Biological Forum – An International Journal **16(5): 177-182(2024)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

To Study the Effect of Covid-19 Pandemic on Market Prices of Horticulture Crops

Mohan G.S.,Vinushree R.*, Ashish Baluni and Megha J.
Department of Agricultural Statistics, College of Agriculture, Dharwad
University of Agricultural Sciences, Dharwad (Karnataka), India.

(Corresponding author: Vinushree R.)*
(Received: 04 March 2024; Revised: 07 April 2024; Accepted: 20 April 2024; Published: 15 May 2024)
(Published by Research Trend)

ABSTRACT: According to the second advance estimate of horticulture production released by the Ministry of Agriculture, India is expected to have the highest ever horticulture production of 329.86 million tonnes in 2020-21, up by 2.93 per cent over previous year. The scenario of horticulture crops in India has become very encouraging, due to the imposed lockdown, activities related to supply chains from agriculture were notably disrupted. Tomato is one of the major vegetable crops whose supply and price was affected by the unexpected changes. This research was carried out to study the effect of Covid-19 pandemic (before and after lockdown) on market prices and arrivals of horticultural crops in APMC, Kolar district. Secondary data was collected on market prices and arrivals of tomato, chilli, cabbage, beans and cucumber crops from Jan 2016 to Dec 2021 from website www.krishimaratavahini.kar.nic.in.com. The statistical tools used for the analysis of data were Descriptive statistics, Regression, Paired-t test. The result revealed that cubic model was the most suitable model for arrivals of the crops and prices were not following justifiable trend which did not yield any suitable model. The agriculture crop area was declined and replaced by vegetables, especially tomato and cabbage. During Covid-19 pandemic tomato and cabbage price variation was maximum but in case of chilli the prices showed less variation. Analysis of data showed linear regression trend which indicates the positive growth of vegetable prices during lockdown in the year 2020 and 2021. The paired t-test approach was used to compare the Covid-19 pandemic hit year 2020-21 with year under study (2016-2019) in context of lockdown, the findings revealed that, except in the year 2018 the years 2020 and 2021 showed significant decline in prices of crops when compared to past years. The Covid-19 crisis has caused significant damage to the national and global economy due to the lockdown measures initiated in March 2020 in many countries.

Keywords: Descriptive statistics, Regression analysis, Paired t-test, Covid-19.

INTRODUCTION

Statistical investigation is a systematic process of collecting and analysing the data to study the trends and patterns. It helps industries, policy makers, and other authorities etc.., to make more accurate decisions. It helps to find the best performance and develop products by doing modelling of the ongoing situation and providing the future scenario. The application of statistical approaches and methods is necessary for efficient practice in resolving the various problems that arise in many branches of agricultural industries.

The importance of horticulture in improving the productivity of land, generating employment, improving economic condition of the farmers and entrepreneurs, enhancing exports and above all providing nutritional security to the people. India is the second largest producer of fruits and vegetables in the world next only to China (NHB, 2011). The country's annual requirement is 74.40 MTs fruits and 175.2 MTs vegetables. With the present level of population, the annual requirement of fruits and vegetables will be of the order of more than production level.

According to the second advance estimate of horticulture production released by the Ministry of Agriculture, India is expected to have the highest ever horticulture production of 329.86 million tonnes in 2020-21, up by 2.93 per cent over previous year. The increase in production has been registered in vegetables, spices, medicinal and aromatic crops. The Floriculture sector has been the hardest hit by the pandemic as production declined by 7.17 per cent.

In India, the share of agriculture in GDP increased to 19.9 per cent, hitting 20 per cent after 17 years of which horticulture contributes 30.4 per cent to agriculture GDP (Anon., 2020). The increasing consciousness of nutrition of high valued commercial crops which comparatively witness low pathogenic distress as against the field crops, thus having wide ambit in booming processing industry. The total horticulture area and production in 2019-20 is 26.46 m ha and 320.77 MT respectively, an increase of about 9.72 MT (increase of **3.12%**) over 2018-19 (Anon., 2021).

