Original Research Article

Spatial Market Integration of Major Copra Markets in India

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ABSTRACT

Aim: The main of the study is to estimate the degree of market integration among the selected major Copra markets in India.

Place and Duration of Study: The study was carried out using the secondary data of average monthly prices of copra obtained from the AGMARKNET website from the period of 2014-2021 for Tamil Nadu and Karnataka. Copra price series data of Tamil Nadu (Anaimalai, Avalpoondurai, and Vellakoil markets) and Karnataka (Tiptur market) has been utilized for the study.

Methodology: The time-series econometric tools including the Augmented Dickey-Fuller (ADF) test, Johansen cointegration test, and Granger causality test were used for analyzing the level of market integration. E-views software has been utilized to perform the entire analysis.

Results: The unit root effects were applied to the price series for copra in the selected markets, and they were stationary at their first difference. The long-run equilibrium relationship among the copra markets revealed that the selected markets were integrated with each other. Tiptur market exhibited a bidirectional causational relationship with Anaimalai, Avalpoondurai, and Vellakoil markets. The Granger Causality test revealed the Tiptur market as the lead market, as it influenced the prices of Anaimalai, Avalpoondurai, and Vellakoil Copra markets.

Conclusion: India's coconut market is prone to volatility and uncertainty due to frequent price fluctuations. Price changes typically result from altered market conditions brought on by seasonal and annual variations in output, in addition to competition from other edible oils. The government can put measures into place to lessen price fluctuations with the aid of integrated market information and the information would also benefit the Copra producers and other market players to select the most effective market.

Keywords: Copra; market integration; time series econometrics

1. INTRODUCTION

Coconut is one of India's traditional crops, supports the livelihood of up to 10 million people, having a significant impact on the rural economy. With an annual contribution to GDP of Rs. 9000 crores and foreign exchange profits of roughly Rs. 1200 crores, the coconut sector supports the country's agrarian economy [1]. The top three countries for coconut production are Indonesia, the Philippines, and India, which together produce three-fourths of the world's coconuts. In India, coconut farming is concentrated in the coastal regions of Kerala, Tamil Nadu, Karnataka, and Andhra Pradesh, which together account for 91% of the nation's total production [2]. India contributes 17.12% of the world's coconut land, and stands in the third position with 30.92% of global coconut production [3,4]. Indian coconut market experiences high price fluctuations due to the seasonal nature of the crop [5].

Market integration is an indicator of marketing efficiency, especially price efficiency. Market integration can be determined by examining the consistency and speed of price transmission between marketplaces located throughout a nation [6]. The strength and speed of price transmission between markets in various parts of a country can be used to

measure market integration [7]. Farmers and retailers get fair prices for their produce in an effective market. The degree of market integration could be assessed by the degree of accessibility of the commodity and its steady pricing. The degree of integration between various regional markets and how domestic markets are integrated with global markets also affects how producers and consumers benefit [8]. Integrated markets are ones where comparable product prices do not change on their own. In an integrated market, a commodity's price responds to price changes for products of the same quality in other markets. Because of this, price differences for a certain variety of commodities in different markets within a region typically shouldn't be more than the costs associated with the transportation and processing of the produce [9-15]. Despite the fact that numerous empirical research utilizing cointegration methodologies have been conducted on the market integration of agricultural commodities in India [16-19], very few attempts have been made in empirically evaluating Copra market integration in India.

This paper highlights the degree of market integration among the Copra markets in Tamil Nadu (Anaimalai, Avalpoondurai, and Vellakoil) and Karnataka (Tiptur). The market's price adjustments and the nature of cointegration have been assessed in the study. The direction of price transmission among the markets also has been assessed as it provides information on the degree of integration and efficiency of the markets.

2. METHODOLOGY

Monthly average price data on the major Copra markets were collected from the AGMARKNET website for the period of 2014 to 2020 to study market integration among the selected markets. The major Coconut producing districts in Tamil Nadu and Karnataka were selected randomly for the study. Therefore, Anaimalai (Coimbatore district), Avalpoondurai (Erode district), and Vellakoil (Tiruppur district) markets from Tamil Nadu, and Tiptur market from (Tumkur district) Karnataka were selected for the study. The analysis for estimating the market co-integration of Copra markets involves the following steps:

2.1 ADF test to check stationarity

The prerequisite condition to check market integration was to check the Augmented Dickey-Fuller *[20]* test that the data should be stationary at the first difference and non-stationary at the level. A stationary series is one whose parameters are not affected by time and exhibits constant mean and variance with time-invariant autocorrelations. If the series is found to be non-stationary at level, then it must be tested for stationarity at the first difference. If the ADF probability value obtained is less than the 5% significance level and the ADF test value is less than the crucial MacKinnon value, the data is deemed to be stationary. (d) refers to the number of times that particular series is differenced to obtain stationarity and I (d) refers to the order of integration of the stationary series.

