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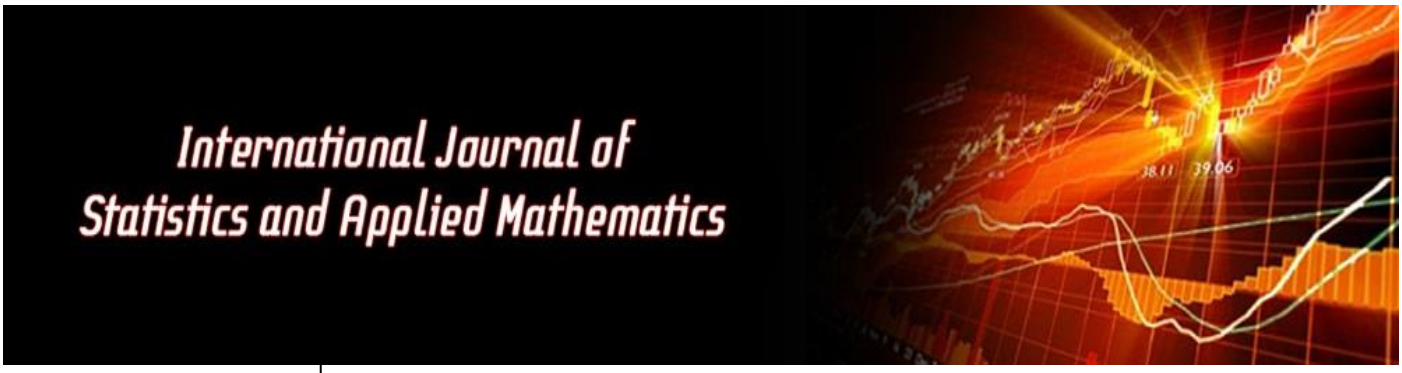

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Price transmission in major banana markets of India

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Abstract
The data on monthly arrivals and prices of banana were collected for six markets *viz;* Mumbai, Nagpur, Bangalore, Chennai, Jaipur and Calcutta for the period of last ten (2012 to 2021) years were obtained from NHB database and AGMARKNET. The selection of major markets for banana was based on maximum arrivals in a particular market.
The study revealed that overall maximum variability in prices was noticed in Mumbai market among the months as compared to Nagpur, Bangalore, Chennai, Jaipur and Calcutta. The overall negative significant correlation was noticed in Chennai and Calcutta markets. The co-integration of prices of banana was observed for the selected market. It indicated that selected markets are competitive to each other. The pair wise Granger causality test of banana prices explicates that the market pair Nagpur-Jaipur have bidirectional causality. The market pair Mumbai-Jaipur, Mumbai-Calcutta, and Chennai-Calcutta has unidirectional causality. It is concluded that high price volatility present in Mumbai, Chennai and Calcutta markets for banana. It should be minimized and needs to protect price security for farming community.