Increase in production of fruits, vegetables, aromatic and medicinal plants and plantation crops, while decrease in production of spices and flowers over previous year, is envisaged.

Year	2018-19	2019-20	2020-21
Area in m hectares	25.74	26.46	27.17
Production in m tonnes	311.05	320.77	326.58

Karnataka state has occupied 3rd place in respect of total area with 18.66 lakh hectares contributing to 8.60 per cent area to total area and 6th place in respect of total production with 177.98 lakh tons contributing 7.4 per cent production to total production at all India level. Karnataka state has occupied 3rd place regarding Fruit crops with area of 3.78 lakh hectares and production of 62.74 lakh tons and 8th place regarding Vegetable crops with 4.66 lakh hectares of area and 90.56 lakh tons of production. The total geographical area of the Kolar district is 3,74,916 hectares, out of which, 2,13,543 is net cultivated area with an horticulture area of 1,11,453 hectares (29.73 % net cultivated area).

Due to the impact of COVID-19 on agriculture and horticulture crops livestock/poultry Krishna district of Andhra Pradesh were 5 respondents (8.33%) decline in production of agriculture, decline in horticulture and 35.00 declines in production of livestock. In agriculture crops 25.00 per cent decline in farm gate prices followed by 86.66 per cent decline in horticulture crops. In marketing majority 76.66 per cent of the farmers faced lack of marketing facilities in agriculture crops, followed by 95.00 per cent in marketing of horticulture produce and 53.33 per cent of the famers faced problems marketing of livestock produce (Venkata *et al.,* 2023). The impact of Covid-19 and the lockdown, the changes in the functioning of agricultural markets and assess the impact on prices and arrivals of commodities at wholesale markets. These impacts viewed as consequences of behavioural responses from consumers, wholesalers and retailers through to farmers. Farm incomes are by their very nature seasonal prices and quantities traded of commodities whose harvest times begin from late March are a key determinant of the liquidity of farmers and how their livelihoods are being affected by the pandemic, and also assess that state government had undertaken a greater degree of market reforms were better able to protect farmers from disruption.

However, most studies focus on national or state-level impacts, lacking district-specific analyses. This study addresses that gap by analyzing six-year trends (2016–2021) in market arrivals and prices of five key horticultural crops—tomato, chilli, cabbage, beans, and cucumber—in the Kolar APMC, Karnataka, before and during the COVID-19 pandemic.

MATERIAL AND METHODS

Kolar district is located at 13.13°N 78.13°E with an average elevation of 849 metres (2,785 ft). It is located at a distance of about 70 kilometres from Bangalore, 50 kilometres from Bangalore International Airport, 147 kilometres from Hogenakkal waterfalls & 32 kilometres from Kolar Gold Fields. The district falls in the Eastern dry agro climatic Zone. It experiences a semi-arid climate, characterized by typical monsoon tropical weather with hot summers and mild winters. The year is normally divided into four seasons.

The secondary data were collected for the period Jan, 2016 to Dec, 2021 that includes marketing prices of horticultural crops on daily basis and also arrivals of six years of horticultural crops *i.e.,* from Jan, 2016 to Dec, 2021 on daily basis (Anon., 2022).

Descriptive statistics. This involved mean, standard deviation and variance which tells about the description of the procurement in particular year. Mean gives the idea of average amount of the milk procurement, standard deviation and the variance along with CV gives the homogeneity of the milk procurement in the DMS over the days of study period.

Regression: It is a functional relationship between the two variables in that one is dependent and another one is independent variable.

Simple linear regression model:

$Y = \alpha + \beta X + \varepsilon$

Where, Y- Dependent variable (prices)

X- Independent variable (arrivals)

α - Intercept.

β - Slope of Regression line.

ε - Random Error.

Paired t-test: The paired t-test gives a hypothesis examination of the difference between population means for a set of random samples whose variations are almost normally distributed.

