Vegetables Supply Chain Challenges and Salvage during the Pandemic in Tamil Nadu, India

K.N.Selvaraj, R.Parimalarangan and K.R.Karunakaran
Tamil Nadu Agricultural University
Coimbatore,
Tamil Nadu, India.
knanjundiahs@gmail.com
nanjundiahselvaraj@gmail.com

ABSTRACT

The fact remains that the present pandemic of COVID19 has reduced the daily consumption of fruits and vegetables due to the factors like availability, price and access as the demand was affected by reduction in income and purchasing capacity. Therefore, it paramount important that the consumers consume adequate quantity of fruits and vegetables for healthy life and ensuring the availability of fruits and vegetables in adequate quantity and reasonable price is critical during the pandemic. An attempt was made in this paper to examine the price behavioral pattern in the pandemic period compared to non-pandemic period and to what extent the measures that have been adopted by both federal and state governments helped in ensuring that supply chain particularly in vegetables was in intact during the crisis period by heavily relying on data sourced from various websites and publications. The results showed that there was not much aberrations in the gross factors and the movement of wholesale and retail prices of select vegetables were parallel confirming that Farm to Table initiatives played a significant role in stabilizing the prices despite pandemic shocks. Estimates of skewness and kurtosis also support that there were lesser aberrations in prices though prices declined during the pandemic. The estimated coefficient of post-level change was negative and highly significant for onion indicating that wholesale and retail prices of onion declined compared to previous period due to pandemic. However, the decline was found slighter compared to earlier period. The impact of pandemic on prices of potato was not adverse rather the wholesale and retail prices increased during the pandemic and increase in retail prices is not parallel due to farm to table initiatives.The empirical results further confirm that the various F- T initiatives helped to abate the crisis due to the compression in demand and market disturbance.

Key Words: Farm to Table Initiatives, Single Interrupted Time Series (ITS) based on segmented linear regression, , Speed of Adjustment Coefficient

The Context

It is widely feared that the COVID-19 pandemic will lead to a significant worsening of the food security situation in low and middle-income countries. One reason for this is the disruption of food marketing systems and subsequent changes in farm and consumer prices. Reduction in income and purchasing capacity of the consumers during the pandemic affected the demand for food. Stock piling the foods were also attempted by the consumers due panic of non-availability of food. These affected the food availability and prices. Prices of agricultural commodities particularly fruits and vegetables have aberrated heavily affecting both the producers and consumers. Consuming at least 400 to 500 grams of fruits and vegetables per day is indispensable to lead healthy life as per the dietary guidelines for Indians. However, an Indian on an average consumes less than 400 grams of fruits and vegetables per day due to various reasons (Mukherjee, et.al., 2015).The fact remains that the present pandemic of COVID 19 has reduced the daily consumption of fruits and vegetables due to host of factors like availability, price and access as the demand wasaffected by reduction in income and purchasing capacity.

Therefore, it paramount important that the consumers consume adequate quantity of fruits and vegetables for healthy life and ensuring the availability of fruits and vegetables in adequate quantity and reasonable price is critical. Thus, an attempt was made in this paper to examine the price behavioral pattern in the pandemic period compared to non-pandemic period and to what extent the measuresthat have been adopted by both federal and state governments helped in ensuring that supply chain particularly in vegetables was in intact during the crisis period.

The Objectives

i. To estimate the gross factors in the supply chain of select vegetables and extent of aberrations in the gross factors due to pandemic in the case of major vegetables such as potato, onion, tomato, chillies and okra;

ii. to examine the post-level change in prices of major vegetables (onion and potato) due to pandemic and

iii. to measure time taken for the existing disequilibrium in the wholesale and retail prices of vegetables to be reduced at least by 50 per cent in order to relate to what extent the Farm to Table initiatives played critical role in stabilizing the prices.

Data and Methodology

Month-wise time series data on wholesale and retail prices of the select vegetables, such as, potato, onion and tomato were collected for the period between April,2020 and December,2020 for five zones of India (North, Western, Eastern, North Eastern and South) published by Department of Consumer Affairs, Government of India

(www.consumeraffairs.nic.in). These data were pooled toobtain the balanced panel (45 observations) to estimate the disequilibrium dissipation of both the wholesale and retail prices(Speed of Adjustment Coefficient estimated from Vector Error Correction Model (VECM):LnWP/RP = β0 + β1ECT (t-1) + ut estimated using Ordinary Least Squares -OLS method) and time taken for the existing disequilibrium in the wholesale and retail prices to be reduced by 50 per cent in order to relate to what extent the Farm to Table initiatives played critical role in stabilizing the prices.

Further, gross factors were estimated to examine any aberrations in the gross factors due to pandemic and movement (parallel/ divergent/convergent) of wholesale and retail prices of select vegetables were also examined. State-wise monthly time series data (2019-20) between March and August for the vegetables such as onion, tomato, chillies and okra were collected from the www. agmarknet.gov.in to make a comparative analysis on prevailing wholesale prices between pandemic and normal period interms of number of states reporting decline/ increase in prices and the magnitude.

Interrupted Time Series Analysis for Single Series (Muller, 2004; Linden 2015) was attempted to examine the post-level change in prices of major vegetables (onion and potato) due to pandemic by estimating the following equation using OLS method for the period between 2013 to 2020 (month wise-96 observations) and retail prices (month-wise for the period from 2019 to 2021). Analysis was carried for the whole period (2013 to 2020- month-wise) and recent period (2019 to 2020 -month-wise) for wholesale prices in order to assess the post level change in wholesale prices (change in pandemic period). Post level change (change in pandemic period) was estimated for retail prices for the select vegetables for the period between 2019 and 2021 (month-wise) based on availability of data. The data were collected from www.indiastat.com, a paid website.

Single Interrupted Time Series (ITS) based on segmented linear regression:

$y = \alpha + \beta 1T + \beta 2X + \beta 3XT + \varepsilon$. Where; T refers to time period, X indicates the study phase and XT represents time after interruption. β1 coefficient indicate pre-trend, β2 shows the post level change, β3 is the post trend change and (β1+ β3) is the post-trend.

Telephonic discussion was also had with officials of Department of Horticulture, Tamil Nadu Government on quantity of vegetables sold through E-thottam (public online platform established during the pandemic) and personal and telephonic survey was also done with officials of farmers. live (Privateon-line trading platform)and Farmers Producer Organizations(FPOs). Data were gathered pertaining to the quantity of vegetables traded on li ne and involvement of FPOs in direct marketing. Internet survey was also carried out to assess the complaints in online trading (e–thottam).

Literature Reviews

Quality and freshness of the product are the most important criteria based on which consumers purchase fruits and vegetables. About 54 per cent of Indian consumers prefer to buy fruits and vegetables from the local markets, while 19 per cent from push carts (Mukherjee, et.al., 2015) implying that ensuring the availability of vegetables in the local markets and supply through mobile vans during the pandemic is found critical.

The pandemic induced lockdown restricted the access to food markets and a majority of consumers (75.31%) experienced a price increase across COVID zones of different intensity of incidence leading to food loss along supply chain and wastage at consumers end. Consumers' livelihood affected from moderate (59.53%) to severe (3.3%) with 92 per cent reporting a change in shopping behavior (Cariappa, et.al., 2021).