Keywords: Banana, market cointegration, price volatility, arrivals

Introduction
Banana is a very popular fruit due to its year round availability, low price and high nutritive value. India leads the world in banana production. The total area under banana in India was 875 thousand ha with production of 32454.11 thousand tones during the year 2021-22 (source: NHB, 2021-22). Although banana is cultivated in all the states, the major banana growing states are Andhra Pradesh, Maharashtra, Gujarat, Tamil Nadu, Karnataka, West Bengal and Uttar Pradesh. Production is higher in Andhra Pradesh followed by Maharashtra, Gujarat and Tamil Nadu during the year 2021-22. The major banana producing districts in Maharashtra state are Jalgaon and Nanded. Jalgaon is the seventh biggest producer of banana in the world. Bananas in Jalgaon district are transporting for marketing at Mumbai, Pune, Nagpur, Delhi and Lucknow etc. by train. Banana is produced in certain packets and the prices in some markets are dependent on the prices in other markets and also an arrivals in particular market. In some markets, only demand determines the prices of fruits. Such type of information is needed by the banana growers in order to take decision of selection of markets for selling their produce at better prices and price stability. In this context, present investigation was carried out in major wholesale markets of India.
Sadiq *et al*. (2018) [7] investigated the causes of price volatility and the process of price discovery of okra in India showed that Hyderabad market was more efficient in price discovery as six out of the seven periods earmarked were efficient in the discovery of price, and the wholesale market dominated in the process of price discovery. Mumtaz *et al*. (2017) [6] explored market integration and price transmission in selected onion markets using Johansen cointegration, Granger causality and impulse response function. The outcomes of the study strongly buttressed to the co-integration and interdependence of onion markets in India. The impulse response function supported that except Mumbai and Kozhikode, all other selected markets are responded well to standard deviation shock given to any of the markets. Preethi *et al*. (2019) [9] studied changes in the price behavior of coconut in major markets of Kerala (Alappuzha and Kozhikode) were analyzed for two periods *viz*., Period I (from 1980-01 to 1995-96) and Period II (from 1996-97 to 2015- 16) and the variations in price due to trend, cyclical, seasonal and irregular fluctuations were calculated. Bhagat *et al*. (2023) studied the

instability in banana export from India and it is suggested that there is a need to give more attention towards export of banana. ARIMA (3, 1, 6) and Brown's exponential smoothing model was found best fit for banana export and its total value respectively. Madhusudan Ghosh (2000) studied spatial integration of rice markets in India and found that intra-state and inter-state regional rice markets are integrated and linked together into a single financial market.

Market integration shows the extent to which prices in different markets move together. The high degree of market integration indicates the competitiveness of the markets. Market integration also plays a vital role in determining pattern and pace of diversification towards the high value crops. The formulation of valid study on the market integration in banana has potential application for the development of agricultural markets. Bhagat *et al.* (2023) [3] studied the cointegration between the major markets of pomegranate in Maharashtra state and concluded that very high price volatility present in selected markets of pomegranate. It should be minimized and needs to protect price security for farming community.

The present investigation has been undertaken to study the relationship between arrivals and prices of banana, to assess the price volatility and co-integration of banana among the selected markets in India.

Materials and Methods

The statistical analysis was carried out by using the following models and tests.

Unit Root test – Augmented Dickey Fuller Test

$$\Delta \ln P_t = \alpha_0 + \delta_1 t + \gamma lnP_{t-1} + \sum_{j=i}^{q} \vartheta_j \Delta lnP_{t-j} + \varepsilon_t$$

Where,

α_0 is the constant

P is the price in each market,

t is the time or trend variable

q is the number of lag length and

ε_t is the error term

Generalized Autoregressive Conditionally Heteroscedastic (GARCH) model [Bollerslev Tim (1986)]

It uses values of the past squared observations and past variances to model the variance at time t GARCH (1, 1) is as follows:

Autoregressive Conditionally Heteroscedastic (ARCH) model [Robert F. Engle (1982)]

An ARCH(m) process is one for which the variance at time t is conditional on observations at the previous *m* times, and the relationship is

$$Var(y_t|y_{t-1}, \ldots, y_{t-m}) = \sigma_t^2 = \alpha_0 + \alpha_1 y_{t-1}^2 + \cdots + \alpha_m y_{t-m}^2$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 y_{t-1}^2 + \beta_1 \sigma_{t-1}^2$$

Johansen Co integration

To check long run prices relation between selected markets.

$$P_t = \sum_{i=1}^{k} A_i P_{t-1} + \mu + \beta_t + \varepsilon_t ; (t = 1,2,3 \ldots T)$$

The procedure for estimating the co-integration vectors is based on error correction model (ECM) given by

$$\Delta P_t = \mu + \pi P_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta P_{t-i} + \beta \mu_t + \varepsilon_t$$

Where,

Γ_i = - (I-Π_i - ……, T); i= 1,2 ….K-1; Π = -(I- Π_i - ……, Π_k)

