

## **Assessment of Level of Market Integration in Indian Cotton Markets**

### **ABSTRACT**

The current study is aimed at using co-integration in assessing the level of market integration among selected cotton markets in India. Monthly cotton price data were collected for the period 2008-09 and 2016-17 from the AGMARKNET website. The advanced time series econometric tools like Augmented Dickey-Fuller(ADF) test, Johansen co-integration test and Granger Causality test were used to study market integration using E-Views software. The price series for cotton in selected markets were subjected to the consequences of unit root and were stationary at first difference. The long-run equilibrium relationship among the cotton markets indicated that these markets were integrated with each other. This implied that prices in Indian cotton markets tend together in response to changes in the demand and supply of cotton. Granger Causality test revealed that the Salem market was the lead cotton market because it influenced the prices of Kurnool and Warangal cotton markets.

*Key words: Cotton, Market Integration, Time Series Econometrics.*

### **INTRODUCTION**

Cotton - a seed hair fiber is commonly found in subtropical areas across the world. It is an important cash crop in many developing countries, supporting the livelihoods of millions of households. India is one of the largest producers of cotton in the world accounting for about 22 per cent of the world's total production. Globally, Cotton is cultivated on a total land area of 33.48 million hectares, with a production of 26.36 million metric tonnes and a yield of 787 kgs per hectare (the crop year 2020-21).

India has the world's largest cotton cultivation area, which accounts for around 37 per cent of the world's total cotton cultivation area and yields 5.79 million metric tonnes (the crop year 2020-21). Currently, the yield per hectare, which was 469 kg/ha, was still lower than the global average yield of around 787 kg per ha. In India, cotton is mostly grown in the states of Gujarat, Maharashtra, Telangana, Punjab, Rajasthan, Haryana, Tamil Nadu, Madhya Pradesh and parts of Andhra Pradesh & Karnataka.

The textile industry in India traditionally, after agriculture has produced significant employment for both skilled and unskilled workers. It offers direct employment to over 35 million in the country. India is also the second-largest producer of fiber and the third-largest cotton exporter in the world. Sixty per cent of India's textile industry is cotton-based. Other fibers produced in India include silk, jute, wool, and man-made fibers.

## LITERATURE REVIEW

Both farmers and retailers receive fair pricing for their produce in an effective market. The degree to which markets integrate with one another determines how accessible the commodity is and how steady its pricing is. The degree of benefits gained by producers and consumers also depends on the amount of integration between different regional markets and how domestic markets are integrated with global markets (Varela et al, 2012). To determine if markets share a linear deterministic tendency, the extent of price integration was evaluated. The study recommends sensible resource allocation based on the degree of price integration and minimizing market distortion in order to improve overall performance (Sendhil et al, 2019). The increased complexity of integration makes it difficult to quantify market efficiency. However, a key tool for assessing the performance of market integration at different levels is the price of commodities (Saji, 2018). The study looked at sugar prices to understand how the sugar business in India linked with global markets and discovered co-integration (Vijayakumar and David Bozward, 2020). A significant factor in determining farm revenue is price stability (Devi et al., 2016). Similar to how the prices of agricultural commodities play a crucial part in the effective distribution of resources, they also serve as indicators of shortages and surpluses that enable farmers to adapt to changing market conditions (Haji and Gelaw, 2011). The degree of market integration and their pricing, which provide significant marketing signals to both producers and consumers reflecting the level of output and consumption, determine the stability of prices and market performance. Market integration demonstrates how closely prices in several markets move together (Barret, 2001). The strength and speed of price transmission between markets in various parts of the country can be used to measure market integration (Ghafoor et al, 2009). Integrated markets are those in which the prices of equivalent goods do not fluctuate on their own. In a market that is integrated, a commodity's price responds to price changes for goods of the same quality in other marketplaces. As a result, pricing variations for a specific variety of goods in various markets within a region generally shouldn't be greater than the expenses related to the transportation and processing of the produce. The degree of price co-movement across geographically distinct markets is characterized by the market performance study employing market integration. Additionally, it directs the sellers in terms of where, when, and how much to sell.

## MATERIALS AND METHODS

Monthly data on cotton prices for the period 2007-08 and 2016-17 were collected from the AGMARKNET website to study the market integration among selected cotton markets in India. The major cotton-producing districts in the states of Tamil Nadu, Telangana and Andhra Pradesh were randomly selected for the study. Thus Salem market(Tamil Nadu), Warangal market(Telangana), and Kurnool market(Andhra Pradesh) were selected for the study. The analysis of market co-integration of cotton markets involves the following steps:

**(i) Correlation Analysis:** Consideration of the correlation between price series for several markets is a straightforward approach to studying market integration. A measure of the degree of linear relationship between two variables is the correlation coefficient. The correlation coefficient calculated by Karl-Pearson was used to analyse cotton market integration.

