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## Market development and policy issues for agri-derivatives in India: a study of cotton and mentha

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**Abstract** This study of cotton and mentha derivatives aims to analyse the information efficiency of the Indian agri-commodity derivatives market. We find weak information linkages: the cotton spot market dominates in price discovery and its futures market in volatility spillover, and the futures market leads the spot market for both price discovery and risk hedging for mentha. To develop the market and improve the transmission of information, it is necessary to build a physical spot market and integrate it with the derivatives market, create awareness, build institutional capacity, improve delivery-based support, and redesign contract specifications.

**Keywords** Agri-commodity, price discovery, volatility spillover, survey, futures market

**JEL codes** Q02, Q13, G13, G14

Given the challenges and importance of the agriculture sector, its ecosystem interlinkages and the reduction in domestic support measures—including minimum support prices (MSP),<sup>1</sup> provided for by the WTO Agreement on Agriculture—warrant the need for an efficient and adequately functioning derivatives market. The literature illustrates the role of a derivatives market in efficient price discovery and risk hedging (Garbade and Silber 1983; Thomas 2003; Gonzalo and Figuerola-Ferretti 2007) and in economic development (Sendeniz-Yuncu et al. 2018; Vo et al. 2019). Many studies have been conducted in developed economies; some show that futures markets improve the price discovery process (Garbade and Silber 1983; Oellermann et al. 1989; Schroeder and Goodwin 1991; Brockman and Tse 1995; Zapata et al. 2005), and a few studies show that the perception of market participants plays a vital role in determining the success

of a commodity derivatives market (Siqueira et al. 2008; Adanacioglu 2011).

The Indian agri-commodity derivatives market was set up in 2003. Its growth trajectory has been chequered, with policymakers enforcing stock limits, suspending trading, and introducing a commodities transaction tax (CTT) (Sen 2008). The analysis of the futures market in India presents inconclusive evidence. Singh and Singh (2014) details a review of the prior work related to the commodity futures market efficiency and related issues. Joseph et al. (2014, 2015) explore the use of frequency-domain approach and wavelet analysis respectively as an alternative tool to examine the relationship between Indian commodity futures and spot prices. Chander and Arora (2015) study cereals and pulses; Malhotra and Sharma (2016) conclude oil and oilseeds spot market to lead the futures market. Seth

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<sup>1</sup> On the recommendations of the Commission for Agricultural Costs and Prices (CACP), the Government of India declares an assured price for crops—the minimum support price (MSP)—before the sowing season. In the year 2018, the government raised the MSP for long staple cotton from INR 4,320 to INR 5,450 per quintal (about 26%) and the MSP for medium staple cotton from INR 4,020 to INR 5,150 per quintal (about 28%) (Department of Agriculture, Cooperation & Farmers Welfare 2018)

and Sidhu (2018) find the wheat futures to lead the spot market. Inani (2018) show the futures market to be more efficient in case of six commodities and the spot market for the remaining four commodities. Some Indian studies also assess the views of commodity derivatives brokers (Srivastava et al. 2008; Gahlot and Datta 2011) and some assess the views of farmers (Sahadevan 2008; Kumar 2010; Vimal 2014).

Though the issues related to the Indian agricultural sector have been deliberated extensively, in the academic and political spheres. Evolving regulatory framework and changing landscape of the Indian agri-commodity derivatives market warrant the need for a longitudinal study (with recent data). Prior work focuses either on the informational efficiency aspect or on the perception of the stakeholders in isolation leaving an important research gap in the literature. A comprehensive analysis of the information linkages between spot and futures market, along with the analysis of the perceptions of different stakeholders for the same is opportune and necessary for coherent policy actions required for the sustainable development of the Indian agri commodity market. This study aims to address the research gap. It focuses on cotton and mentha oil, commodities traded on the Multi Commodity Exchange of India (MCX), and it empirically tests for the information transmission between the spot and futures markets using cointegration, Granger causality, and the vector error correction method (VECM). We analyse volatility spillovers between these markets using the BEKK-GARCH<sup>2</sup> model (Engle and Kroner, 1995) and the Diebold-Yilmaz (2008, 2012). We analyse the issues and challenges in depth and make suggestions for the development of these commodity markets in particular and the growth of the Indian commodity markets in general.

