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Maize Production Forecast using ARIMA Modeling

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Abstract

Maize has become increasingly important in India's foodgrain production, particularly for it's use in ethanol production. Maize is more suitable for ethanol production than rice and sugarcane because of lower food security concerns and less water required for irrigation. This study employs autoregressive integrated moving average (ARIMA) modeling to forecast maize production for the next five years using maize production data from 1966–67 to 2025–26. Model diagnostics identified ARIMA(2,2,2) as the best fit. The study projects maize production to increase from 550.93 lakh tonnes in 2025–26 to approximately 774 lakh tonnes by 2030, reflecting an average annual growth rate of 7%. Investment in drying and storage infrastructure is essential to reduce post harvest losses and ensure quality with maize production expected to rise steadily.

Introduction

Maize production in India has been increasing over the years. Now, use of maize in ethanol has led to serious incentives for farmers to grow more maize. From 241.73 lakh tonnes (across all seasons) in 2014-15, maize production has increased to 550.93 lakh tonnes in 2025-26[1]. India is the 4th largest country in terms of area under cultivation for maize although productivity levels still lag behind global average. The share of maize in ethanol production has increased to almost 50%[2]. Almost half of the ethanol produced uses maize now. Other major crops used in ethanol production are rice and sugarcane. FCI sells surplus rice to distelleries for ethanol production. The problem with use of rice as input for ethanol production is that it's a food crop and is very water intensive. Sugarcane too is water intensive. Maize uses much less water than rice and sugarcane. So, maize has come up as a good choice for ethanol production. Although, lower yield of maize in India leads to efficiency losses. Also, farmers face challenges with storage and drying of their harvest[3]. The amendment to National Policy on Biofuels, 2018 in 2022 advanced the target ethanol blending of 20% in petrol to 2025-26. The policy also discussed use of agri residue in ethanol production and promotion of 2G bio-refineries. Maize is naturally positioned to take benefit of biofuel policy and energy security concerns. The demand for maize is going to increase. This study focuses on forecasting maize production for the next five years from 2026-27 to 2030-31.

Literature Review

Sandhu et al. (2024) highlights advantages of maize over rice and sugarcane for ethanol production. Maize requires one third of the water of rice and one fourth of the water of sugarcane for cultivation. The crop duration for maize is shorter than rice. Sandhu et al. (2024) argue that maize is a more versatile crop because of use in fodder, industry and food. It is more climate resilient. Its residue has much higher carbon : nitrogen ratio than rice, which improves soil health. It doesn't face problem with handling residue like rice. Maize production has lagged in Punjab due to paddy dominance. Farmers are secure about paddy procurement. Factors such as higher cost of quality seeds from private firms and less availability of quality seeds by government, water logging issues in monsoon has led to large gap in potential and realized yield for farmers.

[1]https://upag.gov.in/dash-reports/allindiaapy

[2]https://www.thehindubusinessline.com/economy/agri-business/maize-now-accounts-for-close-to-half-of-ethanol-produced-in-the-country/article70652140.ece

[3]https://www.fao.org/4/x5002e/X5002e02.htm

They also discussed the need for stable prices and guaranteed purchase for farmers, educating farmers on crop diversification, building infrastructure for drying and storage of maize and connecting farmers with industry. (Sandhu et al., 2024)

Kumar et al. (2025) highlighted the benefits of maize in ethanol production over rice and sugarcane. Maize takes less time to grow and consumes less water. Using traditional crops like sugarcane and rice in ethanol production leads to issues like lower output of sugar and less availability of rice for food consumption. The authors also highlighted that single cross hybrid was the major reason behind productivity increase and it covers around 70% of area under maize cultivation. The supply of seeds is dominated by private sector which poses a challenge of higher cost of seeds for farmers. Also, 70% of the maize is cultivated under rainfed conditions and 30% is irrigated. For irrigated maize, long duration hybrids are used mostly, which require more time to grow and are more susceptible to drought, heatwave and waterlogging etc. DMRH 1301 and DMRH 1308 introduced by ICAR in 2017-18 are more resilient and are licensed to more than 25 private companies and have strong adoption in many states. The authors recommended regulating seed prices, investment in hybrid seed technology and efficient irrigation systems. (Kumar et al., 2025)

Bansal et al. (2022) examines the data on maize production, area and yield from 1960 to 2019. They forecasted maize production, area and yield for 2020-2025. They used ARIMA (0,1,0) for forecast of area, ARIMA (2,1,3) for production forecast and ARIMA (2,1,1) for yield forecast. They also found that price movement of maize in Punjab influenced prices in Madhya Pradesh and Uttar Pradesh but not vice versa. They also discussed the need for strengthening supply chain for avoiding excess supply in the market. (Bansal et al., 2022)

