

CAN COLD STORAGE REDUCE SEASONAL VARIATION IN PRICES OF AGRICULTURAL COMMODITIES? A CASE OF POTATO IN BANGLADESH

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ABSTRACT

Cold storage has a significant role to maintain supply of potato throughout the year in a country and hence it can influence to reduce the seasonal price variations because in agriculture supply mainly regulates the price of commodities. This study was undertaken to investigate whether the cold storage can reduce the seasonal variation in prices of potato in Bangladesh. National data on monthly wholesale prices of potatoes (potato local, potato Holland white and red) were collected during the period from 1972 to 2018 from Department of Agricultural Marketing. Ratio to the moving average method was applied to measure the seasonal price indices between the two periods (before establishing sufficient capacity of cold storage and after establishing sufficient capacity of cold storage for storing potato in Bangladesh) for assessing whether the cold storage can reduce seasonal variation in prices of potato. From the study it was revealed that seasonal price variation of different varieties of potatoes became lower after establishing sufficient cold storage capacity (more than 30 per cent of total potato production from 1988 to 2018) in the country, i.e., there is an impact of cold storage in reducing the seasonal price variation of potato. Because price variations for individual months, coefficient of variation and range, all of them are lower after establishing sufficient capacity of cold storage. So, cold storages can reduce the seasonal variation in prices of potato. Government should facilitate more for establishing cold storage; these facilities can improve the seasonal price fluctuations of other vegetables also.

Keywords: Cold storage, seasonal price variation, agricultural commodity, potato, Bangladesh

I. INTRODUCTION

Cold storage is an agro-based industry in Bangladesh which is being used mostly to preserve potato. A perishable commodity like a potato is required to be stored under controlled temperature and humidity to prevent losses accruing from quantity damage and quality deterioration. The potato production has been increased tremendously in Bangladesh since its independence. Potato is not only the source of nutrients, but also

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a source of cash income for farmers. It plays an important role in improving the standard of living of the farmers. So, government should give attention more to maintain its reasonable price throughout the year. Seasonal variation in price of potato is more prominent than that of many other field crops. The price becomes very low during peak harvesting period while it becomes too high before planting period. Frequent excessive price variations can create uncertainty about the market price and enhance risks in potato production as well as potato business. A huge amount of potato (9725 thousand metric tons) was grown in Bangladesh in the fiscal year 2017-2018. It is more than 11 times of potato production since the independence of Bangladesh. For maintaining, regular supply of potato throughout the year, more than 400 cold storages (capacity of 5500 thousand metric tons) have been established in the country mainly at the private level (BBS, 2018).

The price of agricultural commodities fluctuates more than are the prices of most nonfarm goods and services. Mainly supply of agricultural commodities determines the price of the commodities (Tomek and Kaiser, 2014). Since, agricultural commodities are necessary; most of them are inelastic demand (Tomek and Robinson, 2003). So, if the stable supply in the market cannot be maintained properly then there will be a chance of being higher price fluctuation. Instable prices can affect the income of producers greatly. A sharp price decline during and immediately after harvest, deprives the potato farmers from getting a remunerative market price for their produce. If the farmers fail to sell their produce at an incentive price, they are likely to discontinue its production which may adversely affect the economy.

Many agricultural commodities, the principal source of seasonality in prices originates from the supply sides. Seasonal variability in demand can also exist for agricultural products but they are limited in number. Potato has a constant demand throughout the year; it is not influenced by the season. Prices of agricultural products become very low in the harvest period because of more supply in the market. If a sufficient amount of product is stored at harvest period and if market can allocate the available supply over the year to meet a continuous demand, then the price will remain at a reasonable level (Tomek and Robinson, 2003). Potatoes are stored for getting the highest price in future because the supply will be lower after harvest period and later on period, but demand for potato will be more or less constant throughout the year. In this case, cold storage can play an important role regarding the stable supply of potato all the seasons and maintaining a stable price. So, it is an important issue to examine whether the cold storage can reduce the seasonal price variations of potato.

Potato (*alu*) is edible tuber of the cultivated plant *Solanum tuberosum* of the family Solanaceae. The potato has been cultivated as a staple food in at least 40 countries of the world (Islam, 1987). In Bangladesh the cultivation of potato was started in the late 19th century (Siddique and Hussain, 1988). At least in 100 countries of the world, it is the most important vegetables. Several hundred varieties of potatoes are grown

in the world. Potato varieties that are cultivated in Bangladesh are broadly categorized into two groups, local and high yielding. Potato is a staple food in the developed countries and which accounts for 37% of the total production in the world (FAO, 1995). Considering the trend of population growth and consequently the increased demand for food in the country and dwindling cultivable land area, the potato is likely to play a vital role in the future.

Potato is a popular and important vegetable in Bangladesh. For the whole year, it is used as the main vegetable. The land and climatic condition of Bangladesh with abundant water and humid temperature is ideally congenial to the cultivation of potato. The area, production and yield of potato have increased significantly during the last three decades in Bangladesh. Bangladesh is the third largest potato producer in Asia and is among the top 10 of the potato producing countries (FAOSTAT, 2019) of the world. It ranks third in area acreage after rice and wheat and cultivated in almost all agro-ecological regions of Bangladesh.