## Data and methodology

This study relies on the daily price series of cotton and mentha on the spot market and nearest to the maturity of the futures contract traded on the MCX from July 2012 to July 2017 (Zhong et al., 2004; Sehgal and Dutt, 2016). We chose these commodities because India is among the leading producers and traders of cotton and mentha oil, and there is an opportunity to develop a

platform for trading in cotton and mentha derivatives. We source the data on near-month futures prices from Bloomberg and the data on spot prices from the MCX. Our survey comprised a mix of online questionnaires, telephonic interviews and field visits, and we received 68 responses. For cotton, we obtained 21 responses (comprising of 13 from industry, five from the traders and three from associations like the All Gujarat Cotton Ginner Association, Karnataka Cotton Association and Telangana Cotton Association) from the top 10 cotton-producing states: Gujarat, Maharashtra, Telangana, Karnataka, Andhra Pradesh, Haryana, Madhya Pradesh, Rajasthan, Punjab, and Tamil Nadu (The Cotton Corporation of India Ltd, 2018). For mentha, we received 36 responses (six from the industry, 25 from traders, and five from farmers) from the Barabanki, Moradabad, Rampur, Sambhal, and Bareilly districts in Uttar Pradesh. Uttar Pradesh is the major producer of mentha in India; our survey covers the relevant districts extensively (Vimal 2014). This study also considers eight responses of market intermediaries (brokers dealing in agri-commodity derivatives) and three responses from officials of the Securities Exchange Board of India (SEBI).

We examine the information linkages (price discovery and volatility spillover) between the spot and futures segments separately for cotton and mentha. We estimate the return series as a difference in the natural log of prices. We use the Augmented Dickey-Fuller (ADF) test to determine if the price series is stationary (Dickey and Fuller (1981)). We confirm that the price series is stationary at the first difference, and we conduct Johansen's cointegration test to study the long-run relationship between prices. We select the number of lags based on the Schwarz Information Criteria (SIC) and confirm the result by observing the trace statistics and maximum eigenvalue. We use the VECM to assess the degree of adjustment made by the spot and futures markets to correct the disequilibrium in the short run by observing the error correction term coefficients. The findings of the Granger causality test corroborate the findings of the VECM.

In addition to analysing the return data, analysing the volatility spillover can offer deeper insights into the information transmission process (Chan et al. 1991; Hong 2001; Tse 1999; Gagnon and Karolyi 2006;

<sup>2</sup>Baba-Engle-Kraft-Kroner multivariate generalized autoregressive conditional heteroscedasticity

**Table 1** Descriptive statistics

	Mentha		Cotton	
	Future	Spot	Future	Spot
Mean	-0.00034	-0.00018	0.00016	0.00014
Standard deviation	0.0165	0.0172	0.0106	0.0070
Skewness	-0.266	-0.389	-0.425	-0.013
Kurtosis	5.247	15.626	14.796	9.632
Jarque-Bera	264.35	7933.97	7203.54	2061.50
Probability	0.00	0.00	0.00	0.00
Observations	1190	1190	1236	1125

Source Author's calculations

Notes Future denotes the futures price returns of commodities on the MCX platform; Spot denotes the spot price returns on the MCX

Rittler 2012); and we use the BEKK-GARCH model (1,1) following Li (2015). To have more robust results, we construct a spillover index using the Diebold and Yilmaz (2008, 2012) models; these capture the degree of connectedness between markets and improve understanding. We focus on the market being a net receiver or a net transmitter of information based on directional spillover (Chevallier and Ielpo 2013; Sehgal et al. 2015; Antonakakis and Kizys 2015). We use stratified convenience sampling; for each stratum, we take a sample based on a convenience sampling technique.

We divide the market participants into farmers, traders, associations and industry users. We solicited the views and suggestions of brokers and the officials of SEBI(Commodity Derivatives Market Regulation Department)<sup>3</sup> on the issues in the agri-derivatives market. First, we identified the potential participants and mailed them the questionnaire, along with a cover letter highlighting the study and its objectives and assuring the confidentiality and acknowledgement of their responses. To increase the responses, we sent four reminders after specific intervals to the non-respondents and also conducted telephone interviews and field visits for the non-respondents if they agreed.

## Results

This section presents the results in two parts. The first subsection presents the results of information linkages and the second one details the results of the survey.

The findings of this phase of the study form the basis for conducting a survey of stakeholders for cotton and mentha.

