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A STUDY ON FORECASTING OF SELECTED AGRICULTURE COMMODITIES PRICES USING ARIMA MODEL

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ABSTRACT

This study explores the application of the Autoregressive Integrated Moving Average (ARIMA) model to forecast prices of key agricultural commodities: rice, wheat, cotton, maize,and groundnuts. Effective price forecasting in agriculture is crucial for stakeholders includingfarmers, traders, and policymakers to make informed decisions. The ARIMA model is chosenfor its capability to capture time series patterns and fluctuations in commodity prices, which are influenced by diverse factors such as weather conditions, market demand, and governmentpolicies. Historical price data spanning a significant period is utilized to train and validate themodels for each commodity. The accuracy of ARIMA forecasts is evaluated using statistical metrics, and the results are compared across commodities to identify patterns and trends. The findings of this study contribute to enhancing the understanding of price dynamics in agricultural markets and provide valuable insights for mitigating risks and optimizing decision-making processes in the agriculture sector.

1.INTRODUCTION

1. What Is Agriculture

Agriculture encompasses the cultivation and harvesting of crops, the nurturing of livestock, and the planting of trees for both economic gain and meeting human needs. In simpler terms, it involves the science and art of farming, which includes cultivating soil, growing crops, establishing forest vegetation, raising animals, and cultivating fish.

1.1.1 Agriculture in India

Agriculture plays a fundamental role in India's economic framework, making a substantial contribution to its GDP and employing a significant segment of the workforce. It is essential for ensuring food security, supplying raw materials to industries, and remains deeply embedded in India's cultural and socio-economic structure. With its diverse climate and fertile soil, India can cultivate a broad range of crops, positioning itself as one of the largest producers in the global agricultural sector.

Agriculture stands as a critical sector in India, playing a vital role in the nation's economy by employing a significant majority of its workforce and contributing approximately 17-18% to the Gross Domestic Product (GDP). With its diverse climate and expansive arable land, India is well-suited for cultivating a diverse range of crops. The Green Revolution in the 1960s marked a substantial increase in agricultural output, particularly in cereal production, facilitated by the adoption of high-yielding seeds, fertilizers, and improved irrigation methods.

1.1.2 Importance of agriculture in India:

Agriculture serves as a cornerstone of income for both the central and state governments in India, generating significant revenue through land taxes and contributing to the earnings of the Indian railways through the transport of agricultural goods. This revenue supports governmental expenditures and developmental initiatives. Agriculture holds a pivotal role in human civilization as the primary source of raw materials for industry and trade, contributing substantially to national revenue and providing employment for a large segment of the population. Crucial to the country's overall development, agriculture also plays a vital role in environmental sustainability. In India, the agricultural sector contributes 16% to the GDP and employs around 52% of the population, underscoring its critical importance for economic self- sufficiency and the generation of foreign exchange.

1. 2 Economic Contribution

1. GDP Contribution: Agriculture contributes significantly to India's Gross Domestic Product (GDP). As of recent years, it accounts for around 15-20% of the total GDP.

2. Employment: A large portion of the Indian population is employed in the agricultural sector. Over 50% of the workforce is engaged in agriculture and allied activities.
3. Rural Economy: The majority of India's rural population depends on agriculture for their livelihood. This makes it a crucial factor in rural development and poverty alleviation.

1.3 Exports

1. Agricultural Exports: India is a major exporter of agricultural products, including spices, tea, coffee, fruits, and vegetables. This contributes significantly to the country's foreign exchange earnings.
2. Global Market: Indian agricultural products have a presence in the global market, enhancing trade relations and economic ties with other countries.
3. Socio-Cultural Significance
4. Cultural Practices: Agriculture is deeply intertwined with the cultural and traditional practices of India. Festivals and rituals often revolve around agricultural cycles.
5. Rural Development: Agriculture fosters rural development by improving infrastructure, creating jobs, and enhancing the quality of life in rural areas.

1.4 Technological Advancements

1. Innovation: The sector has seen numerous technological advancements, such as high- yield variety seeds, modern irrigation techniques, and sustainable farming practices, which have improved productivity and efficiency.
2. Research and Development: Continuous research and development in agriculture lead to innovations that boost crop yields, enhance soil health, and improve pest control methods.

1.5 Environmental Impact

1. Sustainable Practices: Sustainable agricultural practices help in maintaining ecological balance and preserving biodiversity.
2. Climate Resilience: Agriculture plays a role in climate resilience by adopting practices that mitigate the effects of climate change and promote sustainable land use.