There was not a single cold storage plant in Bangladesh before 1960. Twenty-seven cold storage plants with a total storage capacity of 26928.30 metric tons were in operation in 1968 and stored 25195.10 metric tons potato as against 3896.50 metric tons stored in 1963. The quantity of potato stored in 1968 was 546.60 percent higher than that the year 1963 (GOEP, 1969). There were 165 cold storage plants with a total capacity of 964088 metric tons suitable for potato storage in the country in the year 2009 and stored 733500 metric tons of potato. There were 420 cold storage plants for storing potato in the country in the year 2016 (BBS, 2016).

Since 1987-88, it was found (Figure 1) rapid increment of cold storage capacity in Bangladesh. It is a good sign for the development of perishable products as well as for the development of the economy. Before that it was very small amount of capacity (about 1 percent) as a per cent of total production of potato. During the period from 2000-01 to 2017-18, capacity of cold storage as a per cent of potato production varied from 40 to 55 per cent. And it has been reached at 98 per cent in the year 1997-98 and then it has been gradually decreased and reached at 42 per cent in the year 2004-05.

Unfortunately, due to inadequacy of post-harvest, cold storage facilities, the farmers suffer a huge loss and damage of perishable produces, and become victims of exploitation by middlemen and local wholesalers at both producers and consumers end. The purpose of storing potato in cold storage is to maintain tubers edible condition and to provide a uniform supply of potato to the market during off-season. Cold storage helps in the price stabilization of perishable commodities by removing the gluts occurring in the production season (Kohls and Uhl, 1980). Cold storage helps in the orderly marketing of perishable items by eliminating or reducing storage loss and extending marketing periods, there by narrowing seasonal fluctuation in supply and prices. Cold storage plays a very important role in increasing production of potato by supplying quality seed potato in time (GOEP, 1969).

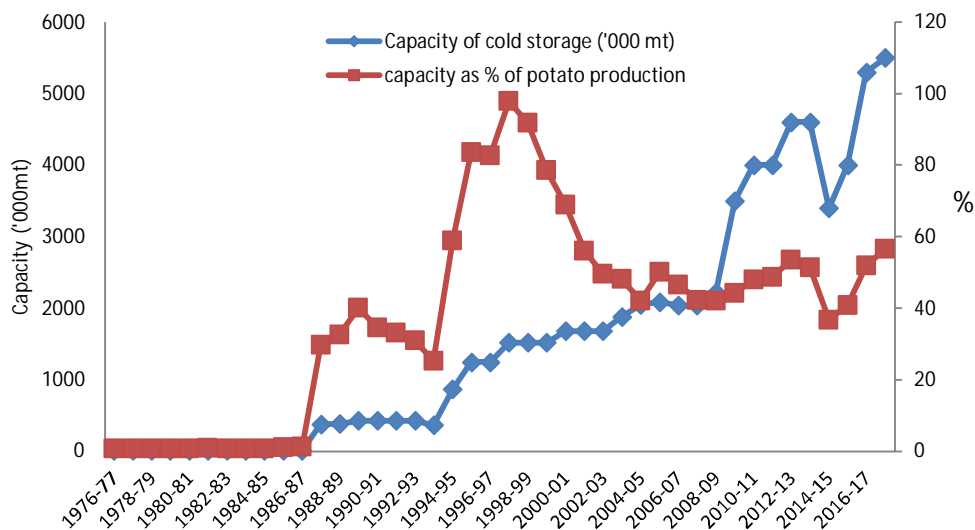


Figure 1: Year wise capacity of cold storage ('000 mt) and capacity as a percent of potato production during the period from 1976-77 to 2017-18 in Bangladesh

Source: Data used from BBS; figure is derived from the authors own calculation

Hajong *et al.* (2014) measured the seasonal price variation of potato in different periods (from 2000 to 2005, 2006 to 2010 and 2000 to 2010). Sabur (1986) estimated seasonal variation in price of potato market wise by using the ratio to moving average method during the period from 1961 to 1982 and found very high seasonal variation in prices of potato for each market. The author opined that lack of cold storage facility was the main reason for this high seasonal variation in prices of potato. Besides these some studies (Ahmad, 1979; Islam, 1987; Fuglie *et al.*, 1997; Minten *et al.*, 2010;) were conducted to measure mainly for marketing system of potato, production of potato, storage and utilization of potato, marketed surplus, economic and technical analysis of different types of post-harvest technology for storing potatoes, role of cold storages in the potato supply chain. The authors could not find any study directly related to the impact of cold storage in reducing seasonal price variation of the potato as a whole in Bangladesh.

Price plays an important role in guiding production, consumption and government policies. Potato prices tend to fluctuate mainly due to the inelasticity of demand and supply. For this reason, stability of prices is an important factor in working for economic decisions in agriculture as well as in the rest of the economy. If the supply of a product does not vary greatly throughout the year, then, there will have a less seasonal price fluctuation, and cold storage can maintain this regular constant supply of perishable products. In this perspective, an attempt has been made to examine whether cold storage can reduce seasonal variation in prices of potato in Bangladesh.

