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RESEARCH PAPER

Co-integration of Cumin Markets in Gujarat

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ABSTRACT

The present study analyses the co-integration of cumin prices in major cumin producing state of Gujarat, one market from each of the 5 districts was selected based on data availability of market arrivals of cumin prices. Price transmission and spatial integration of sample cumin markets were analyzed through employing various statistical/econometric techniques viz. correlation analysis, Johansen Methodology, Granger Causality Test and Vector Error Correction Model (VECM). Correlation analysis showed that the price of the markets in Gujarat were integrated and correlated. Johansen co-integration results showed the long-run equilibrium relationship among the markets indicating that prices in Gujarat cumin markets were well-integrated and move together in response to changes in the demand and supply and price of the product. The Granger causality test indicated that Halved and Gondal are the lead markets because it influenced the prices of most of selected cumin markets with lag of one and two months.

HIGHLIGHTS

- Prices for agricultural commodities are crucial for effective distribution of resources,as they indicate surpluses and shortages and enable farmers to adjust to changing market conditions.
- An effective agricultural marketing strategy is essential for motivating farmers to increase their output.

Keywords: Cumin, Market integration, Gujarat, VECM

India is known as the "land of spices" and generates a wide range and abundance of spices that are consumed across the world. The nation grows about 75 different types of spices, including pepper (King of spices), cardamom (Queen of spices), chilies, ginger, turmeric, coriander, cumin, fenugreek and many others (Ashoka *et al*. 2013). Cumin (*Cuminum cyminum*) also known as Jeera/Zeera is a small herb, which produces aromatic dried fruit. It is used widely for cooking and seasoning. Cumin's unique flavour complexity has made it an integral spice in the cuisines of Mexico, India and the Middle East. It is also used in perfumery and flavouring liquors, as well as in medicinal products. It considered as one of the most valuable medicinal herbs in the world. The plant is semi-erect attaining a height of 20 to 30 cm with a slender and smooth stem and compound leaves. The colour of the flower is generally pink (sometimes white) and the fruits are dry with an approximate length of 4mm (Gondalia *et al*. 2019). Cumin contains several vitamins and minerals (Parthasarathy & Kandiannan, 2007; Mohassel, 2006).

During 2022-23, the cumin production in India was 462 thousand metric tonnes from an area of about 714.19 thousand hectares (Annual report 2022-23, Spices Board of India, Cochin). Rajasthan and Gujarat which comes under arid and semi-arid parts of India are known as 'Seed Spices Bowl' as they contribute more than 80 per cent of total seed spices production (Lal, 2018). Gujarat produced 274.75 thousand MT's of cumin from 276.22 thousand hectares' area during the year 2022-23 and emerged as the leading cumin producing state

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in the country (Annual report 2022-23, Spices Board of India, Cochin). India is the world's largest cumin producing country, contributing about 70% of total world output. The other major cumin-producing countries are Syria (13%), Turkey (5%), UAE (3%), and Iran (Gondalia *et al*. 2019).

Farmers who sell their produce can get fair prices in an efficient market. The degree to which markets maintain price stability and make the commodity available depends on how well-integrated they are. Income from farms is mostly determined on stable prices (Devi *et al*. 2016). The study of market integration is one of the ways to analyze the market performance (Mukhtar and Javed, 2007). Price transmission across markets in different parts of the nation can be measured to determine the strength and speed of market integration (Ghafoor *et al*. 2009). The extent to which domestic markets are connected with global markets and with various regional markets within each other will determine the degree of advantage to be enjoyed by consumers and producers (Varela *et al*. 2012). The study of market performance by market integration characterizes the degree of co-movement of prices across spatially separated markets. It also guides the producers as to where, when and how much to sell. Therefore, present paper is an effort to understand the co-movement of the prices among different domestic markets for cumin in Gujarat.

MATERIALS AND METHODOLOGY

The study was undertaken on a macro framework based on secondary data. Monthly data on prices for the years 2013 to 2023 were collected from AGMARKNET to study the market integration among selected cumin markets in Gujarat. From each district in Gujarat, based upon cumin market arrivals and data availability, at least one important market was taken for the study. The selected markets at district level were Halved (Morbi), Gondal (Rajkot), Jamnagar (Jamnagar), Thara (Banasakanth) and Junagadh (Junagadh).