Prices post-lockdown shot up immediately and significantly for chickpea (4.8%), mung bean (5.2%), and tomato (78.2%) corroborating the loss in highly perishable product – tomato – owing to its spiked price. No structural break in prices due to lockdown was found implying that lockdown-induced price change was not sufficient to alter the long-run price movement, and the prices of the major commodities reverted to the pre-lockdown levels(Cariappa, et.al., 2021).

Indian consumers are willing to pay a premium to get hygienic and nutritional daily essentials, prompting exporters of horticulture produce to draw strategies for the domestic market high-quality fruits during the pandemic period. The domestic suppliers of premium fruits and vegetables were increasingly focusing on the domestic market and tying up with delivery chains like Swiggy, as home demand for top-end perishables has increased (The Economic Times, 7th August, 2020).

With an aim of understanding the impact of pandemic on non-perishable (wheat) and perishable commodities (tomato and onion), and to what extent of adoption of a greater number of agricultural market reform measures mitigated adverse impacts using granular data set (daily observations for 3 months from nearly 1000 markets across five states in India and double- and triple- difference estimation strategy). All prices spiked initially in April, they recovered relatively quickly, underscoringthe importance of time duration for analysis. Market reform measures did help in insulating farmers from lowerprices, but these effects are salient for the perishable goods, and not so much forwheat where the government remained the dominant market player (Varshney, et.al, 2020)

To understand the pandemic impact particularly in low income countries, review was also made with respect to Ethiopia and Kenya. Pandemic-related trade disruptions brought in price changes, which are heterogenous for different vegetables and relatively larger changes were observed at the farm level, compared to the consumer level, leading to winners and losers among local vegetable farmers. Despite substantial hurdles in domestic trade reported

by most value chain agents, increases in marketing – and especially transportation – costs have not been the major contributor to overall changes in retail prices. Marketing margins even declined for half of the vegetables studied. The relatively small changes in marketing margins overall indicate the resilience of these domestic value chains during the pandemic in Ethiopia (Hirvonen, et.al.,2020)

When the supply chains were disrupted by the crisis domestically, assessing performance of the global trade is paramount important as the global trade has significant impact on domestic markets. No doubt, The COVID-19 crisis has had a profound impact on the global economy, and obviously countries like India have not been spared from the fall-out. From the perspective of trade, because of the time lags in international trade due to logistical constraints, its impact will be staggered over many months. Thus, a review was made to understand trade performance inn low income countries such as Kenya in order to corroborate with India context.

Kenya experienced a significant improvement in exports in the first quarter of the year, together with a moderation of imports, leading to a marked decline in the trade deficit. Notably, not all supply chains were disrupted by the crisis, with some Kenyan exports like tea and fruit surpassing levels of years past. Rather, imports have been the principle victim of the crisis, declining by a quarter over the three months since the crisis began (between March and May 2020). Capital goods imports have declined markedly—a trend which, if sustained, could have implications for long-term economic growth. However, the fall in imports of consumer goods could also set the scene for a revitalization of national and regional industry, as local producers step up to fill the void created by thesharp lull in imports (Mold and Mveyange, 2020)

Empirical Findings

Demand – Supply and Consumption Pattern

Tomato, onion and potato are the largely consumed vegetables in the country. Only 20to 30 per cent of the vegetables are for use in households and rest is marketable surplus. Availability and income play an important role in consumption. The project demand and supply estimates exemplify that demand exceeds the supply and under such situation it is likely that the consumption of vegetables across income continues to be heterogenous (Table1). Although vegetables supply in India is increased by seven timesduring period between 1961-63 and 2017-18, trebling of its population during the same period reduced the increase in per capita supply of vegetables (Kgs. per person per year). Annual per capita supply of vegetables in India is increased by only 2.5 times from 37.7 Kgs. to 94.1 Kgs. during the same period. While the change in global and south Asian average in this regard indicate a doubling the vegetables supply per capita, the all-Asia average is increased by three times during the period (Venkatanarayana, 2020).

Average daily intake is higher for higher income groups and studies show that Indian consumers across all income groups are consuming less than the 'recommended' quantity of at least 400 grams (or five daily servings with an average serving size of 80 gm) of fruits and vegetables. Value of monthly per capita consumption of fresh produce across India, broken down by regions show that the western region of the country spent about 285.68 Indian rupees per person in a month on fresh fruits and vegetables, while the southern region had the highest per capita value of fresh produce consumption (www.statista.com).

Farm to Table Initiatives

In the pandemic times, when regular transport and markets have not been functioning, the government resorted to alternative market channels to create smaller, less congested markets in urban areas with the participation of farmers' groups and Farmer Producer Companies (FPCs) so that farmers have direct access to consumers. Government of India and Tamil Nadu state have taken many initiatives to address the concerns of the farmers fronting the problems due to the lockdown following Covid-19 pandemic. Many initiatives such as waiving of cold storage fee for fruits and vegetables, help lines to assist farmers (Kisansaba, e-choupal, Kisanrath) to sell their produce, operated mobile outlets to sell fruits and vegetables and loan provision of ₹10 lakh to those FPOs that procure fruits and vegetables directly from farmers to ensure fair price for the produce. Further, designating warehouses as markets, permitting unified license holders (329 unifiedlicense holders in Tamil Nadu and 50009 in India) and registered FPOs, Traders and Commission Agents (FPOs -106, Traders – 3513 33 Commission agents- 33 in state of Tamil Nadu) for on-line trading through e-Nam., E.thottam a on line trading portal was launched by the Government of Tamil Nadu for ensuring better supply chain.

E-choupal provides information to farmers about market demand of their produce, market prices etc. to allow them to make well-informed decisions and fetch competitive prices in the markets. Kisan Sabha App developed by CSIR (Council of Scientific and Industrial Research) to connect farmers to supply chain and freight transportation management system was recently launched to support farmers during the lockdown. The app aims to provide the most economical and timely logistics support to the farmers and increase their profit margins by minimizing the interference of middlemen and directly connecting with the institutional buyers. Kisan Rath app was also launched to facilitate farmers and traders in searching for transport vehicles for movement of agriculture and horticulture produce. Various states have promoted innovative model allowing investors and farmers to enter into an agreement for contract farming. For example, the Consumer-Farmer Compact in Telangana has been established for ensuring food availability and access in COVID-19 times. In this system, the consumers support farmers with their agricultural needs; in return, farmers ensure consumers are able to access food in a hassle-free manner. Increasing the allocations for DBT (Direct Benefit Transfer) to farmers through PM Kisan has helped most farm families, which providedfarmers with some cushion against the deflationary effect seen on farm-prices due to the prolonged lockdown.

Movements in wholesale prices of major vegetables

Sources show that wholesale prices of tomato, onion and other key seasonal vegetables have declined sharply by up to 60 per cent across the country, mainly due to higher production, compression of demand and market disruption amid COVID-19 crisis. However, the retail prices of most vegetables remain firm. Average wholesale price prevailed during March, 2020 was 20.64 per kg for onion, 12.07 for tomato, 15.41 for chillies and 32.49 for okra (Table 2). Wholesale prices of these vegetables declined during April,2020 (first lockdown period) compared to last month and maximum decline of 67 per cent was noticed in okra followed by onion (43 per cent), chillies (36 per cent) and tomato (29 per cent).