II. MATERIALS AND METHODS

This study was conducted to examine empirically whether cold storage can reduce seasonal price variation of potato in Bangladesh. In assessing this, the seasonal price indices of potato have been estimated by applying the ratio to moving average method before and after establishing the sufficient capacity of cold storage. Seasonal price behaviour is a systematic pattern that occurs within a year. For many agricultural commodities, the main source of seasonality originates from the supply side (Tomek and Kaiser, 2014). The author has found the time series data of capacity of cold storage since 1976-77. From figure 2, it is observed that the sufficient capacity of cold storage established in the year 1987-88 and it was around 30 per cent of total potato production and later on the capacity has been increased, before that period it was around 1 per cent. Monthly wholesale prices of potatoes were found from the year 1972 (potato local), so the whole period of monthly whole sale prices of potatoes was divided into two parts (before (1972 to 1987) and after (1988 to 2018) establishing sufficient capacity of cold storage). So, seasonal price index calculated by using monthly time series data before 1987-88 (from 1972 to 1987) and seasonal price index calculated by using monthly time series data since 1987-88 (from 1988 to 2018) have been compared to examine whether cold storage can reduce the seasonal variation in prices of potato. The impact was measured for the three types of potato; potato local, potato Holland (white) and potato Holland (red). The monthly wholesale prices of potato Holland (white) were found from the year 1991 and for the case prices of potato Holland (red) was from the year 2002. So, seasonal price indices in case of potato Holland (white and red) were compared with the seasonal price indices of potato (local) to measure whether cold storage can reduce the seasonal variation in prices of potato.

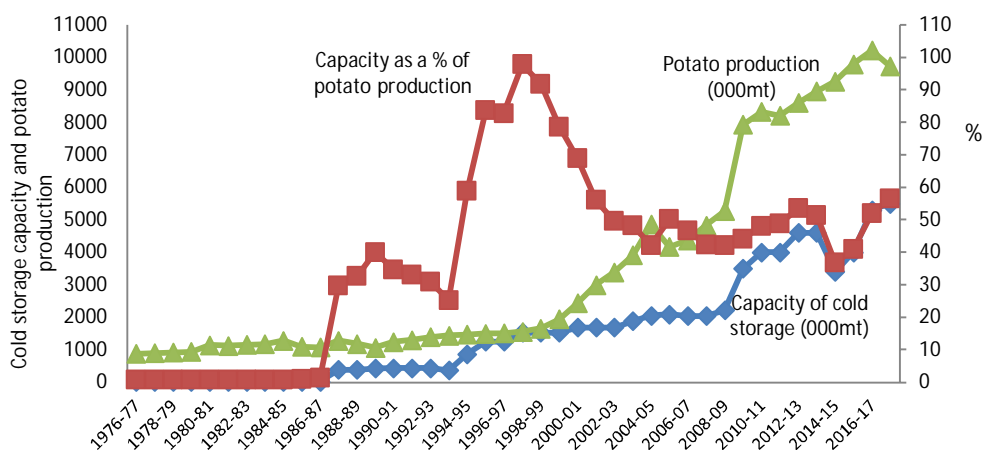


Figure 2: Year-wise capacity of cold storage, production of potato and capacity as a % of potato production in Bangladesh

Source: BBS of different years

This study is based on time series data on the monthly wholesale price of potato in Bangladesh. Secondary data were collected from the Bangladesh Bureau of Statistics (BBS), and Department of Agricultural Marketing (DAM). The collected data were checked and cross-checked for ensuring their reliability, accuracy and adequacy and thereby to make them meaningful for the present study. All the collected data were summarized and scrutinized carefully. In case of the monthly wholesale price of potato collected from DAM, it has been found that some data were missing. Those missing values were estimated by the simple mean of the before one and after one observation. The collected data were summarized and analyzed to fulfil the objectives of the study.

The analysis of time series consists of separating and studying the nature and behaviour of its components (trend (T), cyclical (C), seasonal (S) and irregular (I)). These are two hypotheses as to the association of these components. One is multiplicative and the other is additive. In the multiplicative hypothesis, it is assumed that the components are joined together in a multiplicative fashion (Acharya and Agarwal, 1994). Multiplicative hypothesis was assumed in this study.

Multiplicative model:

$$P_t = T \times C \times S \times I \text{ (in case of monthly observations)}$$

Here P_t is an observation on the monthly wholesale price of potato for period t .

Ratio to the moving average method was used to examine the seasonal price variation of potato from the period of 1976 to 2018 and it is the most widely used method (Sabur, 1990; Sabur *et al.*, 2006; Hajong *et al.*, 2014; Meera and Sharma, 2016; Rayhan *et al.*, 2019) of measuring seasonal variations. Ratio to the moving average method is superior to others because this method provides a true seasonal variation; it has a power to eliminate the effect of the other three components (trend, cyclical and irregular) from the results (Acharya and Agarwal, 1994).

