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Market Dynamics and Seasonal Pricing of Major Vegetables in Kathmandu Valley

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Abstract— *The off-season vegetables are regarded as important agricultural commodities in Nepal, offering significant commercial potential. These vegetables have been identified as valuable value chains that can improve the livelihoods of small-scale farmers through advancements in production and marketing techniques. This study examines the price flexibility and seasonality patterns of major vegetables in Kathmandu Valley, Nepal, with the aim of providing policy recommendations to address the inelastic demand and reduce import dependency. The analysis reveals mixed elasticity in the demand for tomatoes, with inelasticity from November to March and higher elasticity from April to June. Potatoes exhibit predominantly inelastic demand, while onions demonstrate mixed elasticity with inelasticity from July to October and elasticity from November to April. Additionally, cauliflower and cucumber show high inelasticity during the harvesting season and comparatively elastic demand during off-seasons and pre-harvesting periods. The study also identifies high seasonality in the prices of cauliflower and cucumber, moderate seasonality in onions, and low seasonality in potatoes and tomatoes. Considering the high import share of vegetables in Kathmandu Valley, recommendations are provided to reduce import dependency and promote domestic production. These include supporting local farmers through incentives, access to quality inputs, and agricultural training programs. Improving post-harvest infrastructure, such as storage facilities and transportation networks, is crucial to minimize spoilage and optimize the supply chain. Enhancing market efficiency through streamlined supply chains and transparent pricing mechanisms can benefit both farmers and consumers. Promoting value addition in vegetables, investing in research and development for improved varieties, and fostering collaboration and networking among stakeholders are suggested to enhance productivity, competitiveness, and market expansion. While these recommendations focus on increasing domestic production and market efficiency, further analysis of import dynamics and trade policies is necessary to effectively reduce imports and ensure a balanced market supply.*

Keywords— ***Major Vegetables, Price Flexibility, Seasonal Variations, Kathmandu Valley, Econometric Analysis***

I. INTRODUCTION

Agriculture has historically played a crucial role in the economic landscape of Nepal, contributing approximately 26.50 percent to the country's Gross Domestic Product (GDP) [3]. Specifically, within the agricultural sector, horticulture accounts for 16.75% of the GDP, with vegetables contributing 9.71% and fruits and spices contributing 7.04% [8]. The agricultural practices in Nepal heavily rely on rainfall, with around 67% of cultivation depending on precipitation [10].

Nepal, renowned for its diverse climate and ecological variations, possesses a distinct advantage in cultivating both seasonal and off-seasonal vegetables. As a result, vegetables have become the third most prioritized sub-sector within the agricultural industry, as stated by the Agriculture Development Strategy (ADS). Off-season vegetables such

as cabbage, cauliflower, cucumber, tomato, onion, and chili, which are considered commercially significant agricultural commodities in Nepal, have been recognized as highly potential value chains. These value chains have the capacity to enhance the incomes of smallholder farmers by improving production and marketing practices. Consequently, the vegetable sub-sector offers substantial opportunities for commercialization. Compared to cereal crops, vegetables have higher rates of commercialization and a favorable cost-benefit ratio. This sector plays a crucial role in shaping the economic conditions for farmers as it allows for cash generation even from small plots of land within a short time frame. Vegetable cultivation is particularly beneficial for farmers as it supports their livelihoods through food provision, income generation, and employment opportunities. Due to their status as preferred cash crops, vegetables hold significant value in enhancing farmers' overall well-being [4].

Vegetables play an essential role in maintaining a balanced diet as they contribute a significant portion of essential vitamins, proteins, and micronutrients [9]. Although there has been an increase in vegetable consumption among the Nepalese population in recent years, rice remains the primary staple food in their daily diets [1]. According to nutritionists and dieticians, the average per capita daily requirement of vegetables in Nepal is estimated to be 300 grams [12]. However, the actual intake falls significantly below this standard recommendation, with a deficit of 60 percent compared to the quantity of vegetables produced [5].

Owing to factors such as population growth, economic transformations, increased purchasing power from income growth and remittances, the demand for vegetables in Nepal is experiencing rapid surge. However, the current level of production fails to meet this escalating demand [4]. Despite the considerable potential for vegetable production in the country, numerous challenges hinder the growth of vegetable farms. These challenges include the untimely availability of quality inputs, inadequate post-harvest facilities, and the diversion of agricultural loans towards non-productive sectors, resulting in slower progress in increasing vegetable yields [11].

In the agricultural sector, the price of a crop is not primarily determined by its demand, but rather by the elasticity of its supply. The demand for crops tends to remain inelastic, while the supply exhibits high elasticity. As a result, fluctuations in the supply of a crop contribute to variability in its price. The analysis of price flexibility indicates a positive relationship between price and production for gram and mung, which may be attributed to the fact that these crops are major pulses in their respective seasons and experience high demand [2]. Thus, Price flexibility of demand is an important concept in economics as it helps businesses and policymakers understand the dynamics of consumer behavior and market responses to price changes and the seasonality study aid further in seasonal analysis of demand patterns [7].

OBJECTIVES

a) To estimate the price flexibility of major vegetables in Kathmandu Valley.
b) To determine the simple average approach seasonality patterns of major vegetables.
c) To suggest some policy measures based on the results of the study.

II. METHODOLOGY

The true purpose of this study was to assess the existing price elasticity (also, price flexibility) and seasonal alterations in the prices of major vegetables in the selected study area. In order to meet those objectives, planned strategies were implemented to study the site, identify the major vegetables in terms of trade volumes, and type and number of respondents to acquire meaningful data. Consequently, various tools, and techniques in selection of sample, data collection, and analysis and interpretation of data were adopted to attain the targeted goal.