Similarly, there was a subsequent decline in wholesale prices of the major vegetables during the month of May,2020 compared to the previous month and decline was noticed in all the states except few, where tomato prices showed an increase (Table 3). The wholesale tomato prices were ruling below Rs 5 per kg in some states on May 24, while that of onion to Rs 6 per kg in the key producing state of Maharashtra. However, potato prices were stable at 12-13 per kg. The falling price trend was also seen in other vegetables such as ladies finger, capsicum, bitter gourd, bottle gourd, chillies and coriander leaves, among others. It is a matter of concern that farmers are forced to sell at such low prices. The fall in rates is due to an increase in arrival due to better crop production besides mandi disruption in the wake of COVID-19 pandemic.

All India average wholesale rate of tomato dropped by 60 per cent to Rs 11 per kg on May 24 from Rs 27.50 per kg a year ago. Prices have fallen in 19 states but a sharp fall of up to 83 per cent was seen in Telangana, Karnataka, Andhra Pradesh and Maharashtra. In Telangana, prices declined by 83 per cent to Rs 4.69 per kg on May 24 from over Rs 27 per kg a year ago, while prices in Karnataka slipped by 80.76 per cent to Rs 4.41 per kg from Rs 23 per kg. In Andhra Pradesh, prices dropped by 75.48 per cent to Rs 4.88 per kg from Rs 20 per kg. The wholesale prices of onion declined mainly in three states — Maharashtra, Karnataka and Delhi. In Maharashtra, the wholesale rates fell by over 27 per cent to little over Rs 6 per kg on May 24 this year from Rs 9 per kg a year ago, while in Karnataka rates fell by 17 per cent to Rs 8 per kg from Rs 9.50 per kg.

The wholesale prices of chilli capsicum declined by up to 54 per cent in the key markets. In Karnataka, the rates fell by 53.67 per cent to Rs 20.65 per kg on May 24 from Rs 44.58 per kg. In Maharashtra, prices declined by 31 per cent to Rs 20 per kg from 24.50 per kg. In case of ladies finger (Bhindi), the all India average prices declined by 20 per cent to Rs 17.50 per kg on May 24 from Rs 22 per kg a year ago. Prices have fallen in as many as 14 states. In Chattisgarh, rates have dropped by 57 per cent to Rs 4 per kg from Rs 9 per kg, while in Gujarat, it slipped 45 per cent to little over Rs 10 per kg from over Rs 18 per kg. Similarly, the all India average price of bitter gourd fell 19 per cent to little over Rs 22 per kg from Rs 27.50 per kg. Prices have fallen in 15 states. All India average wholesale price of bottle gourd

fell by 16.35 per cent to Rs 10 per kg on May 24 from Rs 12 per kg a year ago. Prices have fallen in 12 states. Prices of beans fell mainly in Karnataka, Odisha and Maharashtra. Maximum fall was seen in Odisha where the wholesale price fell by 35.43 per cent to Rs 24 per kg from Rs 37 per kg. In Karnataka, it dropped by 11 per cent to little over Rs 43 per kg from49 per kg. Even prices of coriander leaves and green chillies showed a declining trend (www.agmarknet.gov.in).

However, three was reverting back of the falling trend of wholesale prices of major vegetables during the months of June, July and August, 2020 (Tables 4-6). The wholesale rate of potato, however, rose 44 per cent to Rs 18 per kg on May 24 from Rs 12.50 per kg a year ago. In Uttar Pradesh, it jumped two-fold to little over Rs 16 per kg. Further, we observed the falling trend in wholesale prices of onion, tomato, chillies and okra during the pandemic period (April ,2020 to August, 2020). We also found that for tomato, chillies and okra, the monthly wholesale prices of these vegetables were found lower during the pandemic compared to prevailingmonthsduring 2019 ruling outthe impact of lack of demand particularly from bulk users.Further, our estimates show that the maximum increase and decrease in wholesale prices ofthese vegetables in reporting states during the months of 2020 (pandemic) over the months of2019 were found less.

Movements in retail prices of major vegetables

Since, many mandis across the country were operated for a limited time with restricted access for public and allowing only bulk consumers to lift a large quantity of vegetables to prevent spread of Covid-19, vegetables in retail markets have become costlier by 30-40 per cent due to a sharp increase in their transportation cost amid fears of supply disruptions. As a result, rising vegetable prices would impact consumers' kitchen budget during the lockdown period and the sharp rise in vegetable prices was due to steep increase in transportation costs. Available data shows that the transportation cost increased by four times higher than the usual charge.

Prices in retail markets become costlier due to a sharp increase in the transportation cost that led to supply disruptions. Our analysis of zone-wise comparison of Gross Factor (Between April 2020 and December,2020) envisages that there was no much aberrations in the gross factors and the movement of wholesale and retail prices of select vegetables were parallel (Figures given as annxure) confirming that there was no such jump in gross factor due to Farm to Table initiatives such as online trading (e-thottam and e-nam), mobile outlets and private initiatives on on-line trading(more than 1000 famers sold the produce through farmers.live).

Impact of Pandemic on Prices – Disequilibrium Dissipation and Estimation of Immediate and Sustained Effects

The large absolute values of Speed of Adjustment Coefficient reported in Tables 7 and 8 for most of the vegetables confirmed that stability in wholesale and retail prices and the large percentage of disequilibrium is removed in each period (month). Further, the estimates reported in Table shows that 61 and 54 per cent of disequilibrium in wholesale and retail prices are dissipatedbefore the next time period (month) and time taken for the remaining disequilibrium to bereducedisless thanorequaltoa month.

To identify the different effects of pandemic on wholesale and retail prices of select vegetables namely the level change (immediate effect), slope change (sustained effect) and both, interrupted time series analysis for single series was estimated using the OLS method. Since we have used OLS estimation procedure, we tested for autocorrelation since at some point in time current prices are correlated with past values of itself. Before the analysis, the standard errors were adjusted for autocorrelation using Newey-West standard errors. Variability of both wholesale and retail prices of potato and onion are found lesser during the pandemic period compare to previous period (Tables 9 and 10). Estimates of skewness and kurtosis also support that there were lesser aberrations in prices though prices declined during the pandemic. The post level change in wholesale prices of potato and onion were heterogenous. The estimated coefficient of post-level change was negative and highly significant for onion indicating that wholesale and retail prices of onion declined compared to previous period due to pandemic. However, the decline was found slighter compared to earlier period. The impact of pandemic on prices of potato was not adverse rather the wholesale and retail prices increased during the pandemic and increase in retail prices is not parallel due to farm to table initiatives (Tables 11 and 12).

Pandemic and International Trade

India’s agricultural trade has strong regional and product patterns and major agricultural exports are labour intensive products such as rice, processed fruits and vegetables and floriculture and plantation crops. Since, these commodities are of great importance to India’s economic development and poverty reduction, understanding the trade performance of these commodities and understanding the performance of agricultural products in terms of their regional and product patterns and to what extend domestic policies induced favourable terms of trade are imperative.