μ is the constant, t is the time or trend variable, ε_t is the error term

Likelihood ratio test statistics (Trace and Max Eigen test Statistics)

$$J_{trace} = -T \sum_{i=r+1}^{N} \ln(1 - \hat{\lambda}_1)$$

$$\lambda_{max} = -T \ln(1 - \hat{\lambda}_{r+1})$$

Where,

r is no. of co integrated vector, $\hat{\lambda}_1$ eigen value and $\hat{\lambda}_{r+1}$ is the largest squared eigen value

Granger causality test

To study direction of causality for the selected time. It involves estimation of the simple form of vector autoregressive model (VAR) is as below:

$$lnP_t^A = \sum_{i=1}^{n} \delta_i \, lnP_{t-1}^B + \sum_{j=i}^{n} \vartheta_j \, lnP_{t-j}^A + \mu_{At}$$

$$lnP_t^B = \sum_{i=1}^{n} \omega_i \, lnP_{t-i}^B + \sum_{j=i}^{n} \partial_j \, lnP_{t-j}^A + \mu_{Bt}$$

Where,

Pt is the price and subscript A and B indicate the two markets.

T is the time trend.

μ_A, μ_B are the error terms of both the model.

Results and Discussions

Variability in arrivals and prices of banana in selected markets

The estimates of mean and coefficient of variation (C.V.) of arrivals and prices of banana in selected markets of India from the period of 2012 to 2021 are presented in Table 1 and 2 respectively. The overall mean arrivals of banana in Mumbai, Nagpur, Bangalore, Chennai, Jaipur and Calcutta markets were1281, 1081, 4136, 3340, 4873 and 2111 metric tones and magnitude of coefficient of variation in arrivals were133.75,

60.75, 100.98, 45.66, 21.45 and 38.58 per cent, respectively during the study period. The maximum variability in arrivals was noticed in Mumbai market among the months as compared to Nagpur, Bangalore, Chennai, Jaipur and Calcutta. The maximum variability in Mumbai and Bangalore markets was recorded in October and May months. While in case of Nagpur, Chennai, Jaipur and Calcutta market maximum variability was recorded in September, May, December and May months, respectively. The lowest variability in arrivals of selected markets was observed during the months of December, January, November, December, July and January respectively. The overall mean prices of banana in Mumbai, Nagpur, Bangalore, Chennai, Jaipur and Calcutta market were1939, 1130, 1350, 2232, 1399 and 1499 Rs. per quintal and magnitude of coefficient of variation in prices were28.75, 23.33, 19.72, 13.89, 16.34 and 15.58 per cent, respectively during the study period.

The overall maximum variability in prices was noticed in Mumbai market among the months as compared to Nagpur, Bangalore, Chennai, Jaipur and Calcutta. The maximum variability of price in Mumbai market was recorded in November month. While in case of Nagpur, Bangalore, Chennai, Jaipur and Calcutta market maximum variability was recorded in October, October, March, February and October months, respectively. The lowest variability in prices of selected markets was observed during the months of March, January, May, October, May and April respectively. The similar results were reported by Bhagat *et al*. (2021) [1].

Table 1: Variability in arrivals of Banana in major markets of India (MT) (2012-2021)