SELECTION OF STUDY AREA

The Kathmandu Valley (KV), comprising of three districts namely, Kathmandu (the capital city of Nepal), Lalitpur and Bhaktapur is the major commercial hub of the nation since time immemorial. The KV, with a total size of 569.80 sq. kms., continued to be significant both politically and economically for hundreds of years. As a matter of fact, the first structured vegetable wholesale market, Kalimati Fruits and Vegetable Market, of the nation was introduced in Kathmandu and continues to be fully operational till date. Moreover, the KV houses the second predominant market, the Balkhu Vegetable Market at its center. Surya Binayak Green Agriculture Wholesale Market, covering 4.4 acres (35 ropani) of land has recently been opened and is the country's largest vegetable market till date. Several other markets namely, Bouddha Modern Vegetable Pvt. Ltd., Icchumati Vegetable Market, Chabahil Vegetable and Fruits Agriculture Market, Gwarko Vegetable and Fruits Market, Sangrila Agro Market, etc. are also situated in the KV, which makes it favorable spot for unbiased data acquisition.

RESEARCH DESIGN, SAMPLING & DATA COLLECTION

The research design for this study was cross-sectional, which allowed for the collection of data from multiple sources at a single point in time. Since the production and

marketing of vegetables were a significant economic sector, a large number of people worked in this industry. In the KV, farmers, collectors, wholesalers, and merchants were the primary players in the production and marketing of vegetables. There was a predetermined number of respondents from each link who were chosen to be representative of the entire population. The sample was made up of the chosen respondents, and the sampling technique was the process used to choose the sample. The sampling frame was made up of the commercial vegetable growers involved in vegetable production and collection, wholesalers, and retailers involved in marketing in the KV. To choose the samples from among these, a random stratified sampling procedure was used. To gather the data, a survey of at least 50 commercial growers in the KV and a few nearby areas was conducted. Similarly, to investigate the flow of vegetables in the market, interviews were also conducted with the associated collectors, wholesalers, and retailers, each of whom had a sample population of 5–10 respondents.

The primary data essential for this study was gathered by adopting various research instruments like, pre-pilot field visit, questionnaire survey, Focus Group Discussion (FGD), Key Informants' Interview (KII), Rapid Market Analysis (RMA), and case studies. The study involved administering a questionnaire survey to farmers, wholesalers, collectors, and retailers in the targeted group to gather information on production, marketing structure, and prices in the region. FGDs were conducted with farmers and wholesale suppliers to gather prices and margins of major vegetables. In order to gain insights into the current scenario of vegetable cultivation, yield statistics, farming participation, marketing structure, and economics, KIIs were conducted with progressive farmers, representatives of farmer and women groups, as well as local leaders and market representatives. RMA was performed to assess the market potential of vegetables by surveying local vegetable grocers on quantity, pricing mechanisms, price stability, and demand and supply. Additionally, case studies of successful vegetable farmers in the area were conducted to identify pricing strategies specific to the study area.

In order to supplement the primary data, various published and unpublished secondary sources of data, articles, reports, and proceedings published by various institutions and organizations like Nepal Agriculture Research Council (NARC), Central bureau of statistics (CBS), Agro-Enterprise Center (AEC), District Agriculture Development Office (DADO), Ministry of Agriculture and Livestock Development (MoALD), etc. were consulted. The collected data has been analyzed using appropriate qualitative and quantitative analysis techniques. Qualitative data from FGDs and KIIs has been transcribed, coded, and thematically analyzed to identify patterns, themes, and trends related to the seasonal flow of vegetables. Quantitative data from surveys of wholesale suppliers, retailers, and farmers has been entered into statistical software like MS Excel and SPSS (Statistical Package for Social Sciences) for data cleaning and analysis. Descriptive statistics, inferential statistics, and quantitative analysis techniques have been employed to analyze the quantitative data and present them using appropriate tables and charts. The findings from the data analysis have been interpreted and discussed in light of the research questions and existing literature.

PRICE ELASTICITY OF DEMAND & PRICE FLEXIBILITY

In a wholesale market, the trade volume is typically demand-guided rather than supply-guided. The quantity of vegetables traded in the market is primarily determined by the demand from buyers such as retailers, restaurants, and consumers. Suppliers or wholesalers respond to this demand by adjusting their supply levels accordingly (Houck, 1965). Price elasticity of demand (PED) is a measure of the responsiveness of the quantity demanded of vegetables in a wholesale market to changes in their prices. It quantifies how sensitive the demand for vegetables is to variations in price. The formula for price elasticity of demand is calculated by dividing the percentage change in quantity demanded by the percentage change in price. A higher value of price elasticity (>1) indicates a greater responsiveness of demand to price changes (elastic), while a lower value (<1) suggests a less responsive demand (inelastic). Understanding the price elasticity of demand for vegetables in a wholesale market is essential for market participants to anticipate the impact of price fluctuations on demand and adjust their strategies accordingly. Policymakers can also utilize this information to make informed decisions regarding pricing policies and market regulations to ensure a well-functioning vegetable market that meets consumer demands effectively.