### Price discovery and volatility spillover

The mean return in the future and spot segments is negative for mentha and positive for cotton (Table 1). For mentha, the return and volatility are higher in the spot market than in the futures market; for cotton, the return and volatility are higher in the futures market than in the spot market. The non-normality of the sample series is confirmed by skewness, kurtosis, and the Jarque-Bera statistic values. The price series were found stationary at the first difference using the ADF for both cotton and mentha (Table 2). Next, we study the price discovery process for cotton and mentha. As per Johansen's cointegration test, cotton and mentha spot and futures prices have a long-term relationship (Table 3). The absolute values of the ECT terms of the VECM (Table 4) show that spot prices lead the price discovery process for cotton (Samal 2017) and futures prices lead the price discovery process for mentha (Sahadevan 2008). These results are substantiated by the Granger causality test (Table 5).

The dynamics differ for the cotton and mentha markets—the futures market exhibits lower pricing efficiency for cotton, unlike mentha—and we need to establish the determinants of this difference and improve it. The results of the BEKK-GARCH model (Table 6) show significant unidirectional short-term

<sup>3</sup> The Forward Markets Commission used to regulate the Indian commodities market until it was merged with SEBI in 2015. Since then, SEBI has been the regulator of the Indian commodities market.

**Table 2 Unit root test results**

ADF test results Series	At Level		At first difference	
	t-Statistic	Prob.*	t-Statistic	Prob.*
Mentha Spot price series	-2.484	0.119	-36.923	(0.00) *
Mentha future price series	-2.274	0.180	-34.806	(0.00) *
Cotton Spot price series	-1.397	0.584	-18.777	(0.00) *
Cotton future price series	-0.835	0.808	-32.978	(0.00) *

Source Author's calculations

**Table 3 Cointegration results**

Commodity	Null Hypothesis	Trace statistics	Max Eigen statistic	Max trace statistic	95% Critical Value (trace)	95% Critical Value (Eigen)
Cotton	r=0	0.327	430.234	640.047	15.495	14.265
	r=1	0.176	209.813	209.813	3.841	3.841
Mentha	r=0	0.424	600.146	1030.713	15.495	14.265
	r=1	0.327	430.567	430.567	3.841	3.841

Source Author's calculations

Notes Lag length is based on the minimum value of Schwarz Information Criterion; r = cointegration rank of the model

**Table 4 VECM results**

Market	Error Correction Coefficient	t-value
Panel A: Cotton		
Futures	-0.99752	[-14.1988]
Spot	0.390261	[ 9.18940]
Panel B: Mentha		
Futures	-0.268249	[-6.21456]
Spot	0.784773	[ 22.1308]

Source Author's calculations

Notes Figures in [] brackets denote t-values; FUTURE denotes the futures prices of commodities on the MCX platform; SPOT denotes the spot price of MCX; \*denotes significance at 1% level; \*\*denotes significance at 5% level; \*\*\*denotes significance at 10%

shocks from the cotton futures market towards the spot market. The short- and long-term volatility spillovers of mentha are bidirectional, and the futures market plays the dominant role.

The results of the Diebold-Yilmaz test reaffirm that with respect to cotton, the spot market and the futures market, respectively play a dominant role in the case of return and volatility spillover (Table 7). When it comes to mentha, the results substantiate the findings of the cointegration and the BEKK-GARCH model that the futures market dominates the spot market for both return and volatility spillover. Hence, the Diebold-Yilmaz test provides a robustness check for our work.

**Table 5 Granger causality results**

Null Hypothesis	F-Statistic	p-value
Panel A: Cotton		
FUTURE does not Granger Cause SPOT	1.145	0.3185
SPOT does not Granger Cause FUTURE	70.857	(0.00) *
Panel B: Mentha		
FUTURE does not Granger Cause SPOT	172.978	(0.00) *
SPOT does not Granger Cause FUTURE	0.171	0.679

Source Author's calculations

Notes a. FUTURE denotes the futures prices of commodities on the MCX platform; SPOT denotes the spot price of MCX.

b. Figures in () brackets denote p-values;

c. \*denotes significance at 1% level; \*\*denotes significance at 5% level; \*\*\* denotes significance at 10%

**Table 6 BEKK GARCH results**

Variable	Cotton		Mentha	
	FUTURE_SPOT		FUTURE_SPOT	
	Coefficient	P- value	Coefficient	P- value
i1	-0.001	0.302	0.000	0.808
i2	0.002	-0.049**	0.000	0.583
c (1,1)	0.008	-0.068***	-0.010	0.000*
b (1,1)	0.494	0.554	0.505	0.000*
b (2,1)	0.491	0.556	0.509	0.000*
a (1,1)	-0.142	0.217	-0.053	0.301
a (2,1)	0.034	0.719	0.106	0.005*
c (2,1)	0.000	1.000	0.000	1.000
c (2,2)	-0.003	0.470	0.008	0.000*
b (2,2)	0.488	0.468	0.337	0.011**
b (1,2)	0.491	0.447	0.544	0.000*
a (2,2)	-0.202	-0.097***	-0.168	0.000*
a (1,2)	0.229	-0.086***	0.554	0.000*
Log Likelihood	6801.38		1912.370	