Sharma et al. (2018) forecasted maize production for 2017-2022. They found ARIMA (2,1,0) as the best model for forecasting in their study. Their model projected an increase in maize production by 13.76% from 2017 to 2022. (Sharma et al., 2018)

Kapngaihlian et al. (2017) predicted maize production for 2014 to 2020 using ARIMA (0,1,2) and used ARIMA (0,2,2) for forecast of maize price for the same period. Their model projected 1.97% growth rate of maize production and 8.24% growth rate for maize prices. (Kapngaihlian et al., 2017)

Kumar and Rana (2025) used data on maize yield from 1954 to 2023 to forecast maize yield from 2024 to 2028. They found the ARIMA (2,1,0) model with drift as the best conventional model for forecasting. Also, they found ARIMA (1,1,2) model with drift as the best automated model for forecasting. The automated model was found to be slightly more precise than conventional model and was used for forecasting maize yield. (Kumar and Rana, 2025)

Data

The data for maize production is taken from Unified Portal for Agricultural Statistics (UPAg) under Department of Agriculture and Farmers Welfare (DA&FW) for the years 1966-67 to 2025-26. The data used for the study combines the production of maize across different seasons not just kharif season.

Methodology and Results

Augmented Dickey-Fuller Test (ADF) was performed, which indicated non-stationarity (ADF statistic = 6.18, p-value = 1.0). Differencing was applied. Model selection was performed using both conventional ACF/PACF analysis and automated ARIMA search. The automated procedure identified ARIMA (2,2,2) as the best-fit model (AIC
= 518.7). Residual diagnostics confirmed the absence of autocorrelation (Ljung-Box p
= 0.88). The ACF and PACF plots of the differenced maize production series indicated significant autocorrelations up to lag 2, suggesting AR(2) and MA(2) components. This conventional identification was consistent with the automated ARIMA search, which selected

ARIMA(2,2,2) as the best-fit model.

```
ADF Statistic: 6.182377660471038
p-value: 1.0
Performing stepwise search to minimize aic
 ARIMA(2,2,2)(0,0,0)[0] intercept   : AIC=518.835, Time=0.19 sec
 ARIMA(0,2,0)(0,0,0)[0] intercept   : AIC=557.776, Time=0.02 sec
 ARIMA(1,2,0)(0,0,0)[0] intercept   : AIC=544.497, Time=0.06 sec
 ARIMA(0,2,1)(0,0,0)[0] intercept   : AIC=527.713, Time=0.06 sec
 ARIMA(0,2,0)(0,0,0)[0]             : AIC=555.999, Time=0.02 sec
 ARIMA(1,2,2)(0,0,0)[0] intercept   : AIC=inf, Time=0.21 sec
 ARIMA(2,2,1)(0,0,0)[0] intercept   : AIC=519.533, Time=0.09 sec
 ARIMA(3,2,2)(0,0,0)[0] intercept   : AIC=inf, Time=0.32 sec
 ARIMA(2,2,3)(0,0,0)[0] intercept   : AIC=inf, Time=0.32 sec
 ARIMA(1,2,1)(0,0,0)[0] intercept   : AIC=527.763, Time=0.11 sec
 ARIMA(1,2,3)(0,0,0)[0] intercept   : AIC=inf, Time=0.23 sec
 ARIMA(3,2,1)(0,0,0)[0] intercept   : AIC=520.791, Time=0.11 sec
 ARIMA(3,2,3)(0,0,0)[0] intercept   : AIC=inf, Time=0.28 sec
 ARIMA(2,2,2)(0,0,0)[0]             : AIC=518.729, Time=0.06 sec
 ARIMA(1,2,2)(0,0,0)[0]             : AIC=inf, Time=0.15 sec
 ARIMA(2,2,1)(0,0,0)[0]             : AIC=519.741, Time=0.05 sec
 ARIMA(3,2,2)(0,0,0)[0]             : AIC=inf, Time=0.24 sec
 ARIMA(2,2,3)(0,0,0)[0]             : AIC=inf, Time=0.25 sec
 ARIMA(1,2,1)(0,0,0)[0]             : AIC=527.930, Time=0.06 sec
 ARIMA(1,2,3)(0,0,0)[0]             : AIC=inf, Time=0.19 sec
 ARIMA(3,2,1)(0,0,0)[0]             : AIC=520.982, Time=0.08 sec
 ARIMA(3,2,3)(0,0,0)[0]             : AIC=inf, Time=0.28 sec

Best model:  ARIMA(2,2,2)(0,0,0)[0]
Total fit time: 3.386 seconds
```

Figure 1: Model selection via stepwise AIC minimization identified ARIMA(2,2,2) as the optimal specification (AIC = 518.729)