The relationship between the estimated demand and supply coefficients has been thoroughly studied, but the literature does not clearly address the connection between direct price flexibility and demand elasticity. Even though it is frequently mentioned in passing, this specific relationship is still unclear. However, it only requires a little matrix algebra and economic theory to make it clear. Here, it is demonstrated that the reciprocal of direct price flexibility—often approximated in econometric work—is the lower absolute limit of the related direct price elasticity under fairly common circumstances. The strength of the cross effects of commodity substitution and, if applicable,

complementarity, determine the difference between the two [6].

$$P.F.(F) = Inv.of\ P.E.(E^{-1})$$

$$F.E = I, where\ I\ is\ Identity\ Matrix$$

$$F_{11}E_{11} + \sum_{k=2}^{n} F_{1k}E_{1k} = 1$$

If two or more commodities are independent, then the inner product terms will be zero. Since, all terms of the equation but the first are negative or zero:

$$F_{11}E_{11} \geq 1 \qquad or, \qquad |E_{11}| \geq \left|\frac{1}{F_{11}}\right|$$

SEASONAL VARIATIONS AND SEASONALITY INDEX (SI)

As the marketing year passes on, there are relative variations in supply and demand, which cause crop prices to generally follow a seasonal trend. Typically, crop prices fall to their seasonal low at harvest and then rise again afterward. Postharvest rallies happen as a result of the crop's fixed supply being steadily depleted by consumption, which drives up prices. Seasonality is a phenomenon that lasts for a crop's entire production cycle, which is typically twelve months. Different from cyclical or trend forces are seasonal forces. One particular kind of cycle is a seasonal one. A cycle is an ongoing, self-sustaining pricing pattern that can happen at any time. Although there is some evidence that cycles have an impact on the livestock market, there is little other than "technical analysis" to suggest that other cycles have an impact on crops. Crop prices may act in a "contra-seasonal" way as a result of significant market shocks (droughts, embargoes, dramatic policy events, etc.). As a result, some analysts distinguish between years that had a unique "condition" and create seasonal models that only include such years.

The Seasonality Index (SI) is a measure used to analyze the seasonal pattern of price fluctuations for a particular product, such as vegetables. It helps identify the degree of seasonality or variation in prices throughout the year. To calculate the SI, the monthly average prices of vegetables over a specified period are used. The process of calculating the SI for wholesale vegetable prices involves the following steps. First, data is collected on the monthly average prices of selected vegetables over a specific time period. Next, the overall average price for each vegetable is calculated by summing up the monthly average prices and dividing them by the number of months. Then, the monthly price variation for each vegetable is determined by dividing the monthly average price by the overall average price. Finally, the SI is obtained by averaging the seasonal variations across all the vegetables, providing an overall index value that represents the relative degree of seasonality in wholesale vegetable prices. This index helps to identify the extent of price fluctuations and seasonality patterns in the market.

The value of SI is typically expressed as a percentage or a value ranging from 0 to 1. A higher index value indicates a higher degree of seasonality, meaning that the prices of the vegetables exhibit significant fluctuations throughout the year. Conversely, a lower index value suggests a more stable price pattern with less pronounced seasonal variations. The SI provides valuable insights into the seasonal behavior of vegetable prices, enabling farmers, traders, and policymakers to make informed decisions regarding production, marketing, and pricing strategies.

III. RESULTS AND DISCUSSIONS

The Price Flexibility Coefficient (PFC) and Seasonality Index (SI) analysis are econometric approaches commonly used to analyze the seasonal flow of vegetables. These techniques provide quantitative measures to understand the relationship between price and demand variations over different time periods. The PFC measures the responsiveness of quantity demanded to change in price. It helps determine the degree of elasticity or inelasticity of demand, indicating how sensitive consumers are to price fluctuations. A negative coefficient suggests that an increase in price leads to a decrease in demand, indicating price elasticity.

The SI, on the other hand, measures the seasonal variations in price or demand. It allows for the identification of patterns, trends, and cycles that occur at specific times of the year. By calculating the average seasonal variations across different months, the SI provides an overall measure of the relative degree of seasonality. By employing these econometric approaches, analysts can gain valuable insights into the seasonal flow of vegetables, understand the price-demand dynamics, identify peak and off-peak seasons, and make informed decisions regarding production, pricing, and market strategies. These techniques provide a quantitative framework to study and analyze the seasonal patterns in the vegetable market.

PRICE FLEXIBILITY OF TOMATO

Analysis of the PFCs for tomatoes in FY 2021/22 reveals interesting patterns. The negative coefficients for Jul/Aug, Aug/Sep, Sep/Oct, Jun/Jul, and May/Jun indicate that tomato prices are relatively flexible during these periods. A negative coefficient suggests that a percentage change in quantity demanded leads to a greater percentage change in price in the opposite direction. This implies that tomato prices are sensitive to changes in demand during these months.

On the other hand, the positive coefficients for Oct/Nov, Nov/Dec, Dec/Jan, Feb/Mar, and Mar/Apr indicate a relatively inelastic price response. A positive coefficient suggests that a percentage change in quantity demanded results in a smaller percentage change in price in the same direction. This indicates a lower sensitivity of tomato prices to changes in demand during these months. Notably, the coefficient for Apr/May stands out significantly with a large negative value of -26.22, which indicates a highly elastic price response to changes in quantity demanded during this period. A small change in demand could lead to a significant price fluctuation. This suggests that April to May is a critical time for tomato prices, where small shifts in demand can have a substantial impact on prices.

PRICE FLEXIBILITY OF POTATO

The negative coefficients observed for the months of Jul/Aug to Nov/Dec, Jan/Feb, Feb/Mar, and May/Jun suggest an inverse relationship between the price and demand for these periods, indicating a certain degree of price elasticity. Specifically, the harvesting season of potatoes in the mid-hills (Aug-Nov) and terai regions (Sep-Oct) of Nepal results in an abundance of supply, leading to market-driven prices during these months. Contrarily, positive coefficients in Dec/Jan, Mar/Apr, and Jun/Jul indicate an equilibrated or inelastic relationship between price and demand, wherein higher prices are accompanied by higher demand. Remarkably, the severe negative coefficient of -26.22 for the period Apr/May jumps out, demonstrating a sharp decline in demand as prices rise. The close to zero coefficients, as in Feb/Mar, indicate that price increases have little effect on demand during certain months.

