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# Price volatility of selected high value vegetables in cordillera administrative region, Philippines

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## ABSTRACT

Price volatility in the concept of this paper is defined as the variation of prices over time. The limitation of study relative to vegetable price volatility made the analysis contribute to the existing field of work. The analysis focused on the price trend and extent of price volatility of cabbage, carrot, and potato for the period of 2002 to 2011. It likewise sought to determine the difference in price volatility between types of prices such as farm, local retail and Metro Manila retail, and the relationship of weather conditions i.e., rainfall amount and temperature, production area, and importation volume to the vegetable prices. The research employed secondary data from various sources.The results showed erratic trends of prices of the selected high value vegetables for the whole period covered. The farm and retail prices exhibited similar pattern indicating that any price changes at the farm level were carried at the retail level. The study illustrated volatile prices for the selected vegetables. This result proved the assumption that there is high degree of price volatility among the selected vegetables. The farm price was the most volatile in relation to retail price. However among the selected vegetables, cabbage prices indicated the highest volatility. Its perishability and susceptibility to weather conditions are the potential contributing factors. The volatility of the different types of prices was statistically significant at 0.001. Further, the farm and retail prices were significantly affected by several factors such as the weather conditions specifically rainfall amount and temperature, the production area, and volume of imports.

**Keywords:** Price volatility, price trend, highland vegetables

## 1. Introduction

Everyone eats as food is essential for survival. Hence, everyone is affected to some extent by changes in food prices. Agricultural commodity price volatility is an ongoing concern. Policymakers as well as all the stakeholders along the food supply chain have an interest in the question of agricultural price volatility and need to better understand the expected future evolution (Matthews, 2010 as cited by Huchet-Bourdon, 2011), Food price volatility creates unpredictability in the market and poses fundamental food security risks for consumers and governments. Volatility also discourages needed investment in agriculture for development due to increased financial risks and uncertainty for producers and traders (The World Bank, 2012),

In the poorest countries, where people spend up to two-thirds of their daily income on food, rising prices are a threat to global growth and social stability (The World Bank, 2012), The higher the price, the stronger are the welfare consequences of volatility on consumers, while the opposite is true for producers. Moreover, the volatility of prices leads to a lot of

uncertainty in the whole food system, causes actors to hold reserves in more liquid form, and thus discourages longer-term investments that can increase productivity and promote trade. The longer-term impacts on food security of food price instability can be great even if prices are not constantly moving higher (Timmer, 1990 as cited by HLPE, 2011),

Volatility, in a purely descriptive sense refers to variations in economic variables over time of which is the scope of this study specifically on variations in agricultural prices over time. Not all price variations are problematic, such as when prices move along a smooth and well-established trend reflecting market fundamentals or when they exhibit a typical and well known seasonal pattern. But variations in prices become problematic when they are large and cannot be anticipated and, as a result, create a level of uncertainty which increases risks for producers, traders, consumers and governments and may lead to sub-optimal decisions. Variations in prices that do not reflect market fundamentals are also problematic as they can lead to incorrect decisions (FAO *et al*., 2011),

Behind concerns about volatility lie concerns about price levels and behind both, lie concerns about food security. While producers benefit, consumers, especially poor consumers, are adversely affected by high prices. Food accounts for a very high share of the total budget of the poorest households. Because poor households often consume foods that are less processed, the effect of rises in commodity prices is felt more strongly. These households find their nutrition status as well as their capacity to avail of proper education, health care, or other basic needs compromised when food prices are high (FAO *et al*., 2011),

Producers are more concerned about low prices, which may threaten their living standards as well as their longer term viability when income is too low to provide for the farm family or for the operational needs of the farm. Low or volatile prices pose significant problems to farmers and other agents in food chains who risk losing their productive investments if prices fall while they are locked into strategies dependent on higher price levels to be viable. Farmers who have already planted their crops are the classic example. Poor smallholders who do not have access to credit may have difficulty financing the crucial inputs needed to plant again and stay in business. Many farmers in developing (and even some in more advanced) economies may not be operating on a sufficiently large scale to be able to carry over income from one season to another. Thus, both the welfare of the family and the viability of the farm may be threatened by excessive volatility (FAO *et al*., 2011),

The objective of this study focused on the price trend of cabbage, carrot and potato for the period of 2002 to 2011, and the extent of price volatility of the selected high value vegetables in Cordillera Administrative Region. It aimed to determine the differences in the price volatility among the types of prices such as between farmgate and local retail, farmgate and Metro Manila retail and local retail and Metro Manila retail. This study likewise sought to determine the relationship of production area, weather conditions specifically rainfall amount and temperature, and importation volume to the vegetable prices.

The limitation of study relative to vegetable price volatility made the analysis contribute to the existing field of work on price volatility. Due to the seasonality of vegetable production in the Philippines, it causes large fluctuations in supply and hence in the spot market price. These seasonal variations in price are influenced by adverse weather conditions, prevalence of pests and diseases, high cost of agricultural inputs and transportation cost among others. The analysis of this study would serve as an imperative guide in understanding vegetable price variations since vegetables have form parts of Filipino subsistence as food and source of

livelihood. It is therefore necessary to recognize the underlying issues such as the price volatility which may possibly impact both consumers and producers. The results could serve as basis for policy recommendations for the government development programs geared towards helping both the producers and the consumers. The programs may involve production programming scheme as a means to regulate issues on oversupply; infrastructure development like greenhouse farming to minimize the effect of adverse weather conditions; and productivity improvement through provision of high yielding varieties. This research would also answer some questions confronting vegetable price volatility. Likewise, it would serve as reference to other researchers who are interested to undertake similar study.

## 2. Conceptual framework

The study focused on examining the price trend and the degree of price volatility of selected high value vegetables namely: cabbage, carrot and potato for the period of 2002-2011. This research also measured the difference in the price volatility among the types of prices such as between farmgate and local retail, farmgate and Metro Manila retail, and local retail and Metro Manila retail. Further the study analysed the relationship of some selected variables such as the production area, weather conditions specifically the amount of rainfall and temperature, and importation volume to the vegetable prices for the periods covered.

