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Price Dynamics of Tomato, Onion and Potato (TOP) in India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The development of society depends on several core elements, including food, livelihood, nutritional security, and healthcare. To gain insight into the dynamics and volatility of prices of top crops, a study was conducted analysing wholesale monthly price data for selected states and all of India from January 2005 to December 2021. Various methodologies such as the Compound Annual Growth Rate (CAGR), seasonality index, Cuddy Della Valle Index, rescaled range analysis, and ARCH-GARCH model were utilized to achieve the research objectives. According to the study, West Bengal had major crop price fluctuations with tomatoes being costly from July to November, onions from August to January, and potatoes from July to December. Karnataka, Rajasthan, and Punjab experienced the highest monthly price instability for tomatoes, onions, and potatoes. Additionally, the prices of TOP crops were more unpredictable than cereals and pulses. The price series of potatoes had long-term memory detection, and onions had the highest price volatility among TOP crops. According to the study, in order to tackle the price variability of TOP crops, it is necessary to enhance price stabilization

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measures. By implementing integrated policies, a stable pricing system can be established for top crops, which will not only safeguard the interests of consumers but also ensure food and economic security for farmers.

Keywords: TOP; price dynamics; seasonality; instability; volatility.

1. INTRODUCTION

Horticultural crops have been recognized for their crucial role in providing nutrition and preventing human diseases, which in turn contributes to the development and prosperity of a nation. In India, horticulture crops contribute 30% to agricultural GDP, cover around 14% of the area, and account for almost 37% of total agricultural exports. India is the second-largest producer of fruits and vegetables worldwide, with fruits and vegetables worth Rs. 9410.81 crores exported in 2017-18. According to IIHR, the demand for fruits and vegetables is expected to increase to 540 million tonnes by 2050. The three most cultivated, produced, and consumed vegetables in India are tomatoes, onions, and potatoes, commonly known as TOP. Their production has significantly increased over the years, making India the second-largest producer of all three vegetables globally. In TE 2018-19, tomato production was 19.8 million tonnes, onion production was 22.8 million tonnes, and potato production was 49.1 million tonnes. Although TOP crops are commonly consumed throughout the country, managing them carries a significant risk due to their limited availability and storage and transportation issues, resulting in postharvest losses and market price fluctuations. Policymakers can benefit from understanding price behaviour, which can aid in creating sound agricultural policies and providing farmers with market insights to make informed decisions about crop adjustments, product disposal, and optimal selling timing.

In Guleria et al.'s [1] investigation of tomato markets in Solan, Ludhiana, Delhi, and Bangalore, the study utilizes the Cudda Della-Valle index and seasonality index, revealing peak instability in May and favourable pricing for farmers from July to November. Solan exhibited heightened price volatility according to the GARCH (1,1) model. Bisht and Kumar's [2] study on major pulses, utilizing the GARCH model, emphasized the dependence of current volatility on preceding periods. Pigeon pea stands out with persistent and explosive recent-period volatility, necessitating consistent monitoring and governmental interventions. Thakur et al.'s [3] exploration of wheat markets in 15 Indian states underscored the economic implications of staple food price deviations. The study emphasized the need for effective market information dissemination to counteract wheat price volatility and support profitable decision-making in agri-business. These studies together with several other studies [4-13] collectively enriched our understanding of market dynamics methods, offering insights for the analysis of price dynamics of tomato, onion, and potato in India in the current study.

2. MATERIALS AND METHODS

2.1 Dataset Description

To achieve the study objectives, we gathered wholesale monthly price information for the entire country and several states (as displayed in Table 1). Our criteria for selection included the availability of consistent data and consideration of the production status. Since we included almost all the major production states, it will give a clear picture of the price dynamics. We obtained this data from the AGMARKNET website, covering January 2005 to December 2021.

Table 1. States selected for the study and their current production status.

Production status	Tomato	Onion	Potato
1	Madhya Pradesh	Maharashtra	Uttar Pradesh
2	Karnataka	Karnataka	West Bengal
3	Gujarat	Gujarat	Gujarat
4	West Bengal	Madhya Pradesh	Madhya Pradesh
5	Uttar Pradesh	Rajasthan	Punjab
6	Maharashtra	Haryana	Haryana
7	Haryana	Uttar Pradesh	Karnataka
8	Punjab	West Bengal	Rajasthan
9	Rajasthan	Punjab	Maharashtra

2.2 Seasonal Variation in Prices

To calculate the seasonal price variation, we utilized the twelve-month ratio to the moving average technique. To determine the level of variation in seasonal indices, we employed the average seasonal price variation (ASPI) coefficient, intra-year price rise (IPR), and coefficient of variation (CV).

$$\text{ASPI} = \frac{(HSPI - LSPI)}{\frac{HSPI+LSPI}{2}} \times 100$$

$$\text{IPR} = \frac{(HSPI - LSPI)}{LSPI} \times 100 \quad \text{CV} = \frac{Standard\ Deviation}{Mean} \times 100$$

The LSPI refers to the lowest seasonal price index, while the HSPI stands for the highest seasonal price index.