1.6 Policy and Government Initiatives

1. Government Support: The Indian government has numerous policies and schemes aimed at supporting the agricultural sector, such as subsidies, minimum support prices, and crop insurance.
2. Institutional Framework: Institutions like the Indian Council of Agricultural Research (ICAR) and various agricultural universities play a crucial role in advancing agricultural research and education.
3. Government Support: The Indian government has numerous policies and schemes aimed at supporting the agricultural sector, such as subsidies, minimum support prices, and crop insurance.
4. Institutional Framework: Institutions like the Indian Council of Agricultural Research (ICAR) and various agricultural universities play a crucial role in advancing agricultural research and education.

2. Major Agriculture Commodities: India producing different types of agriculture commodities among all commodities I have taken majorly 5 commodities. They are

1. Rice
2. Wheat
3. Groundnuts
4. Cotton
5. maize

2.1Rice: Rice, primarily a high-energy food, is a staple for over half of the world's population. In India, rice holds significant importance as it is cultivated on the world's largest rice-producing area, covering 41.9 million hectares and yielding 83.13 million tonnes annually. This cultivation area represents approximately 37% of India's total land dedicated to food grains, compared to 20% for wheat, another crucial food crop. Globally, rice ranks second to wheat in terms of harvested area. In India, around 65% of the population includes rice in their diet.

2.2Wheat: Wheat is a vital crop in Indian agriculture, ranking as the second most important staple food after rice. As

one of the leading global producers, India relies on wheat for significant contributions to food security and the agricultural economy. Predominantly grown in the northern and northwestern states such as Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, and Rajasthan, wheat benefits from the ideal climatic conditions of cool winters and hot summers. It thrives in moderate temperatures ranging from 10 to 25 degrees Celsius during the growing season and requires substantial sunlight during maturation. Well-drained loamy or clayey loam soils are particularly suitable for its cultivation.

2.3 Groundnuts: Groundnut is the major oil seed crop in India, and it plays a major role in bridging he vegetable oil deficit in the country. Groundnuts in India are available throughout the year due to a two-crop cycle harvested in March and October. Groundnuts, or peanuts, are a vital crop in Indian agriculture, primarily cultivated in states such as Gujarat, Andhra Pradesh Tamil Nadu, Karnataka, Maharashtra, and Rajasthan. They thrive in warm climates and well- drained sandy loam soils, with the main growing seasons being the Kharif (monsoon) and Rabi (winter) seasons. Groundnuts are nutritionally rich, providing proteins, healthy fats, vitamins, and minerals, and are used in various forms including raw, roasted, and as oil. Economically, they are a major oilseed crop contributing significantly to India's edible oil production and exports, thus earning valuable foreign exchange.

2.4 Cotton: Cotton has been used as a fabric in India since ancient times, with its cultivation in the Indus Valley dating back over 5,000 years. Archaeological excavations at Mohenjo-Daro reveal a sophisticated level of artistry in cotton spinning and weaving during that period. By around 1500 BC, India had already established itself as a significant centre for the cotton industry. From India, the practice of cultivating cotton spread to Egypt, and later to Spain and Italy. Among the 20 species of cotton, 16 are wild and 4 are cultivated. The cultivated species possess spinnable lint, whereas the wild varieties have only short fuzz or smooth seeds.

2.5 Maize: In India, Maize is grown throughout the year. It is predominantly a Kharif crop with 85 percent of the area under cultivation during the season. Maize is the third most important cereal crop in India after rice and wheat. It accounts for around 10 percent of total food grain production in the country. Maize, or corn, is a crucial crop in Indian agriculture, ranking third after rice and wheat in terms of importance. In the agricultural year 2023-2024, India's maize production was estimated at around 34.6 million tonnes. Key maize-producing states include Karnataka, Madhya Pradesh, and Bihar. Maize is extensively cultivated for its versatility, serving as food, feed, fodder, and industrial raw material.

LITERATURE REVIEW

Rangsan Nochai and Titida Nochai focuses on using ARIMA models to forecast the prices of oil palm in Thailand, including farm price, wholesale price, and pure oil price, from 2000 to 2004. ARIMA models are widely used in time series forecasting due to their ability to handle non-stationary data, making them ideal for predicting volatile agricultural prices. This study highlights the effectiveness of ARIMA models in agricultural price forecasting, providing valuable insights for policymakers and stakeholders in Thailand's bio-diesel production efforts. https://1drv.ms/b/s!AqzwehTfGRHzrzb3nZopPis_elha?e=PKNyPk.