Correlation coefficient between two markets' prices X and Y;

$$r(X, Y) = \frac{Cov(XY)}{\sqrt{Var(x)Var(y)}} \dots\dots\dots (1)$$

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

The significance of correlation was tested using the following formula;

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

**(ii) Augmented Dickey-Fuller (ADF) test to check Stationarity:** When markets are in long-term equilibrium with one another, this is referred to as integration. Stationarity of price series is required prior to analysing this relationship. The Augmented Dickey-Fuller (ADF) unit root test was used to examine the time series data on cotton prices in a few selected markets for stationarity. A stationary series is one in which the parameters are not affected by the passage of time, has a constant mean and variance, and exhibits time-invariant autocorrelations. The series' initial differences are checked for stationarity if the level results reveal that the series is not. The order of integration, I, is the quantity (d) that specifies how many times a series must be differentiated to become stationary (d). The regression exercise was completed after the test was conducted.

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^m a_i \Delta Y_{t-i} + \varepsilon \dots\dots\dots (3)$$

Where,  $Y_t$  = Price of cotton in a given market at time 't'

$$\Delta Y_t = Y_t - Y_{t-1};$$

$$\beta_1 = \text{constant};$$

$$\beta_2 = \text{coefficient on a time trend};$$

$$\varepsilon = \text{Pure white noise error term};$$

m = optimal lag which is selected on the basis of Schwartz Information Criterion (SIC).

**(iii) Co-integration test:** Johansen (1990) developed Co-integration test to test the long-run relationship among the price series. Trace-statistic and maximum Eigenvalues are used to test the null hypothesis of at most 'r' co-integrating vectors against 'more than r' the alternative hypothesis co-integrating vectors.

$$\text{Trace statistic } (\lambda - \text{trace}) = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i) \dots\dots\dots (4)$$

$$\text{Maximum Eigen value statistic } (\lambda - \text{max}) = -T \ln(1 - \hat{\lambda}_i) \dots\dots\dots (5)$$

$\lambda_i$  s are the estimated Eigen values (characteristic roots) obtained from the markets, T is the number of usable observations. The number of co-integrating vectors indicated by the tests is an important indicator of the existence of co-movement of the prices. As the number of co-integrating vectors increases, it implies the strength and stability of price linkages.

**(iv) Granger Causality Test:** Testing for causation between variables  $X_t$  and  $Y_t$  is done using the Granger causality test. Unidirectional Granger causality from X to Y or from Y to X, bidirectional causality, or absence of causality are all potential permutations. The following is a description of the Granger-causality test's Autoregressive Distributed Lag (ADL) model:

$$X_t = \sum_{i=1}^n \alpha_i Y_{t-i} + \sum_{j=1}^n \beta_j X_{t-j} + \mu_{1t} \quad \dots\dots\dots(6)$$

$$Y_t = \sum_{i=1}^n \gamma_i Y_{t-i} + \sum_{j=1}^n \delta_j X_{t-j} + \mu_{2t} \quad \dots\dots\dots(7)$$

Where,

X and Y are the price series of different cotton markets ;

t is the time period ;

$\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$  are coefficients of respective price series ; and

$\mu_{1t}$  and  $\mu_{2t}$  are the error terms.

## RESULTS AND DISCUSSION

### Correlation Analysis:

Table 1 displays the findings of the correlation analysis of cotton wholesale prices monthly among a few chosen markets to examine integration. The findings showed that the selected markets were integrated since the price correlation coefficients were heading towards unity and were significant at the 1 per cent level. The correlation coefficient (r) between cotton market prices ranged from 0.80 to 0.88.

**Table 1: Correlation coefficients of prices of cotton markets.**

Markets	Kurnool	Salem	Warangal
Kurnool	1.00***	0.80***	0.88***
Salem	0.80***	1.00***	0.86***
Warangal	0.88***	0.86***	1.00***

\*\*\* indicated significant at 1 per cent probability level.

### Augmented Dickey-Fuller Test:

It is important to co-integrate the price series in order to determine the long run equilibrium relation between them. Since the given price series cannot be integrated in the presence of a unit root, the co-integration of the price series must be checked for. This may be done by running a stationarity test on the supplied price series. In order to determine if the time series data on cotton prices in the chosen marketplaces are stationary at their level and their variances, the Augmented Dickey-Fuller (ADF) test was used.

