Price of Sponge Gourd	10.257	2.019	5.08	0	0.637	1.57
Price of Tomato	7.241	1.401	5.17	0	0.69	1.45
a Dependent variable: Quantity of cauliflower						
b Linear regression through the origin						
Adjusted R^2 = 0.574						
f-value = 336.226; sig = 0.000						

3.5 Price spread and Producers' share

Marketing efficiency is a measure of market performance. The movement of vegetables from producers to the consumers at the lowest possible cost consistent with the provision of service desired by the consumers is termed as an efficient marketing. The main parameter for judging the marketing efficiency is price spread. The study, Table 12, revealed a mean price spread of 57.33% in PWM. The price spread was highest in tomato (63.52%) and lowest in green peas (36.89%). A large price spread of tomato is due to the huge margins kept by the retailers and market functionaries because tomato should be sold in fresh form and requires better transportation compared to other vegetables. A high price spread for vegetables is because of serious marketing costs and margins held by intermediaries. Inadequate market infrastructure and too many intermediaries between the producers and consumers lead to high marketing costs, resulting in high price spread.

The producers' share in consumer's rupee was highest (63.11%) in green peas followed by cabbage (42.82%) and cauliflower (41.65%); it was lowest (36.48%) in tomato. In Cauliflower and cabbage, Ravekar et al. (2015) have shown that farmers paid the high marketing cost to various market functionaries as their marketing cost, commission, and weighing charges due to which producers' net price is highly affected. The producers' share in consumer's rupee of bitter gourd was 36.85% in PWM. A group researchers have recently shown that the low prices offered by market intermediaries, high transport cost, and multiplicity of market charges have contributed to low producers' share in consumer's rupee of bitter gourd (Kshirsagar et al., 2016). The study revealed that the mean producers' share in consumer's rupee was only 42.16%. Many intermediaries are involved in the movement of the horticultural produce from producer to consumer, who appropriate a large proportion of the consumer's price and the share of producer becomes very low. With perishable commodities, the storage of which is difficult, the share of the producer and the market efficiency is low.

Table 12: Price spread and producers' share of selected vegetables in PWM

Vegetable	Price Spread	*Producers' share*
Bitter Gourd	63.15%**	*36.85%**
Cabbage	57.18%	*42.82%*
Cauliflower	58.35%	*41.65%*
Cucumber	61.37%	*38.63%*
Green Peas	36.89%*	*63.11%***
Sponge Gourd	60.85%	*39.15%*
Tomato	63.52%	*36.48%*
Mean	57.33%	*42.67%*
Note: * lowest value and ** highest value		

4. Conclusion and Recommendations

The results found from this research showed high inconstancies in the market arrival and prices of major vegetables. However, the extent of variability in the market arrivals of tomato across different months was lower than other vegetables because of its all-round production throughout the year. The study shows that although there was a steady increase in market arrival and prices over time, their fluctuation from year to year was very high. The study revealed a negative relationship between market arrivals and prices over the years in almost half of the cases. The month-wise correlation coefficients between arrivals and prices for major vegetables were positive, though statistically non-significant, for most of the months. The positive and significant correlation coefficients in a few months could be attributed to the off-season supplies of these vegetables which fetch higher prices.

The study of monthly data from 2001/02 to 2017/18 showed an increasing trend in market arrival and the price behavior of major vegetables over the years which indicated that irrespective of the increase in supply the price also increased, due to a faster rate of growth in demand than supply.

Regression analysis confirmed the volume of cauliflower was affected by the price and quantity of its close substitutable vegetables. This clearly shows that many vegetables have the same harvesting season due to which the substitutability or complementarily of one vegetable affects the price of the other. A comparison between the farm gate, wholesale, and retail prices revealed the mean price spread of fresh vegetables was 57.33%. The most crucial effect of these price differential was on producers since the mean producer's share was only 42.67%.

This study would be useful to the policymakers to know the status of arrivals and the pricing situation of major vegetables in Pokhara. Based on the findings of the study, to address high price variability and effect of price on quantity arrival at Pokhara wholesale market, the researcher suggests provincial government-4, Nepal especially for the Ministry of Agriculture for due consideration in enhancing market intelligence, stability in price, cold chamber and cold chain development. The researcher recommends the establishment of an effective marketing channel to reduce price spread and increase producers' share. In recent years vegetables are produced in larger areas and by modern methods, but the demand is not encountered because of an inefficient linkage between the producer and consumer. The provincial government-4 is suggested to emphasize agriculture-oriented research and education. The study suggests further research on market efficiency of Pokhara wholesale market. Until recently, all efforts have been geared towards producing more without thinking about how to market them. There is a need to know about new technologies in food storage and preservation. There is also a need for research on consumer demands and preferences, handling, and packaging.

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