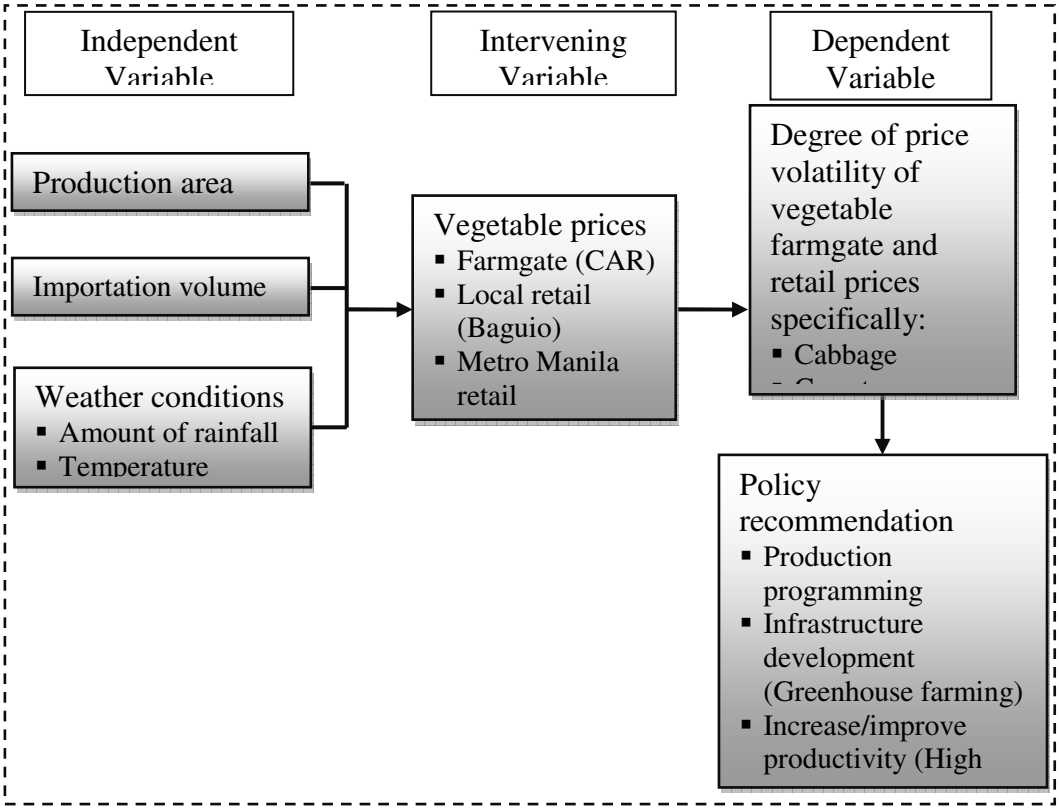


**Figure 1:** Paradigm of the study

## 2. Review of literature

### 2.1 Definition and measurements of volatility

Volatility in this study is concerned with the variability of the price series around its central value i.e. the tendency for individual price observations to vary far from its mean value. Thus volatility is often defined as high deviations from a global tendency. However, a large part of the variation in commodity prices is also attributable to variations of the trend itself rather than variations around the trend according to some researchers (e.g. Dehn *et al*., 2005 as referred by Huchet-Bourdon, 2011),

According to Matthews (2010) and European Commission (2009) as quoted by Huchet-Bourdon (2011), there are two kinds of volatility found in the literature: a historical (realized) volatility and an implicit future volatility. The historical volatility is based on observed past prices. It reveals how volatile a price has been in the past. As for the implicit volatility, it corresponds to the markets' expectation on how volatile a price will be in the future as measured by the value of price options. In this study, only the historical volatility was considered. Several historical volatility measurements have been used in the literature. Economists have employed measures based on the price levels. They have focused on the standard deviation of prices or of logarithmic prices or on the coefficient of variation which expresses the standard deviation as a percentage of the sample mean. The main advantage of the latter is that it does not depend on the unit of measurement.

Huchet-Bourdon (2011) explained that some measures take into account the fact that most economic series exhibit some form of trend, and permit the removal of trend movements in the volatility measures. In that context, some authors use the standard deviation of the first difference in the logarithmic value of prices (e.g. Gilbert & Morgan, 2010; European Commission, 2009; Jacks *et al.*, 2009; OECD, 2009; Gilbert, 2006; Clem, 1985) and some others recommend the use of "de-trended" series to compute volatility measures (e.g. Matthews, 2010; Cuddy & Della Valle, 1978), The advantage of the first computation is its simplicity while using de-trended series means that a model is required to take into account or approximate the nature of the underlying trend. In that way, the main drawback is that the volatility measure may depend on the choice of the de-trending technique. For instance, Cuddy & Della Valle (1978) as cited by Huchet-Bourdon (2011) proposed a corrected coefficient of variation, based on linear and log-linear trend.

Other authors also estimate a volatility model. Gilbert and Morgan (2010) as mentioned by Huchet-Bourdon (2011), for example, estimate a GARCH (Generalized AutoRegressive Conditional Heteroscedasticity) model which is often used for modeling volatility in financial markets (Bollerslev, 1986), The idea is to estimate the conditional variance of innovation from the auto-regressive process followed by a time series. However, the interpretation of the volatilities computed with such a measure poses some questions. Besides, parameters underlying this kind of model are not always well determined.

One common measure used to gauge price volatility is the coefficient of variation (CoV) of a given price series which expresses an estimation of the variability of the series as a ratio to its average value. This permits comparison across commodities with different average prices. A traditional measure of variability used in this calculation is the standard deviation of observed prices. This measure refers to *ex post* observations of actual prices. But it implicitly considers all price variability to be unexpected. Clearly, some variability can be predicted (*e.g.* seasonal variation, business cycles, or other trending behavior) such that results from using the simple standard deviation may overstate the degree of volatility or uncertainty. Therefore, in order to have a better measure of the unpredictability or uncertainty faced by the market, it is common

to take into account only movements of the series that cannot be predicted on the basis of its previous values (OECD-FAO, 2010),

Volatility in food prices can be measured at the producer, wholesale, or retail level. If margins between producer, wholesale, and retail prices are a constant proportion of the price, then measuring the volatility at any of the three levels will give the same result. However, if margins are fixed, then producer prices will be the most volatile and retail prices the least, with the volatility of wholesale prices falling in between. In practice, however, other factors influence the marketing margins such as the degree of competition at each level in the channel, the availability of information, changes in road quality or congestion, and the volume of trade between markets. Instability can also be measured at different time scales, using daily, monthly, or annual price data (Minot, 2011),

### 2.1.1 Why are food prices high and volatile?

According to Food and Agriculture Organization (FAO, 2012), some degree of price volatility is typically observed in agricultural commodity markets due to three market fundamentals: Agricultural output varies from period to period because of natural shocks such as weather events (droughts, floods, etc.) and pests and diseases; since agricultural product demand and supply are inelastic in the short-run, wide price adjustments may be necessary to clear markets, especially where stocks are low; and as production takes considerable time in agriculture, supply cannot respond much to price changes in the short term, unless stocks are available somewhere to counter changes in production.

