DRF-573
[1-6]

RESEARCH ARTICLE Asian Journal of Dairy and Food Research

Forecast Analysis of Corn and Cassava Production in North Sumatra Province, Indonesia

Rahmanta[1], Siti Khadijah Hidayati Nasution[1], Edi Warsito[2]

10.18805/ajdfr.DRF-573

ABSTRACT

Background: Fluctuations in food production, namely corn and cassava, from year to year tend to change, making food production forecasting quite important. Production movements greatly affect other sectors, so a method is needed to forecast future food production. The purpose of this study is to examine North Sumatra Province's food production predictions.

Methods: The Central Statistics Agency and the Food Crops and Horticulture Agency provided the secondary data used in this study, which covered the years 1996-2022. Using the Eviews 13 program, the data analysis technique applies the ARIMA (Autoregressive Integrated Moving Average) method.

Result: The results of the study indicate that in Langkat Regency, the best model for forecasting corn production is the ARIMA (1,1,0) model, with corn production experiencing moderate growth over the next decade, while the best model for forecasting cassava production is the ARIMA (2,1,2) model, with cassava production also experiencing growth. In Tapanuli Utara District, the best model for forecasting corn production is the ARIMA (2,1,2) model, with corn production expected to increase in the future. Meanwhile, the best model for forecasting cassava production is the ARIMA (2,1,1) model, with cassava production showing a slight decrease.

Key words: ARIMA, Cassava, Corn, Forecasting, Production.

INTRODUCTION

Agribusiness is a system of interconnected businesses or enterprises, ranging from the provision of agricultural production inputs, farming, post-harvest activities and various businesses that deliver agricultural products to consumers, as well as a number of supporting activities that serve this interconnected system of businesses (Krisnamurthi, 2020). Food is a primary need of citizens that should be met and as the population grows, the need for food in terms of both quality and quantity must increase. North Sumatra is one of the regions with food security that is still unstable. Food security is a crucial factor in developing a region, especially in developing regions or countries, because it has two important roles, making it the main objective in developing a region's economy. The first role involves ensuring that food is available to all members of society in relatively good quality for their daily lives, health and productivity. The second role involves ensuring that food security is essential for the development of creative and productive talent, which is the main determinant of scientific discoveries, technology and productivity in the fields of employment and nutrition (Perdana, 2022).

Local food is food that has been produced, developed and consumed for a long time in a particular region or by a particular local community. Using local food can support the local economy by reducing dependence on imported food and increasing demand for local products. Supporting local agriculture positively impacts food security by diversifying food sources and building a resilient food system. It also contributes to environmental sustainability through sustainable agricultural practices and reduces carbon footprints.

Food is still in high demand due to population growth in North Sumatra. Food productivity is influenced by harvest area and food commodity production volume. The trend of converting agricultural land to non-agricultural use has triggered efforts to increase agricultural productivity as a strategy to boost food commodity production capacity.

Food crops include corn and cassava, where corn is one of the most important food crops grown and consumed as a primary source of calories by humans (Sinha, 2023). Cassava, on the other hand, has a skin that accounts for approximately 10-13% of the tuber's weight, with a protein content of around 46 to 55 g/kg. Cassava peel contains crude protein, ether extract, ash, nitrogen-free extract and metabolizable energy. Cassava leaves are rich in protein

[1]Faculty of Agriculture, Universitas Sumatera Utara, Medan, Indonesia.
[2]Office of Food Security, Food Crops and Horticulture of North Sumatra Province, Indonesia.

Corresponding Author: Rahmanta, Faculty of Agriculture, Universitas Sumatera Utara, Medan, Indonesia.
Email: rahmanta@usu.ac.id
ORCID: https://orcid.org/0000-0002-0661-907X

How to cite this article: Rahmanta, Nasution, S.K.H. and Warsito, E. (2025). Forecast Analysis of Corn and Cassava Production in North Sumatra Province, Indonesia. *Asian Journal of Dairy and Food Research.* **1-6.** doi: 10.18805/ajdfr.DRF-573.

Submitted: 12-07-2025 **Accepted:** 31-07-2025 **Online:** 26-08-2025

Table 1: ARIMA model for corn production in langkat regency.

Model	AIC	SBC	SSE	Adjusted R squared	Var significant
(2,1,2)	0.166269	0.454233	1.039208	0.887492	Not significant
(2,1,0)	0.054324	0.246300	1.127635	0.888534	Not significant
(1,1,1)	0.054394	0.246369	1.127656	0.888532	Not significant
(1,1,0)	-0.019474	0.124507	1.127709	0.893172	Significant

Table 2: Corn production forecasting with ARIMA (1, 1, 0) in langkat regency.