Table 1: Price Flexibility Coefficient (PFC) of Major Vegetables in Kathmandu Valley

FY 2021/22 & 2020/21	Price Flexibility Coefficient				
	Tomato	Potato	Onion	Cauliflower	Cucumber
Jul/Aug	-0.35	-1.05	1.57	-0.32	-0.11
Aug/Sep	-0.43	-1.62	-0.01	-0.12	0.08
Sep/Oct	-0.29	-1.46	-0.24	-0.15	0.15
Oct/Nov	1.54	-0.98	-0.61	2.33	-0.11
Nov/Dec	14.05	-0.76	-0.80	-0.83	-0.38
Dec/Jan	2.47	0.63	-0.42	-2.57	1.14
Jan/Feb	-8.18	-0.66	-0.82	-1.88	0.01
Feb/Mar	1.19	-0.01	-0.81	2.16	2.71
Mar/Apr	3.40	0.24	0.56	-1.86	-0.52
Apr/May	-26.22	2.92	-0.72	-3.00	-0.37
May/Jun	-10.41	-0.62	-0.62	-30.32	-0.62
Jun/Jul	-1.08	0.62	-0.91	0.14	3.83

PRICE FLEXIBILITY OF ONION

The PFCs for onion reveal intriguing patterns that shed light on the unique dynamics of this market. In contrast to the high positive coefficient of 1.57 observed in Jul/Aug, indicating an inelastic demand, the negative coefficients observed in all other months suggest a potential for price-induced demand. However, it is important to note that the magnitude of these coefficients implies that even substantial price reductions do not have a significant impact on increasing demand. This finding underscores the overall inelastic nature of onion demand, which can be attributed to various factors such as consumer preferences, market conditions, and the dominant import market from China, which plays a pivotal role in the supply chain.

Additionally, the month of Jul/Aug presents an appealing dynamic as the monsoon season poses challenges for preserving the product, leading to quick spoilage and damage. This further contributes to the reduced responsiveness of consumers to price changes during this period.

PRICE FLEXIBILITY OF CAULIFLOWER

Cauliflower exhibits significant variations in price flexibility coefficients, indicative of its highly seasonal characteristics. Particularly, the months of Jan/Feb, Feb/Mar, and Mar/Apr exhibit relatively high positive coefficients of 2.16, 2.33, and 2.16, respectively, indicating a strong positive relationship between price and demand

during these months. This aligns with the fact that January to March is the harvesting season for cauliflower in Nepal, when local supply is abundant, and prices are typically lower. Conversely, the negative coefficients observed in Jul/Aug, Aug/Sep, Sep/Oct, Nov/Dec, and May/Jun suggest a decrease in demand with increasing prices. Interestingly, May/Jun stands out with a remarkably negative coefficient of -30.32, indicating a highly elastic demand during this period. This can be attributed to the off-season for cauliflower, when local supply is scarce, and prices are typically higher due to reliance on imported cauliflower. These findings highlight the significance of seasonality in shaping the price-demand dynamics of cauliflower in Nepal.

PRICE FLEXIBILITY OF CUCUMBER

With its harvesting season spanning from April to November, cucumber experiences distinct shifts in demand throughout the year. Positive coefficients, such as 1.14 and 3.83, indicate a relatively inelastic demand during the peak months of the harvest season, suggesting that price variations have a limited impact on consumer behavior. On the other hand, negative coefficients, like -0.11 and -0.38 in the months of Oct/Nov and Nov/Dec respectively, imply a more elastic demand during end of the harvesting periods, indicating that consumers are more responsive to price changes. These findings shed light on the seasonal dynamics of the cucumber market in KV, emphasizing the importance of considering the specific timeframes and factors influencing consumer preferences and market conditions.