The recent episode of price volatility has its origins in such fundamental factors – strong demand from developing economies facing shortages of supply caused by weather shocks in key producing and exporting countries in a situation of low stock levels.

### 2.2 Some contributors to high prices and volatility

In addition to market fundamentals, a catalogue of factors points to a likelihood of higher prices and a risk of increased volatility in future years (FAO, 2012):

1. Climate change: Experts concur broadly that climate change will, in the longer term, lead to worsening conditions in some arid and semi-arid regions where agricultural production is already difficult, while temperate regions in particular, but not exclusively, may benefit. It is also thought that climate change will lead to more frequent extreme events such as droughts, heat waves and floods. Clearly, climate change will provoke some adjustment of production patterns around the world, as well as increased risks of local or regional supply problems that could add to future volatility.

2. Geography of production: Changes in the geography of production are making output more variable which in turn increase price volatility. Production is moving towards distant and potentially fragile areas of greater yield variability, a phenomenon that is already occurring. World markets are more dependent on supplies from new agricultural production regions than in the past. Yields in these regions are less stable and supply more variable than in some other parts of the world where natural conditions are better and where the application of technologies and improved management practices have both increased and stabilized yields.

3. Economic shocks: Beyond the uncertainty driven by a changing climate and a fragile environment, the trajectory of the global food system is increasingly subject to external economic shocks which are being manifested from a more frequent range of complex sources. These shocks have a profound influence in shaping the agricultural landscape in recent years, and are likely to play an equal role in the years to come.

4. Policy responses: Policy responses by countries on price spikes also contributed to volatility, and could continue to do so unless the international community is able to take steps to avoid such actions. In 2007-2008, some policy measures were put in place by a number of countries that caused panic buying to exacerbate the situation, increasing the amplitude of price movements and in some cases provoking price increases that were otherwise inexplicable by market fundamentals.

5. Energy markets: The increasing linkages between energy markets and those of agricultural commodities have also amplified food price volatility. A first link is through the close relationship that exists between energy prices and agricultural production. Petroleum price volatility, which tends to be high, influences food price volatility through two key elements: transportation costs and fertilizer prices. A second link occurs through biofuel and the expanding use of agricultural commodities as feedstocks for biofuel production. As such, price transmission of oil price fluctuations to crop prices may be more rapid.

6. Exchange rates: The linkages between macroeconomic factors and agricultural markets have received increased attention in recent years, with movements in exchange rates in particular having potential impacts on food prices. Changes in exchange rates especially in major exporting countries contribute to changes in international food prices. Thus, as macroeconomic factors lead to more volatile exchange rates, food price volatility also rises.

### 2.3 Why volatility matters?

According to FAO (2012), the impact of food price volatility falls heaviest to the poorest – especially the urban poor and the landless – who may spend as much as 75 percent of their income on food. Diets of the poor also often lack diversity so the scope for switching to less expensive foods is often limited. High food prices reduce the quantity and the quality of the food they can consume, worsening food insecurity and malnutrition and pushing more households below the poverty line. High and volatile food prices challenge the fundamental human right to adequate food. They not only increase, but also deepen poverty and food insecurity and lead to irreversible harm.

The impact of high and volatile food prices on consumers is clearly negative but what about the impact on agricultural producers and exporters? In principle, higher prices should be good news for them. The rents arising from higher prices should not be taxed by government. They should provide incentives and financial assistance for increased investment and a positive supply response. However, in practice the incentives and a positive supply response may not materialize. Input prices, especially for oil-based fertilizers, can increase faster than output prices leaving producers no better off. Supply-side constraints such as transport and storage limitations or lack of access to inputs and credit can prevent producers capitalizing on higher prices. For poor food producers price volatility means uncertainty and increased risk that deter the investments essential to increasing food production and reducing vulnerability.

Governments need to ensure that such opportunities for growth and increased export revenues are not squandered. They need to create an enabling environment that supports the channelling of increased producer revenues into investment and growth. But this may not be straightforward given other policy claims and constraints such as defending food security and controlling inflation. Targeted input subsidies, investments in productive infrastructure such as storage and irrigation, risk management, research and extension involve significant budgetary cost.

At national level, increasing food prices fuel inflation and volatile food import bills threaten exchange reserves and disrupt and slow growth and development. Where agricultural commodity exports are significant, price volatility on international markets can be transmitted to government revenues and the rest of the economy.

Further, on the supply side, food price inflation is the result of dynamic forces that occur both at the farm where the raw agricultural ingredients for retail food items are produced, and along the marketing chain as the farm output is transformed and moved to the retail customer. An array of costs are layered on top of the price of the raw agricultural commodity, including handling, transportation, storage, and processing, as well as the insurance, financing, and advertising costs necessary to move the product to the retail customer. The relative importance of these marketing costs varies widely for different retail food products depending on the degree of processing and transformation (i.e., cleaning, packaging, shipping, advertising, etc.), As a result, economic forces such as higher energy costs or increased labor rates do not impact all food categories equally (Schnepf, 2012),

**2.4 Price levels, price volatility and unpredictability of prices**

FAO (2011) states that in analyzing food prices, it is important to distinguish between several related, but different, concepts. One important distinction is that between average prices over time and variability (volatility) of prices over time. It is possible for average prices to change without any change in variability. One simple way that might happen would be if a food-importing country were to impose a constant tariff on imports, the tariff would make food more expensive, but in most circumstances it would have no effect on the variability of domestic prices. Conversely, it is also possible to have a change in price variability with no change in the average level. This might happen, for example, if the weather became more variable but food production remained the same on average.

That being said, price levels and price volatility are related – they are both determined by supply and demand. In addition, high prices tend to be correlated with high volatility. Initially, high prices encourage people to draw down their stocks, which can moderate price changes that would otherwise have been caused by supply and demand shocks. However, once stocks have been drawn down, the system is vulnerable to a further supply or demand shock. The absence of the buffer means that price variation will tend to be greater than if stocks were available.

Another crucial distinction is that between variability and unpredictability. Prices exhibit variability for many reasons, but some price changes may be largely predictable. The classic example of predictable changes in food prices is seasonality, whereby prices are lowest during and soon after harvest and highest immediately before harvest. While seasonal changes are not exactly constant from year to year, they are often similar from one year to the next. Weather shocks, on the other hand, are typically unpredictable and may lead to

unpredictable changes in prices, especially if stocks are low to begin with. Therefore, some price changes are relatively easy to anticipate and others are much harder to predict. Predictable changes in prices have different costs and benefits than unpredictable changes.