Market integration

Market integration can be defined as a situation in which the prices of related goods among different locations move together over a long period of time. When there is proportional movement in price groups i.e. any change in prices of a commodity is responsive to the price changes in the same quality products present in another markets, the markets are considered to be integrated with each other. It is cardinal to excogitate any agricultural policy in many developing countries and has been an important area of agricultural market research. The analysis of market co integration of selected cumin markets involved following steps:

Correlation analysis

One simple way to study market integration is to consider the correlation of price series for different markets. Correlation coefficient is a measure of degree of linear association between two variables. Karl Pearson's correlation coefficient (r) used to analyze integration of price series in pair of cotton markets (X and Y) was estimated as follow:

$$r(X,Y) = \text{cov}\frac{(XY)}{\sqrt{\text{var}(X).\text{var}(Y)}}$$

To test the significance of correlation coefficient (r) t-test was used.

Null Hypothesis (H0): μ = 0

Alternate Hypothesis (H1): μ ≠ 0

The significance of correlation was tested using the following formula;

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \sim t(n-2) \text{ degrees of freedom}$$

Stationarity of the time series

Markets are considered to be integrated when long term equilibrium exists between them. However, price series need to be stationary to establish such relationship. In the absence of stationarity, the estimated relationship may be spurious without any significant meaning. The relationship is expected to hold good when price series are found stationary at the same level of differencing. The price-series in different markets were checked for stationarity by using Augmented Dickey-Fuller (ADF) unit root test. If the data generating process at levels is following a unit root and therefore non-stationary, then the data has to be transformed into first differences and the unit root test has to be repeated.

The test was applied after running regression of the following form:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + a_i \, \Delta Y_{t-1} + e$$

Where,

Y_t = Price of cumin in a given market at time t

$Y_t = Y_t - Y_{t-1}$

e = Pure white noise error term

m = Optimal lag value which is selected on the basis of Schwartz Information Criterion (SIC) and Akaike Information Criterion (AIC).

To test for a unit root in the price series accepting the null hypothesis i.e., $\delta = 0$ indicates that time series is non stationary. While rejection of null hypothesis and acceptance of the alternative hypothesis i.e., <0 indicates that the time series is stationary.

Cointegration test

Cointegration explains the extent of deviation from the long run equilibrium relationship by the nonstationary series. In fact, cointegration is the link between integrated processes and steady state equilibrium and hence provides the relevant theoretical framework for analyzing dynamics of instantaneous changes in a pair of series along with their valuable long run information. Once it was confirmed that all of the price-series were stationary at the level or at same order of differences, the long run co-integration of markets were tested by Johansen maximum-likelihood techniques (Johansen and Juselius, 1990) Maximum likelihood ratio test statistics are proposed to test number of cointegrating vectors. The null hypothesis of atmost '*r*' cointegrating vectors against a general alternative hypothesis of more than 'r' cointegrating vectors is tested by trace statistics. Similarly, the null hypothesis of '*r*' cointegrating vector against the alternative hypothesis of '*r* + 1' is tested by Maximum Eigen-Value-Statistic. The number of cointegrating vectors indicated by the tests is an important indicator of the extent of co-movement of prices. An increase in the number of co-integrating vectors implies an increase in the strength and stability of price linkages.

Granger Causality Test

After undertaking the cointegration analysis of the long-run linkages of the various variables, and identifying they are linked, the causal relationship between the prices series in the selected cumin markets was approached through Granger's Causality technique. If a variable Y is Granger-caused by variable X, it means that the values of variable X help to predict the values of the variables Y. The Granger causality test conducted within the framework of a Vector Auto Regressive (VAR) model was used to test the existence and direction of long-run causal price relationship between the markets. The F-test was used to check the significance of changes in one price series affecting the other price series. This test also identifies the key market, i.e., the market that influences the price of all other markets (price leader). The causality relationship between two price series based on the pairs of ordinary least squares (OLS) regression equation, through bivariate VAR is given below:

$$\Delta \ln X_t = \sum_{i=1}^{m} \alpha_i \, \Delta \ln X_{t-i} + \sum_{j=1}^{m} \beta_j \, \Delta \ln Y_{t-j} + \varepsilon_{1t}$$

$$\Delta \ln Y_t = \sum_{i=1}^{m} \alpha_i \, \Delta \ln Y_{t-i} + \sum_{j=1}^{m} \beta_j \, \Delta \ln X_{t-j} + \varepsilon_{2t}$$

Where, X and Y are the different market prices series

ln stands for prices series in logarithm form

t is the time variable

The m stands for the number of lags of both variables in the system

The null hypothesis in both the equations is that $ln\ X_t$ does not cause Granger-cause $ln\ Y_t$ in each case. A rejection of the null hypothesis will imply that there is Granger causality between the variables (Gujarati, 2004).