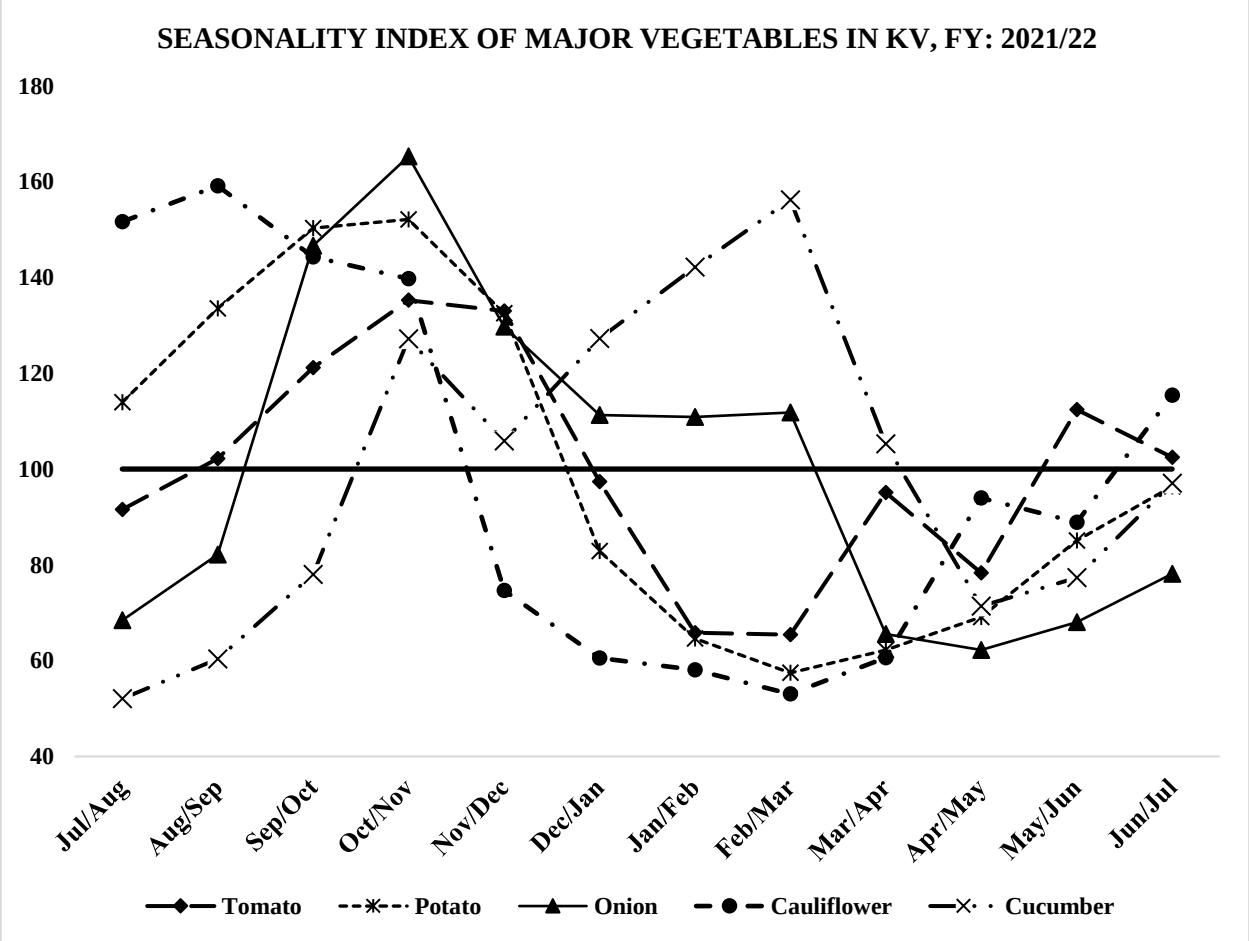

Fig.1: Seasonality Index (SI) of Major Vegetables in Kathmandu Valley

SEASONALITY OF VEGETABLES

The analysis of SI for the primary vegetables in Fiscal Year 2021/22 uncovers captivating trends in the variations of prices over the course of the year. Among the vegetables, Cauliflower exhibits the highest seasonality among vegetables, with a significant variation in prices across different months. It reaches its peak in Oct/Nov with a Seasonality Index of 165, indicating a substantial increase in prices during that period. Cucumber follows a similar trend, showing notable price fluctuations, reaching its highest index of 156 in Feb/Mar.

Onion, although exhibiting moderate seasonality, shows a consistent increase in prices from Sep/Oct to Nov/Dec, with a peak Seasonality Index of 165. This suggests that onion prices tend to rise during the later part of the year. Tomato and Potato demonstrate relatively lower seasonality compared to the other vegetables. Tomato prices exhibit a slight decline in the early months, reaching the lowest Seasonality Index of 65 in Feb/Mar, before gradually increasing again towards the end of the fiscal year. Similarly, Potato prices remain relatively stable throughout the year, with a slight dip in Dec/Jan.

Table 2: Analysis of Seasonality of Major Vegetables in Kathmandu Valley

Vegetable	Analysis of Seasonality Data	Growing Season [12]
Tomato	Low Seasonality; Slight decline of SI to 65 during Feb/Mar.	All Year Round
Potato	Low Seasonality; Slight decline of SI to 57 during Feb/Mar.	All Year Round
Onion	Moderate Seasonality; Consistent increase in price from Sep/Oct to Oct/Nov	All Year Round
Cauliflower	Highest Seasonality; Peak SI 165 during the month Oct/Nov	January- March
Cucumber	High Seasonality; SI 156 during the month Feb/Mar	April- November

Tomato and Potato, being year-round crops, exhibit relatively lower seasonality in terms of price fluctuations. This aligns with their continuous availability throughout the year, as indicated by the SI. Their steady supply contributes to a more stable price trend, with minor variations observed during certain months.

On the other hand, Onion, despite being a year-round crop, experiences production and storage challenges during the rainy (monsoon) season in June/July and July/August. This aligns with the notable dip in prices during those months, as reflected in the SI. The adverse weather conditions during the monsoon season can hamper the onion production and quick spoilage (rotting) due to high relative humidity, leading to reduced supply and also the demand (poor quality product) and subsequently lower prices in the market.

Cauliflower has a specific growing season from January to March, which coincides with its highest SI during that period. The limited availability of cauliflower outside this Period contributes to higher prices, as demand outpaces supply. The concentrated production season of cauliflower explains its pronounced price fluctuations during the specified months. Cucumber, with a growing season from April to November, exhibits a high level of seasonality. Its prices remain relatively stable during the growing season, aligning with its higher availability in the market. However, as the season ends in November, there is a decline in supply, leading to increased prices.

Overall, the comparison between the SI and the growing seasons of vegetables supports the argument that the availability and production patterns play a significant role in price fluctuations. Year-round crops like tomato and potato, with continuous availability, experience lower seasonality. Vegetables with specific growing seasons, such as cauliflower and cucumber, demonstrate higher seasonality due to the limited supply during certain months. The challenges faced during the monsoon season also impact the production, storage, and prices of onions. This analysis highlights the importance of understanding the interplay between growing seasons, supply, and market dynamics in explaining the observed variations in vegetable prices. Farmers, traders, and consumers can utilize this information to make informed decisions regarding production planning, procurement, and pricing strategies.

IV. CONCLUSION AND RECOMMENDATIONS

Overall, the demand for tomatoes exhibits mixed elasticity, with relatively inelastic demand during the months of November to March, as indicated by the positive coefficients. However, during the months of April to June, the price flexibility coefficients are highly negative, indicating a more elastic demand. In the meantime, potatoes appear to be predominantly inelastic overall, with limited responsiveness to price changes during the months of July and August. Similarly, onions show mixed elasticity patterns, with demand inelasticity during the months of July to October and flexibility during the months of November to April, suggesting a more elastic demand. Based on the import model and the risk of being spoiled during monsoon seasons, onions show reduced consumer responsiveness to price changes during July and August, which is the critical period for them. On the other hand, cauliflower, and cucumber, being seasonal crops, demonstrate high

inelasticity during harvesting season due to the surplus flow of the product into the market and comparatively elastic demand during off-seasons and pre-harvesting periods.