## 3. Research objectives and hypotheses

### 3.1 Research objectives

This study meant to:

1. Identify the price trend of cabbage, carrot, and potato for the period of 2002 to 2011.
2. Identify the degree of price volatility (farmgate and retail) of the selected high value vegetables in Cordillera Administrative Region, Philippines.
3. Determine the difference in the price volatility between farmgate and local retail; farmgate and Metro Manila retail; and local retail and Metro Manila retail.
4. Determine the extent of relationship of production area, weather conditions such as amount of rainfall and temperature, and volume of importation to the prices of the selected vegetables.

### 3.2 Hypotheses

The following hypotheses were assumed for testing:
1. There is high degree of volatility of the prices of the selected high value vegetables.
2. There is difference in the price volatility between farmgate and local retail; farmgate and Metro Manila retail; and local retail and Metro Manila retail.
3. There is relationship of production area, weather conditions, and volume of importation to the prices of the selected high value vegetables.

### 3.3 Research methodology

The study covered Cordillera Administrative Region which is known as the major producer of high value vegetables in the Philippines. The research method involved multivariate, descriptive and inferential analysis. Multivariate analysis specifically seasonal decomposition was applied to present the price trend of cabbage, carrot and potato for the period of 2002 to 2011. Descriptive analysis was used for the mean tests and degree of price volatility of the selected high value vegetables. Further, inferential statistics including Analysis of Variance (ANOVA) and Tukey test, and Pearson correlation was used to measure the difference of price volatility between the types of prices and to investigate the relationship of production area, weather conditions, and importation volume to the types of prices respectively.

The research employed secondary data retrieved from the on-line database of the Bureau of Agricultural Statistics (www.bas.gov.ph), This included monthly data on farmgate and retail prices in Baguio and Metro Manila; and annual data on production area and importation volume of the selected highland vegetables. Likewise, monthly data about weather conditions in the region especially the amount of rainfall and temperature for the given period were collected from the Benguet State University-Philippine Atmospheric, Geophysical and Astronomical Services Administration (BSU-PAGASA), Data gathering was conducted from June to August, 2013. Other information pertinent to the research was obtained through internet and library research.

## 4. Analysis and interpretation

## 4.1 Price Trend Analysis

### 4.1.1 Price Trend of Cabbage

Figure 2 shows the seasonal adjusted prices of cabbage from 2002-2011. The farmgate and retail prices show no consistent upward and downward trend of prices although it can be observed that both the local retail and Metro Manila retail prices exhibited the same pattern as the farmgate price. This explains that when prices of cabbage at the farm level either increase or decrease, it is carried over at the retail level. Data consistently show peaks and valleys. Mostly, it is observed that prices rise during the second and last quarters of the year. The rainy season often starts at the second quarter and for this reason it may had caused the cabbage price to increase. In addition, the increased price during the last quarter may also be attributed to weather condition like typhoon which often occurs during this season. The low supply of vegetables towards the start of the fourth quarter as affected by the planting season in preparation to Christmas celebration and even aggravated by damage crops due to typhoon promotes higher price.

The highest quarterly average price of cabbage for all the price type was listed on the fourth quarter of 2009. This can be related to several factors: primarily, there was a decline in the area planted with cabbage resulting to a decrease in the production volume. Typhoon *"Ondoy"* and "*Pepeng"* had also affected the region during the latter quarters of 2009 leaving much damage on crops. In addition, it can be noted that the price peak in 2009 was followed by a dropped the following year of 2010 and an increased price in 2011. The increased volume of supply for 2010 and decreased for 2011 can be considered as contributing factor to this event.

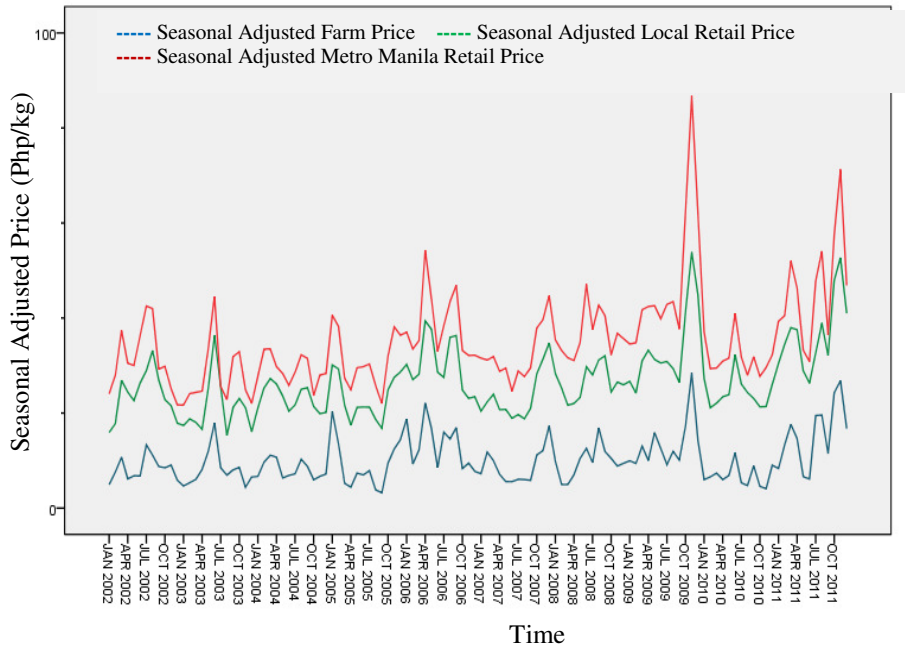


**Figure 2:** Seasonal adjusted series for prices of cabbage

### 4.1.2 Price trend of carrot

As presented in Figure 3, the prices exhibited a sudden rise and fall. The prices often increase during the second and fourth quarters each year. The susceptibility of carrot to excessive amount of water brought by too much rain which is normally experienced during the start of second quarter leads to increase in price, while the holiday season can be attributed to the price hike during the last quarter.