2.3 Price Instability

To measure the price instability, the Cuddy Della Valle Instability Index (Cuddy and Della Valle, 1978) was used, and it is a modification of the coefficient of variation to accommodate the trend present in the data, which is commonly present in economic time series data. This method is superior to scale-dependent measures such as standard deviation.

The Cuddy Della Valle index (CDVI) is calculated as follows:

$$\text{CDVI} = \text{CV} \sqrt{X}$$

Where $X = 1 - R^2$, CV is the coefficient of variation, R^2 is the adjusted coefficient of determination. Instability is categorised as low: 0-15, medium: 15-30, and high: > 30 [14,3] (Sihmar, 2014).

2.4 Rescaled Range Analysis

This is done to analyse the properties of the time series price data. For a time series of length n, the Rescaled Range calculated by Hurst is given by,

$$(R/S)_n = K \times n^H$$

Where K is a constant. H is known as the Hurst constant. Taking logs on both sides,

$$\log (R/S)_n = \log K + H. \log (n)$$

The value of H determines the classification of a time series as random, persistent, or anti-persistent. The nonparametric method of R/S analysis is used for this purpose. A time series with H = 0.50 is classified as random, meaning no long-term dependence exists. If the range of H is between 0.50 and 1, the time series is persistent, with long-term memory detection. In other words, if the current trend is positive, it is likely to continue being positive in the future, and vice versa for negative trends. On the other hand, if the range of H is between 0 and 0.5, the time series is anti-persistent, with more frequent reversals than a random time series.

V-Statistic:

Testing of stability of the time series was done by using V-Statistic, which is given by the formula,

$$V_n = \frac{\left(R/S\right)_n}{\sqrt{n}}$$

According to Priyadarshini et al. [15], it will appear horizontal when comparing the plot of Vn against log n for independent random time series. However, for persistent time series, it will slope upwards; for anti-persistent time series, it will slope downwards.

Correlation between periods:

This can be evaluated as follows:

$$C_N = 2^{(2H-1)} - 1$$

When there is zero correlation, it suggests that the time series is random. On the other hand, a positive correlation indicates a persistent time series, while a negative correlation reflects a constant time arrangement. The C_N can be seen as a way to measure the amount of long-term memory in the series [15].

2.5 Measurement of Volatility

In this study, we utilised the GARCH (1,1) model and R software to obtain estimates of price volatility. There are multiple methods for measuring volatility, but this was the approach taken in our analysis.

ARCH LM Test: Engle's (1982) ARCH-LM test is the standard approach to detecting ARCH effects. The ARCH test is a Lagrange multiplier (LM) test for autoregressive conditional heteroscedasticity (ARCH) in the residuals (Engle, 1982).

GARCH model: The model is given by,

$$Y_{it} = a_0 + b_1 Y_{it-1} + b_2 Y_{it-2} + e_{it} \quad \sigma_{it}^2 = \omega + \sum_{i=1}^{p} \beta i \ \sigma_{t-i}^2 + \sum_{i=1}^{q} \lambda i \ e_{t-i}^2$$

Where Y_{it} is the spot price in the t^{th} period of the i^{th} commodity. $\lambda i + \beta i$ *value closer to one indicates persistent volatility, while a value greater than one suggests an explosive deviation from the mean*

3. RESULTS AND DISCUSSION

3.1 Basic Statistics of TOP in India

Table 2 provides the compound annual growth rates for area, production, and productivity. Based on the data, onion showed the highest growth in both area and production during the study period. However, tomatoes had the highest growth rate in terms of productivity.

During the study period, it was observed that West Bengal had the highest maximum price, minimum price, average price, and standard deviation among the selected states for the TOP crops (Table 3).