The study also indicates high seasonality in the prices of cauliflower and cucumber, which are inherently seasonal crops, during pre-harvesting and off-season periods. Onions exhibit moderate seasonality in prices, with a consistent price increment from September to November. This price hike aligns with the occurrence of the country's biggest festivals, Dashain and Tihar, which justifies the increase. Lastly, potato and tomato, being year-round crops, show low seasonality, with a slight decline in the seasonality index during the months of February and March.

Considering a relatively inelastic demand from the results of this study and the import share of vegetables in Kathmandu Valley, which stands at around 40% in FY 2021/22, it becomes crucial to explore strategies for reducing dependency on imports. In line with this, one of the key recommendations is to prioritize increasing domestic production of vegetables. This can be achieved by providing support and incentives to local farmers, including access to quality seeds, modern farming techniques, and agricultural training programs. By enhancing domestic production, the valley can reduce its reliance on imported vegetables and create a more sustainable and self-sufficient market. Furthermore, it is essential to improve post-harvest infrastructure to minimize spoilage and optimize the supply chain. This includes investing in storage facilities, transportation networks, and cold chain infrastructure. By ensuring that vegetables are properly handled, stored, and transported, the overall quality and marketability of the produce can be maintained, reducing wastage and losses.

In addition to these measures, enhancing market efficiency is crucial. This involves streamlining supply chains, reducing intermediaries, and establishing transparent pricing mechanisms. By creating a more competitive and fair market environment, farmers can receive better returns for their produce, while consumers can access vegetables at reasonable prices. To counter the inelastic demand, promoting value addition in vegetables can be an effective strategy. This can include processing, packaging, and branding initiatives that add value to the produce. Value-added products can command higher prices and open up opportunities for market expansion, both domestically and internationally.

Supporting research and development activities in the vegetable sector is another recommendation. By investing in R&D, improved varieties of vegetables can be developed that are better suited to local conditions, have higher yields, and exhibit desirable traits. This can contribute to increased productivity and competitiveness in the market.

Lastly, collaboration and networking among stakeholders in the vegetable supply chain are essential. This includes fostering partnerships between farmers, traders, retailers, and policymakers to share knowledge, coordinate efforts, and collectively address challenges. By working together, stakeholders can leverage their expertise and resources to drive market efficiency and enhance the overall performance of the vegetable sector.

While these recommendations focus on increasing domestic production, improving market efficiency, and promoting value addition, it is important to consider the implications for imports. As the domestic production capacity improves, the need for imports can potentially be reduced. However, a comprehensive analysis of import dynamics, market demands, and trade policies would be necessary to devise strategies for reducing imports effectively and ensuring a balanced market supply.

REFERENCES

[1] ADB. (2018). *Dysfunctional Horticulture Value Chains and the Need for Modern Marketing Infrastructure: The Case of Pakistan.* Asian Development Bank (pp. 2–5).

[2] Adjemian, M. K., & Smith, A. C. (2012). Using USDA Forecasts to Estimate the Price Flexibility of Demand for Agricultural Commodities. *American Journal of Agricultural Economics*, *94*(4), 978–995. https://doi.org/10.1093/ajae/aas032.

[3] AITC. (2020). *Agriculture and Livestock Diary 2077.* Annual ed, Hariharbhawan; AITC, MoALD, Lalitpur.

[4] CASA. (2020). *Vegetable Sectoer Stratetgy-Nepal.* Kathmandu: CASA Nepal Country Team.

[5] Gautam, D. M., & Bhattarai, D. R. (2006). Post-harvest Horticulture. In Public Printing Press.

[6] Houck, J. P. (1965). The Relationship of Direct Price Flexibilities to Direct Price Elasticities. *Journal of Farm Economics*, *47*(3), 789. https://doi.org/10.2307/1236288.

[7] Huang KS (2006). A Look at Food Price Elasticities and Flexibilities. Economic Research Service, U.S. Department of Agriculture, Washington, DC.

[8] MoF. (2017). *Economic Survey 2016/17, Kathmandu.* Ministery of Finance, Singha Durbar, Kathmandu, Nepal.

[9] Schreinemachers, P., Simmons, E. B., & Wopereis, M. C. S. (2018). Tapping the economic and nutritional power of vegetables. Global Food Security, 16(September 2017),36–45. https://doi.org/10.1016/j.gfs.2017.09.005

[10] Shrestha, B. (2008). *Off- Season Vegetables Marketing Channels of Small Growers: A Case of Yampaphant, Tanahun, Nepal.*

[11] Simkhada, S. (2019). *Review on Nepal's Increasing Agricultural Import. Acta Scientific Agriculture, 3(10), 77–78.* https://doi.org/10.31080/asag.2019.03.0650.

[12] USAID Nepal. (2011). *Value Chain/ Market Analysis of the Off-Season Vegetable in sub-sector in Nepal.* General Development Office. Kathmandu, Nepal: United States Agency for International.