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                               SARIMAX Results
==============================================================================
Dep. Variable:                      y   No. Observations:                   60
Model:               SARIMAX(2, 2, 2)   Log Likelihood                -254.364
Date:                Thu, 06 Aug 2026   AIC                            518.729
Time:                        01:00:12   BIC                            529.031
Sample:                    12-31-1966   HQIC                           522.741
                         - 12-31-2025
Covariance Type:                  opg
==============================================================================
                 coef    std err          z      P>|z|      [0.025      0.975]
------------------------------------------------------------------------------
ar.L1         -0.2531      0.345     -0.734      0.463      -0.929       0.423
ar.L2         -0.5084      0.222     -2.293      0.022      -0.943      -0.074
ma.L1         -0.9877      0.351     -2.811      0.005      -1.676      -0.299
ma.L2          0.4711      0.361      1.305      0.192      -0.236       1.178
sigma2       361.9825     79.307      4.564      0.000     206.544     517.421
===================================================================================
Ljung-Box (L1) (Q):                   0.02   Jarque-Bera (JB):                81.25
Prob(Q):                              0.88   Prob(JB):                         0.00
Heteroskedasticity (H):               6.85   Skew:                             1.42
Prob(H) (two-sided):                  0.00   Kurtosis:                         8.06
===================================================================================
```

Figure 2: SARIMAX results

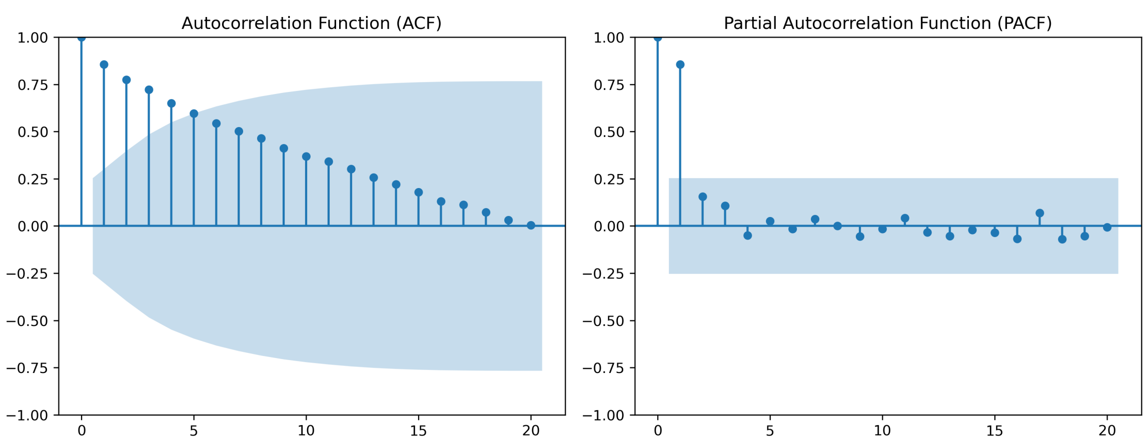

Figure 3: ACF and PACF plots for maize production series.

The forecast values of maize production for the next five years are shown in table 1 below and results are also shown graphically in figure 4 where red curve shows the forecast values. The best fit model and historical data for maize production are shown graphically in figure 5.

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Table 1: Forecast of maize production (2026–2030) using ARIMA(2,2,2)