3.2 Price Dynamics of Tomato

The tomato market follows a seasonal pattern where prices tend to go up from July to November. This is because a majority of tomato production, about 70%, occurs during the Rabi season, which involves transplanting in October-February and harvesting in December-June. Kharif production from July to November typically accounts for less than 30% of the year's total tomato production. As a result, the limited supply during this period causes tomato prices to increase yearly from July to November. These findings were reported in the Economic Survey of 2021. CV, ASPI, and IPR were estimated to assess the variation in seasonal price indices. The results showed that West Bengal has the highest variation, followed by Gujarat and Haryana. It is worth noting that West Bengal is among the top states in India when it comes to producing tomatoes. Based on the CDV Index, it was discovered that there is a significant fluctuation in tomato prices across various states, with Karnataka and Gujarat experiencing the highest instability. This instability is notable in all selected states, with a CDVI value exceeding 30 (Sihmar, 2014). It is intriguing to note that despite being a key producer of tomatoes in India, Karnataka has the highest price instability.

3.3 Price Dynamics of Onion

It was found that seasonal indices show higher prices from August to January each year. This is due to the rabi season, which includes transplantation from December to January and harvest from end-March to May, accounting for about 70% of the total onion production annually. During the Rabi harvest period, the seasonal component puts pressure on prices, leading to a decrease, while in other months, it leads to an increase, reaching its peak in October-December. The Kharif and late Kharif, the other two onion production seasons, usually experience a shortage of supply (Economic Survey, 2021). An assessment of seasonal price indices using CV, ASPI, and IPR revealed that Madhya Pradesh has the highest variation, followed by Maharashtra and Rajasthan. It is worth noting that despite being India's top onion-producing state, Maharashtra still experiences the highest seasonality variation. Onions have significant price instability in various states, with Rajasthan and Maharashtra showing the highest level of instability. All selected states had CDVI values over 30, indicating high instability. Maharashtra, despite being the highest onion producer, had the second-highest level of instability among the selected states.

3.4 Price Dynamics of Potato

The potato's seasonal indices were created by calculating the twelve-month ratio using the moving average method. It has been observed that the seasonal indices generally increase from July to December, indicating a rise in prices during that period every year. Haryana had the highest seasonal price index variation, followed by West Bengal and Uttar Pradesh. Punjab had the highest instability in potato prices, followed by Uttar Pradesh. All selected states had high price instability. Despite being the top producer of potatoes, Uttar Pradesh had the second-highest instability in prices.

Table 2. Compound annual growth rate of area, production and productivity in TOP

Crop	Area	Production	Productivity
Tomato	3.60%	6.55%	2.85%
Onion	6.76%	9.50%	2.57%
potato	2.87%	4.58%	1.66%

Table 3. Summary statistics of TOP in India

	Tomato		Onion		Potato	
	West Bengal	**India**	**West Bengal**	**India**	**West Bengal**	**India**
Maximum	60.41	39.84	76.92	62.45	34.89	31.92
Minimum	1.80	4.45	3.67	4.06	1.85	3.58
Average	18.84	14.76	16.78	15.38	8.77	10.92
SD	12.78	7.61	11.36	9.67	5.17	4.81

Table 4. Seasonal indices for wholesale price of tomato

	GJ	**HR**	**KA**	**MP**	**MH**	**PB**	**RJ**	**UP**	**WB**	**India**
January	62.91	75.77	84.32	70.10	81.19	85.06	76.95	67.55	56.88	79.72
February	53.51	67.91	62.22	66.65	67.85	74.19	66.72	56.62	36.58	65.82
March	51.11	75.33	60.68	65.77	69.91	75.46	69.13	63.92	37.06	64.27
April	57.37	71.80	74.70	74.81	79.86	81.15	62.44	68.32	38.37	70.75
May	81.46	52.21	110.07	87.32	79.43	53.62	58.39	63.90	79.19	82.27
June	122.75	68.63	126.25	108.31	119.14	58.35	71.79	78.51	113.89	100.98
July	**179.63**	**145.09**	**143.50**	**173.96**	**144.23**	**133.16**	**157.91**	**156.10**	**162.27**	**136.56**
August	**140.46**	**145.41**	**104.94**	**148.13**	**106.60**	**138.34**	**154.24**	**155.65**	**150.31**	**125.41**
September	**108.99**	**122.86**	**88.76**	**105.99**	**106.14**	**119.53**	**127.36**	**129.02**	**133.42**	**113.69**
October	**122.19**	**134.32**	**107.13**	**108.04**	**117.64**	**130.79**	**126.53**	**132.12**	**149.23**	**125.43**
November	133.10	142.67	130.12	110.64	127.36	143.45	132.25	136.42	147.34	135.84
December	86.51	98.00	107.31	80.28	100.66	106.91	94.64	91.87	95.46	99.26

