Abstract

Agricultural commodity prices exhibit high volatility influenced by factors such as weather, supply-demand dynamics, policy interventions, and global uncertainties. In developing economies like India, effective price management is essential for securing farmers' incomes and enhancing market efficiency. This study proposes a framework for managing prices of 18 agricultural commodities traded by Farmer Producer Organizations (FPOs) in the Indian derivative market, built on three pillars: price discovery, volatility, and forecasting. The study analyzes 10 years price data from 2016 to 2025. Firstly, a systematic meta-review using bibliometric analysis and PRISMA framework was conducted to identify the research gaps. Thereafter, advanced econometric techniques, including the Vector Error Correction Model (VECM) and Granger causality tests were employed to empirically explore the lead-lag relationships between spot and futures prices in the long and short run, respectively. The Dynamic Conditional Correlation Exponential Generalized Autoregressive Conditional Heteroskedasticity (DCC-EGARCH) model was used to capture the volatility dynamics. Finally, a hybrid Ridge–Gradient Boosting Regressor (Hy-R-GBR) was developed for forecasting the futures prices for near and next near term expiry dates of each commodity. Results reveal a strong long-run equilibrium between spot and futures prices, with futures markets usually leading in price discovery. The volatility analysis shows asymmetric price variations in spot-futures prices, noting that futures markets demonstrate more stability than spot markets. The impact of the COVID-19 trade suspension is also assessed, indicating that despite this setback, price discovery mechanisms remained resilient. Additionally, 12 of 18 commodities delivered higher returns via derivatives than via spot markets, and year-on-year returns increased. The Hy-R-GBR model outperforms alternatives in forecasting, with R^2 values between 0.97 and 0.999 and low errors in MAE, RMSE, and MAPE. The overall findings indicate that derivative markets significantly enhance price efficiency, aid in managing volatility risks, and facilitate informed decision-making among FPOs and other stakeholders involved in these markets. By leveraging these findings, FPOs can determine what, when, and how to produce, thereby optimizing profits from derivative trading. Furthermore, the study advocates the researchers, policymakers, and market regulatory bodies to enhance FPO participation, refine derivative policies, and expand commodity coverage. This is aimed at fostering sustainable agricultural market development and reinforcing farming communities in India.

Keywords: Agricultural Commodity Derivatives; FPOs; Price discovery; Price volatility; Price Forecasting; Wealth generation; DCC-EGARCH; Hybrid Ridge-Gradient Boosting Regressor (Hy-R-GBR)