Twelve months moving average can eliminate the two components (seasonal and irregular) from the time series that means it consists of trend (T) and cycle (C). If the actual value for any month is divided by the 12-month moving average centered to that month, presumably cycle and trend are removed. This is given below. Thus, the ratio to the moving average represents irregular and seasonal influences. If the ratios for each worked over a period of years are then averaged most random influenced will usually be eliminated hence in effect: $[(S \times I) / I] = S$ (Meera and Sharma, 2016). For that reason, this method was applied to measure seasonal variation in prices of potato.

$$\begin{aligned} P_t/MA_t &= \frac{T \times C \times S \times I}{T \times C} \\ &= (S \times I) \end{aligned}$$

Here MA_t is a moving average at time t

Averaging this over the years and adjustment through a correction factor provides the best estimate of seasonal index. The correction factor is calculated as follows:

$$k = 1200/s$$

Where, k = correction factor

s = sum of average indices for 12 months

III. RESULTS AND DISCUSSION

In agriculture sector, price of commodity is mainly determined by the supply of that commodity (because of special characteristics of biological nature of the production process of agricultural commodities; demand is more or less constant in the short run) (Tomek and Kaiser, 2014), if supply of a commodity is more than demand for that commodity, price tends to be lower than average and vice versa. So, if stable supply of an agricultural commodity is maintained throughout the year (i.e., stable supply quarterly or monthly in a year) then the seasonal variation in prices will not be a greater extent. This stable supply of commodity can be maintained through storing, increasing the frequency of production in a year and importing. Potato is grown only one season in our country and country is depending for potato on the domestic production of potato only. There is no import of table potato. So, cold storage is the only tool for maintaining the stable supply of potato throughout the year in our country. Other factors (such as low production or bumper production, exporting, demand, more acreage etc.) do not have the much influencing power to fluctuate the monthly price of potato. For instance, if the production of potato becomes lower, then the price will be high and it will be the case for each month if cold storage (sufficient capacity) is available and if it works (i.e., very high price and very low price among the months of that year will not be in this case); so, price fluctuation will not be higher (in percentage term) among the months. On the other hand, if there is a bumper production of potato, then price of potato will be lower than average price for each of the months of that year if cold storage is available and if it works (i.e., very low price and higher price among the months of that year will not be in this case also); for that reason, price fluctuation will not be higher (in percentage term) among the months. So, for this study, if we can be able to show that the seasonal price variation of potato is lower after establishing sufficient capacity of cold storage in the country then it can be concluded that cold storage can reduce the seasonal variation in prices of potato in Bangladesh.

Seasonal price variation of potato (local) before and after establishing sufficient capacity of cold storage

Monthly wholesale prices of potato (local) were used during the period from 1972 to 1987 (before establishing sufficient capacity of cold storage) and the period from 1988 to 2018 (after establishing sufficient capacity of cold storage) for calculating

the seasonal price index for assessing whether cold storage can reduce seasonal price variation of potato (local).

It is evident from Table 1 that during 1972 to 1987, potato price index was the highest (142.00) in the month of November i.e., price becomes about 42 percent higher than the average price in this month and the lowest (58.66) in the month of March i.e., price becomes 41.34 percent lower than the average price in this month. On the other hand, potato price was 23.21 percent greater than the average price in the month of November during the period 1988 to 2018 (where it was 42 per cent before establishing sufficient capacity of cold storage) and the average price was greater in this month than that for any other months and lowest (68.46) in the month of March i.e. price becomes 31.54 percent lower (where it was 41.34 per cent before establishing sufficient capacity of cold storage) than the average price in this month. Hajong *et al.*, (2014) measured the seasonal price variations of potato period from 2000 to 2010 and found the lowest price also in the month of March.

Here it is a noticeable thing that the price pattern remains same in the two periods. There was no change in the month of highest price and lowest price. March is the lowest price for both the periods and November is the highest price for both the periods also. But the coefficient of variation (30.28) during the period (1972 to 1987) was higher than the coefficient of variation (18.72) during the period 1988 to 2018 that means a seasonal price variation of potato became lower after establishing sufficient cold storage capacity in the country. Hajong *et al.* (2014) measured the seasonal price variations of potato period from 2000 to 2010 and found coefficient variation and range 18.48 and 53.29 respectively. That is more or less similar results compared to this study's results. Sabur (1986) estimated the seasonal price variation of potato of different markets by using the same method during the period from 1961 to 1982 that is before establishing the sufficient capacity of cold storage. The author found highest seasonal price indices (from 150 to 161) in the same month (November) for different markets which were greater than the highest seasonal price index found from this study (after establishing sufficient capacity of cold storage) and found range between highest and lowest seasonal price indices from 91.74 to 113.14. He found violent seasonal variation in prices of potato and concluded that the violent seasonal variation in prices was mainly due to seasonal fluctuation in the arrival of potato in the market and suggested also for the program of constructing cold storages to prevent violent seasonal fluctuation in price.

Table 1: Seasonal price indices of potato (local) between the periods 1972 to 1987 (before establishing sufficient capacity of cold storage) and 1988 to 2018 (after establishing sufficient capacity of cold storage)

Month	Seasonal price index of potato (local) (1972 to 1987)	Changes in price (%) from average price of potato (local) (1972 to 1987)	Seasonal price index of potato (local) (1988 to 2018)	Changes in price (%) from average price of potato (local) (1988 to 2018)
January	84.39	-15.61	92.44	-7.56
February	59.86	-40.14	71.86	-28.14
March	58.66	-41.34	68.46	-31.54
April	69.15	-30.85	80.65	-19.35
May	80.37	-19.63	92.26	-7.74
June	90.06	-9.94	103.54	+3.54
July	101.73	+1.73	106.67	+6.67
August	125.46	+25.46	113.65	+13.65
September	124.19	+24.19	112.98	+12.98
October	129.06	+29.06	112.57	+12.57
November	142.00	+42.00	123.21	+23.21
December	135.02	+35.02	121.65	+21.65
CV	30.28		18.72	
Range	83.33		54.74	