Source Author's calculations

#### Notes

- Models estimated using QMLE with robust (heteroscedasticity/misspecification) standard errors. 'i' denotes the mean equation coefficients. In the variance equations, 'c' denotes the constant terms, 'a' denotes the ARCH terms, i.e. coefficients of the square of one-period residual terms ( $\epsilon_{st-1}$ ,  $\epsilon_{ft-1}$ ) and 'b' denotes the GARCH terms, i.e. coefficients of one-period variance/covariance terms ( $h_{st-1}$ ,  $h_{ft-1}$ ). The GARCH BEKK model is used.
- Futures denotes the futures prices of commodities on the MCX platform; SPOT denotes the spot price of MCX. 1 and 2 refer to the futures and spot market respectively.
- Cross coefficient a (1,2) represents the short-term volatility spillovers from 1 to 2; b (1,2) represents the long-term volatility spillovers from 1 to 2; other coefficients are interpreted in the same manner;
- \*denotes significance at 1% level; \*\* denotes significance at 5% level; \*\*\* denotes significance at 10% level.

The results differ for cotton and mentha in terms of price discovery and volatility spillover. These findings call for an investigation of the reasons that inhibit or facilitate the development of the commodity market.

#### Survey findings

Against this backdrop, we report the survey results in the subsequent paragraphs, each detailing the opinions of the market participants (farmers, traders or arhatiyas (commission agents), business firms, and associations; brokers; and SEBI).

#### Market participants

About 75% of the respondents perceive a low degree of vertical integration in Mentha, or that the value chain

has many transaction points; for cotton, relatively fewer respondents (about 60%) feel the same. Moreover, 50% and 33% of the respondents, consider the number of mandis at each level to be sufficient for Mentha and cotton respectively. About 75% of the respondents perceive that the cotton spot market is competent to discover prices in a transparent manner; for mentha, that percentage is less than 50%.

The cotton spot market is impeded by the prevalence of the MSP; the absence of standardization; and the inadequate availability of data on the supply and demand of cotton, based on quality, variety, and foreign matter. The respondents say large companies and global traders manipulate the market; soybean traders in India feel the same way (Kumar 2010). The mandi tax<sup>4</sup> on

<sup>4</sup> The Agriculture Produce Marketing Committee (APMC) Acts of state governments mandate states to maintain wholesale markets. The APMC Act authorizes a state government to levy a fee on the sale and purchase of agricultural produce to defray the maintenance cost. This fee is known as the mandi tax. In Uttar Pradesh, the mandi tax is presently levied at the rate of 1.5% over and above the goods and services tax (GST) levied at the rate of 12%.

**Table 7 Diebold Yilmaz results**

Cotton	SR	SV	FR	FV	From others
SR	85.46	0.23	13.4	0.91	14.5
SV	7.28	82.47	1.7	8.55	17.5
FR	24.42	0.77	72.82	1.99	27.2
FV	3.31	4.89	3.43	88.37	11.6
Contribution to others	35	5.9	18.5	11.4	70.9
Contribution including own	120.5	88.4	91.4	99.8	0.177

  

Mentha	FR	FV	SR	SV	From others
FR	90.2	0.71	8.87	0.23	9.8
FV	1.97	94.2	2.42	1.42	5.8
SR	18.52	0.69	80.39	0.41	19.6
SV	0.05	13.43	0.54	85.98	14
Contribution to others	20.5	14.8	11.8	2.1	49.2
Contribution including own	110.7	109	92.2	88	0.123

Source Author's calculations

Notes FR(V) and SR(V) denotes the prices (volatility) of futures contract traded on MCX and the spot market respectively.

mentha dissuades potential derivatives traders. The respondents emphasized that the government should create a value addition infrastructure—by setting up quality testing laboratories and developing a grading and standardization mechanism—and bring about standardization by educating farmers in enhancing farm-level productivity and quality.

More than 80% of the respondents know about the cotton futures market, but over 50% of them do not trade, and a little less than 25% do not trade in the mentha futures market, because futures prices are volatile. The cotton futures market lacks delivery-based trading support and quality testing and grading facilities. The National Commodity and Derivatives Exchange (NCDEX) operates delivery centres in only a few states. The commodities transaction tax and the mandi tax constrain trading in mentha futures.