The analysis follows the hypothesis,
H_0: Series has a unit root
$H_{1:}$ Series do not have a unit root

The regression is as follows,

$$\Delta Yt = \beta 1 + \beta 2 + \delta Yt - 1 + \sum_{i=1}^{m} ai\, \Delta Yt - i + e$$

Where,

Yt = Price of copra in a given market at a time 't'

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

β_1 = constant;
β_2 = coefficient on a time trend;
e = Pure white noise error term;
m = optimal lag which is selected on the basis of Schwartz Information Criterion (SIC).

2.2 Co-integration test

A general paradigm for analyzing numerous cointegrating vectors was developed by *[21]* which allows for estimating every potential cointegrating relationship between the variables. Johansen's cointegration test shows the long-term relationship among the price series. When there is no cointegration between the variables being studied, the difference model uses the VAR (vector autoregressive model); when there is cointegration, the VECM (vector error correction model) is utilized. Making decisions in cointegration testing with E-views is dependent on the importance of the trace statistics findings. If the trace statistic value exceeds the critical value, the variables under study have a cointegration relationship or a long-term association. Integrated markets exhibit lower price differences.

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.

Trace statistic (λ –trace) $= -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}i)$

Maximum Eigenvalue statistic (λ – max) = - T ln (1 - $\hat{\lambda}$i)

λ_i is the estimated Eigen values (characteristic roots) obtained from the markets,
T is the number of usable observations.

An essential sign of the existence of price co-movement is the number of co-integrating vectors shown by the tests. The strength and stability of price links are implied by a rise in the number of cointegrating vectors.

2.3 Granger Causality test

The Granger Causality test was employed in this investigation to determine causality. Causality analysis ascertains how price changes in one market affect other markets. One market's response to this shift may differ from another market, or both markets may respond differently, or there may be no mutual reaction between the two markets under consideration. When there is no causal relationship between two variables, the probability value is greater than the critical value (0.05), and when there is a causal relationship, the probability value is lower *[22].*

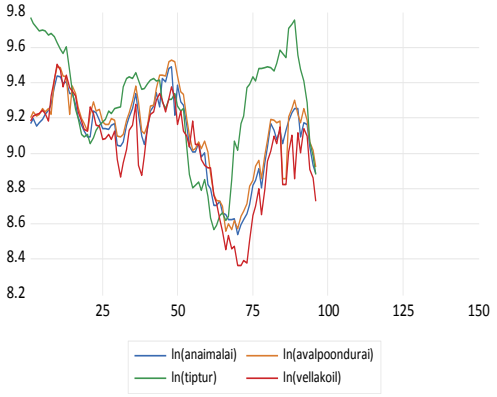
3. RESULTS AND DISCUSSION

3.1 Augmented Dickey-Fuller Test

The given price series must be examined for co-integration because it cannot be integrated with the presence of a unit root. Using the Augmented Dickey-Fuller test, price series data from all markets were checked for stationarity. The results are shown in Table 1.

The results revealed that the ADF values for the Copra price series of all the selected markets were higher than the critical value (1%) stated by MacKinnon statistical table at the level in both situations, i.e., merely intercept and intercept with the trend, denoting the existence of unit root and non-stationarity of the time series. The Copra price ADF values at first differences in all markets ranged from -6.23 to -10.45 (only intercept). In the case of intercept with trend, the ADF values ranged between –6.19 to -10.39 and were found to be lower than the critical value (1 per cent) of -4.05 [23,24]. Additionally, the stationarity results are displayed in Fig:1 and 2. Where, Fig:2 displays the same price series at their first difference, after which the data demonstrates stationarity and Fig:1. displays the

graphical presentation of the price series of all markets at level, which reveals the unit root in the data.



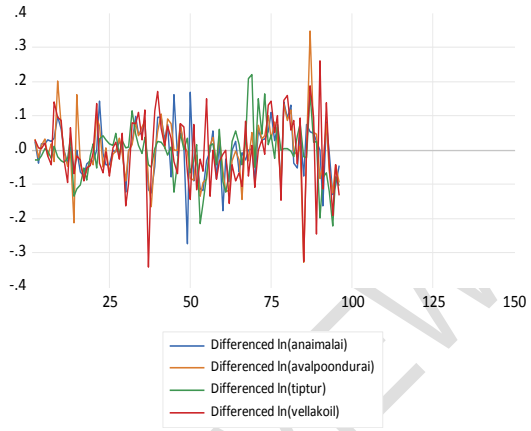


Fig:1. Graphical presentation of the price series of all markets
Fig:2. Price series at their first difference, after which the data demonstrates stationary