N.B.: Negative (-) sign indicates decreased and positive (+) sign indicates increased

Source: Authors' own calculation by using data from DAM

It is also evident from Figure 3, that the seasonal price index line of the period 1988 to 2018 is closer to the average price index (100 here) than the seasonal price index of the period 1972 to 1987 i.e., seasonal price variation became lower in the period 1988 to 2018 (after establishing sufficient cold storage capacity) than the previous period. Smith (1963) comparing the seasonal variations in prices of farm commodities between the two periods through this way. It is evident from Table 1 and Figure 4 that changes in prices (%) from the average price of potato were less (in absolute term) in every month in the period 1988 to 2018 than the period 1972 to 1987 except in the month of July. Hence cold storage has the impact to reduce the seasonal price variation of potato (local).

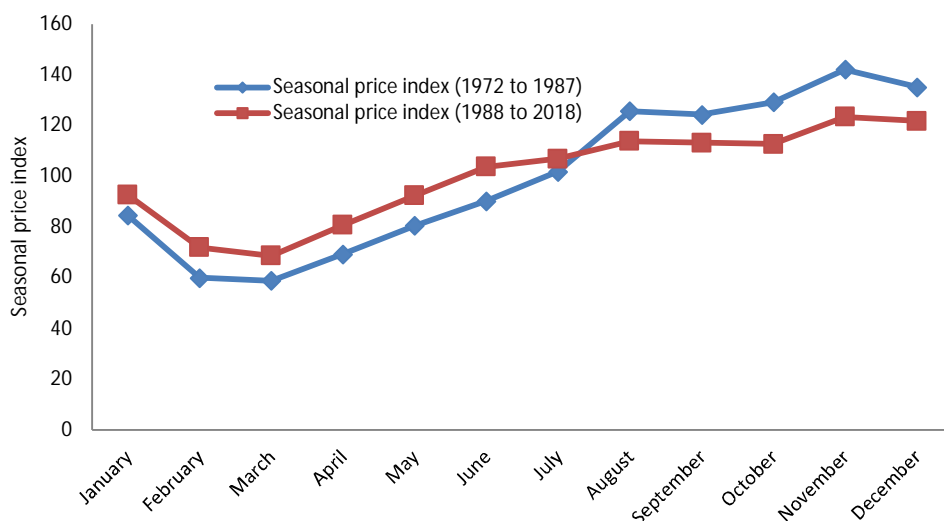


Figure 3: Seasonal price indices of potato (local) for two periods between the periods 1972 to 1987 (before establishing sufficient capacity of cold storage) and 1988 to 2018 (after establishing sufficient capacity of cold storage)

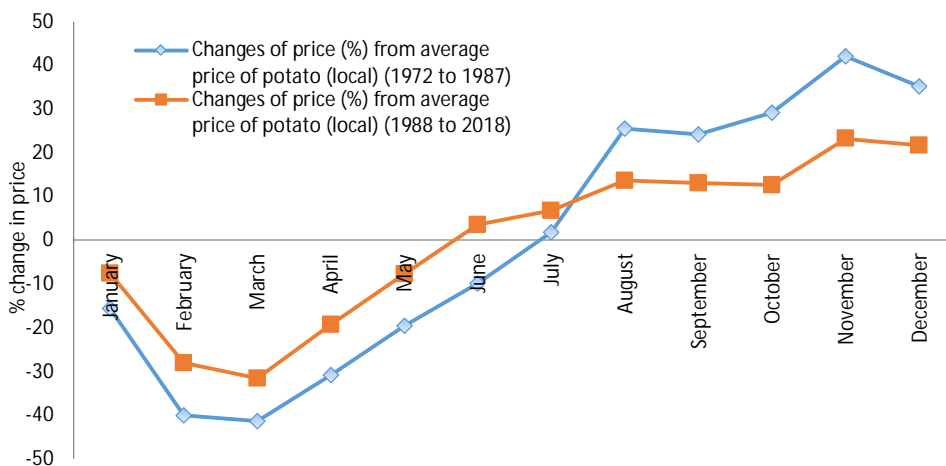


Figure 4: Comparison of average seasonal price variations of potato (local) between the periods 1972 to 1987 (about 1% capacity of cold storage i.e., before establishing sufficient capacity of cold storage) and 1988 to 2018 (capacity more than 25% of potato production; after establishing sufficient capacity of cold storage)

Seasonal price variation of potato Holland (white) before and after establishing sufficient capacity of cold storage

The authors found the monthly wholesale price of potato Holland (white) from 1991. So, the seasonal price index of potato Holland (white) has been estimated by using the monthly wholesale price during the period from 1991 to 2018 and this seasonal price index has been compared with the seasonal price index of potato (local) during the period before establishing the sufficient capacity of cold storage (i.e., 1972 to 1987). This is compared can be justified on the ground that they are very close substitute each other, if there is a change in the price of potato (local) then the price of potato Holland (white) will be also changed in the same direction and also at the same rate more or less.