The covid -19 outbreak, no doubt, has shocked both domestic and global economies particularly supply chains. Though Covid -19 distorted supply chain globally, the impact was not evidently noticed in India particularly with respect to food products. The balance of trade in agriculture in India improved by 46.16 percent registering a growth of 17. 34 per cent during 2020-21 according to the Commerce Ministry. Commodities such as non-basmati, oil

meals, sugar, raw cotton and fresh vegetables and vegetable oils registered a significant growth in export during the period 2020 -21. Though there were uncertainties in global trade particularly due to various restrictions imposed by the various countries. Indian export of agricultural products to major overseas destination such as USA, China, Bangladesh, UAE, Saudi Arabia, Indonesia, Nepal, Iran and Malaysia have registered positive growth and it was noticed that export was also taken place from several clusters. Handholding by the Ministry of Commerce and trade for market linkages, improved post-harvest value chain and development of institutional structures like FPOs are the keys for growth in agricultural exports.

However, the concerns were raised regarding the implementation of various export restrictions by major agricultural producing countries due to the pandemic. Further, Covid -19 related lockdowns adversely affected agriculture due to logistic restrictions leading to farm labour immobility resulting in decline crop production thereby creating an adverse impact on international trade. Apart from export restrictions, the fact remains that there were temporary increases in world demand as the consumers purchased food for quarantine. The major exporters have frequently restricted their exports to insulate the domestic market from the international price volatility under such conditions product and market pattern analysis is critical to understand the policy induced export performance of agricultural products.

Our product wise analysis reveals that export performance of floriculture, processed fruits and juices, groundnut, guargum and cocoa products in quantity terms declined during the pandemic when compared to previous year. Particularly the floriculture declined by 6.53 per cent, processed fruits and juices by 6 per cent, guargum by 39 per cent and cocoa products by 4 per cent. Nevertheless, there was a substantial increase in exports in terms of quantity in products like non basmathi rice (159%), wheat (850 %) and other cereals(504 %), processed vegetables(64 %), milled products (40%). In value terms, there was a positive change in exports except, guargum, cocoa products and basmati rice (Table 13). One of the concerns is that there was a decline in demand globally even for food products due to pandemic logistic restrictions and restrictions by the countries. As a result, it is expected that the global price of agricultural products may go up, putting more pressure on consumer budgets leading to decline in consumption basket. It is noticed that unit price of various agricultural products declined during pandemic compared to last year. The decline is noticed in basmati rice by 11 per cent, non-basmati rice by 8 per cent, wheat by 8 per cent, processed vegetables by 16 per cent indicating that sustaining the supply chain system globally help the prices of the agricultural products not to rule high. The comparative analysis of April- August of 2020-21 vis -a- vis April- August of 2019-20 also shows a slightly different picture however the unit prices of agricultural products shows a declining tendency (Table 14).

Conclusion and Implications

The results show that there were not many aberrations in the gross factors and the movement of wholesale and retail prices of select vegetables was parallel confirming that Farm to Table initiatives played a significant role in stabilizing the prices despite pandemic shocks. Variability of both wholesale and retail prices of potato and onion are found lesser during the pandemic period compare to previous period. Estimates of skewness and kurtosis also support that there were lesser aberrations in prices though prices declined during the pandemic. The post level change in wholesale prices of potato and onion were heterogenous. The estimated coefficient of post-level change was negative and highly significant for onion indicating that wholesale and retail prices of onion declined compared to previous period due to pandemic. However, the decline was found slighter compared to earlier period. The impact of pandemic on prices of potato was not adverse rather the wholesale and retail prices increased during the pandemic and increase in retail prices is not parallel due to farm to table initiatives. The large absolute values of Speed of Adjustment Coefficient for most of the vegetables confirmed that there was stability in wholesale and retail prices and 61 and 54 per cent of disequilibrium in wholesale and retail prices are dissipated before the next time period (month). The empirical results further confirm that the various F- T initiatives helped to abate the crisis due to the compression in demand and market disturbance.

References

Cariappa A.G. Adeeth, Kamlesh Kumar Acharya, Chaitanya A Adhav, Sendhil R and P Ramasundaram. 2021., "COVID-19 induced lockdown effects on agricultural commodity prices and consumer behaviour in India – Implications for food loss and waste management." SSRN: https://ssrn.com/abstract=3680634 or http://dx.doi.org/10.2139/ssrn.3680634.

Hirvonen Kalle, Belay Mohammed, Bart Minten, and Seneshaw Tamru.2020. "Food marketing margins during the COVID-19 pandemic Evidence from vegetables in Ethiopia". IFPRI Working Paper, 150. August,2020

Linden Ariel.2015. "Conducting interrupted time-series analysis for single- and multiple-group comparisons" The Stata Journal. 15, Number 2, pp. 480–500.

Mold Andrew and Anthony Mveyange. 2020. "The impact of the COVID-19 crisis on trade Recent evidence from East Africa". The Africa Growth Initiatives. www.brookings.edu/africagrowth. July,2020.

Mukherjee Arpita, Souvik Dutta and Tanu M. Goyal.2015. India's Phyto Nutrient Report. Academic Foundation, New Delhi.

Muller, A. 2004. "Florida's motorcycle helmet law repeal and fatality rates". American Journal of Public Health 94: 556–558.

Varshney Deepak, ·Devesh Roy and J.V. Meenakshi. 2020. "Impact of COVID-19 on agricultural markets: assessing the roles of commodity characteristics, disease case load and market reforms" Indian Economic Review (2020) 55 (Suppl 1): S83–S103. https://doi.org/10.1007/s41775-020-00095-1.

Venkatanarayana Motkuri. 2020. "Vegetable Consumption in India: SupplyChain and Prices". August 2020. Online at https://mpra.ub.uni-muenchen.de/101979/. MPRA Paper No. 101979, posted 23 Jul 2020 02:19 UTC.

Websites

https://www. agmarknet.gov.in
https://www.consumeraffairs.nic.in
https:// www.indiastat.com
https://www.statista.com/statistics/669622/monthly-per-capita-fresh-produce-consumption-by-regions-india/

Daily news papers

The Economic Time, Daily, 7th August, 2020. Covid-19 boosts local demand for premium fruits, vegetables.

The Times of India. Daily. 4.8.2021. Tamil Nadu: After huge sale of fruits, e-thottam to become app.

The Hindu. Daily. 4.8.2021. The COVID-19 lockdown seems to have brought the best in Farmers Producers' Organizations (FPOs), numbering 550 in Tamil Nadu.