Year	Corn production (Ton)
2023	37.364.98
2024	37.827.78
2025	38.278.36
2026	38.716.85
2027	39.143.38
2028	39.558.10
2029	39.961.17
2030	40.352.76
2031	41.102.26
2032	41.102.26
2033	41.460.55

(16.6% to 39.9%), a good source of vitamins B, C and carotene (Williams, 2023).

Corn production in North Sumatra varies, but in 2024, corn production reached 1,948,641 tons with a productivity of 6.24 tons per hectare. Corn consumption in North Sumatra is around 1.4 million to 1.5 million tons per year. Most of it is used for animal feed and flour raw materials. Meanwhile, the average cassava production in North Sumatra in 2024 reached 1,070,530 tons from a harvested area of 25,966 hectares. Cassava is an important food commodity in the region and has significant potential for food diversification. Residents of North Sumatra, particularly in rural areas, consume cassava as a source of carbohydrates and energy (Central Statistics Agency, 2025).

Time series data is typically used for forecasting. Data that is arranged according to time is called a time series. A sequence of observations of a variable made throughout time and sequentially recorded over time is called a time series (Lestari, 2020). Forecasting is a useful science for predicting or estimating and as a basis for planning, monitoring and decision-making regarding what will happen in the future in a systematic and pragmatic manner based on known values from past data. Forecasting that uses data obtained over a specific period of time in sequential form, whether annually, monthly, weekly, or daily and hourly, is referred to as time series forecasting (Nasirudin *et al*., 2023; Laia *et al*., 2019). The primary objective of time series forecasting is to carefully analyze and process past values to develop a forecasting model that facilitates prediction, monitoring, or control of future values. One method of time series forecasting is the ARIMA (Autoregressive Integrated Moving Average) method (Murat *et al*., 2018; Fattah *et al*., 2018; Padit *et al*., 2024).

To reduce the impact of fluctuations in corn and cassava production, it is necessary to predict or forecast corn and cassava production. By knowing the estimated corn and cassava production for the next period, stakeholders can choose and determine the appropriate planning to formulate policies, make decisions and anticipate any adverse effects that may occur (Al-Qarazi *et al*., 2021; Darnila *et al*., 2023). Forecasting corn and cassava production provides information on estimated future corn and cassava production based on data from previous periods.

The Autoregressive Integrated Moving Average (ARIMA) approach is one forecasting technique that can be used to predict the production of maize and cassava. In the short run, the ARIMA model, sometimes referred to as the ARIMA approach, can give a summary of specific future values (Oktiani, 2020; Shankar, 2023). Based on the above description, the purpose of this study is to forecast corn and cassava production in North Sumatra using the ARIMA model. The forecasts generated through the model are expected to serve as a basis for planning, policy and decision-making by various parties involved, both directly and indirectly, in the production of corn and cassava. Based on the background described above, the research question can be formulated as follows: How will the production of local food commodities, namely corn and cassava, develop in North Sumatra, Indonesia.

MATERIALS AND METHODS

Research area determination method

The study was carried out in North Sumatra, which is situated between 98° and 100° East Longitude and 1° and 4° North Latitude. The northern region of Sumatra Island, Indonesia, is home to North Sumatra, one of the major hubs for food production. This study was carried out in 2024.

Data analysis method

The research sample was selected purposively, namely districts that are believed to have potential in the development of local food sources, namely corn and cassava, which are characterized by the fulfillment of agroclimatic conditions for the cultivation of these commodities, the availability of land area and local government policies for the development of these commodities. Secondary data that is, data that has previously been gathered can be gathered from pertinent organisations like the Agriculture Department, the District Central Statistics Agency and the Central Statistics Agency

Table 3: ARIMA model for cassava production in langkat regency.

Model	AIC	SBC	SSE	Adjusted R squared	Var significant
(2,1,2)	1.696682	1.984646	3.786300	0.613952	Significant
(2,1,1)	1.814707	2.054677	5.935034	0.422376	Not significant
(1,1,1)	1.879584	2.071560	7.400482	0.311067	Not significant
(1,1,0)	1.836422	1.980404	7.741101	0.309384	Not significant

Table 4: Cassava production forecasting with ARIMA (2, 1, 2) in langkat regency.