Table 2: Seasonal price indices of potato local (1972 to 1987; before establishing sufficient capacity of cold storage) and potato Holland (white) (1991 to 2018; after establishing sufficient capacity of cold storage)

Month	Seasonal price index of potato (local) (1972 to 1987)	Changes in price (%) from average price of potato (local) (1972 to 1987)	Seasonal price index of potato Holland (white) (1991 to 2018)	Changes in price (%) from average price of potato Holland (white) (1991 to 2018)
January	84.39	-15.61	88.60	-11.40
February	59.86	-40.14	67.06	-32.94
March	58.66	-41.34	65.39	-34.61
April	69.15	-30.85	76.35	-23.65
May	80.37	-19.63	89.12	-10.88
June	90.06	-9.94	98.76	-1.24
July	101.73	+1.73	110.40	+10.40
August	125.46	+25.46	114.89	+14.89
September	124.19	+24.19	115.98	+15.98
October	129.06	+29.06	115.12	+15.12
November	142.00	+42.00	128.40	+28.40
December	135.02	+35.02	129.86	+29.86
CV	30.28		22.57	
Range	83.33		64.47	

N.B.: Negative (-) sign indicates decreased and positive (+) sign indicates increased

Source: Authors' own calculation by using data from DAM

During the period 1991 to 2018 for potato Holland (white), potato price index was the highest (129.86) in the month of December i.e., price becomes 29.86 percent greater than the average price in this month whereas price was 35.02 percent greater for the potato (local) in the same month. The price index of potato Holland (white) was lowest (65.39) in the month of March i.e., price becomes 34.61 percent lower than the average price in this month and in the same month price of potato (local) was 41.31 percent lower than the average price (Table 2). Changes in potato price (%)

from the average price after establishing sufficient capacity of cold storage became lower in every month (except July) which was observed easily from Figure 6.

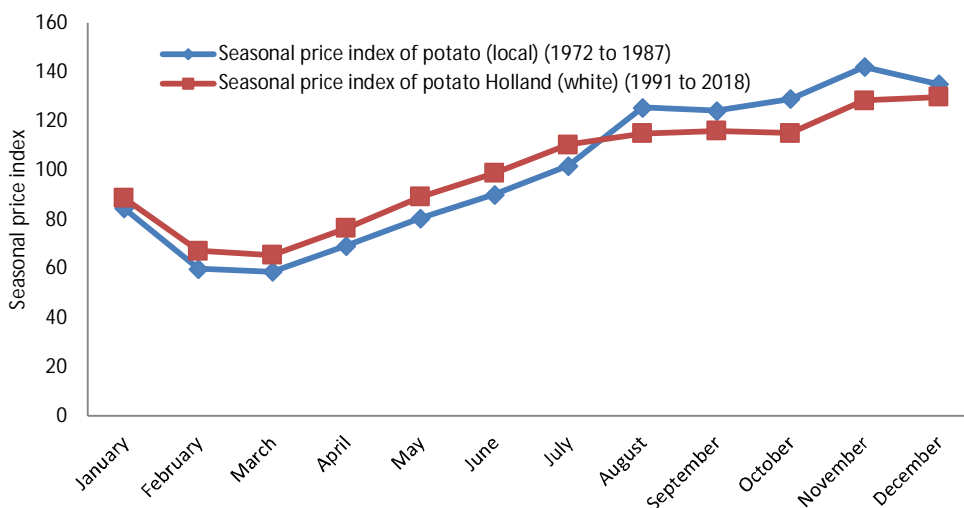


Figure 5: Seasonal price indices of potato local (1972 to 1987; before establishing sufficient capacity of cold storage) and potato Holland (white) (1991 to 2018; after establishing sufficient capacity of cold storage)

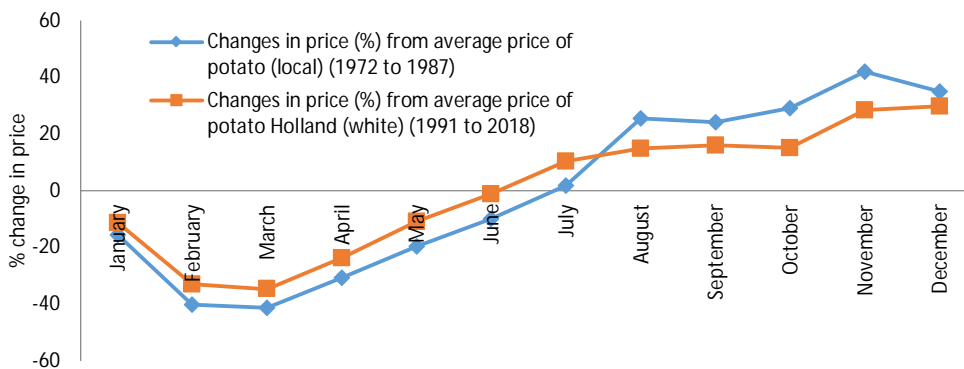


Figure 6: Comparison of average seasonal price variations of potato (local) and potato Holland (white) between the periods 1972 to 1987 (about 1% capacity of cold storage i.e., before establishing sufficient capacity of cold storage) and 1991 to 2018 (capacity more than 25% of potato production; after establishing sufficient capacity of cold storage)

The coefficient of variation (30.28) for potato local during the period (1972 to 1987) was higher than the coefficient of variation (22.57) for potato Holland (white) during the period (1991 to 2018) that means a seasonal price variation of potato decreased after establishing sufficient cold storage capacity in the country.