Table 5. Seasonal indices for wholesale price of onion

	GJ	HR	KA	MP	MH	PB	RJ	UP	WB	India
January	**101.58**	**117.94**	**110.54**	**123.94**	**104.77**	**116.32**	**112.32**	**111.45**	**114.07**	**113.03**
February	81.65	100.16	91.14	91.25	83.79	94.78	92.38	98.33	93.60	94.26
March	65.65	80.15	65.97	66.05	60.58	77.62	72.79	81.37	67.88	75.88
April	57.34	63.69	57.84	53.90	53.49	65.35	59.80	67.28	55.79	64.44
May	58.07	55.23	59.67	51.78	55.05	56.99	52.62	60.87	59.71	64.24
June	76.73	64.72	77.83	68.12	74.02	64.20	62.01	62.77	69.87	74.72
July	87.53	80.67	95.83	85.01	86.65	81.62	81.62	81.17	85.87	86.91
August	**116.49**	**104.95**	**112.62**	**104.23**	**118.82**	**106.67**	**108.33**	**103.61**	**107.57**	**105.87**
September	**127.20**	**126.63**	**115.80**	**128.18**	**132.46**	**122.98**	**137.61**	**124.67**	**123.04**	**118.78**
October	**146.88**	**144.21**	**125.54**	**152.88**	**145.44**	**139.58**	**141.15**	**141.20**	**138.96**	**134.40**
November	**141.46**	**139.32**	**142.25**	**147.82**	**151.16**	**139.50**	**143.14**	**142.27**	**144.27**	**138.80**
December	**139.43**	**122.34**	**144.98**	**126.84**	**133.76**	**134.40**	**136.21**	**125.01**	**139.37**	**128.67**

Table 6. Seasonal indices for the wholesale price of potato.

	GJ	**HR**	**KA**	**MP**	**MH**	**PB**	**RJ**	**UP**	**WB**	**India**
January	84.36	62.19	97.09	79.77	87.06	68.92	71.30	64.76	72.54	84.89
February	69.04	58.78	83.64	76.03	77.80	63.76	69.44	61.33	58.80	72.56
March	72.37	66.77	79.18	79.46	80.52	71.68	77.24	71.64	69.89	75.14
April	91.00	84.03	91.54	92.90	92.11	92.83	92.79	84.11	84.61	87.60
May	94.95	94.86	103.67	98.37	99.03	97.98	100.66	98.80	100.39	97.22
June	100.43	105.92	107.40	100.31	100.89	105.24	105.79	107.15	106.56	104.47
July	**104.14**	**115.80**	**108.02**	**107.10**	**103.61**	**117.09**	**109.08**	**117.74**	**110.16**	**106.81**
August	**108.26**	**120.32**	**101.07**	**110.46**	**105.64**	**116.97**	**110.53**	**119.82**	**113.18**	**109.68**
September	**110.73**	**129.10**	**98.67**	**110.84**	**107.21**	**119.49**	**115.09**	**122.06**	**116.94**	**117.31**
October	**121.42**	**137.31**	**102.46**	**117.31**	**113.57**	**126.91**	**122.75**	**128.70**	**124.62**	**116.25**
November	**133.02**	**140.69**	**115.80**	**130.06**	**122.89**	**130.80**	**131.19**	**133.21**	**133.34**	**124.93**
December	**110.29**	**84.23**	**111.46**	**97.38**	**109.67**	**88.34**	**94.14**	**90.67**	**108.97**	**103.12**

Table 7. ARCH-LM test: Null hypothesis: no ARCH effects

	Chi-squared	p-value
Tomato	124.76	<0.001
Onion	136.74	<0.001
Potato	157.04	<0.001

Table 8. GARCH model

Particulars	Tomato	Onion	Potato
ARCH term (λi)	0.09426	0.999	0.9432
GARCH term (βi)	0.0125	0.000	0.000
GARCH fit	(1,1)	(1,1)	(1,1)
$\lambda i + \beta i$	0.955	0.999	0.943
Volatility	High	High	High