Error Correction Method (ECM)

The cointegration analysis reflects the long-run movement of two or more series, although they may drift apart in the short run. Once the series are stationary at first difference then one could run regressions in their first differences. However, by taking first differences, the long run relationship that is stored in data being lost. This implies that one needs to use variables in levels as well. Advantage of the Error Correction Methodology

(ECM) is that it incorporates variables both at their level and first differences. By doing this, ECM captures short run disequilibrium situations as well as long run equilibrium adjustments between the prices. ECM can incorporate such short run and long run changes in the price movements. A generalized ECM formulation estimating both short run and long run transmission of onion prices in different market is as following:

$$Y_t = \propto_{01} X_t + a_{11}X_{t-1} + a_{12}Y_{t-1} + \epsilon_t$$

$$\Delta Y_t = a_0\Delta X_t + (1-a_{12})\left[\frac{(a_{01}+a_{11})}{(1-a_{12})}X_{t-1} - Y_{t-1}\right] + \varepsilon_1$$

The generalized form of this equation for k lags and an intercept term is as follows;

$$\Delta Y_t = a_{00} + \sum_{i=0}^{k-1} a_{i1}\Delta X_{t-i} + \sum_{i-1}^{k-1} a_{i2}\Delta Y_{t-i} +$$

$$m_0[m_1X_{t-k} - Y_{t-1}] + \epsilon_t$$

Where,

$$m_0 = (1 - \sum_{i=0}^{k} ai_2)$$

$$m_1 = \sum_{i=0}^{k} a\frac{i_1}{m_0}$$

The parameters m_0 measures the rate of adjustment of the short-run deviations towards the long run equilibrium. Theoretically, this parameter lies between 0 and 1. The value 0 denotes no adjustment and 1 indicates an instantaneous adjustment. A value between 0 and 1 indicates that any deviations will have gradual adjustment to the long-run equilibrium values.

For the present analysis, Johansen's Vector Error Correction Model (VECM) has been used. It permits the testing of cointegration as a system of equations in one step. Another advantage of this approach is that we do not need to carry over an error term from one step into the rest. In addition, it does not require the prior assumption of endogenity or exogeneity of the variables.

RESULTS AND DISCUSSION

Correlation analysis

The results of correlation analysis of monthly prices of cumin in Gujarat markets are presented in Table 1. The coefficients of the prices of the selected markets were significant at 1 per cent level and their values tended towards unity in some of the markets. This indicates all the selected cumin markets in Gujarat were not highly correlated, but shows positive relationship between the variables. The high integrated market ranges r-value from 0.84 to 0.96.

Table 1: Correlation coefficients of cumin prices in selected markets of Gujarat

	Halved	Gondal	Jamnagar	Thara	Junagadh
Halved	1				
Gondal	0.9679*	1			
Jamnagar	0.0189	0.0147	1		
Thara	0.9632*	0.9463*	0.0180	1	
Junagadh	0.8772*	0.8241*	0.0391	0.8434*	1

**Indicates significance level at 1 per cent probability level.*

Augmented Dickey-Fuller (ADF) test

In order to avoid spurious results, there is a need to check whether the variables are stationary or not. The Augmented Dickey Fuller (ADF) based unit root test was applied to check whether the price series of cumin are stationary at their level, followed by their differences.

Table 2: Results of Augmented Dickey-Fuller (ADF) test

ADF Test results at level			
Markets	**t-statistic**	**Probability**	**Remarks**
InHalved	-1.77	0.389	Non-stationary
InGondal	-1.97	0.296	Non-stationary
lnJamnagar	-4.29*	0.000	Stationary
lnThara	-2.34	0.159	Non-stationary
lnJunagadh	0.86	0.994	Non-stationary
ADF Test results at first differences			
Markets	**t-statistic**	**Probability**	**Remarks**
ΔInHalved	-4.49*	0.000	Stationary
Δ InGondal	-8.57*	0.000	Stationary
ΔInThara	-6.60*	0.000	Stationary
ΔInJunagadh	-12.33*	0.000	Stationary

Notes: ** denotes significance at 1 per cent level of significance.*

Δ denote the first difference of the time series.