Nitish Kumar Singh and M.V. Alagawadi examines the application of the ARIMA model for predicting the monthly prices of rice, red gram, and groundnut in the Suryapet mandi, an e-NAM market in Telangana, India. The study utilizes historical data from August 2016 to November 2019 to forecast prices for the following year, comparing its performance with other models like linear regression and exponential models. The results indicate that the ARIMA model provides accurate predictions, with ARIMA (0,1,0)(0,1,1)[12] for rice, ARIMA (0,1,0)(0,1,0)[12] for red gram, and ARIMA (0,1,0) for groundnut being the most Suitable configurations.https://1drv.ms/b/s!AqzwehTfGRHzrzeEVNCJT6i0wQVI?e=UuU2dk

Saroj Kanta Biswal and Anita Sahoo utilize ARIMA models to predict weekly price fluctuations. By analyzing 14 years of data, they found that a seasonal ARIMA (1, 1, 1) (1, 0, 1) model best fits the price trends. Their research aims to bridge the gap between forecasted and actual market prices, helping farmers make informed decisions. They discovered that while their forecasts generally align with actual prices, certain periods exhibit significant deviations, highlighting the volatility in green gram prices. This analysis equips farmers with crucial insights for pricing strategies and market timing. https://1drv.ms/b/s!AqzwehTfGRHzrzvGQTz8mlDz2Fez?e=P5Tufe

Shibanjan Dutta And Suraj Maiti, the ARIMA models (3,1,0) for potato prices and (1,1,1) for onion prices provided effective forecasts. The study emphasized the importance of price forecasting in stabilizing agricultural markets, benefiting both farmers and consumers. Overall, the research underscored the significance of accurate forecasting in enhancing economic efficiency and food security in India's agricultural sector. https://1drv.ms/w/s!AqzwehTfGRHzr0GvXglxaEAjJ6gS?e=w6NcLP

Kumar and Baishya (2020) focuses on forecasting potato prices in India using ARIMA models based on data from 2002 to 2019. Their research identifies optimal ARIMA configurations for seven states and India, highlighting seasonality and price trends across regions. By evaluating models using criteria like AIC, BIC, MAPE, and RMSE, they forecasted 2020 prices. The study underscores the importance of accurate price forecasts for stakeholders, emphasizing the potential for informed decision-making and policy formulation agriculture markets. https://1drv.ms/w/s!AqzwehTfGRHzr0LRyPEerfaunUKb?e=FtC9Sz3

2.RESEARCH METHODOLOGY

2.1statement of the problem

In the context of agricultural commodity markets, particularly focusing on rice, wheat, cotton, and maize, there exists a significant challenge in accurately forecasting their prices. These commodities are vital for global food security and economic stability, yet their prices are highly volatile due to complex interactions of factors such as climate variability, global trade policies, and market demand-supply dynamics. Existing forecasting methods may not adequately capture the nuances of these fluctuations, leading to suboptimal decision-making for farmers, traders, and policymakers alike. Therefore, there is a pressing need to explore and apply robust forecasting techniques, such as the ARIMA model.

2.2 Need of the study

The study on forecasting agricultural commodity prices—like rice, wheat, cotton, and maize— using the ARIMA model is crucial for several reasons. Agricultural commodity prices are highly volatile due to factors like weather, market dynamics, and global trade policies. Accurate forecasts help farmers plan planting and harvesting cycles, optimize resource allocation, and manage risks effectively. For traders and investors, reliable price predictions enable better market timing and investment decisions. Policymakers benefit from these forecasts in formulating agricultural policies that ensure food security and stabilize markets.

2.3 Objectives of the study

1. To forecasting the selected agriculture commodities prices using ARIMA model
2. To know the fluctuations of selected Agriculture commodities prices
3. To testing the stationary of the selected Agriculture commodities prices
4. To giving some suggestions to Agribusinesses and investors

2.4 Data collection

Secondary data: This research is depends upon only secondary data and taking previous 10 years monthly selected agriculture commodities prices. Data related from the year 2014 to 2024. Data will be collected from through

- Indexmudi.com

2.5 Limitations of the study

- This study is restricted to secondary data only
- This study predicts only 5 Agriculture commodities prices
- In this study we have taken 10 years previous prices to forecast the prices

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DATA ANALYSIS AND INTERPRETATION