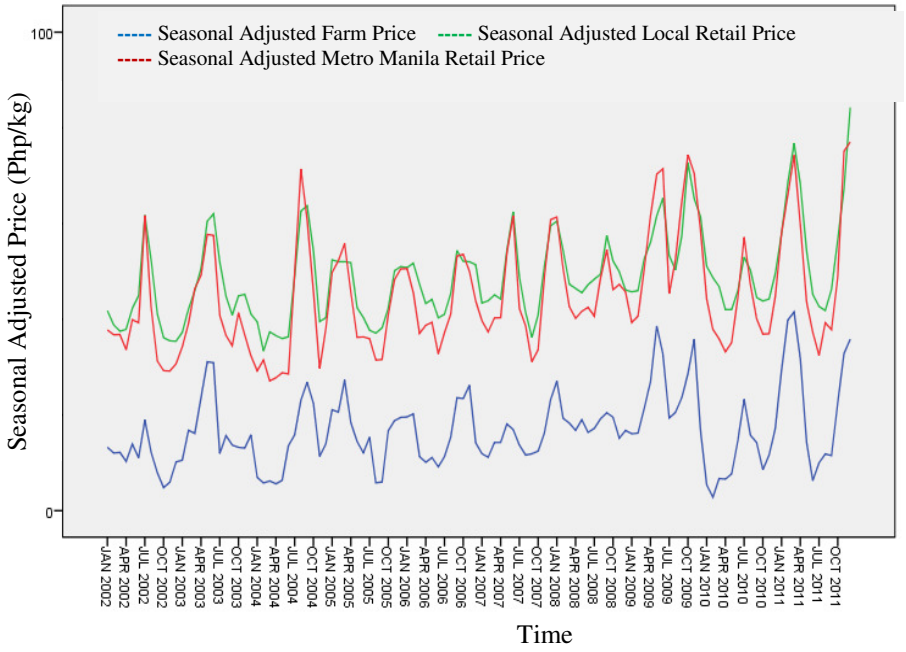


**Figure 3:** Seasonal adjusted series for prices of carrot

For the periods of 2009-2011, the same events as that of cabbage were seen to have affected the rise and fall of carrot prices. It can be observed that local retail prices are higher than the Metro Manila retail prices. This may be explained by increase in local demand for carrot while most of the produce were brought to the Metro Manila markets. Thus the increase in demand but low supply results to higher local retail price. Further, the figure shows greater difference between farm price and retail price. This observation is similar to potato. This could be explained by the added activities required after the vegetables are delivered in the trading areas. These value added activities increase the retail prices.

### 4.3 Price trend of potato

Figure 4 presents similar pattern for the three types of prices. Potato prices display an increasing trend during the latter periods. Data show that volume of supply for the last five years almost doubled the production of the first five years. However, prices were observed to be increasing. This event may be attributed to the increasing demand for potato by fast food stores. Though there was an increase in the supply, it may not match with the growing demand thus it commands higher prices. On the other hand, more erratic price movements were noticed from 2009 to 2011. As compared with cabbage and carrot prices, fourth quarter of 2009 exhibited the highest price. The sudden rise and fall of the volume of supply during these periods are seen as contributing factor. In addition, the figure depicts a very close movement of the retail prices which is similar to the carrot retail prices. Since carrot and potato do not easily deteriorate during transport, the local and Metro Manila retail prices do not vary much unlike the cabbage.

### 4.4 Price volatility

The quarterly price volatility index of the selected commodities in three types of prices from 2002 to 2011 as expressed in percentage is presented in the following sections. Price volatility has become a concern of all the stakeholders involved in the vegetable sector such as the government, the farmers, and the retailers among others.

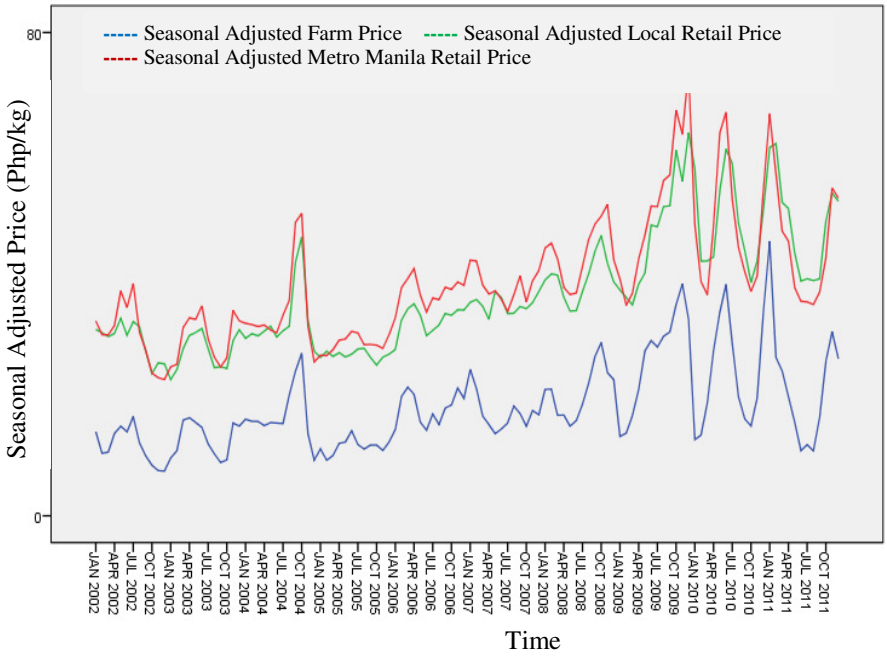


**Figure 4:** Seasonal adjusted series for prices of potato

This price volatility is interrelated with the levels of prices. Too high or too low vegetable price may result to excessive volatility which implies that the higher the price, the higher the effect on the consumers' welfare while the opposite is true for producers. The price volatility is driven by several predictable (i.e., seasonality) and unpredictable (i.e., weather shocks) factors. Volatile prices have a major impact on food security because it may affect household income and purchasing power. Thus, an action to regulate prices must be considered to address issues confronting both producers and consumers due to volatile prices.

### 4.5 Cabbage price volatility

Figure 5 shows the cabbage price volatility index. It can be observed in Figure 5 the high degree of farm price volatility as compared to retail price volatility. This large extent of farm price volatility imposed risk among cabbage farmers. This is supported by the finding of FAO *et al.* (2011) stating that price variations become problematic when they are large and cannot be anticipated and, as a result, create a level of uncertainty which increases risk for producers as well as for traders, consumers and governments. The degree of volatility of the retail prices shows almost the same pattern. In addition, the higher farm price volatility of cabbage as shown in the figure revealed that farmers have no control over the prices of their produce. They are mostly constrained with the prices dictated by the traders whose pricing may also be affected by supply availability in the region and those from other areas, the imports, weather conditions, transport cost and target profit margin among others. In general, results show high degree of price volatility of the selected vegetables. Hence, this confirmed the assumption that there is high degree of price volatility of the selected vegetables.