It is also evident from figure 5, that the seasonal price index line of potato Holland (white) of the period 1991 to 2018 is closer to the average price index (100 here) than the seasonal price index in of potato (local) of the period 1972 to 1987 i.e., seasonal price variation became lower after establishing sufficient cold storage capacity. Cold storage can reduce the seasonal price variation.

Seasonal price variation of potato Holland (red) before and after establishing sufficient capacity of cold storage

The monthly wholesale price of potato Holland (red) was found from the year 2002. So, the seasonal price index has been estimated by using the monthly wholesale price for the year 2002 to 2018. And this seasonal price index has been also compared with the seasonal price index of potato (local) for the period before establishing the sufficient capacity of cold storage.

Table 3: Seasonal price indices of potato local (1972 to1987; before establishing sufficient capacity of cold storage) and potato Holland (red) (2002 to 2018; after establishing sufficient capacity of cold storage)

Month	Seasonal price index of potato (local) (1972 to 1987)	Changes in price (%) from average price of potato (local) (1972 to 1987)	Seasonal price index of potato Holland (red) (2002 to 2018)	Changes in price (%) from average price of potato Holland (red) (2002 to 2018)
January	84.39	-15.61	93.40	-6.60
February	59.86	-40.14	69.91	-29.09
March	58.66	-41.34	67.62	-32.38
April	69.15	-30.85	76.70	-23.30
May	80.37	-19.63	88.74	-11.26
June	90.06	-9.94	98.21	-1.79
July	101.73	+1.73	110.43	+10.43
August	125.46	+25.46	113.26	+13.26
September	124.19	+24.19	110.85	+10.85
October	129.06	+29.06	117.66	+17.66
November	142.00	+42.00	125.45	+25.45
December	135.02	+35.02	127.72	+27.72
CV	30.28		20.89	
Range	83.33		60.09	

N.B.: Negative (-) sign indicates decreased and positive (+) sign indicates increased

Source: Authors' own calculation by using data from DAM

In case of potato Holland (red) (after establishing 30% capacity of cold storage), potato price index was the highest (127.72) in the month of December i.e. price becomes 27.72 percent greater than the average price in this month whereas price was 35.02 percent greater for the potato (local) in the same month (during the period when capacity of cold storage was about 1percent of potato production) that means

changes in prices from average was lower in case of after establishing sufficient capacity of cold storage. The seasonal price index of potato Holland (red) was lowest (67.62) in the month of March i.e. price becomes 32.38 percent lower than the average price in this month and in the same month (before establishing sufficient capacity of cold storage) price of potato (local) was 41.31 percent lower than the average price and Sabur (1986) found 43 to 52 per cent lower in different markets than the average price that means changes in prices from average price was lower also after establishing sufficient capacity of cold storage (Table 3). Changes in potato price (%) from the average price after establishing sufficient capacity of cold storage became lower in every month (except July) which was observed easily from Figure 8.

The coefficient of variation of potato Holland (red) was lower than the coefficient of variation of potato (local) during the period (1972 to 1987) that means a seasonal price variation of potato became lower after establishing sufficient cold storage capacity in the country (Table 3).

It is also observed from figure 7, that the seasonal price index line of potato Holland (red) during the period 2002 to 2018 is closer to the average price index (100 here) than the seasonal price index of potato (local) during the period 1972 to 1987 i.e., seasonal price variation became lower after establishing sufficient cold storage capacity. That means cold storage has the impact to reduce the seasonal price variation.

In general, it was found that the price of potato fluctuation became lower after establishing cold storage in Bangladesh. The causes of this less fluctuation might be supply of potato becomes more stable throughout the year in the market after increasing sufficient cold storage capacity.

Figure 9 represents the four seasonal price indices of three types of potato before and after establishing sufficient capacity of cold storage. It is clearly understood from a single figure that included four seasonal price indices that seasonal price indices lines which are estimated by using the prices of potato during the periods after establishing enough capacity of cold storage for potato storing, are closer to the average price index than the seasonal price index line (for the period 1972 to 1987) before establishing enough capacity of cold storage. That means cold storage reduced the seasonal price variation of potato in Bangladesh.

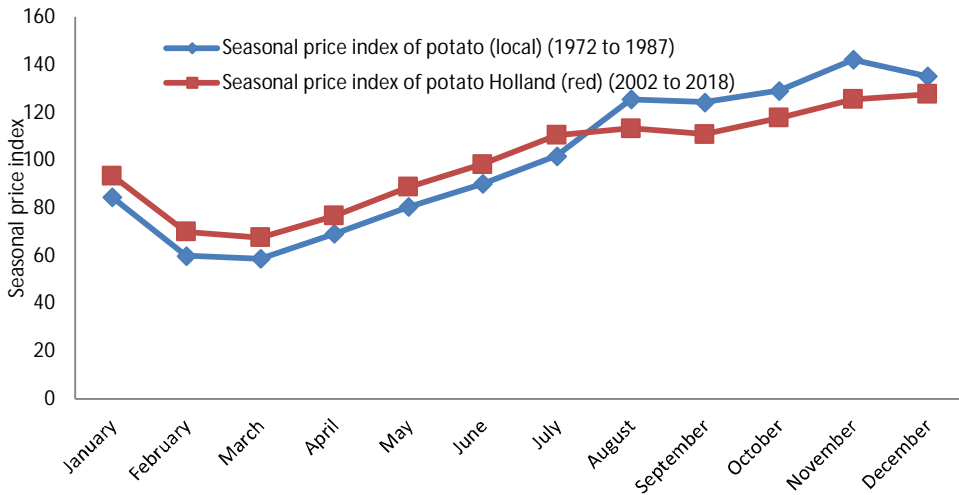


Figure 7: Seasonal price indices of potato local (1972 to 1987; before establishing sufficient capacity of cold storage) and potato Holland (red) (2002 to 2018; after establishing sufficient capacity of cold storage)