Tables:

Table 1. Supply-demand gap in Vegetables (million tonnes)

Year	Supply	Demand	Gap
2020-21	211.29	214.82	-3.53
2021-22	221.02	224.27	-3.25
2028-29	302.95	302.93	0.02
2029-30	316.92	316.33	0.59

Source :www.indiastat.com

Table 2. Monthly Change in Vegetable Prices between March and April, 2020

Particulars	Onion	Tomato	Chillies	Okra
Ave price- March,2020 (Rs/qtl)	2064.18	1207.61	1541.80	3249.61
Ave price - April, 2020 (Rs/qtl)	1567.77	1291.90	1207.12	2653.02
Ave price - April, 2019 (Rs/qtl)	1379.19	2112.14	3497.64	3139.15
No of states -Price Declined -	15	6	1	11
No of states price increased	2	13	1	5
Max decline (%)	43.28	29.26	35.74	66.63
Minimum decline (%)	9.96	4.33	-	3.15
Max increase (%)	7.21	65.82	7.69	35.26
Min Increase (%)	1.58	0.90	-	5.39
No of states -Price Declined over 2019	-	17	2	12
No of states price increased over 2019	18	3	-	4
Max decline (%)	-	77.31	71.39	64.51
Minimum decline (%)	-	5.4	-	3.42
Max increase (%)	108.63	191.35	-	22.91
Min increase (%)	20.37	9.2	-	11.22

(Based on number of states reported - https://agmarknet.gov.in/)

Table 3. Monthly Change in Vegetable Prices between April and May, 2020

Particulars	Onion	Tomato	Chillies	Okra
Ave price- April ,2020 (Rs/qtl)	1567.77	1291.90	1207.12	2653.02
Ave price - May, 2020 (Rs/qtl)	1116.32	1099.98	1994.59	1646.62
Ave price - May, 2019 (Rs/qtl)	1445.51	2747.55	3454.04	2152.30
No of states -Price Declined -	18	12	-	17
No of states price increased	-	7	2	-
Max decline (%)	47.29	59.07	-	55.68
Minimum decline %)	2.66	1.59	-	7.73
Max increase (%)	-	41.22	110.30	-
Min Increase (%)	-	0.74	29.19	-
No of states -Price Declined over 2019	6	19	2	14
No of states price increased over 2019	13	1	-	4
Max decline (%)	24.22	79.19	49.39	56.70
Minimum decline %)	0.21	21.98	29.26	5.08
Max increase (%)	30.48	62.37	-	37.81
Min increase (%)	0.60	-	-	8.78

(Based on number of states reported - https://agmarknet.gov.in/)

Table 4. Monthly Change in Vegetable Prices between May and June 2020

Particulars	Onion	Tomato	Chillies	Okra
Ave price- May,2020 (Rs/qtl)	1116.32	1099.98	1994.59	1646.62
Ave price - June, 2020 (Rs/qtl)	1236.34	1765.35	3564.88	1490.29
Ave price - June, 2019 (Rs/qtl)	1849.38	2812.94	3677.22	1817.06
No of states -Price Declined -	3	3	-	10
No of states price increased	16	17	2	8
Max decline (%)	19.44	18.20	-	46.01
Minimum decline (%)	2.91	0.17	-	9.08
Max increase (%)	35.54	193.75	93.87	95.22
Min Increase (%)	3.13	1.44	59.01	1.87
No of states -Price Declined over 2019	16	19	2	11
No of states price increased over 2019	4	2	-	7
Max decline (%)	31.83	65.67	5.74	40.38
Minimum decline (%)	0.66	6.43	1.54	6.34
Max increase (%)	33.15	55.64	-	126.93
Min increase (%)	8.28	8.07	-	9.38

(Based on number of states reported - https://agmarknet.gov.in/)

Table 5. Monthly Change in Vegetable Prices between June and July, 2020

Particulars	Onion	Tomato	Chillies	Okra
Ave price- June,2020 (Rs/qtl)	1236.34	1765.35	3564.88	1490.00
Ave price - July, 2020 (Rs/qtl)	1283.38	3213.12	3788.22	1740.89
Ave price - July, 2019 (Rs/qtl)	1908.63	374.84	3335.08	1765.71
No of states -Price Declined -	6	1	1	9
No of states price increased	14	21	1	9
Max decline (%)	14.06	16.58	6.24	35.17
Minimum decline (%)	1.01	-	-	0.66
Max increase (%)	45.26	328.00	26.11	84.66
Min Increase (%)	0.33	3.75	-	2.96
No of states -Price Declined over 2019	19	4	-	12
No of states price increased over 2019	1	18	2	7
Max decline (%)	57.05	26.19	-	42.61
Minimum decline (%)	1	2.35	-	0.75
Max increase (%)	8.16	121.25	17.24	109.42
Min increase (%)	-	0.99	10.67	1.31

(Based on number of states reported - https://agmarknet.gov.in/)

Table 6. Monthly Change in Vegetable Prices between July and August, 2020

Particulars	Onion	Tomato	Chillies	Okra
Ave price- July,2020 (Rs/qtl)	1212.26	3213.12	4128.77	1740.89
Ave price - August, 2020 (Rs/qtl)	1283.38	2881.23	4539.53	1764.46
Ave price - August, 2019 (Rs/qtl)	2313.5	2718.76	3185.73	2441.51
No of states -Price Declined -	10	14	4	11
No of states price increased	8	7	11	8
Max decline (%)	24.19	45.63	23.38	28.52
Minimum decline (%)	10.05	7.38	8.12	0.15
Max increase (%)	13.25	78.08	40.31	51.99
Min Increase (%)	0.12	0.48	0.18	0.66
No of states -Price Declined over 2019	18	8	4	12
No of states price increased over 2019	-	13	11	7
Max decline (%)	56.72	12.41	18.08	61.05
Minimum decline (%)	11.18	0.41	0.73	8.53
Max increase (%)	-	73.22	74.88	59.30
Min increase (%)	-	1.45	8.08	8.50

(Based on number of states reported - https://agmarknet.gov.in/)

Table 7. Estimated results of Speed of Adjustment in wholesale and retail prices of select vegetables

	Potato		Onion		Tomato	
	ln(WP)	ln (RP)	ln(WP)	ln (RP)	ln(WP)	ln (RP)
Constant	3.41*(0.06)	3.59*(0.05)	3.10*(0.12)	3.38*(0.10)	3.47*(0.12)	3.72*(0.11)
ECT(-1)	-0.61** (0.29)	-0.54** (0.29)	0.59*** (0.36)	0.49 (0.34)	-0.23 (0.30)	-0.31 (0.31)
R^2	0.01	0.09	0.06	0.05	0.12	0.02
AdjustedR^2	0.08	0.06	0.04	0.02	-0.01	0.01
Standard Error ofRegression	0.27	0.22	0.50	0.44	0.56	0.42
F Value	4.48**	3.88**	2.68***	2.05		0.94

Note: Figuresinparenthesesarestandard error.