### 4.6 Carrot price volatility

Figure 6 presents the price volatility of the three types of prices of carrot for the periods covered. The carrot farmgate price shows higher and more irregular volatility as compared to the retail prices. The susceptibility of both cabbage and carrot to heavy rains often experienced in the region is contributing to large fluctuation of prices at the farm level thus higher volatility. The highest volatility was recorded in the last quarter of 2009. It can be recalled that on the latter months of 2009, two consecutive typhoons affected the region resulting to flash floods and landslides that damaged crops but increased price and volatility. The recorded decline in the supply of carrot and the large amount of import in 2009 contributed to the price differences between the local retail price and Metro Manila retail price.

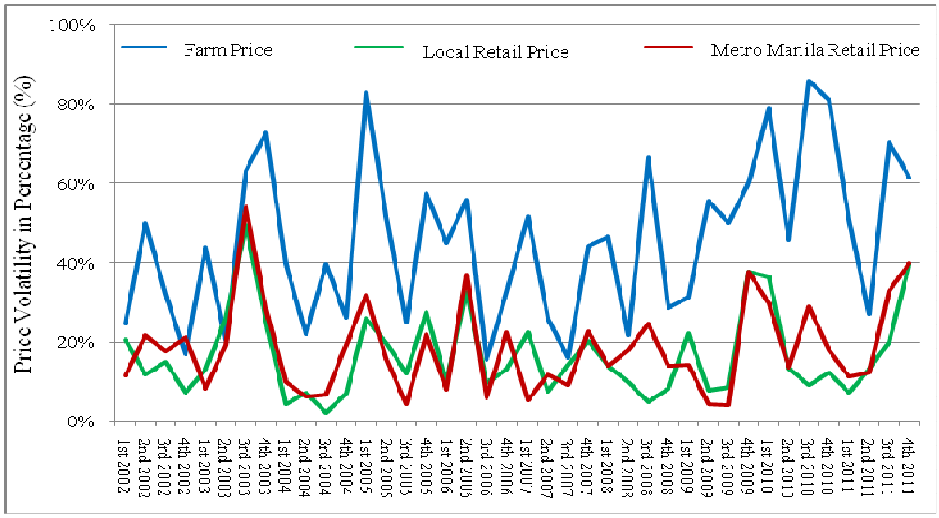


**Figure 5:** Quarterly price volatility index of cabbage

The Metro Manila retail price volatility displays higher but almost similar pattern to that of the local retail price volatility for the ten-year period. This may be attributed to the potential increase in demand for carrot but may not match with the supply. The volume of imports irregularly sold at the Metro Manila markets make the price movement more unpredictable as well.

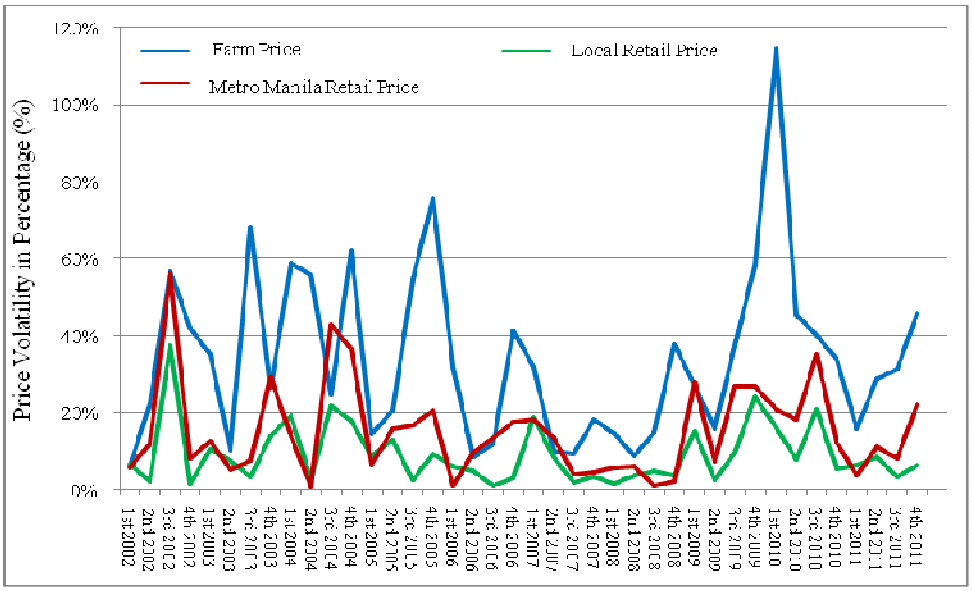


**Figure 6:** Quarterly price volatility index of carrot

### 4.7 Potato price volatility

The carrot prices show almost the same pattern as shown in Figure 7. The farmgate price is more volatile as compared to both the retail prices which may be the result of the farm price being often dictated by the traders. On the other hand, the figure depicts lower price volatility as compared to cabbage and carrot. This entails that since potato can be stored for a longer period, it is not easily affected by the irregularity of prices in the market since farmers can hold their produce and deliver when price is more favorable.