Months	Mumbai		Nagpur		Bangalore		Chennai		Jaipur		Calcutta	
	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)
JAN	1342	128.27	1078	46.34	3953	96.07	3210	66.16	2751	40.88	2085	31.36
FEB	1565	164.22	1016	57.39	4226	113.50	3432	47.50	2966	40.92	1987	44.34
MAR	1368	143.99	1190	79.40	4329	108.89	3500	55.98	3485	52.30	1974	55.64
APR	1220	150.73	986	108.90	3583	98.17	3380	54.31	4829	28.06	1900	52.19
MAY	876	127.69	925	85.44	4039	118.00	3275	68.59	5677	19.06	1911	61.18
JUN	1153	167.61	689	60.38	4108	104.66	3083	67.42	5053	31.67	2147	41.90
JULY	1365	165.08	719	60.51	4240	110.03	3286	62.24	6887	10.85	2494	43.51
AUG	1185	159.79	1358	94.40	4077	106.32	3418	42.05	7303	15.04	2262	38.48
SEP	1222	125.45	1772	130.11	4522	112.80	3207	42.40	6699	17.06	2040	57.12
OCT	1470	171.75	1314	118.42	3974	103.42	3309	40.91	5241	48.18	2124	41.17
NOV	1904	110.89	1064	72.36	4615	87.64	4039	54.11	3974	44.50	2227	34.43
DEC	702	35.95	862	68.41	3967	106.24	2948	23.18	3293	53.79	2185	33.34
Mean	1281	133.75	1081	60.65	4136	100.98	3340	45.66	4873	21.45	2111	38.58

Table 2: Variability in prices of banana in major markets of India (Rs./q) (2012-2021)

Months	Mumbai		Nagpur		Bangalore		Chennai		Jaipur		Calcutta	
	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)
JAN	1902	42.36	1008	21.76	1227	28.15	2160	17.70	1293	26.66	1386	18.57
FEB	1685	34.99	1043	28.01	1289	26.68	2126	18.22	1126	42.33	1447	16.61
MAR	1677	30.69	1066	28.94	1323	25.36	2386	43.35	1330	18.68	1499	12.93
APR	1816	31.77	1192	28.61	1201	20.90	2167	17.36	1408	16.88	1613	11.00
MAY	1908	31.78	1166	27.50	1248	15.71	2159	15.12	1489	15.27	1615	12.40
JUN	1897	36.97	1072	23.79	1288	15.87	2214	15.87	1327	19.20	1621	12.92
JULY	2160	33.77	1135	25.14	1413	26.00	2249	15.62	1494	19.07	1614	16.70
AUG	2223	35.13	1238	26.24	1522	26.15	2352	17.67	1468	19.95	1536	12.01
SEP	2081	38.44	1164	28.85	1495	25.20	2304	12.81	1380	17.78	1421	26.80
OCT	2035	42.55	1209	29.53	1504	32.82	2289	9.75	1639	31.12	1477	27.16
NOV	1856	45.26	1177	28.84	1442	25.13	2108	17.67	1427	32.05	1415	24.82
DEC	2027	32.91	1094	26.41	1246	23.98	2270	12.32	1401	23.81	1348	22.48
Mean	1939	28.75	1130	23.33	1350	19.72	2232	13.89	1399	16.34	1499	15.58

Correlation between arrivals and prices of banana in selected markets

The month wise results of correlation between the arrivals and prices of selected markets are presented in Table 3.

Table 3: Month wise correlation between arrivals and prices of banana in selected markets of India (2012-2021)

Months	Mumbai	Nagpur	Bangalore	Chennai	Jaipur	Calcutta
January	-0.37	0.09	0.48	-0.73*	0.16	-0.65*
February	-0.49	0.14	0.55	-0.78**	-0.02	-0.56
March	-0.25	0.07	0.70*	-0.52	-0.36	-0.68*
April	-0.22	-0.09	0.73*	-0.73*	-0.38	-0.85**
May	-0.23	0.30	0.02	-0.77**	0.17	-0.80**
June	-0.30	0.43	0.18	-0.78**	0.22	-0.35
July	-0.58	0.73*	0.54	-0.72*	-0.27	-0.72*
August	-0.35	0.42	0.51	-0.48	-0.67*	-0.77**
September	-0.24	-0.14	0.68*	-0.41	-0.68*	-0.81**
October	-0.20	0.24	0.67*	-0.47	-0.91**	-0.87**
November	-0.19	0.14	0.72*	-0.83**	-0.55	-0.74*
December	0.23	0.48	0.69*	0.24	-0.67*	-0.64*
Overall	-0.25	0.33	0.77**	-0.76**	-0.51	-0.84**