* $p \leq 0.01$; ** $p \leq 0.05$;*** $p \leq 0.10$

Table 8. Number of periods required for the existing disequilibrium in wholesale and retail prices of select vegetables to be reduced by 50%

Potato			Onion		Tomato	
Disequilibrium dissipation (before next period %)		Time taken for the existing disequilibrium to be reduced by half (Months)	Disequilibriumdissipation(before nextperiod %)	Time taken for the existing disequilibrium to be reduced by half (Months)	Disequilibrium dissipation (before next period %)	Time taken for the existing disequilibrium to bereduced by half(Months)
Wholesale price	61	1.40	59	1.31	23	0.47
Retail price	54	1.12	49	0.97	31	0.59

Table 9. Descriptive statistics of wholesale price of Onion and Potato

	Onion			Potato		
Year	Kurtosis	Skewness	CV	Kurtosis	Skewness	CV
2013	-1.32	0.72	47.90	1.99	1.38	20.57
2014	-1.60	-0.09	22.17	-1.47	-0.01	26.45
2015	-0.22	1.04	41.64	-0.51	0.10	9.33
2016	4.97	2.06	14.82	-1.85	-0.12	17.15
2017	-0.22	1.04	48.78	-0.49	-0.88	10.72
2018	2.94	1.86	36.48	-0.09	0.08	26.33
2019	1.60	1.53	76.20	0.34	0.39	17.71
2020	5.16	2.16	59.65	-0.12	0.37	17.55

Table 10. Descriptive statistics of retail prices of Onion and Potato

	Onion			Potato		
Year	Kurtosis	Skewness	CV	Kurtosis	Skewness	CV
2018	2.91	1.85	32.47	-1.01	0.05	24.26
2019	1.57	1.53	68.73	-0.85	0.43	21.98
2020	-0.03	1.04	66.83	-1.02	-0.37	16.26
2021	1.79	1.26	28.72	4.40	1.76	14.95

Table 11. Pandemic effect on wholesale prices of Onion and Potato – Results of interrupted time series

	Onion		Potato	
Interpretation	2013-2020	2019-20	2013-2020	2019-20
	Estimate	Estimate	Estimate	Estimate
Pre - Trend	-0.10	464.30**	-3.38***	56.73***
	(5.66)	(126.42)	(1.60)	(22.96)
Post - Level change	-273.43	-3345.32**	851.74*	500.21***
	(820.89)	(1240.81)	(231.36)	(225.39)
Post - Trend change	228.77***	-235.62	76.46*	16.34
	(105.38)	(178.79)	(29.70)	(32.48)
Post - Trend	-228.87	-228.38***	73.08***	73.07***
	(826.56)	(1367.23)	(232.96)	(248.35)

(Figures in the parentheses indicate standard errors)

***P ≤ 0.05, ** P ≤ 0.01, * P ≤ 0.10

Table 12. Pandemic effect on retail prices of Onion and Potato – Results of interrupted time series (2018-2021 upto September)

Interpretation	Onion	Potato
Pre - Trend	0.96 (0.49)	0.38 (0.20)
Post - Level change	-8.06 (9.92)	12.88** (4.01)
Post - Trend change	-0.72 (0.75)	-1.22** (0.31)
Post - Trend	0.24 (10.41)	-0.84 (4.21)

(Figures in the parentheses indicate standard error)
***P ≤ 0.05, ** P ≤ 0.01, * P ≤ 0.10

Table 13. Performance of food and processed food exports (2019-20 & 2020-21) *

Products	Quantity (in MTs)			Value (in Rs. Crores)			Unit value (in USD / Tonnes)		
	2019-20	2020-21	% change	2019-20	2020-21	% change	2019-20	2020-21	% change
Floriculture	16949	15842	-6.53	542	576	6.27	4478	4914	9.74
Fruit & vegetable seeds	19222	32249	67.77	772	930	20.47	5628	3881	-31.04
Fresh fruits	834835	956961	14.63	5496	5648	2.77	913	800	-12.38
Fresh vegetables	1930511	2326538	20.51	4617	5372	16.35	335	310	-7.46
Pulses	232081	276863	19.30	1512	1978	30.82	913	959	5.04
Processed vegetables	223308	366380	64.07	2212	3149	42.36	1386	1159	-16.38
Processed fruits & juices	568883	534749	-6.00	4591	5150	12.18	1130	1301	15.13
Groundnut	664436	638551	-3.90	5096	5381	5.59	1071	1139	6.35
Guargum	381878	234821	-38.51	3262	1949	-40.25	1196	1120	-6.35
Cereal preparation	342648	410374	19.77	3885	4699	20.95	1589	1547	-2.64
Cocoa products	27433	26391	-3.80	1275	1108	-13.10	6523	5675	-13.00
Milled products	286450	401823	40.28	1075	1535	42.79	525	515	-1.90
Alcoholic beverages	139453	247849	77.73	1649	2446	48.33	1657	1332	-19.61
A basmati rice	4454771	4631531	3.97	31026	29849	-3.79	972	868	-10.70
Non-basmati rice	5056278	13087941	158.85	14400	35448	146.17	399	366	-8.27
Wheat	219690	2086372	849.69	444	4034	808.56	285	263	-7.72
Other cereals	501118	3026736	504.00	1455	5117	251.68	406	229	-43.60
Total				114200	147814				

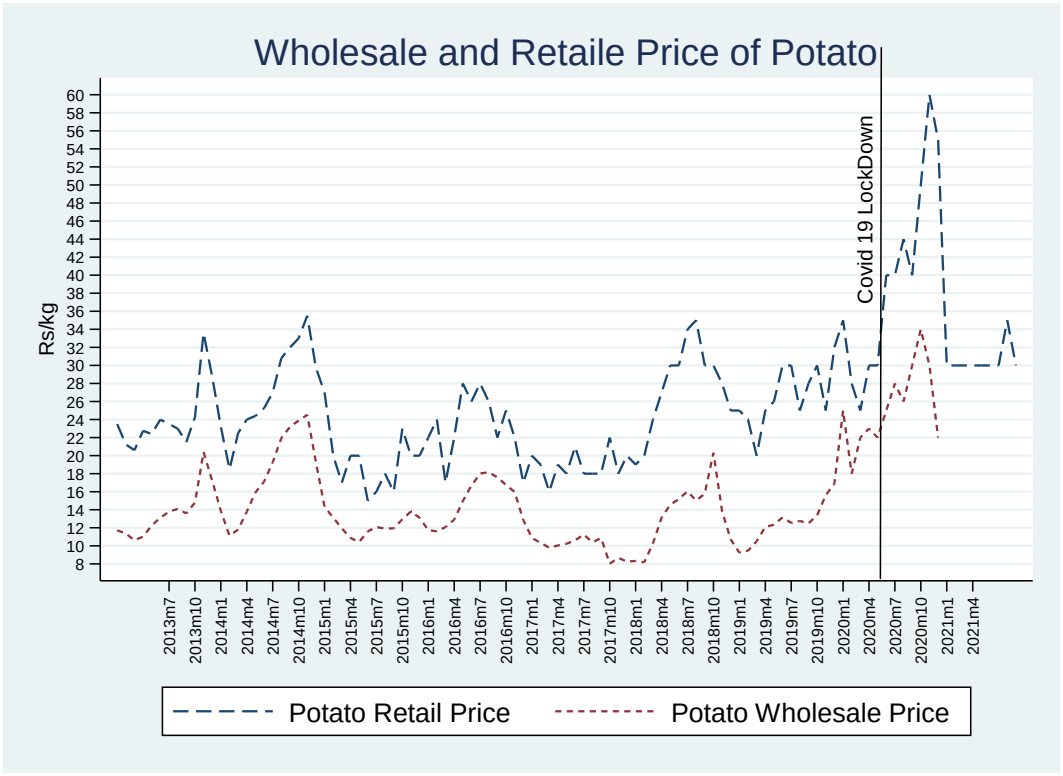
*Source: DGCIS - April-March (2020-21)