APPENDICES

Table 3: Calculation of Price Elasticity and Price Flexibility Coefficient for Tomatoes in Kathmandu Valley

	FY 2021/22		FY 2020/21		Price Elasticity	Price Flexibility Coefficient
	Supply Quantity (MT)	Price (Rs. /kg)	Supply Quantity (MT)	Price (Rs. /kg)		
Jul/Aug	1,937.007	42.395	1,189.454	54.384	-2.85	-0.35
Aug/Sep	2,156.515	37.248	1,029.055	70.790	-2.31	-0.43
Sep/Oct	1,771.546	58.458	1,136.768	69.623	-3.48	-0.29
Oct/Nov	1,845.615	74.958	1,730.848	68.008	0.65	1.54
Nov/Dec	2,114.606	87.602	2,020.627	52.988	0.07	14.05
Dec/Jan	3,036.624	57.843	2,723.745	45.063	0.41	2.47
Jan/Feb	2,942.799	40.193	3,081.824	29.357	-0.12	-8.18
Feb/Mar	4,022.442	40.698	2,954.501	28.455	0.84	1.19
Mar/Apr	4,817.369	58.024	4,348.795	42.473	0.29	3.40
Apr/May	3,329.184	53.533	3,437.657	29.293	-0.04	-26.22
May/Jun	2,075.915	85.715	2,449.883	33.113	-0.10	-10.41
Jun/Jul	1,380.103	61.014	1,886.379	47.288	-0.92	-1.08

Table 4: Calculation of Price Elasticity and Price Flexibility Coefficient for Potatoes in Kathmandu Valley

	FY 2021/22		FY 2020/21		Price Elasticity	Price Flexibility Coefficient
	Supply Quantity (MT)	Price (Rs. /kg)	Supply Quantity (MT)	Price (Rs. /kg)		
Jul/Aug	5,928.153	39.905	4,717.026	54.643	-0.95	-1.05
Aug/Sep	5,643.250	43.233	4,617.754	67.577	-0.62	-1.62
Sep/Oct	5,755.263	45.965	4,475.370	78.740	-0.69	-1.46
Oct/Nov	5,281.811	50.875	3,963.549	75.363	-1.02	-0.98
Nov/Dec	6,154.875	41.738	4,076.638	68.233	-1.31	-0.76
Dec/Jan	4,433.812	30.475	6,560.119	38.267	1.59	0.63
Jan/Feb	5,377.781	28.047	6,312.881	25.563	-1.52	-0.66
Feb/Mar	5,086.861	23.813	4,134.738	23.850	-146.45	-0.01
Mar/Apr	3,490.822	25.100	4,464.752	26.513	4.09	0.24
Apr/May	2,784.802	26.563	2,921.749	30.777	0.34	2.92
May/Jun	3,527.574	33.003	2,945.779	37.573	-1.62	-0.62
Jun/Jul	5,063.815	40.893	4,709.864	39.065	1.61	0.62

Table 5: Calculation of Price Elasticity and Price Flexibility Coefficient for Onions in Kathmandu Valley

	FY 2021/22		FY 2020/21		Price Elasticity	Price Flexibility Coefficient
	Supply Quantity (MT)	Price (Rs. /kg)	Supply Quantity (MT)	Price (Rs. /kg)		
Jul/Aug	3,122.514	46.820	2,378.663	31.380	0.64	1.57

Aug/Sep	2,984.926	46.760	1,441.313	47.180	-120.31	-0.01
Sep/Oct	2,158.204	60.760	775.895	106.910	-4.13	-0.24
Oct/Nov	2,311.387	65.100	1,298.772	123.870	-1.64	-0.61
Nov/Dec	2,747.225	49.540	1,690.010	98.790	-1.25	-0.80
Dec/Jan	3,289.930	55.020	2,099.660	72.170	-2.39	-0.42
Jan/Feb	2,817.096	57.600	2,339.024	69.160	-1.22	-0.82
Feb/Mar	3,166.786	58.340	2,644.090	69.460	-1.23	-0.81
Mar/Apr	3,170.892	36.480	3,489.714	38.450	1.78	0.56
Apr/May	3,009.148	33.560	2,618.706	37.580	-1.39	-0.72
May/Jun	2,871.194	33.280	2,044.148	44.470	-1.61	-0.62
Jun/Jul	3,294.556	39.110	2,651.441	50.190	-1.10	-0.91

Table 6: Calculation of Price Elasticity and Price Flexibility Coefficient for Cauliflower in Kathmandu Valley

	FY 2021/22		FY 2020/21		Price Elasticity	Price Flexibility Coefficient
	Supply Quantity (MT)	Price (Rs. /kg)	Supply Quantity (MT)	Price (Rs. /kg)		
Jul/Aug	679.622	79.340	355.636	111.380	-3.17	-0.32
Aug/Sep	995.312	85.930	325.325	114.210	-8.32	-0.12
Sep/Oct	1,628.841	83.330	819.309	98.160	-6.54	-0.15
Oct/Nov	1,297.834	99.060	1,153.328	76.685	0.43	2.33
Nov/Dec	2,217.312	47.563	2,294.547	46.273	-1.21	-0.83
Dec/Jan	2,069.130	43.440	2,371.522	32.730	-0.39	-2.57
Jan/Feb	1,393.554	45.293	2,098.100	27.743	-0.53	-1.88
Feb/Mar	2,290.494	37.563	2,019.613	29.127	0.46	2.16
Mar/Apr	1,616.234	24.287	1,257.152	51.933	-0.54	-1.86
Apr/May	922.734	66.375	1,017.906	51.817	-0.33	-3.00
May/Jun	760.877	67.865	774.822	43.905	-0.03	-30.32
Jun/Jul	944.589	76.775	496.832	68.380	7.34	0.14

Table 7: Calculation of Price Elasticity and Price Flexibility Coefficient for Cucumber in Kathmandu Valley