The overall negative significant correlation was noticed in Chennai (-0.76) and Calcutta (-0.84) markets. It indicated that increase in arrival of banana in market leading to decline in banana price. However, overall positive significant correlation was noticed in Bangalore market. It revealed that increase in arrival leading to increase in price of banana in this market during the study period. The negative significant correlation was observed in Chennai market during the months January, February, April, May, June, July and November months. While in case of Calcutta market it was noticed negative significant correlation between arrival and price of banana in all months except February and June. The non-significant negative correlation was noticed in Mumbai market for all the months. The similar results were reported by Bhagat *et al*. (2023) [3] for pomegranate markets in Maharashtra state and Tamilselvi *et al*. (2020) [10].

Table 4: Result of Shapiro-Wilk Normality test for the prices of bananain selected market.

Market	W	P value
Mumbai	0.94	0.00
Nagpur	0.96	0.00
Bangalore	0.96	0.00
Chennai	0.78	0.00
Jaipur	0.98	0.00
Calcutta	0.97	0.00

The results of normality and stationarity in selected markets of banana are presented in Table 4 and Table 5. It indicated that the prices of banana in selected markets are not normal during the study period and also the prices of banana in selected markets are non-stationary at level and stationary after first difference for both the test ADF and pp-test.

Table 5: ADF and PP test for Unit Root in the prices of banana.

Augmented Dickey-Fuller test results at level				Phillips-Perron test results at level		
Market	**t-statistic**	**Prob.**	**Remarks**	**Z (alpha)**	**Prob.**	**Remarks**
Ln(Mumbai)	-2.69	0.32	Non -stationary	-0.38	0.01	stationary
Ln(Nagpur)	-2.39	0.42	Non -stationary	-17.50	0.10	Non -stationary
Ln(Bangalore)	-4.40	0.01	stationary	-37.50	0.01	stationary
Ln(Chennai)	-3.51	0.04	stationary	-56.49	0.01	stationary
Ln (Jaipur)	-3.58	0.04	stationary	-90.24	0.01	stationary
Ln(Calcutta)	-4.36	0.01	stationary	-35.03	0.01	stationary
Augmented Dickey-Fuller test results after 1st diff.				**Phillips-Perron test results after 1st diff.**		
D(Ln Nagpur)	-5.12	0.01	stationary	-121.94	0.01	stationary

Price Volatility of banana in selected markets

The results of price volatility are depicted in Table 6. The sum of Alpha and Beta (α+β) indicated ARCH and GARCH effect for the selected banana markets. It was observed thatamong, the sum of Alpha and Beta is nearer to 1 that is 1.10, 0.91 and 1.10 for Mumbai, Chennai and Calcutta markets, respectively, indicated that the volatility shocks in the prices of banana are quite persistence for long time in these markets. While in case of Nagpur, Bangalore and Jaipur markets it indicated that the volatility shocks in the prices of banana are not quite persistence for long period of time. The similar results were also reported by Mumtaz *et al*. (2017) [6] and Bhagat *et al*. (2023) [4] for tomato markets of Maharashtra.

Table 6: Results of ARCH-GARCH analysis of banana prices for selected markets

Parameter	Mumbai	Nagpur	Bangalore	Chennai	Jaipur	Calcutta
Alpha (α)	1.03	0.03	-0.02	-0.05	-0.03	0.99
Beta (β)	0.07	0.11	0.52	0.96	0.57	0.11
Sum (α+ β)	1.10	0.14	0.52	0.91	0.54	1.10

Co integration analysis

Johansen multiple co-integration trace test was applied for indicating the long run relationship between the price series of selected markets. The results are depicted in Table 7. The results showed that co-integration equation was significant at 5 per cent level of significance which implied that there exists co-integration among the markets.

Table 7: Results of multiple co-integration analysis of logged banana prices in selected markets.