Table 1. Results of Augmented dickey-fuller test (ADF) of the selected Copra markets

Markets	Particulars	At level	At first difference	0.01 critical value
Anaimalai	Intercept	-1.53	-9.73***	-3.50
	Intercept and Trend	-1.93	-9.68***	-4.03
Avalpoondurai	Intercept	-1.69	-8.29***	-3.50
	Intercept and Trend	-2.09	-8.25***	-4.03
Vellakoil	Intercept	-1.75	-10.45***	-3.50
	Intercept and Trend	-2.39	-10.39***	-4.03
Tiptur	Intercept	-1.86	-6.23***	-3.50
	Intercept and Trend	-1.89	-6.19***	-4.05

*Null Hypothesis: Series has a unit root, *** indicated significance at 1 per cent probability level*

3.2 Johansen Co-integration test

Johansen multiple cointegration test was applied to the Copra time series of the selected markets of Tamil Nadu (Anaimalai, Avalpoonduari, and Vellakoil) and Karnataka (Tiptur). The results of the Maximum Eigen statistic and Trace statistic unconstrained co-integration rank tests are shown in Table 2. The table indicated the presence of two cointegrating equations at a 5% level of significance (Maximum Eigen statistic) and four cointegrating equations at a 5% level of significance (Trace statistic). The aforementioned conclusions support those *of [25].*

3.3 Granger Causality Test

To study the direction of causation among the price series, the Granger Causality test was employed. The test results are summarized in Table 3. The results revealed that Anaimalai and Avalpoonduari, Tiptur and Anaimalai, Tiptur and Avalpoondurai, Tiptur, and Vellakoil exhibited bidirectional causation. Also, Anaimalai and Vellakoil, Avalpoondurai, and Vellakoil showed unidirectional causational relationships among the chosen Copra markets. Vellakoil had no impact on the Copra Prices of Anaimalai and Avalpoonduari markets. The

Granger Causality test revealed Tiptur market as the lead market, as it influenced the prices of Anaimalai, Avalpoondurai, and Vellakoil Copra markets.

Table 2. Results of Johansen co-integration analysis of selected Copra markets

Co-integrating Equations	Max-Eigen Statistic	0.05 Critical Value	Trace Statistic	0.05 Critical Value
None	36.93 **	27.58	79.19 **	47.85
At most 1	22.31**	21.13	42.25 **	29.79
At most 2	12.51	14.26	19.94**	15.49
At most 3	7.79**	3.84	7.79**	3.84

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

Table 3. Results of pair-wise Granger causality test of selected Copra markets

Null Hypothesis	Obs	F-Statistic	Prob.	Relationship
Avalpoondurai market does not Granger Cause Anaimalai market	94	3.66**	0.02	**AVP ↔ ANM**
Anaimalai market does not Granger Cause Avalpoondurai market		11.51***	0.00	
Tiptur market does not Granger Cause Anaimalai market	94	8.25***	0.00	**TPT ↔ANM**
Anaimalai market does not Granger Cause Tiptur market		3.63**	0.03	
Vellakoil market does not Granger Cause Anaimalai market	94	0.97	0.38	NS
Anaimalai market does not Granger Cause Vellakoil market		5.61***	0.00	**ANM → VLK**
Tiptur market does not Granger Cause Avalpoondurai	94	4.95***	0.00	**TPT ↔ AVP**
Avalpoondurai does not Granger Cause Tiptur		5.10***	0.00	
Vellakoil does not Granger Cause Avalpoondurai	94	1.52	0.22	NS
Avalpoondurai does not Granger Cause Vellakoil		3.80**	0.02	**AVP → VLK**
Tiptur does not Granger Cause Vellakoil	94	6.30***	0.00	**TPT↔VLK**
Vellakoil does not Granger Cause Tiptur		3.80**	0.02	

*** indicated significance at 1 per cent probability level, ** indicated significance at 5 per cent probability level,NS - Non-Significant*

4. CONCLUSION

The study made an assessment of the degree of the spatial market integration of Copra markets of Tamil Nadu and Karnataka, using co-integration of the monthly average prices from January 2014 to December 2021. The outcomes showed that the chosen markets are strongly integrated and converged to long-term equilibrium. The Granger Causality test determined that the Tiptur market in Karnataka was the lead Copra market because its prices had an impact on those of the Anaimalai, Avalpoondurai, and Vellakoil markets in Tamil Nadu. The reason for Tiptur being the lead market is due to the fact that Tumkur district of Karnataka is the largest coconut-producing district, where nearly one-third of Karnataka's coconut area and production is being contributed by this district alone. The study concluded that it would be most beneficial for Copra producers and other market players to select the most effective market based on market integration and price expectations in other markets.