The results presented in Table 2 indicate that ADF test values for the selected markets except Jamnagar market cumin prices series were less than the critical value given by MacKinnon statistical tables at level implying the existence of unit root. But at the first difference, the ADF values for cumin price series of the selected markets viz. Halved (Morbi), Gondal (Rajkot), Thara (Banasakanth) and Junagadh (Junagadh) were more than critical value indicating that these series were stationary and free from consequences of unit root at their first differences.

Johansen Co-integration Analysis

The integration among Gujarat cumin markets was analyzed by applying the Johansen multiple cointegration procedure and the estimated results are presented in Table 3. Unrestricted co-integration rank tests (Trace and Maximum Eigen Value) indicated the presence of at least 5 co-integrating equations at 5 per cent level of significance. This indicated that cumin prices in Gujarat markets of major producing states of country were having long run equilibrium relationship.

Table 3: Results of Johansen Co-integration Analysis, (Gujarat markets)

H_0	H_A	Statistics	Critical value at 5 per cent	Probability
		Trace test		
$r = 0$	$r \geq 1$	264.80	69.81	0.000
$r \leq 1$	$r \geq 2$	150.05	47.85	0.000
$r \leq 2$	$r \geq 3$	77.28	29.79	0.000
$r \leq 3$	$r \geq 4$	29.31	15.49	0.000
$r \leq 4$	$r \geq 5$	5.49	3.84	0.019
		Maximum Eigen-value test		
$r = 0$	$r \geq 1$	114.75	33.87	0.000
$r \leq 1$	$r \geq 2$	72.77	27.58	0.000
$r \leq 2$	$r \geq 3$	47.96	21.13	0.000
$r \leq 3$	$r \geq 4$	23.82	14.26	0.000
$r \leq 4$	$r \geq 5$	5.49	3.84	0.019

Trace and Maximum Eigen-value test indicates 5 co-integrating equations at the 0.05 level.

** denotes rejection of the hypothesis at the 0.05 level.*

H_0 = There is no co-integration (no long run relationship between markets).

Granger Causality Test

After confirming the integration of price series, granger causality was also estimated between the pairs of selected cumin markets of Gujarat. Granger causality test, tests the null hypothesis of no causality between the selected pairs of markets. The results presented in Table 4 reveals that the market pairs Halved-Gondal and Halved-Thara have bidirectional causality indicating prices being transmitted in both directions. The cumin prices in Halved market while influenced the cumin prices of Gondal and Thara market, at the same time Halved prices were also being influenced by the prices of Gondal and Thara market. Further. Gondal market showed unidirectional manner in price transmission with cumin price of Junagadh and Thara markets and it had also influenced the Junagadh market in one way by the Thara market. Halved and Gondal markets can be considered as lead cumin markets among the selected markets taken for the study.

vector Error Correction Model

The cointegration analysis (Johansen Cointegration test) reflected the corresponding long-run movements in cumin prices in the Gujarat markets, while in short run these may drift apart. The short run relationship in prices along with the speed of adjustment towards the long-run equilibrium was examined through employing Vector Error Correction Model (VECM). As the VECM is very sensitive to the incorporated number of lags, appropriate number of lags was selected through using lag selection criteria VAR model. The number of lags in the VECM was taken to be two as the Akaike information criterion (AIC) was lowest at the order of two in the system for all the selected markets of Gujarat. The detailed results of VECM are given in Table 5 and the meaningful error correction mechanism in each selected market has been reflected in the following set of equations:

$$\Delta In\ Halved_t = -0.143ECT_{t-1} + 0.50 \sum\Delta In\ Gondal_{t-1}$$

$$\Delta In\ Gondal_t = -0.013\ ECT_{t-1} + 0.33\sum\Delta InHalved_{t-1} + -0.39\sum\Delta In\ Jamnagar_{t-1}$$

$$\Delta In\ Jamnagar_t = -0.011ECT_{t-1} + -0.21 \sum\Delta In\ Jamnagar_{t-2}$$

$$\Delta In\ Thara_t = -0.752ECT_{t-1} + 0.64\sum\Delta In\ Halved_{t-2} + 0.52\sum\Delta In\ Gondal_{t-1} + 0.31\sum\Delta In\ Gondal_{t-2} + -0.16\sum\Delta In\ Junagadh_{t-1} + -0.33\sum\Delta In\ Junagadh_{t-2}$$

$$\Delta In\ Junagadh_t = -0.447ECT_{t-1} + 0.29\sum\Delta In\ Halved_{t-1} + -0.64\sum\Delta In\ Tharal_{t-1} + -0.27\sum\Delta In\ Thara_{t-2}$$