Hypothesized No. of CE(s)	Trace Statistics			Max-Eigen statistics		
	Trace statistics	**0.05 critical value**	**P-value**	**Max-eigen Statistic**	**0.05 critical value**	**P-value**
None *	127.93**	83.94	0.00	49.54**	36.63	0.00
At most 1 *	78.39**	60.06	0.00	35.81*	30.44	0.01
At most 2 *	42.58*	40.17	0.03	21.73	24.16	0.10
At most 3	20.85	24.28	0.13	11.65	17.80	0.33
At most 4	9.20	12.32	0.16	9.19	11.22	0.11
At most 5	0.01	4.13	0.95	0.01	4.13	0.95

The results of pair wise Johansen co-integration test for the prices of banana are depicted in Table 8. The results of bivariate Trace and Maximum Eigen value test for all selected banana markets pairs, the first null hypothesis of r=0 are rejected as the critical value is less than both from the trace and max eigen statistics and corresponding probability value is also less than 5 per cent level of significance. The results clearly indicated that there exists co-integration between all the pairs of markets. It means that the prices of banana are co-integrated in the long run. The prices of banana in these pair of markets move together and efficiently functioning. It indicated that the prices are competitive and closely associated.

Table 8: Pair wise Johansen co-integration test for the prices of banana.

Markets pair	Hypothesized No. of CE(s)	Trace Statistics			Max-Eigen statistics		
		Trace statistics	0.05 critical value	P value	Max-eigen Statistic	0.05 critical value	P-value
Mumbai- Nagpur	None *	89.48**	12.32	0.00	45.75**	11.22	0.00
	At most 1 *	43.74**	4.13	0.00	43.74**	4.13	0.00
Mumbai-Bangalore	None *	66.73**	25.87	0.00	45.80**	19.39	0.00
	At most 1 *	20.93**	12.52	0.00	20.93**	12.52	0.00
Mumbai-Chennai	None *	57.91**	15.49	0.00	43.60**	14.26	0.00
	At most 1 *	14.30**	3.84	0.00	14.30**	3.84	0.00
Mumbai-Jaipur	None *	65.60**	15.49	0.00	45.43**	14.26	0.00
	At most 1 *	20.17**	3.84	0.00	20.17**	3.84	0.00
Mumbai-Calcutta	None *	63.87**	25.87	0.00	47.05**	19.39	0.00
	At most 1 *	16.82*	12.52	0.01	16.82*	12.52	0.01
Nagpur-Bangalore	None *	70.74**	18.40	0.00	50.56**	17.15	0.00
	At most 1 *	20.18**	3.84	0.00	20.18**	3.84	0.00
Nagpur-Chennai	None *	56.34**	15.49	0.00	42.71**	14.26	0.00
	At most 1 *	13.64**	3.84	0.00	13.64**	3.84	0.00
Nagpur-Jaipur	None *	73.00**	12.32	0.00	73.00**	11.22	0.00
	At most 1	0.00	4.13	0.98	0.00	4.13	0.98
Nagpur-Calcutta	None *	61.69**	18.40	0.00	43.25**	17.15	0.00
	At most 1 *	18.43**	3.84	0.00	18.43**	3.84	0.00
Bangalore-Chennai	None *	36.25**	18.40	0.00	22.08*	17.15	0.01
	At most 1 *	14.16**	3.84	0.00	14.16**	3.84	0.00
Bangalore-Jaipur	None *	49.17**	25.87	0.00	27.82**	19.39	0.00
	At most 1 *	21.35**	12.52	0.00	21.35**	12.52	0.00
Bangalore-Calcutta	None *	34.77**	25.87	0.00	21.15*	19.39	0.03
	At most 1 *	13.62*	12.52	0.03	13.62*	12.52	0.03
Chennai-Jaipur	None *	40.47**	20.26	0.00	26.19**	15.89	0.00
	At most 1 *	14.28*	9.16	0.01	14.28*	9.16	0.01
Chennai-Calcutta	None *	32.44**	18.40	0.00	23.53*	17.15	0.01
	At most 1 *	8.91**	3.84	0.00	8.91**	3.84	0.00

*, ** denote significance at 5 and 1 per cent level

Table 9: Market pair wise results of Granger Causality test of banana price.