REFERENCES

1. Jayasekhar, S. and Thamban, C. 2016. Coconut research in India: Need of stakeholders' synergy for prosperity. *Indian Coconut Journal,* 58(12): 24-27.
2. CDB [Coconut Development Board]. 2016. CDB homepage [online]. Available: http://www.coconutboard.nic.in. [13 May. 2016].
3. Vasanthakumar, V. C. 2016. Tamil Nadu leads in coconut productivity: CDB survey report. *Indian Coconut Journal,* 58 (10): 18-22.
4. CDB [Coconut Development Board]. 2020. CDB homepage [online]. Available: http://www.coconutboard.nic.in. 8 Jul. 2020].
5. Jayasekhar, S., Chandran, K.P., Jaganathan, D. and Thamban, C. 2016. Indian coconut sector: Trade and marketing. Indian enhanced Coconut Journal 61(8): 05-08.
6. Fackler P.L., Goodwin B.K. 2001. Spatial Price Analysis. Didalam: Gardner B, Rausser G, editor. *Handbook of Agricultural Economics,* Volume 1, Chapter 17. Elsevier Science.
7. Ghafoor, A., K. Mustafa, K. Mushtaq and Abedullah (2009). Cointegration and Causality: An Application to Major Mango Markets in Pakistan. The Lahore Journal of Economics, 14(1), 85-113.
8. Varela, G., Carroll, E.A. and Iacovone, L. (2012). Determinants of Market Integration and Price Transmission in Indonesia, Policy Research Working Paper: 6098, Poverty Reduction and Economic Management Unit, World Bank.
9. Akshata Nayak, Lokesha H, Gracy CP. Market Integration of Major Oilseeds and Vegetable Oils in India- Evidence from Karnataka. *IJAEB.* 2020;13(4):453-460.
10. Cotton area and production statistics - Committee on Cotton Production and Consumption (COCPC) in its meeting held on 22.03.2022. 10.
11. Devi IB, Srikala M, Ananda T. Price behavior of chillies in Guntur market of Andhra Pradesh, India. *Indian Journal of Agricultural Research.* 2016;50(5):471- 474. 11.
12. Khatkar RK, Singh VK, Karwasra JC, Bhatia JK. Market integration and price volatility in domestic mustard markets. *Indian Journal of Economics and Development.* 2013;9(2):114-123.
13. Tingre AS, Bhopale AA. Market Integration and price volatility of maize in Maharashtra, *Indian Journal of Economics and Development.* 2015;3(3):194-198.
14. Tahir Mukhtar, Muhammad Tariq Javed. Market Integration in Wholesale Maize markets in Pakistan, Regional and Sectoral Economic Studies. 2008;8-2.
15. Upreti P, Singh A, Jha GK, Nithyashre ML. An economic analysis of price behavior, efficiency and market integration of sugar in India*. Indian Journal of Agricultural Marketing (Conference Special).* 2018; 30:179–188. 7.
16. Ghosh, M. (2011). Agricultural Policy Reforms and Spatial Integration of Food Grain Markets in India. *J.Economic Development*, 36(2), 15-37.
17. Sekhar, C.S.C. (2012). Agricultural market integration in India: An analysis of select commodities. *Food Policy*, 37(3), 309-322.
18. Reddy, B.S., Chandrashekhar, S.M., Dikshit, A.K. and Manohar, N.S. (2012). Price trend and integration of wholesale markets for onion in metro cities of India. *Journal of Economics and Sustainable Development,* 3(70): 120-130.
19. Bhardwaj, S.P., Paul, R.K. and Kumar, A. (2015). Future Trading in Soybean–An Econometric Analysis*. J. Ind.* Soc. *Agric. Statist*, 69, 11-17.
20. Atkin, M., and Bladford D., 1982. Structural changes in import market shares for apples in the United Kingdom. *European Review of Agricultural Economics*., 9(3):313-326.
21. Johansen S, Juselius K. Maximum Likelihood Estimation and Inference on Cointegration - With Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics.* 1990;52(2):169- 210.

22. Sandra, I.K., Fariyanti, A. and Hidaya, N.K. 2023. Spatial market integration of garlic in Indonesia. *BIRCI-Journal*. 6(1): 188-198.
23. Anuja AR, Khar A, Jha GK, Kumar R. Price dynamics and market integration of natural rubber under major trade regimes of India and Abroad. *Indian Journal of Agricultural Sciences.* 2013;83(5):19-22.
24. Awasthi PK, Tomar A, Korde D. Market integration and price volatility across soybean markets in Central India. *International Journal of Agricultural Sciences.* 2016;8(51):2349-2352.
25. Paul RK, Sinha K. Spatial market integration among major coffee markets in India. *Journal of the Indian Society of Agricultural Statistics.* 2015;69(3):281-287.