Table 2 showed that in both circumstances, i.e., merely intercept and intercept with the trend, signifying the existence of unit root and non-stationarity, the ADF values for the cotton price series of all the selected markets were greater than the critical value (1 percent) stated by MacKinnon statistical table at the level. In the case of intercept with trend, the ADF values ranged from -8.37 to -13.36 and were lower than the critical value (1 percent) of -4.03, indicating that all price series were stationary and free from the effects of unit root after differencing. The ADF values for cotton prices in all markets ranged from -8.37 to -13.39 (only intercept) at first differences. Anuja et al. (2013), Awasthi et al. (2014), V. Mahesh, R.K. Grover, and R.S. Geetha (2019), and Anuja et al (2016)

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

Markets	Particulars	At level	At first difference	0.01 critical value
Kurnool	Intercept	-3.06	-13.39***	-3.48
	Intercept and Trend	-4.25	-13.36***	-4.03
Salem	Intercept	-2.15	-9.43***	-3.48
	Intercept and Trend	-2.77	-9.44***	-4.03
Warangal	Intercept	-3.1	-8.37***	-3.48
	Intercept and Trend	-4.57	-8.37***	-4.03

Null Hypothesis: Series has a unit root

\*\*\* indicated significance at 1 per cent probability level

### Johansen Co-integration Analysis:

Using time series data and the Johansen multiple co-integration process, the integration between the chosen cotton markets in the states of Andhra Pradesh, Tamil Nadu, and Telangana, namely Kurnool, Salem, and Warangal, was examined. E-Views analysis software was used to complete the task. Table 3 lists the outcomes of the Maximum Eigen statistic and Trace statistic unrestrained co-integration rank tests. The table showed the presence of three co-integrating equations at a 5% level of significance and at least one co-integrating equation at a 5% level of significance (Maximum Eigen statistic) (Trace statistic). The quantity of co-integrating equations affects the co-strength. integration's As a result, all

of the chosen cotton markets have an equilibrium connection over the long term. The aforementioned findings concur with Paul and Sinha's (2015) and Suresh's findings (2017).

**Table 3: Results of Johansen Co-integration Analysis of selected cotton markets**

Co-integrating Equations	Max-Eigen Statistic	0.05 Critical Value	Trace Statistic	0.05 Critical Value
None	25.74 **	21.13	42.05 **	29.79
At most 1	10.62	14.26	16.30 **	15.49
At most 2	5.68 **	3.84	5.68 **	3.84

\*\* denoted rejection of the hypothesis at 0.05 level

#### Granger Causality Test:

The Granger Causality test was used to determine the direction of causation or causal relationship between the price series of three markets-Kurnool, Salem, and Warangal markets in the states of Andhra Pradesh, Tamil Nadu, and Telangana. The results are shown in Table 4. Salem and Kurnool, Warangal and Kurnool, and Salem and Warangal markets were found to have unidirectional causation relationships in price transmission among the cotton markets that were chosen. Both the Kurnool and Warangal markets' cotton prices had been impacted by the Salem market. Conversely, the Kurnool market has no impact on the cotton pricing in Warangal or Salem markets.

**Table 4: Results of Pair-wise Granger Causality Test of selected cotton markets**

Null Hypothesis	Obs.	F-Statistic	Prob.	Relationship
Salem market does not Granger Cause Kurnool market	119	12.37***	0.00	S→K
Kurnool market does not Granger Cause Salem market		0.01	0.89	NS
Warangal market does not Granger Cause Kurnool market	119	13.07***	0.00	W→K
Kurnool market does not Granger Cause Warangal market		1.14	0.28	NS
Warangal market does not Granger Cause Salem market	119	0.58	0.44	NS
Salem market does not Granger Cause Warangal market		15.59***	0.00	S → W

\*\*\* indicated significance at 1 per cent probability level, NS - Non-Significant

#### CONCLUSION

The correlation study revealed that there was a correlation between the price series of the chosen cotton markets. The integration of certain cotton markets was clearly demonstrated by the long-run equilibrium relationship, which suggested that prices in cotton markets move in tandem in reaction to changes in supply and demand as well as input costs. Salem market was identified as the lead cotton market by the Granger Causality test because its prices influenced the prices of the Kurnool and Warangal cotton markets. Long-term market

integration led to enough market support and a fair price for cotton growers, which increased cotton production. According to the study, cotton farmers and other market participants would find it most helpful to choose the most efficient market based on market integration and price projections in other markets.

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