The minimum value of Akaike Information criterion (AIC) was used for selecting the lags and which was lowest at the order two in all the selected national markets. The statistical significance of

Table 4: Results of Pair-wise Granger causality, (Gujarat markets)

Null Hypothesis	F-statistics	Probability	Granger Cause	Direction
In Gondal does not Granger Cause In Halved	16.48	4.E-07	Yes	Bidirectional
In Halved does not Granger Cause In Gondal	4.10	0.018	Yes	
In Jamnagar does not Granger Cause In Halved	0.41	0.658	No	
In Halved does not Granger Cause In Jamnagar	0.24	0.784	No	None
In Thara does not Granger Cause In Halved	9.88	0.000	Yes	Bidirectional
In Halved does not Granger Cause In Thara	34.49	1.E-12	Yes	
In Junagadh does not Granger Cause In Halved	1.02	0.360	No	
In Halved does not Granger Cause In Junagadh	2.79	0.064	No	None
In Jamnagar does not Granger Cause In Gondal	2.87	0.060	No	
In Gondal does not Granger Cause In Jamnagar	1.89	0.153	No	None
In Thara does not Granger Cause In Gondal	0.87	0.418	No	
In Gondal does not Granger Cause In Thara	59.42	8.E-19	Yes	Unidirectional
In Junagadh does not Granger Cause In Gondal	1.00	0.367	No	
In Gondal does not Granger Cause In Junagadh	3.63	0.029	Yes	Unidirectional
In Thara does not Granger Cause In Jamnagar	1.78	0.171	No	
In Jamnagar does not Granger Cause In Thara	0.47	0.620	No	None
In Junagadh does not Granger Cause In Jamnagar	0.08	0.923	No	
In Jamnagar does not Granger Cause In Junagadh	0.27	0.761	No	None
In Junagadh does not Granger Cause In Thara	0.94	0.389	No	
In Thara does not Granger Cause In Junagadh	11.32	3.E-05	Yes	Unidirectional

*** denotes rejection of the hypothesis at the 0.05 level.*

Table 5: Vector Error Correction Model

Error Correction	DHalved	DGondal	DJamnagar	DThara	DJunagadh
CointEq1	-0.143562	-0.013540	-0.011960	-0.752220	-0.447808
	(.07914)	(0.00790)	(0.00888)	(0.16243)	(0.06689)
	[-1.81405]	[-1.71389]	[-1.34736]	**[-4.63103]**	**[-6.69453]**
D(HALVED (-1))	-0.020672	0.334771	0.065298	0.176916	0.295074
	(0.09449)	(0.12688)	(0.08137)	(0.10654)	(0.10861)
	[-0.21878]	**[2.63845]**	[0.80248]	[1.66051]	**[2.71677]**
D(HALVED(-2))	-0.164972	0.005466	0.089459	0.642827	-0.093828
	(0.09804)	(0.13166)	(0.08443)	(0.11055)	(0.11270)
	[-1.68265]	[0.04152]	[1.05955]	**[5.81473]**	[-0.83255]
D(GONDAL(-1))	0.508765	0.097874	0.028956	0.525038	0.108880
	(0.08572)	(0.11511)	(0.07382)	(0.09666)	(0.09854)
	[5.93500]	[0.85026]	[0.39224]	**[5.43183]**	[1.10497]
D(GONDAL(-2))	0.143081	0.004387	-0.048352	0.319936	0.183756
	(0.09400)	(0.12623)	(0.08095)	(0.10600)	(0.10805)
	[1.52209]	[0.03475]	[-0.59728]	**[3.01837]**	[1.70058]
D(JAMNAGAR(-1))	-0.132173	-0.397822	-0.112323	-0.096613	0.023091
	(0.10343)	(0.13888)	(0.08907)	(0.11662)	(0.11889)
	[-1.27794]	**[-2.86442]**	[-1.26110]	[-0.82843]	[0.19422]
D(JAMNAGAR(-2))	0.015679	0.117388	-0.219634	0.149835	0.090966
	(0.10766)	(0.14456)	(0.09271)	(0.12139)	(0.12375)
	[0.14564]	[0.81202]	**[-2.36906]**	[1.23433]	[0.73509]