Let us assume two paired sets, such as X_i and Y_i for i = 1, 2, …, n such that their paired difference are independent which are identically and normally distributed.

Paired t-test statistic :

$$t = \frac{\hat{d}}{S/\sqrt{n}}$$

RESULTS AND DISCUSSION

To study the effect of covid-19 pandemic on market prices of crops

Descriptive statistics. The descriptive analysis including mean and coefficient of variance of each crops from year 2016 to 2021 is presented in Table 1, which includes mean value of both arrivals and prices of crops under study. The maximum arrivals was observed in 2021 year and from 2017 to 2021 arrivals shows increasing trend, same trend showed in all crops. While coming to prices, showed decreases in both 2020 and 2021 year compare to previous year from 2016-19.

Table 1: Descriptive statistics of crops during study period.

Year	Tomato arrivals		Tomato prices	
	Mean	CV %	Mean	CV %
2016	4381.86	95.33	1371.50	78.60
2017	3239.95	51.53	1718.09	61.53
2018	3298.62	69.08	694.16	31.50
2019	4949.64	80.40	1303.73	30.81
2020	13238.72	54.18	1162.64	51.06
2021	14285.50	73.13	1024.73	80.62
Year	**Chilli arrivals**		**Chilli prices**	
	Mean	**CV %**	**Mean**	**CV %**
2016	15.60	58.09	2743.29	57.72
2017	16.44	55.67	2780.82	35.61
2018	11.56	50.99	2265.21	30.90
2019	11.61	54.44	2847.53	33.39
2020	14.98	49.30	2610.27	33.08
2021	14.88	66.61	2487.26	30.98
Year	**Cabbage arrivals**		**Cabbage prices**	
	Mean	**CV %**	**Mean**	**CV %**
2016	31.23	77.28	606.40	57.04
2017	35.75	88.45	923.36	76.68
2018	49.84	53.14	384.40	41.24
2019	101.39	79.91	992.92	32.83
2020	82.95	43.47	694.38	79.89
2021	139.61	55.20	618.63	82.14
Year	**Beans arrivals**		**Beans prices**	
	Mean	**CV %**	**Mean**	**CV %**
2016	60.90	79.73	3374.55	71.95
2017	28.85	53.63	3818.77	42.69
2018	36.64	49.17	2603.15	45.57
2019	44.55	66.48	4354.52	50.91
2020	61.92	43.14	3415.66	46.19
2021	69.06	58.65	3414.52	41.89
Year	**Cucumber arrivals**		**Cucumber prices**	
	Mean	**CV %**	**Mean**	**CV %**
2016	224.33	57.16	625.62	55.53
2017	197.35	73.87	638.68	54.79
2018	206.80	74.45	631.07	50.80
2019	157.29	59.47	910.00	50.70
2020	185.79	72.09	673.41	60.78
2021	241.69	41.49	635.34	58.05

Note: Arrivals expressed in quintals (Q) and Prices expressed in Rs/Q

Linear regression equation of trend of prices of crops. The linear regression equation of trend of prices of crops before Covid-19 period presented in Table 2. indicated that cabbage, beans and cucumber crops showed increasing trend while rest of all decreasing trend, that too only cucumber crop was significantly changing remaining all 4 crops was changing non-significantly.

The linear regression equation of trend of prices of crops during Covid-19 period presented in Table 3. that indicates all crops prices showed increasing trend during Covid-19 pandemic period but none of the crops was changing significantly.

The linear regression equation of arrivals and prices of crops during overall study period presented in Table 4. indicated that prices of all crops under study are decreasing with increases in arrivals unit that too changing significantly.

Comparison of prices of crops during lockdown with past four years. The prices of crops from year 2020 and 2021 during lockdown period tested to check the mean difference from the year 2016 to 2019 with same study period, the result of paired t-test was presented in Table 5 and 6.