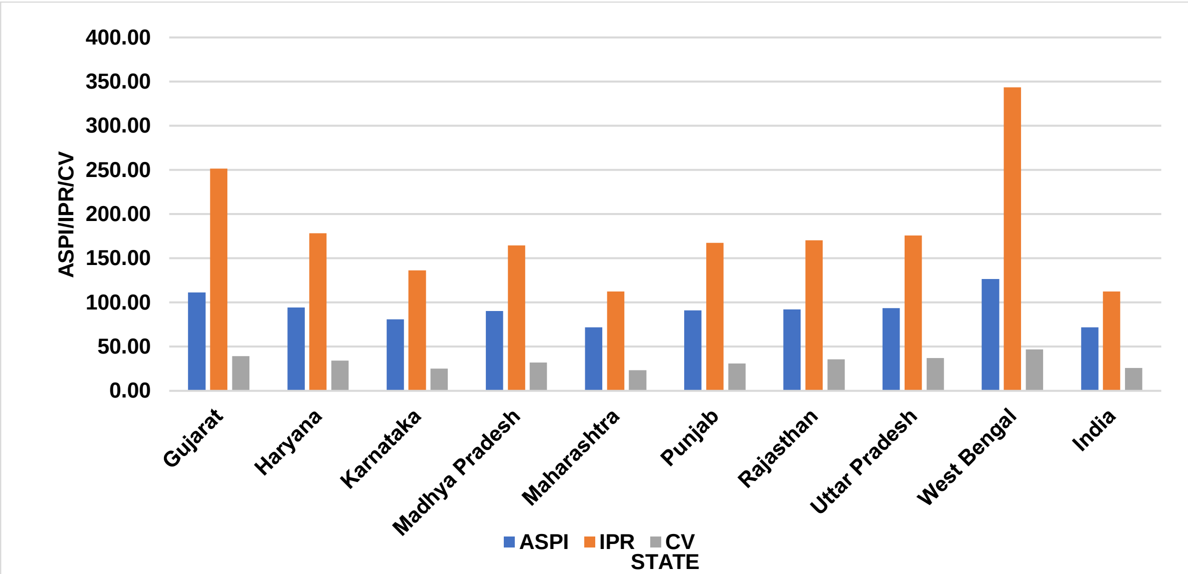

Fig. 1. Plot showing variation in the seasonal price index of tomato

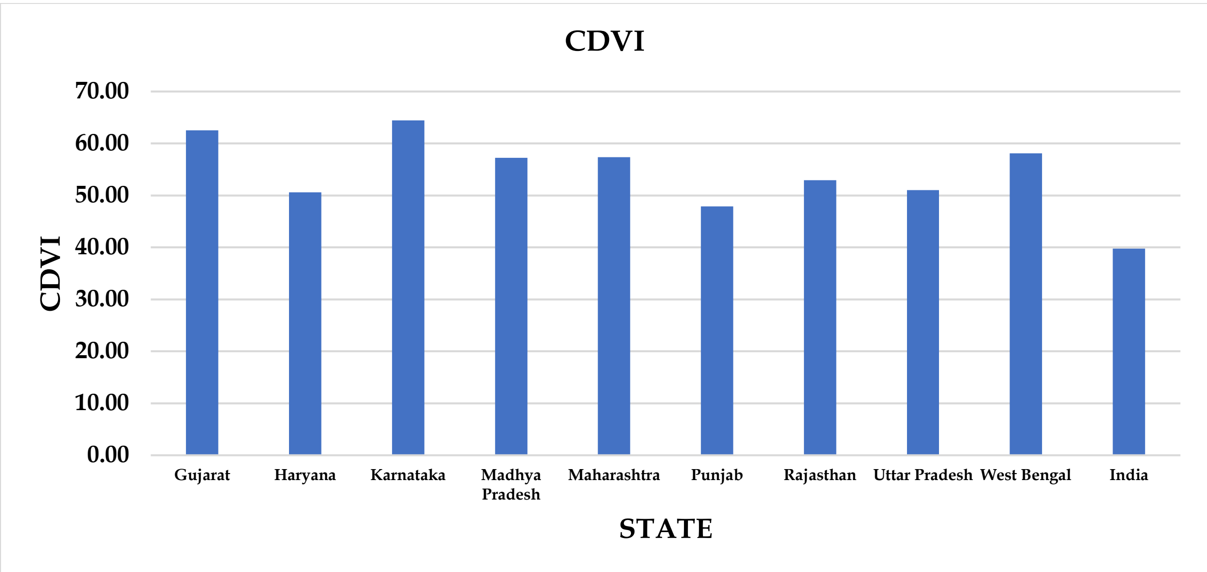

Fig. 2. Plot showing price instability in the tomato among selected states

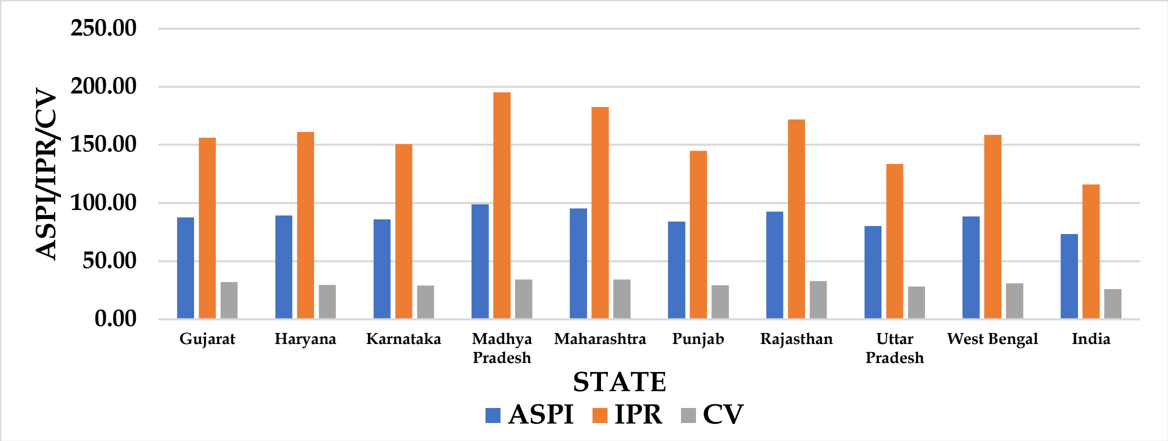

Fig. 3. Plot showing variation in seasonal price index of onion

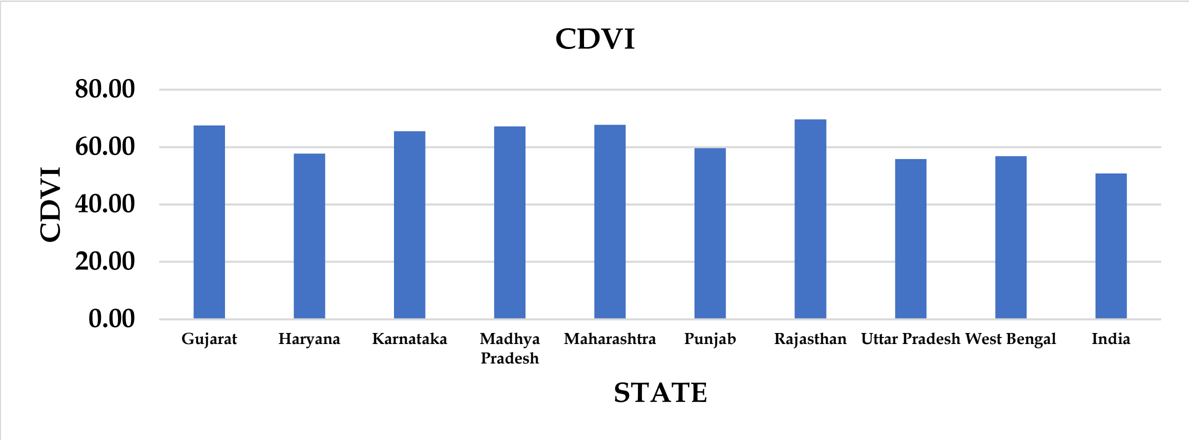

Fig. 4. Plot showing price instability in the onion among selected states

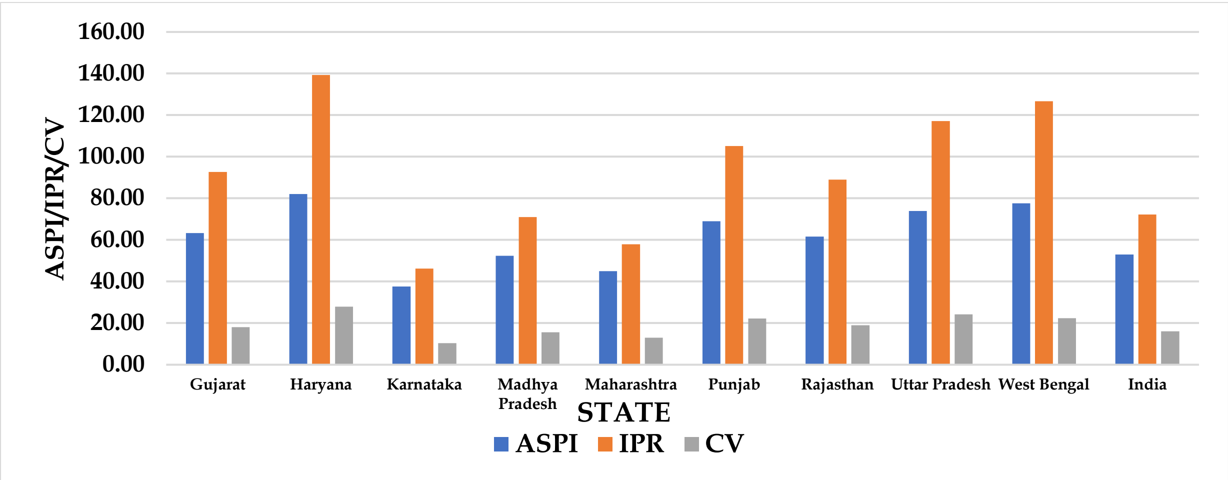

Fig. 5. Plot showing variation in seasonal price index of potato

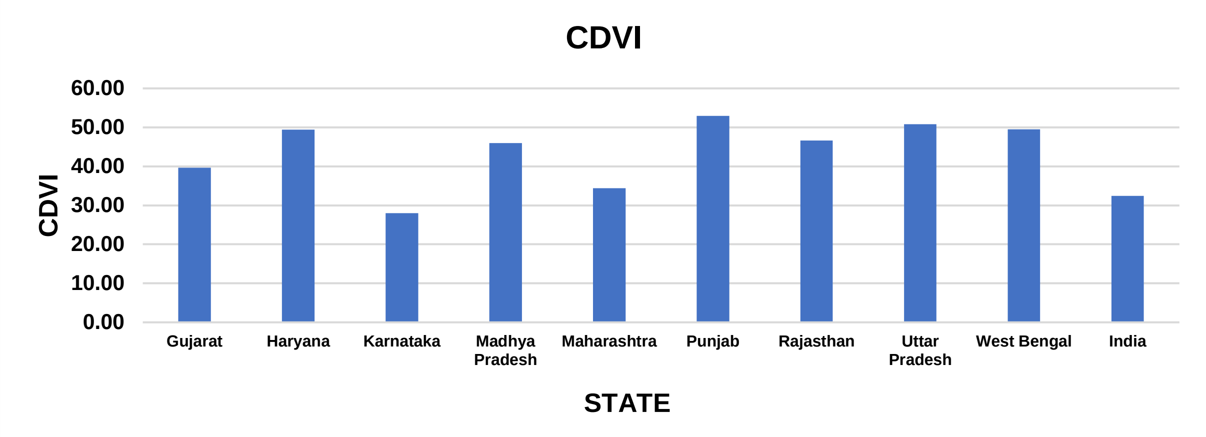

Fig. 6. Plot showing price instability in the potato among selected states

Are prices generally more stable and less seasonal in production centres?:

In general, crops such as cereals and pulses are considered to have less seasonality and price instability in their production centres. However, our study found that prices were not less seasonal or stable even in states with the highest production of TOP crops. For instance, Karnataka, the second-largest producer of tomatoes, had the highest price instability. Similarly, Maharashtra, the highest producer of onions, had the second-highest