Market Pairs	No. of obs.	F-Statistic	P-value	Remarks
Mumbai- Nagpur	117	0.74	0.48	No causality
Nagpur-Mumbai	117	0.58	0.56	No causality
Mumbai-Bangalore	117	0.34	0.71	No causality
Bangalore- Mumbai	117	0.16	0.85	No causality
Mumbai-Chennai	117	0.97	0.38	No causality
Chennai-Mumbai	117	0.01	1.00	No causality
Mumbai-Jaipur	117	3.58*	0.03	Unidirectional
Jaipur-Mumbai	117	0.09	0.92	No causality
Mumbai-Calcutta	117	4.16*	0.02	Unidirectional
Calcutta-Mumbai	117	1.83	0.16	No causality
Nagpur-Bangalore	118	0.20	0.82	No causality
Bangalore-Nagpur	118	2.05	0.13	No causality
Nagpur-Chennai	118	0.28	0.75	No causality
Chennai-Nagpur	118	0.50	0.61	No causality
Nagpur-Jaipur	118	4.24*	0.02	Bidirectional
Jaipur -Nagpur	118	4.86*	0.01	Bidirectional
Nagpur-Calcutta	118	2.00	0.14	No causality
Calcutta-Nagpur	118	0.31	0.73	No causality
Jaipur-Chennai	118	2.09	0.13	No causality
Chennai-Jaipur	118	0.64	0.53	No causality
Jaipur-Calcutta	118	0.55	0.58	No causality
Calcutta-Jaipur	118	0.30	0.74	No causality
Bangalore-Chennai	118	0.90	0.41	No causality
Chennai-Bangalore	118	2.58	0.08	No causality
Bangalore-Jaipur	118	0.59	0.56	No causality
Jaipur-Bangalore	118	0.14	0.87	No causality
Bangalore-Calcutta	118	1.61	0.21	No causality
Calcutta-Bangalore	118	1.30	0.28	No causality
Calcutta-Chennai	118	0.92	0.40	No causality
Chennai-Calcutta	118	4.49*	0.01	Unidirectional

After confirming the integration of prices series, in next step, performed pair wise Granger causality test for six banana markets to comprehend causal relation between them. Granger causality test, tests the null hypothesis of no causality between the selected pairs of banana markets. The results presented in Table 9 explicates that the market Nagpur-Jaipur have bidirectional causality. The market pair Mumbai-Jaipur, Mumbai-Calcutta, and Chennai-Calcutta has unidirectional causality. It means that a price change in the former market in each pair granger cause the price formation in the latter market, whereas the price change in the latter market is not feed backed by the price change in the former market. The similar results were reported by Mumtaz *et al*. (2017) [6] and Bhagat *et al*. (2023) [3] for major markets of pomegranate in Maharashtra.

Conclusions

The overall maximum variability in prices was noticed in Mumbai market among the months as compared to Nagpur, Bangalore, Chennai, Jaipur and Calcutta. The maximum variability of price in Mumbai market was recorded in November month. While in case of Nagpur, Bangalore, Chennai, Jaipur and Calcutta market maximum variability was recorded in October, October, March, February and October months. The overall negative significant correlation was noticed in Chennai and Calcutta markets.

The volatility shocks in the prices of banana are quite persistence for long time in Mumbai, Chennai and Calcutta markets during the study period. The co-integration of prices of banana was observed for the selected market. It indicated that selected markets are competitive to each other. The pair wise Granger causality test of banana prices explicates that the market pair Nagpur-Jaipur have bidirectional causality. The market pair Mumbai-Jaipur, Mumbai-Calcutta, and Chennai-Calcutta has unidirectional causality. It is concluded that high price volatility present in Mumbai, Chennai and Calcutta markets of banana. It should be minimized and needs to protect price security for farming community.

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