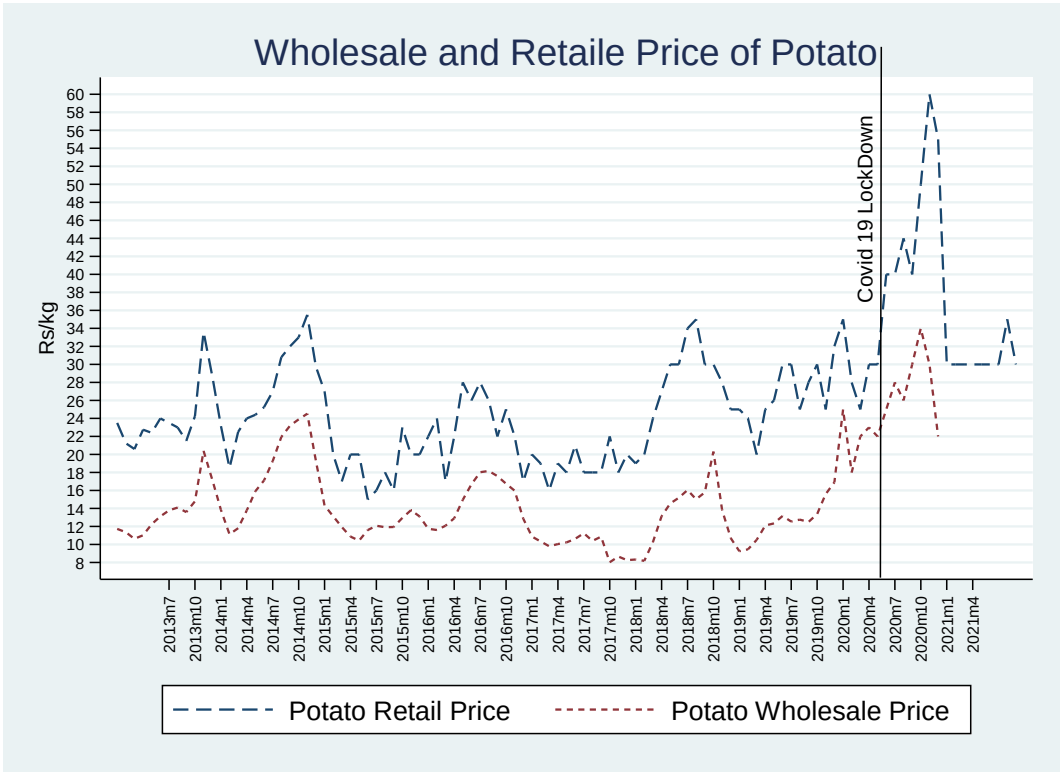
Table 14. Agricultural export performance in the pandemic period (2019-20 & 2020-21) *

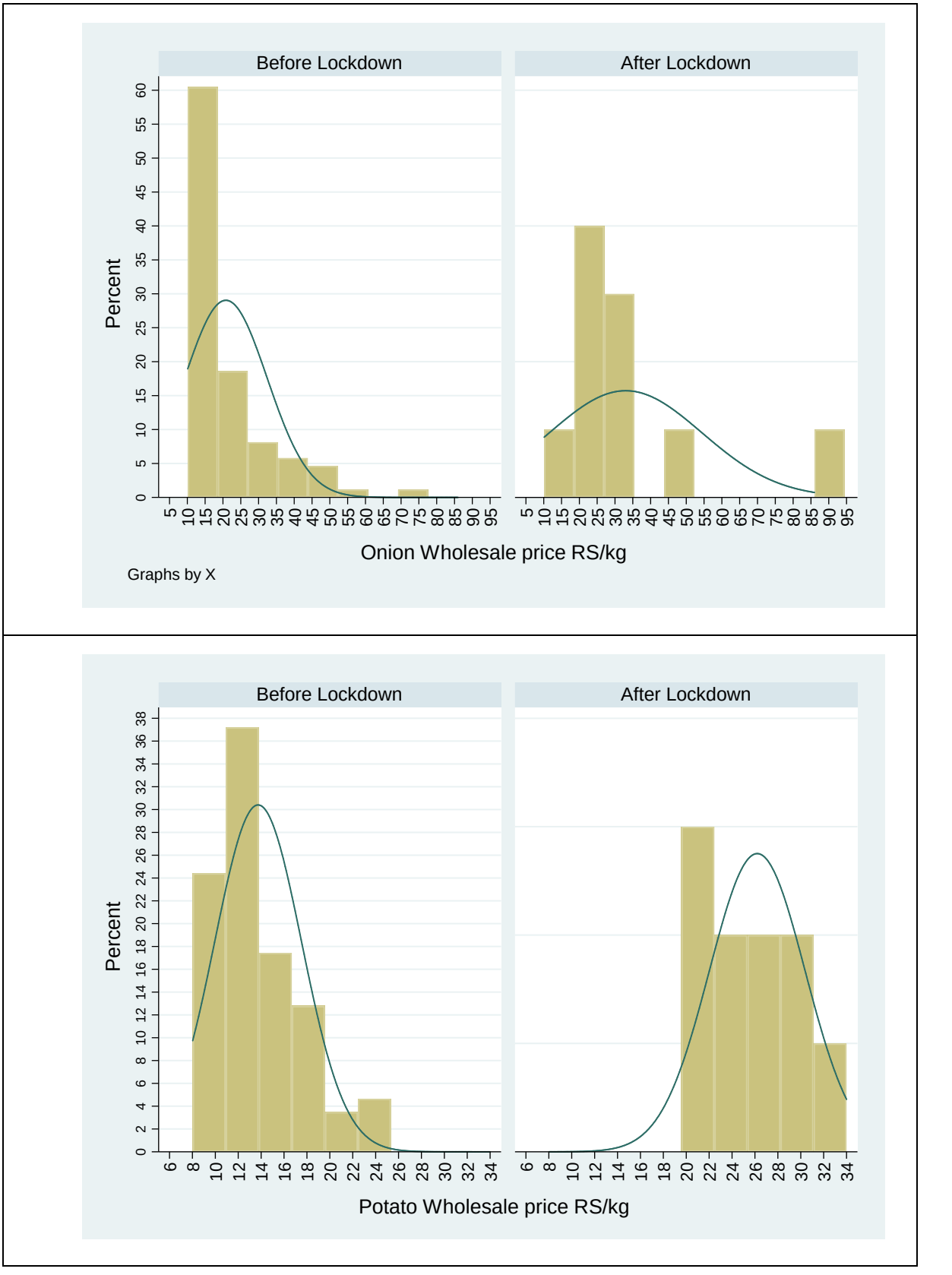
Product Name	Quantity in MTs			Value (in Rs. Lakhs)			Unit value (in USD / Tonnes)		
	2019-20	2020-21	% change	2019-20	2020-21	% change	2019-20	2020-21	% change
Basmati Rice	1665017	2034565	22.19	1261945	1365914	8.24	1010.56	895.14	-11.42
Non-Basmati Rice	2126076	3941572	85.39	601107	1156986	92.48	376.97	391.38	3.82
Guargum	181806	90791.1	-50.06	154456	75783.3	-50.94	1132.75	1112.93	-1.75
Groundnut	154012	174611	13.37	122040	157161	28.78	1056.55	1200.09	13.59
Processed Vegetables	89647.1	151846	69.38	87710.4	147020	67.62	1304.53	1290.95	-1.04
Alcoholic Beverages	53766	90666.1	68.63	64644.1	91010.4	40.79	1603.10	1338.40	-16.51
Other Cereals	211607	50885.5	-75.95	58572.9	17220.9	-70.6	369.07	451.23	22.26
Cocoa Products	11365.4	8659.95	-23.8	53602.3	39315.6	-26.65	6288.38	6053.24	-3.74
Pulses	98848	156762	58.59	69902.1	109638	56.84	942.89	932.52	-1.10
Fruits / Vegetable Seeds	5899.15	4842.73	-17.91	41979	39801.7	-5.19	9488.15	10958.46	15.50
Milled Products	117310	153803	31.11	42411	62889.6	48.29	482.04	545.20	13.10
Floriculture	8280.09	5087.61	-38.56	24309.8	20310.1	-16.45	3914.57	5322.75	35.97
Wheat	91644	217815	137.67	17262.2	45361.6	162.78	251.15	277.68	10.56
Total				4600155.8	5384398.3	17.05			