	FY 2021/22		FY 2020/21		Price Elasticity	Price Flexibility Coefficient
	Supply Quantity (MT)	Price (Rs. /kg)	Supply Quantity (MT)	Price (Rs. /kg)		
Jul/Aug	1,488.281	26.185	718.338	29.600	-9.29	-0.11
Aug/Sep	1,516.837	32.795	1,122.612	31.855	11.90	0.08
Sep/Oct	1,543.072	43.645	943.509	39.905	6.78	0.15
Oct/Nov	832.454	66.970	627.912	69.345	-9.51	-0.11
Nov/Dec	878.869	41.420	415.840	72.020	-2.62	-0.38
Dec/Jan	468.689	78.350	358.180	58.005	0.88	1.14
Jan/Feb	333.750	76.215	295.075	76.115	99.76	0.01

Feb/Mar	392.805	90.055	370.345	77.360	0.37	2.71
Mar/Apr	1,407.655	49.995	1,008.484	62.800	-1.94	-0.52
Apr/May	1,959.045	28.005	916.954	48.510	-2.69	-0.37
May/Jun	792.727	37.530	619.962	45.295	-1.63	-0.62
Jun/Jul	688.550	64.865	587.690	39.145	0.26	3.83

Table 8: Calculation of Seasonality Index for Tomatoes in Kathmandu Valley

Months	Price (Rs. /Kg for FY 2021/22)	Price (Rs. /Kg for FY 2020/21)	Monthly Average	Seasonal Index
Jul/Aug	42.395	54.384	48.390	91.55
Aug/Sep	37.248	70.790	54.019	102.20
Sep/Oct	58.458	69.623	64.040	121.16
Oct/Nov	74.958	68.008	71.483	135.24
Nov/Dec	87.602	52.988	70.295	133.00
Dec/Jan	57.843	45.063	51.453	97.35
Jan/Feb	40.193	29.357	34.775	65.79
Feb/Mar	40.698	28.455	34.577	65.42
Mar/Apr	58.024	42.473	50.249	95.07
Apr/May	53.533	29.293	41.413	78.35
May/Jun	85.715	33.113	59.414	112.41
Jun/Jul	61.014	47.288	54.151	102.45
Average	58.140	47.570	52.855	

Table 9: Calculation of Seasonality Index for Potatoes in Kathmandu Valley

Months	Price (Rs. /Kg for FY 2021/22)	Price (Rs. /Kg for FY 2020/21)	Monthly Average	Seasonal Index
Jul/Aug	39.905	54.643	47.274	113.94
Aug/Sep	43.233	67.577	55.405	133.54
Sep/Oct	45.965	78.740	62.353	150.28
Oct/Nov	50.875	75.363	63.119	152.13
Nov/Dec	41.738	68.233	54.985	132.53
Dec/Jan	30.475	38.267	34.371	82.84
Jan/Feb	28.047	25.563	26.805	64.61
Feb/Mar	23.813	23.850	23.831	57.44
Mar/Apr	25.100	26.513	25.807	62.20
Apr/May	26.563	30.777	28.670	69.10
May/Jun	33.003	37.573	35.288	85.05
Jun/Jul	40.893	39.065	39.979	96.36
Average	35.801	47.180	41.490	

Table 10: Calculation of Seasonality Index for Onions in Kathmandu Valley

Months	Price (Rs. /Kg for FY 2021/22)	Price (Rs. /Kg for FY 2020/21)	Monthly Average	Seasonal Index
Jul/Aug	46.820	31.380	39.100	68.40
Aug/Sep	46.760	47.180	46.970	82.16
Sep/Oct	60.760	106.910	83.835	146.65
Oct/Nov	65.100	123.870	94.485	165.28
Nov/Dec	49.540	98.790	74.165	129.74
Dec/Jan	55.020	72.170	63.595	111.25
Jan/Feb	57.600	69.160	63.380	110.87
Feb/Mar	58.340	69.460	63.900	111.78
Mar/Apr	36.480	38.450	37.465	65.54
Apr/May	33.560	37.580	35.570	62.22
May/Jun	33.280	44.470	38.875	68.00
Jun/Jul	39.110	50.190	44.650	78.11
Average	48.531	65.801	57.166	

Table 11: Calculation of Seasonality Index for Cauliflower in Kathmandu Valley

Months	Price (Rs. /Kg for FY 2021/22)	Price (Rs. /Kg for FY 2020/21)	Monthly Average	Seasonal Index
Jul/Aug	79.340	111.380	95.360	151.65
Aug/Sep	85.930	114.210	100.070	159.14
Sep/Oct	83.330	98.160	90.745	144.31
Oct/Nov	99.060	76.685	87.873	139.74
Nov/Dec	47.563	46.273	46.918	74.61
Dec/Jan	43.440	32.730	38.085	60.57
Jan/Feb	45.293	27.743	36.518	58.07
Feb/Mar	37.563	29.127	33.345	53.03
Mar/Apr	24.287	51.933	38.110	60.61
Apr/May	66.375	51.817	59.096	93.98
May/Jun	67.865	43.905	55.885	88.87
Jun/Jul	76.775	68.380	72.578	115.42
Average	63.068	62.695	62.882	

Table 12: Calculation of Seasonality Index for Cucumber in Kathmandu Valley

Months	Price (Rs. /Kg for FY 2021/22)	Price (Rs. /Kg for FY 2020/21)	Monthly Average	Seasonal Index
Jul/Aug	26.185	29.600	27.893	52.06
Aug/Sep	32.795	31.855	32.325	60.33
Sep/Oct	43.645	39.905	41.775	77.96

Oct/Nov	66.970	69.345	68.158	127.20
Nov/Dec	41.420	72.020	56.720	105.86
Dec/Jan	78.350	58.005	68.178	127.24
Jan/Feb	76.215	76.115	76.165	142.14
Feb/Mar	90.055	77.360	83.708	156.22
Mar/Apr	49.995	62.800	56.398	105.25
Apr/May	28.005	48.510	38.258	71.40
May/Jun	37.530	45.295	41.413	77.29
Jun/Jul	64.865	39.145	52.005	97.06
Average	53.003	54.163	53.583	