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Agriculture Price Analysis and Its Forecasting Methods

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Agricultural price analysis can be defined as the scientific study of the behavior of agricultural commodity prices in terms of time, primarily caused by factors of demand and supply. The price of the commodity, expressed in monetary terms, reflects the value of the commodity in the market. The price analysis involves the evaluation of the movements of the price of the commodity in the past, as well as the fluctuations in the price, which occur during the seasons and the cyclical periods and the causes of the price movements and whether the price movements are uniform or not. Agricultural price analysis assumes a position of immense significance from the following viewpoints:

- For the farmers, in order to make efficient decisions in the agricultural marketing process;
- For the government, in order to frame appropriate policies to determine the MSP, subsidies and international trade, and
- For the traders and the consumers, in order to make efficient decisions in the market.

Agricultural price analysis, combined with forecasting, provides a scientific basis for forecasting the price movements in the future, which helps in price stability.

Component of Agriculture Price Variation

Long-Term or Trend Variation: It indicates the gradual increase or decrease in price over a long period of time, which is often the result of factors like technological advancements, inflation or demand-supply fluctuations. It is often estimated with the help of a trend line and its significance is verified with the help of the coefficient of determination (R^2).

Seasonal Variation: Seasonal variation occurs in a pattern where prices tend to move in a particular way during a particular season of the year, depending upon the crop's production cycle, storage capacity and demand for the crop. Prices tend to rise during lean periods and dip during peak harvest times. Murulidhar *et al.* (2022) reported an inverse relationship between arrivals and prices, where higher arrivals led to lower prices and vice versa across seasons in Hubballi and Raichur markets.

Cyclical Variation: Cyclical variation happens in a longer time period, *i.e.*, 3-10 years, due to the occurrence of market-related factors such as business cycles, export demand and changes in purchasing power. Tingre *et al.* (2019) found that tomato prices in major markets of Maharashtra exhibited cyclical variation, with prices fluctuating around the long-term trend over multiple years.

Irregular Variation: Irregular variation occurs when sudden and unpredictable changes take place in the price of a commodity due to unforeseen and non-recurring factors such as drought, floods, pest attacks and strikes. This type of variation cannot be predicted or forecast in a regular manner. According to a study by Muthuraj (2017) reported irregular variation in groundnut prices, with sudden and unpredictable changes in prices not following a consistent relationship with arrivals.

Spatial Variation: Spatial variation refers to the difference in the prices of the same commodity in different markets. It arises as a result of the difference in the cost of transport,

quality and demand between markets. In a study conducted by Prashanth *et al.* (2024) observed significant spatial variation in wholesale potato prices across selected markets, with Burdwan market recording higher mean prices, while Agra and Indore markets showed comparatively lower prices, indicating price differences across regions.

Price Forecasting

Price forecasting is a scientific approach to predict the future price of agricultural commodities based on past data and statistical analysis. It is a useful tool for decision-making for farmers, traders and policymakers. Forecasting is used to predict the trends and changes in the prices of agricultural commodities, thereby making better preparation for uncertainties.

In agricultural price forecasting, various techniques like AutoRegressive Integrated Moving Average (ARIMA), GARCH (Generalized AutoRegressive Conditional Heteroskedasticity), ANN (Artificial Neural Network) and hybrid/deep learning techniques are used to analyze the various trends in the price of agricultural commodities. It is a reliable tool for making short and medium-term predictions of price data. Price forecasting is a vital tool for maintaining market stability, reducing risks and enhancing the income security of farmers.

Review of Literature

Bhusanar *et al.* (2023) observed that the ARIMA model was able to forecast the arrival and price of groundnut in APMC markets of Rajasthan by using time series data from 2005 to 2021. The results showed that the ARIMA (1,1,1) model was the best fit for arrivals (R^2 = 0.931), whereas the ARIMA (2,1,1) model was the best fit for price forecasting (R^2 = 0.852). The results showed a steady increase in arrivals and price of groundnuts in 2022-2026, which indicates that price forecasting is helpful in taking decisions by farmers and designing policies by policymakers.

Devra *et al.* (2023) studied that the combination of the ARIMA and Artificial Neural Network (ANN) model improved the accuracy of oilseed crop price forecasting in Gujarat State. The results showed that the hybrid model, *i.e.*, ARIMA-TDNN (Time Delay Neural Network), performed better in forecasting oilseed crop price compared to other models, as it showed the lowest values of Root Mean Square Errors (RMSE) and Mean Absolute Errors (MAE) by using monthly price data of groundnut, soybean, sesame, and rapeseed and mustard oilseed crops for the period 2001-2020.

Badal *et al.* (2023) performed a comparative analysis of price forecasting of tomatoes in the Varanasi market of Uttar Pradesh, considering daily price data from 2017 to 2021. The results showed that the ANN model of architecture [14-8-1] gave the highest accuracy in price forecasting, along with the lowest values of MAE, RMSE and MAPE (Mean Absolute Percentage Error), compared to the GARCH (1,1) and ARIMA (3,1,4) models. It was concluded that the ANN model performed better in price forecasting by capturing nonlinear and complex relationships in price data compared to traditional statistical techniques.

Kumar *et al.* (2024) worked on the price forecasting of cotton in the major markets of Haryana, *i.e.*, Adampur, Sirsa and Fatehabad by considering monthly price data from September 2005 to May 2022, obtained from AGMARKNET. The researchers applied the ARIMA (1,1,1), ARIMA (0,1,1) and ARIMA (1,1,0) models for price forecasting and concluded that the price of cotton in these markets showed an increasing trend in the forecast period of 2022-2028. The results showed that the ARIMA model gave reliable results for price forecasting in the short term and could be applied for market planning and policy formulation.

Manogna *et al.* (2025) emphasized the better performance of deep learning models in price forecasting in the agricultural domain, using daily wholesale price data from 2010 to 2024 for 165 markets in India. In the study, the performance of traditional models like ARIMA, machine learning models like SVR(Support Vector Regression), XGBoost(Extreme Gradient Boosting), and deep learning models like MLP(Multi-Layer Perceptron), RNN(Recurrent Neural Network), LSTM(Long Short-Term Memory), GRU(Gated Recurrent Unit) and ESN(Echo State Network) were compared for 23 agricultural commodities. The study concluded that the RMSE and MAPE values were the lowest for LSTM and GRU,

which proves the efficient performance of deep learning models in handling nonlinear temporal relationships in the price series.

Conclusion

Agricultural price forecasting is an extremely vital tool in agricultural market planning, risk management and income stabilization. Using historical price data, agricultural price forecasting models can provide valuable insights into price movements, enabling stakeholders to make informed decisions. ARIMA models are highly efficient in forecasting linear price trends, but GARCH models are more accurate in volatile price movements. However, ANN, LSTM, and GRU models have demonstrated high accuracy in forecasting agricultural prices, which are often non-linear in nature.

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