level of instability and variation in seasonality among selected states. The same was observed in Uttar Pradesh for potatoes. This pattern suggests that there are some serious issues with the marketing system for TOP crops.

3.5 Rescaled Range Analysis (TOP)

The Hurst constant value can be determined based on the log(R/S)-log(n) curve. Notably, the Hurst constant for tomato is 0.667 (with a standard error of 0.068), while for onion, it is 0.771 (with a standard error of 0.045), and for potato, it's 0.862 (with a standard error of 0.032). Since the H value is greater than 0.5, this indicates that the price series has long-term memory detection and is persistent.

To test the stability of a time series, V statistics were used. In the case of independent random time series, the plot of Vn against log n will be horizontal. However, a persistent time series will slope upwards, and an anti-persistent time series will slope downwards. The price series for tomato, onion, and potato showed an upward slope, indicating that it is a persistent time series. Therefore, we can conclude that the price series is persistent.

Correlation between periods was obtained by plotting the V statistic with log n. Correlation in between periods C_N was found to be 0.26 for tomato, indicating that the time series under analysis has 26% long-term memory. In the case of onion, it was 0.45 (45% long-term memory), and for potato, it was 0.65 (65% long-term memory). C_N can be considered as the quantitative proportion of long memory in the arrangement [15].

3.6 Price Volatility of TOP in India

In the present study, GARCH (1,1) model has been used to get the volatility estimates using R software**.** The GARCH model helps in getting more efficient estimators by handling the heteroskedasticity in the errors properly. Firstly ARCH-LM test is done to detect the ARCH effect. From the ARCH – LM test, the null hypothesis is rejected and there exists an ARCH effect.

$\alpha i + \beta i$ indicates the degree of persistence in volatility – closer to one, volatility to persist for a long time and >1 indicates an explosive series meandering away from the mean. It is common knowledge that TOP crops are known for their high price volatility and we established that through this study. Onion has the highest and most persistent volatility among these crops, followed by tomato and potato.