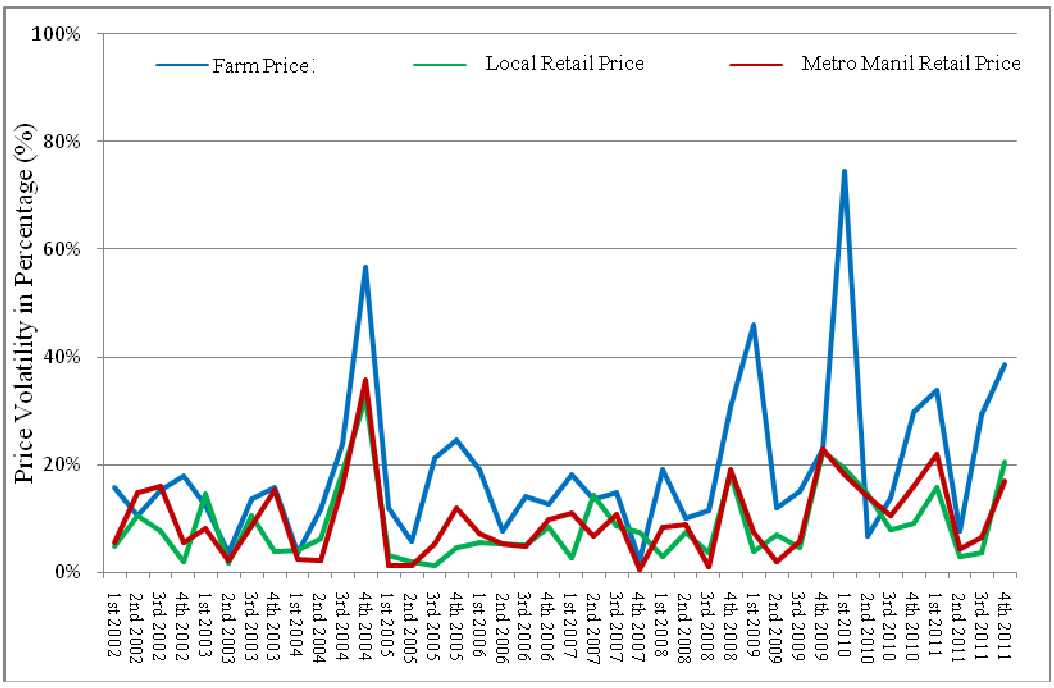


**Figure 7:** Quarterly price volatility index of potato

### 4.8 Price volatility differences

### 4.8.1 Differences in mean volatility per type of vegetable

Table 1 reveals the differences in mean volatility of the selected vegetables. It can be observed from the table that the difference of volatilities is statistically significantly at 0.001. The cabbage farm price yielded the highest volatility. The nature of cabbage as being perishable may explain the extent of its volatility. The findings show that the more perishable the vegetable, the more volatile it is and the more storable the vegetable, the less volatile it is.

It is noted from Table 1 that the price volatility of carrot also differed significantly to both cabbage and potato. Agricultural commodities in contrast to manufactured products are considered more volatile because of a range of uncontrollable factors affecting its production and marketing. Table 1 shows a significant difference of potato price volatility in relation to cabbage and carrot price volatility and the type of price at 0.001. The table reveals that potato price is the least volatile. However, this is not an indication that prices move along a smooth and well- established trend since this still creates price fluctuations in the market affecting both farmers and consumers decision.

**Table 1:** Differences in mean volatility per type of vegetable

| Price type | Mean price volatility | | | F-Computed |
|---|---|---|---|---|
| | CABBAGE | CARROT | POTATO | |
| Farm | 78.17 | 59.32 | 33.24 | 17.755*** |
| Local retail | 29.26 | 15.96 | 15.04 | 10.089*** |
| Metro manila retail | 31.81 | 26.50 | 16.72 | 6.928*** |
| F-computed | 45.227*** | 28.008*** | 12.868*** | |

Legend: ns = not significant, *= significant at 0.05, **= significant at 0.01, *** = significant at 0.001

### 4.9 Differences in mean volatility per type of price

Using Tukey test, Table 2 explains the differences in mean volatility of the selected vegetables particularly the farm, local retail and Metro Manila retail prices. The findings reveal that the types of prices differed significantly. Thus the hypothesis that there is difference in the price volatility among the types of prices such as between farmgate and local retail; farmgate and Metro Manila retail; and local retail and Metro Manila retail is accepted.

Table 2 shows the farm price volatility of the selected vegetables in particular subset. This means that farm price volatility of the selected vegetables differs with each other. Since cabbage farm price volatility occupies the third subset, this implies that it is the most volatile in relation to the other types of prices and vegetables. There is substantial difference of farm price volatility to the retail price volatility. This implies that farm prices are responsive to every factor or variable that may cause possible price changes such as the cost of farm inputs, productivity of the area planted and farmers' expectation of higher price among others.

It is also observed in Table 2 that the local retail price volatility of both potato and carrot reveals almost similar volatility as shown by their respective mean volatility of 15.03% and 15.96%. Table 5 reveals the differences in mean volatility of the selected vegetables at the Metro Manila retail. Potato price volatility in Metro Manila retail indicated the least volatile

among the other vegetables. Alternatively, carrot and cabbage shows comparable but higher mean volatility with 26.50% and 31.81% respectively.

**Table 2:** Differences in mean volatility per type of price

| Price type | N | Subset for alpha = 0.05 | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| Farm price | | | | |
| Potato | 40 | 33.24% | | |
| Carrot | 40 | | 59.32% | |
| Cabbage | 40 | | | 78.17% |
| Sig. | | 1.00 | 1.00 | 1.00 |
| Local retail price | | | | |
| Potato | 40 | 15.03% | | |
| Carrot | 40 | 15.96% | | |
| Cabbage | 40 | | 29.26% | |
| Sig. | | .96 | 1.00 | |
| Metro Manila retail price | | | | |
| Potato | 40 | 16.72% | | |
| Carrot | 40 | | 26.50% | |
| Cabbage | 40 | | 31.81% | |
| Sig. | | 1.00 | 0.40 | |
| Means for groups in homogeneous subsets are displayed. | | | | |
| a. Uses Harmonic Mean Sample Size = 40.000. | | | | |

### 4.10 Correlation analysis

In the Philippines, changes of vegetable prices may be attributed to some controllable and uncontrollable factors such as production area, production supply and weather conditions. These observations substantiated the findings of FAO (2012) that price volatility is affected by natural shocks such as weather conditions, the inelasticity of demand and supply in the short-run, and the agricultural production which takes considerable time.

### 4.11 Correlation analysis for cabbage prices

The rainfall amount and temperature is slightly correlated to cabbage farm price as shown in Table 3. However, only the rainfall amount shows significant relationship to farm price at 0.10 level of significance. The excessive rainfall amount experienced during typhoon affects the farm price as this may result to damage of crops. The case of extreme temperatures may also affect cabbage prices at the farm level since cabbage is a leafy vegetable. Significant low correlation of local retail price to rainfall amount and temperature is observed. The rainfall amount shows significant slight correlation to the Metro Manila retail prices. This is due when excessive rain especially during typhoon is experienced in the region. It often causes road cuts or landslides and damaged crops which eventually cause decreased supply in the Metro Manila and increased prices.

**Table 3:** Correlation of cabbage prices to the different factors

| Type of price | Factors | Corr | Sig |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Farm | Rainfall[a] | .176* | .055 |
| | Temperature[a] | .130 | .163 |
| | Production area[b] | .318 | .370 |
| | Imports[b] | -.347 | .326 |
| Local retail | Rainfall[a] | .213** | .019 |
| | Temperature[a] | .245*** | .008 |
| | Production area[b] | .476 | .164 |
| | Imports[b] | -.424 | .222 |
| Metro Manila retail | Rainfall[a] | .189** | .039 |
| | Temperature[a] | .139 | .136 |
| | Production area[b] | .548 | .101 |
| | Imports[b] | -.450 | .192 |
| Legend: a. Using monthly data; b. Using annual data since no available monthly data<br>0.00 to ±0.20 – slight correlation; ±0.21 to ±0.40 – low correlation; ±0.41 to ±0.60 – moderate correlation; ±0.61 to ±0.80 – high correlation; ±0.81 to ±1.00 – very high correlation<br>* Correlation is significant at the 0.10 level; ** Correlation is significant at the 0.05 level; *** Correlation is significant at the 0.01 level | | | |

## 4.12 Correlation analysis for carrot prices

Table 4 shows the correlation of selected variables to carrot prices. The carrot farm price shows a significant slight correlation to rainfall amount. Adverse rainfall amount affects the production of carrot. The effect is observed both at the farm and retail levels. The local retail price exhibits significant correlation to the rainfall amount and production area. The temperature and importation volume show no correlation to the local retail price. The Metro Manila retail price is significantly correlated to the rainfall amount and production area which shows low and high correlation respectively. Table 4 reveals changes in the area planted affect the local retail and Metro Manila retail prices. Both temperature and importation volume show no correlation to Metro Manila retail prices.