Table 1: Forecasted prices of Rice

S.No	Date	Price	S.No	Date	Price
1	2024M03	49285.89	18	2025M08	49907.60
2	2024M04	52530.27	19	2025M09	46930.24
3	2024M05	49001.36	20	2025M10	49610.01
4	2024M06	52177.55	21	2025M11	46695.23
5	2024M07	48722.82	22	2025M12	49318.67
6	2024M08	51832.24	23	2026M01	46465.16
7	2024M09	48450.13	24	2026M02	49033.46
8	2024MIO	51494.19	25	2026M03	46239.92
9	2024M11	48183.17	26	2026M04	48754.24
10	2024M12	51163.25	27	2026M05	46019.42
11	2025M01	47921.83	28	2026M06	48480.89
12	2025M02	50839.27	29	2026M07	45803.56
13	2025M03	47665.97	30	2026M08	48213.29
14	2025M04	50522.09	31	2026M09	45592.23
15	2025M05	47415.50	32	2026M10	47951.31
16	2025M06	50211.58	33	2026M11	45385.35
17	2025M07	47170.29	34	2026M12	47694.84

Table 2: Forecasted prices of Cotton

S.No	Date	Price	S .No	Date	Price
1	2024M03	166.8697	18	2025M08	157.0240
2	2024M04	166.1133	19	2025M09	156.6084
3	2024M05	165.3831	20	2025M10	156.2072
4	2024M06	164.6782	21	2025M 11	155.8198
5	2024M07	163.9977	22	2025M12	155.4459
6	2024M08	163.3407	23	2026M01	155.0849
7	2024M09	162.7065	24	2026M02	154.7365
8	2024MIO	162.0942	25	2026M03	154.4000
9	2024M11	161.5031	26	2026M04	154.0753
10	2024M12	160.9325	27	2026M05	153.7617
11	2025M01	160.3816	28	2026M06	153.4591
12	2025M02	159.8498	29	2026M07	153.1669
13	2025M03	159.3364	30	2026M08	152.8848
14	2025M04	158.8408	31	2026M09	152.6124
15	2025M05	158.3623	32	2026M10	152.3495
16	2025M06	157.9004	33	2026M11	152.0957
17	2025M07	157.4545	34	2026M12	151.8507

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Table 3: Forecasted prices of Groundnuts

S .No	Date	Price	S.No	Date	Price
1	2024M03	166703.8	18	2025M08	147336.2
2	2024M04	165310.1	19	2025M09	146443.9
3	2024M05	163952.5	20	2025MIO	145574.6
4	2024M06	162630.0	21	2025M11	144727.9
5	2024M07	161341.7	22	2025M12	143903.0
6	2024M08	160086.9	23	2026M01	143099.0
7	2024M09	158864.4	24	2026M02	142316.9
8	2024M10	157673.7	25	2026M03	141554.5
9	2024M11	156513.7	26	2026M04	140811.8
10	2024M12	155383.8	27	2026M05	140088.3
11	2025M01	154283.1	28	2026M06	139383.6
12	2025M02	153211.0	29	2026M07	138697.1
13	2025M03	152166.5	30	2026M08	138028.4
14	2025M04	151149.1	31	2026M09	137377.0
15	2025M05	150158.1	32	2026MIO	136742.4
16	2025M06	149192.7	33	2026M11	136124.3
17	2025M07	148252.3	34	2026M12	135522.2

Table 4: Forecasted prices of Wheat

S.No	Date	Price	S.No	Date	Price
1	2024M03	24028.93	18	2025M08	22176.51
2	2024M04	23891.34	19	2025M09	22094.67
3	2024M05	23757.88	20	2025M10	22015.28
4	2024M06	23628.45	21	2025M11	21938.29
5	2024M07	23502.90	22	2025M12	21863.61
6	2024M08	23381.14	23	2026M01	21791.19
7	2024M09	23263.04	24	2026M02	21720.94
8	2024M10	23148.49	25	2026M03	21652.80
9	2024M 11	23037.40	26	2026M04	21586.72
10	2024M12	22929.64	27	2026M05	21522.62
11	2025M01	22825.13	28	2026M06	21460.45
12	2025M02	22723.76	29	2026M07	21400.16
13	2025M03	22625.45	30	2026M08	21341.68
14	2025M04	22530.09	31	2026M09	21284.96
15	2025M05	22437.60	32	2026M10	21229.94
16	2025M06	22347.90	33	2026M 11	21176.59
17	2025M07	22260.90	34	2026M12	21124.83

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Table 5: Forecasted prices of Maize