Supply chain disruptions during the COVID-19 lockdown were widespread across India and globally. Tripathi *et al.* (2021) observed that vegetable direct-marketing systems in India temporarily collapsed due to mobility restrictions and labor shortages, severely impacting smallholder farmers. Similarly, Pakhuan and Choenkwan (2021) reported substantial disruptions in ginger production in Northeast Thailand, emphasizing the vulnerability of labor-dependent horticulture systems. On the agronomic front, Bishnoi *et al.* (2021) demonstrated that optimized row spacing significantly influenced the yield performance of cluster bean, suggesting scope for adaptive cultivation practices under pandemic conditions. Kumar *et al.* (2021) provided a multi-level assessment of how COVID-19 affected agricultural systems in Uttar Pradesh, noting

constraints across supply, labor, and market access. Furthermore, Phad (2022) highlighted that the performance of Agricultural Produce Market Committees (APMCs) in the Marathwada region declined sharply, pointing to systemic weaknesses in wholesale market infrastructure during the pandemic.

The descriptive analysis including mean and coefficient of variance of each crops from year 2016 to 2021 is presented in Table 1. It was observed that during study period tomato crop showed maximum variation in both price and arrivals as compare to all other crops, followed by cabbage, cucumber, beans and chilli crop which showed minimum variation in both price and arrivals. During Covid-19 pandemic tomato price and cabbage price variation happened maximum but in beans and cucumber, price variation observed moderately and maintain more homogeneity in chilli price. This can be supported from the evidences given from the study carried out by Afrin *et al.* (2020) on dynamics of area change in vegetable production in karnataka. Among the vegetables potato, and leafy vegetables recorded negative growth rate. Inequality between districts has also been observed for growth in area under vegetables. Tomato, gourds, cole crops and other vegetables group showed positive trend of area over the study period. However, onion and leafy vegetables would have more or less constant area over the projected period.

Before Covid-19 pandemic there was a positive slope observed in cabbage, beans and cucumber prices that too in small range, In case of tomato and chilli prices shown decreasing slope. During Covid-19 pandemic the positive slope of linear regression trend line indicate the positive growth of vegetable price during the lockdown in year 2020-21. Similar study related to the impact of the Covid-19 pandemic on the prices of the three essential food items and perishable commodities in India conducted by Bairagi *et al.* (2022). The results revealed that price of basic food items increased significantly during the pandemic compared to the pre-pandemic period. In contrast, during the same period, the price of onions declined significantly. The findings may suggest panic-buying, hoarding, and storability of food items. The results further reveal that remittance income and cash transfers from the government negatively affected commodity prices.

The paired sample t-test was conducted to compare mean of prices of before Covid-19 (2016-2019) and during Covid-19 (2020-2021), the results of paired t-test was presented in the Table 5 and 6. During first Covid-19 pandemic year 2020, this study observed that the prices of tomato and cabbage showed significant difference between before (2016-19) and during Covid-19 (2020). The prices of chilli and beans also significantly differed during pandemic and before, except 2016. In case of cucumber price, It was observed that there was a significant difference in during pandemic and before (2016 & 2019) but non-significant with 2017 & 2018. During second Covid-19 pandemic year 2021, this study observed that the prices of tomato and chilli showed significant difference between before (2016-19) and during Covid-19 (2020), the prices of cabbage and beans also significantly differ during pandemic and before except 2016 (non-significant). In case of cucumber price, observed that there is a significant difference only in previous year 2019 but non-significant from 2016-2018.

Table 2: Linear regression fit equation of crops before Covid-19 period.

Crop Name	Linear regression equation	R^2	Inference
Tomato	Y = 15.664 – 0.337 X	0.32^{ns}	Decreasing
Chilli	Y = 11648.31 – 0.208 X	0.16^{ns}	Decreasing
Cabbage	Y = -8749.64 + 0.219 X	0.33^{ns}	Increasing
Beans	Y = -4476.19 + 0.185 X	0.21^{ns}	Increasing
Cucumber	Y = -7021.07 + 0.179 X	0.49*	Increasing

Table 3: Linear regression fit equation of crops during Covid-19 pandemic period.