D(THARA(-1))	-0.084027	0.153554	-0.192452	-0.148481	-0.647968
	(0.13836)	(0.18579)	(0.11915)	(0.15601)	(0.15904)
	[-0.60732]	[0.82648]	[-1.61521]	[-0.95174]	**[-4.07424]**
D(THARA(-2))	0.104656	-0.008216	-0.126538	0.132797	-0.270292
	(0.08866)	(0.11906)	(0.07635)	(0.09998)	(0.10192)
	[1.18036]	[-0.06900]	[-1.65724]	[1.32828]	**[-2.65205]**
D(JUNAGADH(-1))	-0.028607	0.078174	-0.015869	-0.160033	0.007357
	(0.06848)	(0.09195)	(0.05897)	(0.07721)	(0.07871)
	[-0.41776]	[0.85015]	[-0.26911]	**[-2.07261]**	[0.09346]
D(JUNAGADH(-2))	-0.089134	-0.029467	-0.025957	-0.334185	0.021598
	(0.06588)	(0.08847)	(0.05673)	(0.07429)	(0.07573)
	[-1.35296]	[-0.33309]	[-0.45751]	**[-4.49864]**	[0.28520]
C	156.3291	0.136941	66.62635	-101.5103	391.1679
	(152.955)	(205.393)	(131.720)	(172.470)	(175.819)
	[1.02206]	[0.00067]	[0.50582]	[-0.58857]	[2.22483]
R-squared	0.424260	0.235147	0.124523	0.741243	0.423864
Adj. R-squared	0.370131	0.163238	0.042213	0.716916	0.369698
Sum sq. resids	3.23E+08	5.82E+08	2.39E+08	4.10E+08	4.26E+08
S.E. equation	1660.876	2230.273	1430.293	1872.772	1909.144
F-statistic	7.837893	3.270050	1.512859	30.46929	7.825197
Log likelihood	-1133.293	-1171.320	-1114.012	-1148.783	-1151.264
Akaike AIC	17.75649	18.34604	17.45755	17.99663	18.03511
Schwarz SC	18.02251	18.61207	17.72358	18.26266	18.30113
Mean dependent	193.4672	136.1497	13.72610	139.7315	289.7502
S.D. dependent	2092.724	2438.130	1461.473	3519.873	2404.719
Determinant resid covariance (dof adj.)	1.85E+32	1.85E+32	1.85E+32	1.85E+32	1.85E+32
Determinant resid covariance	1.13E+32	1.13E+32	1.13E+32	1.13E+32	1.13E+32
Log likelihood	-5675.917	5675.917	-5675.917	-5675.917	-5675.917
Akaike information criterion	89.00646	89.00646	89.00646	89.00646	89.00646
Schwarz criterion	90.44745	90.44745	90.44745	90.44745	90.44745

all co-integrated vectors confirmed the existence of long run relationship among the prices in all cumin markets. The sign of the first co-integrating vector of normalized co-integrating coefficients was negative in case of Thara and Junagadh markets which indicated the stability of short run price movements in these markets. The estimated error correction coefficient indicated that about 75 and 44 per cent adjustment towards long run equilibrium in Thara and Junagadh market occurs in one month respectively. In addition, the cumin prices in Thara market are influenced by one and two months of lagged price of Gondal and Junagadh markets as well as two month lagged price of Halved market. Further, the cumin prices in the selected markets are mostly influenced by Halved and Gondal markets Thus, Halved and Gondal is the price leader among the selected cumin market in Gujarat.

CONCLUSION

The long run equilibrium relationship provides a clear evidence of the integration of selected cumin markets. This implies that prices in domestic markets of cumin move together in response to changes in the demand and supply and cost of a product. Granger Causality test resulted Halved and Gondal markets can be considered as leading cumin markets among the selected markets. The study also suggests that the market integration of prices in different markets will be a guiding principle for selecting the most efficient market and accordingly the policy makers and the producers will find it most useful.

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