**Table 4:** Correlation of carrot prices to the different factors

| Type of price | Factors | Corr | Sig |
|---|---|---|---|
| Farm | Rainfall[a] | .198** | .030 |
| | Temperature[a] | .038 | .683 |
| | Production area[b] | .416 | .232 |
| | Imports[b] | -.173 | .632 |
| Local retail | Rainfall[a] | .264*** | .004 |
| | Temperature[a] | .136 | .146 |
| | Production area[b] | .662** | .037 |
| | Imports[b] | -.297 | .405 |
| Metro Manila retail | Rainfall[a] | .265*** | .004 |
| | Temperature[a] | .105 | .262 |
| | Production area[b] | .627* | .052 |
| | Imports[b] | -.340 | .336 |
| Legend: a. Using monthly data; b. Using annual data since there are no available monthly data<br>0.00 to ±0.20 – slight correlation; ±0.21 to ±0.40 – low correlation; ±0.41 to ±0.60 – moderate correlation; ±0.61 to ±0.80 – high correlation; ±0.81 to ±1.00 – very high correlation<br>* Correlation is significant at the 0.10 level; ** Correlation is significant at the 0.05 level; *** Correlation is significant at the 0.01 level | | | |

### 4.13 Correlation analysis for potato prices

Table 5 shows no significant correlation of weather conditions to the farm price of potato which reveals that potato is not easily affected by extreme weather conditions which may be due to its storability. However, both production area and volume of imports display significant high correlation to farm price. There is no significant relationship between weather conditions and imports to the local retail price of potato. The table shows significant very high correlation between production area and the local retail price. The Metro Manila retail price is affected by changes in the production area and importation volume. The table shows very high correlation of production area and high correlation of imports to Metro Manila retail price. The positive correlation entails that an increase in production area and the volume of imports do not necessarily decrease the price due to increase in supply since price may be affected by other factors such as the demand for the commodity.

The results show significant correlation of vegetable prices to some variables. However, the extent of relationship is particular to each of the vegetable. A positive slight to very high correlation is observed. Thus, this finding accepts the hypothesis that there is relationship of production area, weather conditions, and volume of importation to the prices of the selected high value vegetables.

**Table 5:** Correlation of potato prices to the different factors

| Type of price | Factors | Corr | Sig |
|---|---|---|---|
| Farm | Rainfall[a] | .039 | .674 |
| | Temperature[a] | .000 | .996 |
| | Production area[b] | .797*** | .006 |
| | Imports[b] | .695** | .026 |
| Local retail | Rainfall[a] | .045 | .626 |
| | Temperature[a] | .062 | .511 |
| | Production area[b] | .865*** | .001 |
| | Imports[b] | .463 | .178 |
| Metro Manila retail | Rainfall[a] | .058 | .528 |
| | Temperature[a] | .018 | .851 |
| | Production area[b] | .858*** | .002 |
| | Imports[b] | .669** | .034 |

Legend: a. Using monthly data; b. Using annual data since there are no available monthly data
0.00 to ±0.20 – slight correlation; ±0.21 to ±0.40 – low correlation; ±0.41 to ±0.60 – moderate correlation; ±0.61 to ±0.80 – high correlation; ±0.81 to ±1.00 – very high correlation
* Correlation is significant at the 0.10 level; ** Correlation is significant at the 0.05 level; *** Correlation is significant at the 0.01 level

## 5. Conclusions and recommendations

### 5.1 Conclusions

The prices of the selected vegetables involving farm, local retail and Metro Manila retail were erratic for the whole periods covered. There is no consistent surge and decline of prices observed except for potato which exhibits increasing trend from 2005 to 2011. The farm and retail prices of cabbage, carrot and potato are volatile. The farm price is the most volatile among the type of prices and likewise cabbage prices illustrated the highest volatility in

relation to carrot and potato prices. Retail price volatility exhibits comparable volatility or almost similar price volatility. On the other hand, the farm price reveals more extreme volatility. Vegetable prices specifically farm and retail are affected significantly by several factors such as the weather conditions including rainfall amount and temperature, the production area, and volume of imports. The relationship of the selected variables to the vegetable prices indicates positive slight to very high correlation.

### 5.2 Recommendations

The formulation of programs and/or policies that might address the underlying issues on volatile prices must be taken into consideration. The following of which may be recommended:

1. The lack of education of some farmers often compels them in making incorrect decisions. An intensive training on production programming for example to further educate farmers may address the issues concerning volatility of prices at the farm level. In addition, most farmers do not have the ability to market their produce to the consumers making them rely much on the traders; however, these traders frequently put the farmers at their expense by dictating the prices of the vegetables. Organizing the farmers and linking them to the business sectors may be considered an effective strategy to aid them in marketing their vegetables.

2. One issue confronting farmers is the lack of capital and declining productivity of the soil which may result discouragement to continue production and eventually leave the farm and/or convert the farms to residential/commercial areas. This, if happens may pose greater risk to consumers in terms of food security. The provision of input assistance to the farmers such as financial support and/or credit services and developing high yielding varieties may promote continued production.

3. Farmers are constrained with several uncontrollable factors affecting their operation like adverse weather conditions, poor and/or lack of infrastructure facilities among others. The results reveal that cabbage and carrot prices are more volatile due to their susceptibility to intense weather conditions and at the same time their perishability. More investments on infrastructure projects like farm to market roads, greenhouse, and cold chain facilities may be considered to solve the predicament of the farmers.

4. Research and development of resistant seed varieties and climate resilient crops that will improve vegetable production in the region and likewise support farmers and consumers should be undertaken.

### 5.3 Limitation of the Study and Future Work

This research on price volatility is limited to cabbage, carrot and potato for a ten-year period. Future study on similar research could be extended to a greater periods and wider range of commodity. A set of various statistical analyses should also be used to compare and validate the results.

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