S .No	Date	Price	S.No	Date	Price
1	2024M03	16997.57	18	2025M08	15771.60
2	2024M04	16900.61	19	2025M09	15721.90
3	2024M05	16807.38	20	2025M10	15674.12
4	2024M06	16717.75	21	2025M11	15628.18
5	2024M07	16631.58	22	2025M12	15584.01
6	2024M08	16548.72	23	2026M01	15541.54
7	2024M09	16469.07	24	2026M02	15500.71
8	2024M10	16392.48	25	2026M03	15461.46
9	2024M 11	16318.84	26	2026M04	15423.72
10	2024M12	16248.05	27	2026M05	15387.43
11	2025M01	16179.98	28	2026M06	15352.55
12	2025M02	16114.54	29	2026M07	15319.00
13	2025M03	16051.62	30	2026M08	15286.76
14	2025M04	15991.13	31	2026M09	15255.75
15	2025M05	15932.97	32	2026M10	15225.94
16	2025M06	15877.05	33	2026M11	15197.28
17	2025M07	15823.29	34	2026M12	15169.72

Interpretation: The table presents the monthly prices of five agricultural commodities—rice, cotton, groundnuts, wheat, and maize from March 2024 to December 2026. Rice prices fluctuate, peaking in April each year, with a general decline observed by December 2026.

Cotton prices show a steady decrease over the period, from 166.87 in March 2024 to 151.851 by December 2026. Groundnuts prices also follow a downward trend, starting at 166,704 in March 2024 and falling to 135,522 by December 2026. Similarly, wheat prices decline steadily from 24,028.9 in March 2024 to 21,124.8 in December 2026. Maize prices exhibit a gradual reduction as well, starting at 16,997.6 in March 2024 and decreasing to 15,169.7 by December 2026. Overall, the data indicates a consistent decline in the prices of all five commodities over the observed period.

FINDINGS

1. In the above analysis forecasted Rice commodity prices are decreasing continuously from 2024 March to 2026 December i.e. 49285.9 to 47694.8 per ton.
2. From the above forecasted cotton commodity prices have little volatility in their prices from 2024 March to 2024 august then cotton prices are continuously decreasing from 2024 September to 2026 December i.e. 166.87 to 151.85 per kg.
3. Forecasted Groundnut commodity prices are decreasing continuously from 2024 march to 2026 December, it means in 2024 March groundnuts price is 166703.8 and 135522 in 2026 December per ton.
4. The Wheat commodity forecasted prices are slight fluctuations from 2024 April to 2024 October and 2025 January onwards prices are continuously decreasing up to 2026 December. In 2024 March wheat price is 24028.9 and in 2026 December 21124.8 per ton.
5. In the above analysis forecasted maize commodity prices are decreasing continuously from 2024 to 2026 i.e., in 2024 March maize price is 16997.57 per ton and 15169.72 in 2026 December per ton.
6. In the above analysis almost all commodities prices are decreasing from 2024 to 2026.
7. In the above analysis groundnuts and cotton & rice having the high prices comparing to wheat and maize in the year 2026.
8. Maize commodity having less prices in 2026 comparing to all commodities.

Suggestions

1. Agriculture investors better to choose Rice commodity for trade because of rice prices will be increasing up to June 2025 and July 2025 onwards rice prices are decreasing continuously so investors do less investment on rice commodity.
2. Cotton commodity investors better to invest up to January 2025 because cotton prices are increasing and February 2025 onwards cotton prices are decreasing up to 2026 December.
3. Groundnuts commodity prices are decreasing from 2024 June to December 2026 so investors better to choose other commodities.
4. Wheat commodity investors better to analyse market condition of wheat commodity because of wheat prices decreasing from 2024 t02026 December investors better to choose another for trade.
5. In the above analysis maize prices are decreasing continuously from 2024 to 2026 December so investors better to avoid investment on wheat commodity.

CONCLUSION

The ARIMA model's forecast indicates a continuous decline in the prices o selected agricultural commodities from march 2024 to December 2026. Based on the extensive analysis conducted using the ARIMA model for forecasting agricultural commodity prices (specifically rice, wheat, cotton, maize, and groundnuts), several key findings and recommendations emerge. Firstly, the study reveals significant volatility in commodity prices over the forecasted period from 2024 to 2026.

Rice prices are expected to decline steadily, impacting global food security strategies. Cotton, despite initial fluctuations, shows a continuous downward trend, affecting textile industries reliant on stable pricing. Groundnuts exhibit a consistent decrease, underscoring challenges for peanut- based products in global markets. Conversely, wheat prices stabilize briefly before a gradual decline, impacting both consumers and producers. Maize, experiencing a similar trend, highlights challenges in agricultural policy and production planning. Overall, the study underscores the need for diversified agricultural strategies, resilient market policies, and technological innovations to mitigate the impact of price volatility on global food security and economic stability

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