Crop Name	Linear regression equation	R^2	Inference
Tomato	Y = -29986.4 + 0.703 X	0.51^{ns}	Increasing
Chilli	Y = -12490.1 + 0.340 X	0.32^{ns}	Increasing
Cabbage	Y = -25464.1 + 0.591 X	0.39^{ns}	Increasing
Beans	Y = -11452.6 + 0.336 X	0.41^{ns}	Increasing
Cucumber	Y = 525.75 + 0.0027 X	0.36^{ns}	Increasing

Note: Y is dependent variable, price in Rs/Q; X is independent variable, time in days; R^2 - Coefficient of determination; ns - Non-significant

Table 4: Overall Linear regression fit equation of crops during study period.

Crop Name	Linear Regression equation	R^2	Adj. R^2	Inference
Tomato	Y = 1262.6 – 0.0069 X	0.39**	0.34	Decreases
Chilli	Y = 2658.48 – 2.56 X	0.34**	0.29	Decreases
Cabbage	Y = 737.74 – 0.47 X	0.40**	0.36	Decreases
Beans	Y = 4138.58 – 14.15 X	0.530**	0.52	Decreases
Cucumber	Y = 904.65 – 1.08 X	0.301**	0.29	Decreases

Note:- Y – Dependent variable, Prices; X – Independent variable, Arrivals

* - Significant at 5 per cent; ** - Significant at 1 per cent

Adj.R^2–Adjusted coefficient of determination ; R^2 - coefficient of determination

Table 5: Comparison of before COVID-19 pandemic with during COVID-19 (2020) pandemic.

Crop	2016 vs 2020		2017 vs 2020		2018 vs 2020		2019 vs 2020	
	t statistics	p value	t statistics	p value	t statistics	p value	t statistics	p value
Tomato prices	3.20**	0.001	11.57**	<0.01	-15.72**	<0.01	3.538**	<0.01
Chilli prices	1.359^{ns}	0.174	2.812**	<0.01	-6.781**	<0.01	3.476**	<0.01
Cabbage prices	-2.296*	0.022	8.136**	<0.01	-11.12**	<0.01	7.613**	<0.01
Beans prices	-0.364^{ns}	0.715	4.652**	<0.01	-9.62**	<0.01	9.019**	<0.01
Cucumber prices	-2.107*	0.035	-1.145^{ns}	0.252	-1.409^{ns}	0.159	7.437**	<0.01

Table 6: Comparison of before COVID-19 pandemic with during COVID-19 (2021) pandemic.

Crop	2016 vs 2021		2017 vs 2021		2018 vs 2021		2019 vs 2021	
	t statistics	p value	t statistics	p value	t statistics	p value	t statistics	p value
Tomato prices	4.087**	<0.01	9.44**	<0.01	-7.54**	<0.01	4.858**	<0.01
Chilli prices	2.911**	<0.01	4.57**	<0.01	-4.018**	<0.01	5.617**	<0.01
Cabbage prices	-0.293^{ns}	0.76	6.892**	<0.01	-7.091**	<0.01	10.372**	<0.01
Beans prices	-0.341^{ns}	0.73	3.997**	<0.01	-13.16**	<0.01	8.677**	<0.01
Cucumber prices	-0.386^{ns}	0.69	0.132^{ns}	0.89	-0.166^{ns}	0.868	10.597**	<0.01

Note: * - Significant at 5 per cent ; ** - Significant at 1 per cent; ns – Non significant

CONCLUSIONS

Diversification in horticulture requires effective marketing linkages, supported by modern marketing practices including introduction of grading, post-harvest management, cold chains etc. The price spread along the marketing channel is directly proportional to the number of market intermediaries involved along the channel. Horticulture development is currently constrained by poor marketing arrangements. The gap between prices received by the farmers and those paid by urban consumers is large, reflecting inefficient marketing arrangements. Marketing is critical for moving products from producer to consumer and maintaining price stability. Changes in the demand and supply of agricultural products and marketing must be coordinated with projected increases in agricultural production. The Covid-19 crisis has caused significant damage to the national and global economy due to the lockdown measures initiated in March 2020 in many countries, including India. Using the past observations of the same variable, a model describing the pattern of the time series will be developed and model will be used to obtain trend of market prices and arrivals of crops.