Next, we attempted to evaluate whether respondents accept aggregators. More than 67% of the respondents did not want an aggregator trading on their behalf, even for a nominal fee, for cotton or mentha. If the reasons are identified and addressed—and the stakeholders are made aware of the benefits of derivatives trading and

their concerns of excessive speculation alleviated—farmer producer organizations (FPO) can succeed in the Indian agri-commodity market. The respondents emphasized that the government should increase the number of warehousing facilities, quality testing and grading facilities, and delivery centres.

Most respondents trade on their own. They perceive that the derivatives market plays an important role in price discovery, risk hedging, or both. The contract design of the derivatives market keeps potential participants away: the lot sizes are too large; the speculation is excessive; and the varieties produced in the physical market are not standardized. Potential participants in the cotton derivatives market lack the confidence that the delivery-based support will supply the promised quality and that the MSP will act as an alternative risk hedging mechanism.

The futures market should serve as a self-procurement platform. The government should use the futures market as an early warning system to prevent prices from falling below the MSP). Removing the CTT<sup>5</sup> on mentha should improve stakeholder participation. The existing contract lot size is two drums of 180 kg each,

<sup>5</sup> International commodities exchanges do not levy a CTT, and particularly not on agri-commodities. In India, the CTT adversely impacts the market microstructure, global cost competitiveness, and net tax revenue collection (Sehgal and Agrawal 2019).

but small farmers produce only 100 kg per hectare, and they cannot participate in the futures market. The respondents feel that the carrying and handling costs do not justify the huge difference between future and spot prices.

#### Market intermediaries

About 50% of the clients of brokers trade in agri-derivatives, but only a minuscule percentage trade in cotton and mentha, because of dabba trading,<sup>6</sup> frequent fluctuations in the margin money requirement, and government policies such as the CTT. The brokers feel that the government should permit institutions to trade in derivatives, modify contract design parameters, and introduce cottonseed contracts to enable spread-based strategies and drive volumes in related products like cotton, kapas, and cottonseed oilcake. They recommend improving the price dissemination system and permitting the use of liquidity enhancement schemes<sup>7</sup> in the Indian agri-commodity derivatives market. The brokers believe that launching options, mini contracts, and micro contracts in agri-commodities—especially in pulses, edible oil, wheat, sugar, and oilseeds—would improve risk management and enhance the role of aggregators. Banks are reluctant to accept instruments like bank guarantees or fixed deposits as collateral, and policymakers must mandate banks to accept these instruments.

#### Market regulator

Officials of the SEBI affirm that the agri-commodities derivatives market performs an essential role in the price discovery and risk hedging process of the Indian commodities market, but its information efficiency and global competitiveness is constrained by poor liquidity, spot market volatility and size, lot and tick size, and the CTT (Gulati et al. 2017; Sehgal and Agrawal 2019). The SEBI expects exchanges to improve their grievance and redressal mechanism and employ trainers to increase the awareness of commodity derivatives. The respondents emphasized that the 75,000 farmers in FPOs should participate in the market; aggregators could trade on their behalf. Most respondents believe that the spot market efficiently discovers cotton prices, but fewer believe so for mentha.

#### Conclusions

This paper examines the transmission of information between the spot and futures markets for cotton and mentha. It finds that the information linkages for cotton are weak; price discovery takes place in the spot market and volatility spillovers emanate from the futures market. The mentha futures market dominates in price discovery and volatility spillovers. The futures market is constrained by several problems: MSP, inadequate availability of data, lack of standardization, mandi tax, CTT, large contract size, high probability of huge losses, trust issues concerning quality (standardization), timing, and low liquidity. The spot and futures prices share a long-term relationship.

To develop the Indian agri-commodity derivatives market, the government should increase awareness among farmers, adopt a stable policy framework associated with the global trade in agricultural commodities, and stop levying multiple charges (mandi tax, GST, and CTT). To improve market liquidity, the government should develop a comprehensive data collection and dissemination system and a more organized spot market for agricultural commodities, and it should encourage FPOs to participate.

Instead of suspending contracts frequently, SEBI should create an environment for contracts to succeed. It should develop classification criteria to segregate market players in all commodity derivatives exchanges into commercial hedgers and non-commercial traders. A commodity surveillance system would let exchanges and the regulator take corrective measures well in time.

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<sup>6</sup> Grey market or informal operations conducted illegally outside the regulator's purview.

<sup>7</sup> The SEBI does not presently allow the use of liquidity enhancement schemes in sensitive commodities, where government intervention exists.

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