4. CONCLUSIONS

From 2001-20, among the TOP crops, onions had a high growth rate of 6.76% in terms of area and 9.50% in production. Meanwhile, tomatoes had the highest productivity rate at 2.85%. When it comes to monthly price variation, West Bengal had the most significant fluctuation among the selected states for top crops. Seasonal index studies indicated that the periods of highest price variation for tomato, onion, and potato were July to November, August to January, and July to December, respectively, which align with their production patterns. West Bengal had the highest seasonal index variation for tomatoes, while Madhya Pradesh had the highest variation for onions, and Haryana had the highest for potatoes.

At the national level, all TOP crop prices were found to be highly unstable, with potatoes being the least unstable. Karnataka, Rajasthan, and Punjab experienced the highest instability in prices for tomatoes, onions, and potatoes, respectively. Interestingly, even production centre prices for top crops are unstable and less seasonal compared to cereals and pulses. A rescaled range analysis showed that all top crop prices are persistent, with potatoes having the highest persistence. ARCH-GARCH analysis revealed that onion had the highest price volatility and persistence, followed by tomato and potato. From the study, it was understood that the implementation of price stabilization measures needs to be strengthened to manage the price volatility of top crops and buffer against extreme fluctuations. There is a need for policies tailored to the specific needs of different regions, and strengthening of the marketing information systems. Other one important factor is that investment is needed in infrastructure development, particularly in storage and transportation, to reduce wastage and ensure timely delivery, addressing supply-demand imbalances. In conclusion, strengthened integrated policies and strategies can contribute to a more stable price system for TOP for consumer protection, at the same time ensuring both food security and economic resilience for farmers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Guleria A, Singh P, Priscilla L. Price dynamics and volatility in tomato market in India. Agricultural Research Journal. 2023;60(4).
2. Bisht A. Estimating volatility in prices of pulses in India: An application of GARCH model. Economic Affairs. 2019;64(3): 295564.
3. Thakur A, Ray P, Acharya KK, Das A, Jaiswal R, Ravishankar U. Price dynamics in Indian wholesale wheat markets: Insights and implications. The Indian Journal of Agricultural Sciences. 2021;91(8).
4. Birthal P, Negi A, Joshi PK. Understanding causes of volatility in onion prices in India. Journal of Agribusiness in Developing and Emerging Economies; 2019.
5. Čermák M, Malec K, Maitah M. Price Volatility Modelling–Wheat: GARCH Model Application. AGRIS on-line Papers in Economics and Informatics. 2017;9(665-2018-3592):15-24.
6. Gulati A, Ganguly K, Wardhan H. Agricultural Value Chains in India: Ensuring Competitiveness, Inclusiveness, Sustainability, Scalability, and Improved Finance; 2022.
7. Islam N, Thomas S. Foodgrain price stabilization in developing countries (No. 3). International Food Policy Research Institute (IFPRI); 1996.
8. Kaur G. Empirical Study of Price Volatility of Staple Foodgrains Commodities During Covid19 in India by GARCH Model using CPI. Global Journal of Enterprise Information System. 2021;13(1):9-18.
9. Lama A, Jha GK, Paul RK, Gurung B. Modelling and forecasting of price volatility: An application of GARCH and EGARCH models . Agricultural Economics Research Review. 2015;28(1):73-82.
10. Mishra R, Kumar DA. Price behaviour of major vegetables in hill region of Nepal: An econometric analysis. SAARC Journal of Agriculture. 2012;10(2):107-120.
11. Mittal S, Hariharan VK, Subash SP. Price volatility trends and price transmission for major staples in India. Agricultural Economics Research Review. 2018;31(347-2018-3190):65-74.
12. Saxena R, Paul RK, Kumar R. Transmission of price shocks and volatility spillovers across major onion markets in India. Agricultural Economics Research Review. 2020;33(347-2020-1414).
13. Shinoj P, Kumar BG, Sathiadhas R, Datta KK, Menon M, Singh SK. Spatial price integration and price transmission among major fish markets in India. Agricultural Economics Research Review. 2008; 21(conf): 327-335.

14. Sendhil R, Arti T, Lal P, Gururaj BM, Jamaludheen A, Chaudhary U, Rathore R. Price dynamics and extent of integration in Indian wholesale and retail wheat markets. Journal of Agricultural Science and Technology. 2019;21(3): 517-530.

15. Priyadarshini E, Jayalakshmi K, Shalini M, Chakkravarthy SE, Vidhya M, Govindarajan A. Analysis of onion prices at wholesale level in India–an application of Rescaled Range Analysis. In Journal of Physics: Conference Series IOP Publishing. 2021 March;1770(1):012107.

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