FUTURE SCOPE

- The study helps to make the policy makers for understanding the nature if market supply chains.
- The investors, traders, retailers will get the idea of most sustainable agricultural/horticultural produce with context of pandemic, disaster like situation.
- Same kind of methodology can be done for the impact of pandemic, flood, drought and other natural disaster on other sectors like silk industry, commercial crops, processing industries etc.
- Addition to it, future trends of impact can also be calculated with various future projections tools like SARIMA, MLP-ANN, NNAR etc.

REFERENCES

Anonymous (2020). Agri share in GDP hit 20% after 17 years. *DownToEarth*. Retrieved from https://www.downtoearth.org.in/news/agriculture/agri-share-in-gdp-hit-20-after-17-years-economic-survey-75271

Anonymous (2021). Ministry of Agriculture & Farmers Welfare. *Press Information Bureau*. Retrieved from https://www.pib.gov.in/PressReleasePage.aspx?PRID=1703196

Anonymous (2022). Daily Report (2016–21), Market prices and arrivals of crops. Retrieved from http://www.krishimaratavahini.kar.nic.in

Afrin Zainab, B. I., Umesh, K. B., Sreenivas, Murthy, D., Srikantha Murthy, P. S., Narse Gowda, N. C. and Manjunath, V. (2020). *Dynamics of Area Change in Vegetable Production in Karnataka*. *Economic Affairs*, *65*(4), 499–504.

Bairagi, S., Mishra, A. K. and Mottaleb, K. A. (2022). Impacts of the COVID-19 pandemic on food prices: Evidence from storable and perishable commodities in India. *PLoS One*, *17*(3), 33–55.

Bishnoi, D., Umesha, C. and Sharma, C. S. (2021). Impact of Row Spacing on Growth and Yield of Cluster bean (*Cyamopsis tetragonoloba* L.) varieties. *Biological Forum – An International Journal*, *13*(3), 144–148.

Kumar, P., Singh, S. S., Pandey, A. K., Singh, R. K., Srivastava, P. K., Kumar, M., Dubey, S. K., Sah, U., Nandan, R., Singh, S. K., Agrawal, P., Kushwaha, A., Rani, M., Biswas, J. K. and Drews, M. (2021). Multi-level impacts of the COVID-19 lockdown on agricultural systems in India: The case of Uttar Pradesh. *Agricultural Systems*, *187*, 103027.

Pakhuan, W. and Choenkwan, S. (2021). Impacts of the COVID-19 pandemic on ginger production: Supply chains, labor, and food security in Northeast Thailand. *Forest and Society*, *5*(1), 120–135.

Phad, S. P. (2022). Impact of covid-19 on performance of APMC's in Marathwada region. *Journal of Global Economy*, *18*(2), 176–186.

Tripathi, A., Bharti, N., Sardar, S. and Malik, S. (2021). COVID-19, disrupted vegetable supply chain and direct marketing: Experiences from India. *Journal of Agribusiness in Developing and Emerging Economies*, *13*(1), 1–15.

Venkata, R., Subbaiah, P. V., Narasimha, R., Siva Prasad, P. N. and Rajsekhar, N. (2023). An analysis of impact of COVID-19 on agriculture, horticulture crops and livestock in Krishna district, India. *Asian Journal of Agricultural Extension, Economics & Sociology*, *41*(8), 187–193.

How to cite this article: Mohan G.S.,Vinushree R., Ashish Baluni and Megha J. (2024). To Study the Effect of Covid-19 Pandemic on Market Prices of Horticulture Crops. *Biological Forum – An International Journal*, *16*(5): 177-182.