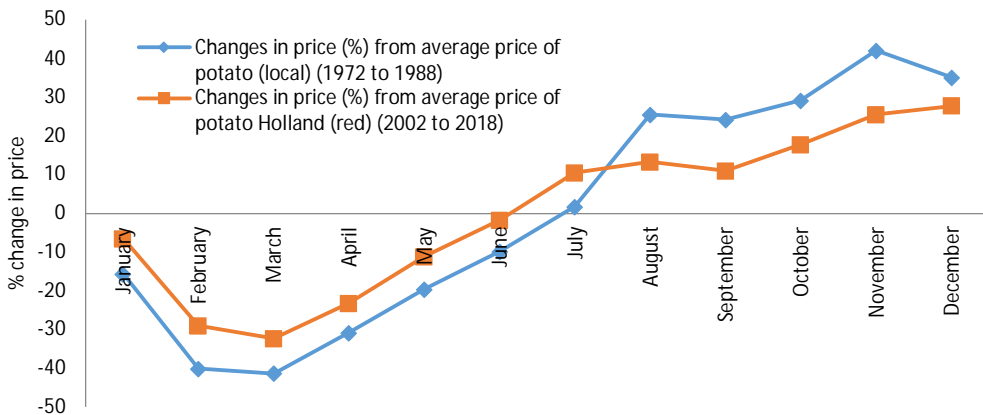


Figure 8: Comparison of average seasonal price variations of potato (local) and potato Holland (white) between the periods 1972 to 1987 (about 1% capacity of cold storage; before establishing sufficient capacity of cold storage) and 1991 to 2018 (capacity more than 25% of potato production; after establishing sufficient capacity of cold storage)

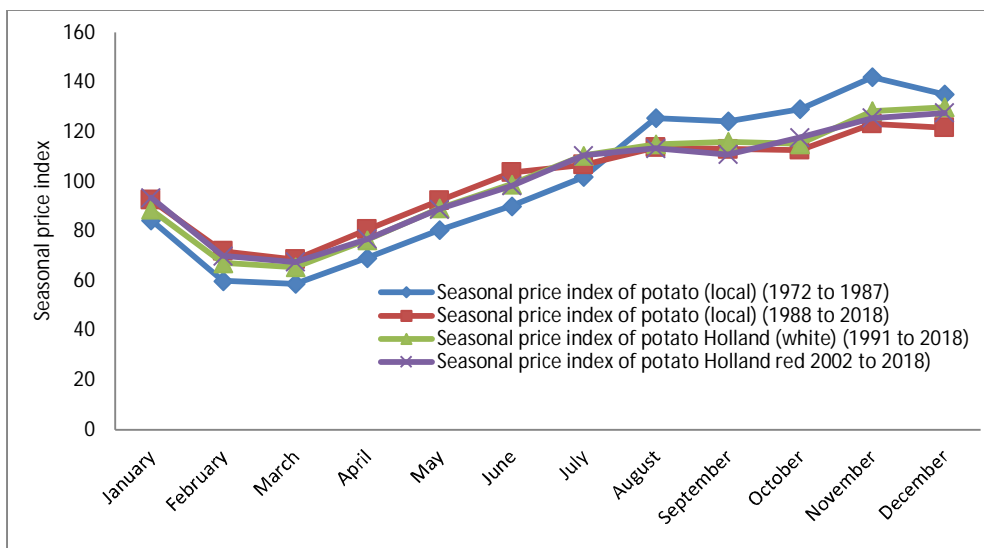


Figure 9: Comparing the seasonal price index of three types of potato before and after establishing sufficient capacity of cold storage in Bangladesh

IV. CONCLUSION

Frequent excessive seasonal price fluctuations of agricultural commodities create uncertainty about the market price and enhance risks in agricultural production as well as its business. So, the producers and business people need less seasonal variation in prices to operate their activities smoothly throughout the year that can also help for the development of agriculture sector. This study was attempted to examine whether cold storages reduce the seasonal variation in prices of potato in Bangladesh. For assessing this, the seasonal price indices of three types of potato were estimated before and after establishing sufficient capacity of cold storage in Bangladesh. The findings of the study revealed that seasonal price variation of potato has been decreased after establishing sufficient (more than 30 percent) capacity of cold storage of total potato production in the country as a whole. So, government should facilitate more for establishing cold storage, these facilities can reduce the seasonal variation in prices of other agricultural commodities those can be stored for regular supply for maintaining demand throughout the year and hence it can also reduce the price and income risk of producers and traders in this business.

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