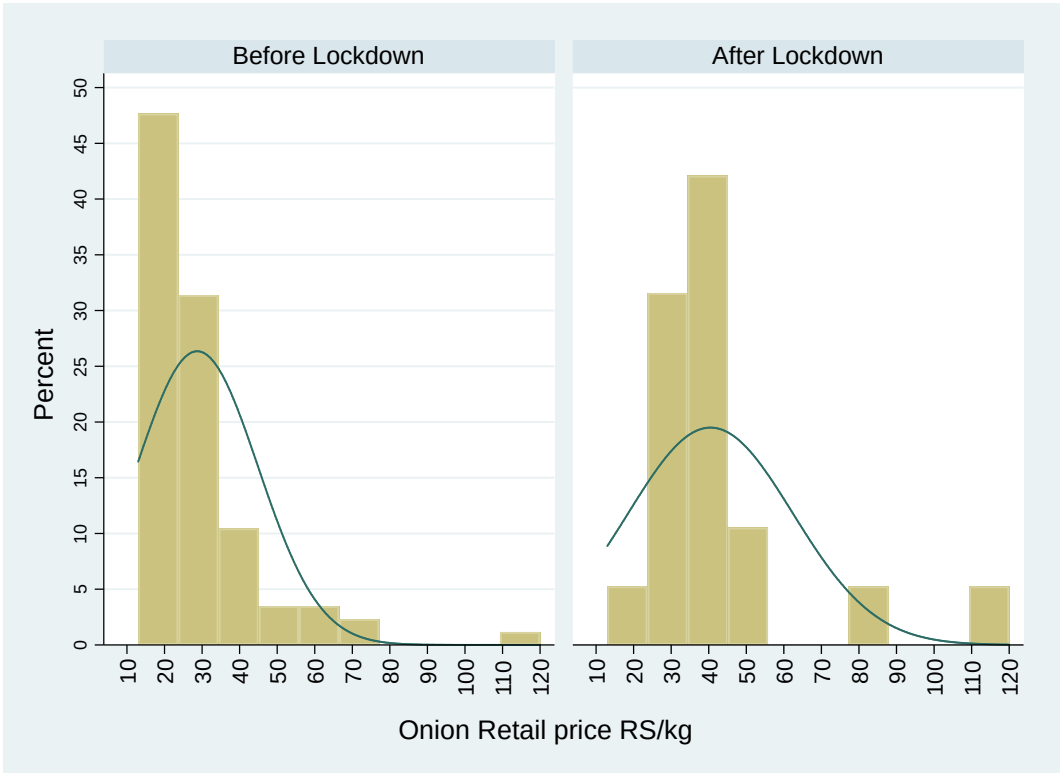
*Source: DGCIS - April-August (2019-20 & 2020-21)

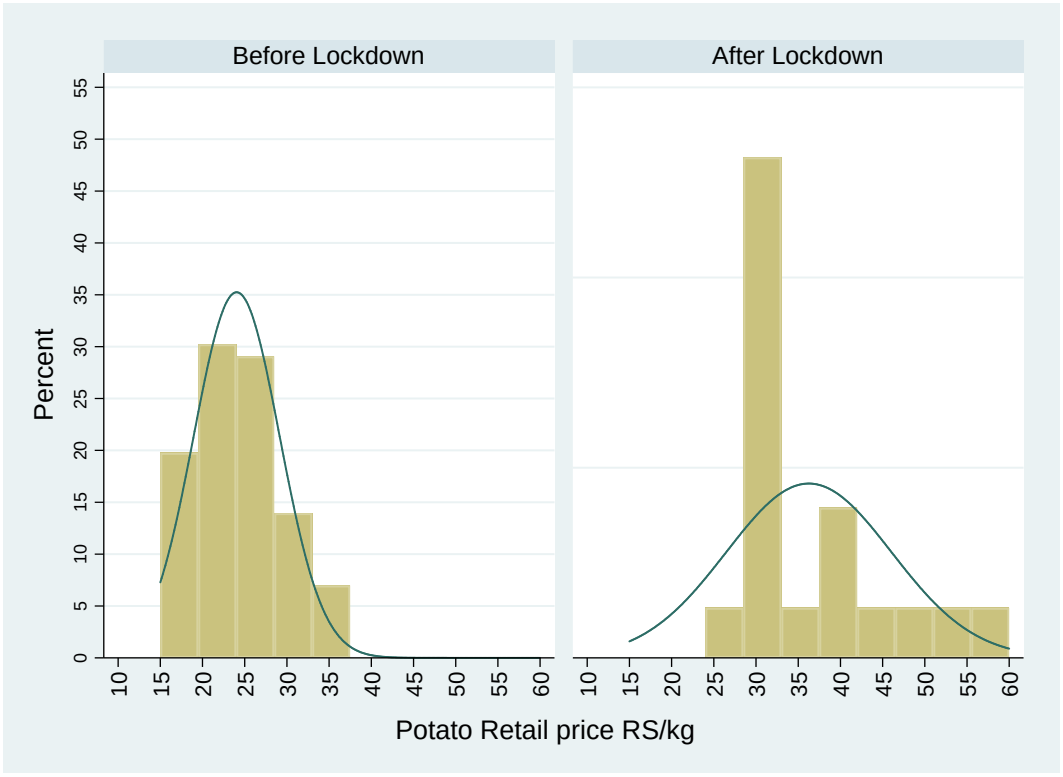
Figures on trends in wholesale and retail prices of select commodities






Before Lockdown
After Lockdown
Percent
0 5 10 15 20 25 30 35 40 45 50 55 60
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95
Onion Wholesale price RS/kg
Graphs by X
Before Lockdown
After Lockdown
Percent
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
Potato Wholesale price RS/kg


Before Lockdown
After Lockdown
Percent
0
5
10
15
20
25
30
35
40
45
50
10
20
30
40
50
60
70
80
90
100
110
120
Onion Retail price RS/kg


Before Lockdown
After Lockdown
Percent
0
5
10
15
20
25
30
35
40
45
50
55
10
15
20
25
30
35
40
45
50
55
60
Potato Retail price RS/kg