Year	Forecast Production	Lower CI	Upper CI
2026	549.93	512.64	587.22
2027	589.49	542.68	636.31
2028	678.69	623.28	734.11
2029	734.71	658.78	810.63
2030	773.89	674.84	872.93

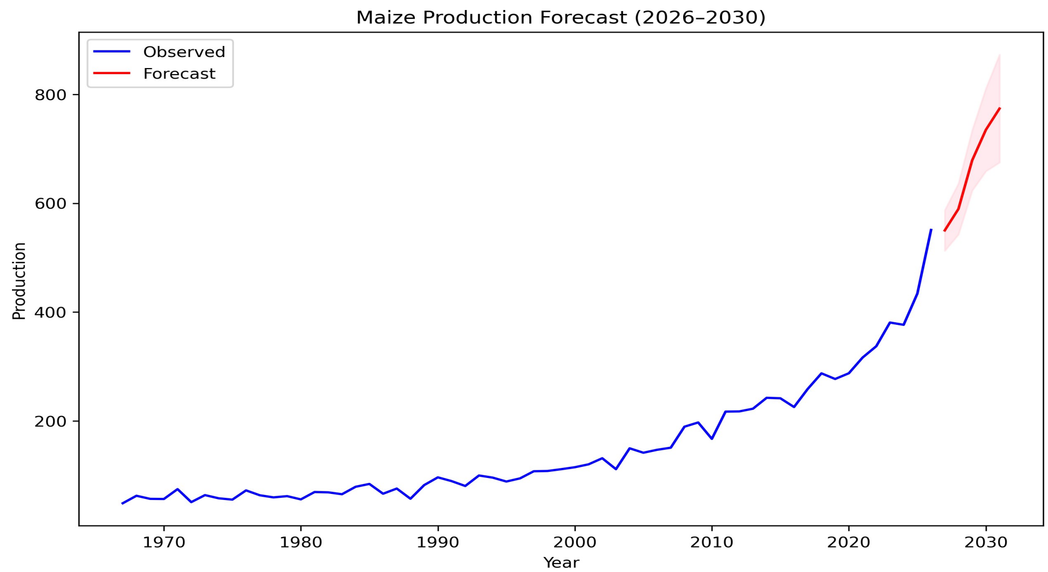

Figure 4: Forecast of maize production (2026–2030) using ARIMA(2,2,2).

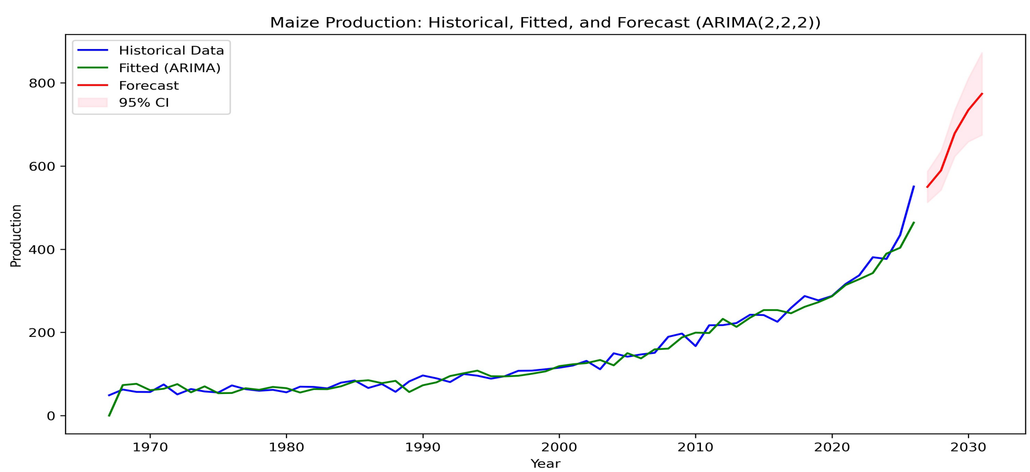

Figure 5: Historical maize production with ARIMA(2,2,2) fitted values and forecasts (1966–2030).

Conclusion

The study found ARIMA (2,2,2) as the best model for forecasting maize production. The maize production is expected to increase to about 774 lakh tonnes (combining production across all seasons not just kharif season) in 5 years from 550.93 lakh tonnes in 2025-26. This amounts to around 7% average annual growth rate. The forecast of steady increase in production of maize has policy implications for the government to increase investment in storage and crop drying infrastructure.

References

- Kumar, Manish, and Shiv Kumar Rana. 2025. "Data Driven Approach for Modeling and Forecasting of Maize Yield in India." In Agricultural Sciences: Techniques and Innovations, Vol. 4, 171–180. B P International.https://doi.org/10.9734/bpi/asti/v4/6379
- Kapngaihlian, Jenny, T. Arivelarasan, and Yendrembam Latika Devi. 2018. "Time Series Modeling for Forecasting of Maize Production and Prices in India." Research Journal of Agricultural Sciences 9 (1): 132–136.
- Sharma, Pawan Kumar, Sudhakar Dwivedi, Lyaqat Ali, and R. K. Arora. 2018. "Forecasting Maize Production in India Using ARIMA Model." Agro Economist – An International Journal 5 (1): 1–6.
- Bansal, Surbhi, Shruti Mohapatra, Namami Gohain, and Arghyadeep Das. 2022. "Production Status, Market Integration and the Law of One Price: An Exploration of the Major Maize Markets of India." Indian Journal of Economics and Development 18 (4): 832–841. https://doi.org/10.35716/IJED/22054
- Kumar, Bhupender, Kiran T. M. Kumara, Shankar Lal Jat, and Hanuman Sahay Jat. 2025. Economic Impacts of Maize Hybrids. Policy Brief No. 70. New Delhi: ICAR–National Institute of Agricultural Economics and Policy Research.
- Sandhu, S., G. S. Kocher, and A. S. Dhatt. 2024. "Ethanol from Maize: A Stride Towards Crop Diversification Strategy of Punjab State." Agricultural Research Journal 61 (2): 318–321. https://doi.org/10.5958/2395-146X.2024.00041.8