Year	Cassava production (Ton)
2023	6.189.71
2024	6.808.90
2025	8.002.34
2026	9.861.34
2027	12.224.86
2028	15.687.25
2029	19.261.00
2030	22.552.75
2031	24.789.60
2032	25.359.51
2033	24.125.98

of North Sumatra Province in order to support this study (Central Statistics Agency, 2025).

Model analysis data

Production and productivity forecasts for food crops were conducted in two sample districts over a ten-year period, namely Langkat District and North Tapanuli District. Production forecasting was conducted based on time series data of local food production. The method used was the ARIMA method. Forecasting methods are methods that use data obtained in the past to estimate future values (Wardah and Iskandar, 2016). The analysis method used for production forecasting in North Sumatra is the ARIMA (Autogressive Integrated Moving Average) method. The steps applied in analyzing the data are as follows: (a) Identifying the stationarity of the data in variance and mean, (b) Creating ACF and PACF graphs from the stationary data, (c) Estimate the ARIMA model to be used by examining the ACF and PACF graphs, (d) Calculate the ARIMA model's parameters p, d and q. (e) Perform diagnostic checks on the obtained model, (f) Select the best model and perform forecasting. In summary, the mathematical procedure for forming ARIMA is as follows:

a) Diagnostic test

After performing the estimation and obtaining the parameter estimates, in order for the provisional model to be used for forecasting, it is necessary to test the feasibility of the model. This stage is called diagnostic checking, where the model specifications are tested to determine whether they are correct or not.

Forecasting error testing is used by comparing the forecast results with actual data. The Schwarz Bayesian Criterion value (SBC), Akaike Info Criterion (AIC) value, Sum Squared Residual (SSE), and Adjusted R Squared are used to show that the forecasting method used is valid or has a small error. The equation formula is as follows:

$$SBC = -2 * \ln(L) + k * \ln(n)$$

Where,
L: Maximum likelihood value of the model.
n: Number of observations (sample size).
k: Number of parameters estimated in the model.

$$AIC = -2 \times \text{log-likelihood} + 2 \times \text{number of parameters}$$

$$SSE = \Sigma (y_i - \hat{y}_i)^2$$

Where,
y_i: Actual Y value.
$\hat{y}_i$: Predicted Y value from the model.

$$\text{Adjusted R squared} = 1 - (1 - \text{R-squared}) * (n - 1)/(n - p - 1)$$

Where,
n: Number of observations.
p: Number of predictors in the model.

b) Prediction/forecasting

The final stage of the time series process is prediction or forecasting from the model that is considered most appropriate and can predict for several periods ahead.

$$Y_t = \alpha + A_1 Y_{t-1} + A_2 Y_{t-2} + + A_p Y_{t-p} + e_t$$

RESULTS AND DISCUSSION

Corn production forecast results in langkat regency

To select the best forecasting model, there are four criteria that will be considered, as follows:
a) A small Schwarz Bayesian Criterion (SBC) value.
b) A small Akaike Info Criterion (AIC) value.
c) A small Sum Squared Residuals (SSE) value.
d) A large Adjusted R Squared value.

The results of the ARIMA forecasting model for corn production in Langkat Regency are presented in Table 1. Table 1 shows that the ARIMA (1,0,0) model is the best ARIMA model with a small Schwarz Bayesian Criterion value, a small Akaike Info Criterion (AIC) value, a small Sum Squared Residuals (SSE) value and a large Adjusted R Squared value for forecasting corn production in Langkat Regency, North Sumatra. Furthermore, corn production forecasting in Langkat Regency is shown in Table 2.

Table 5: ARIMA model for corn production in North Tapanuli regency.

Model	AIC	SBC	SSE	Adjusted R squared	Var significant
(1,1,0)	1.209573	1.353555	3.952778	0.796725	Significant
(0,1,1)	1.99879	2.142780	8.996857	0.537330	Not significant
(0,1,2)	1.563719	1.755695	4.482369	0.759469	Not significant
(2,1,2)	1.390536	1.678500	3.788919	0.777316	Significant

Table 6: Corn production forecasting with ARIMA (2, 1, 2) in North Tapanuli regency.

Year	Corn production (Ton)
2023	28.260.61
2024	28.408.50
2025	28.545.74
2026	28.673.05
2027	28.791.10
2028	28.900.53
2029	29.001.94
2030	29.095.89
2031	29.182.90
2032	29.263.47
2033	29.338.06

Table 2 shows that corn production forecasts are expected to increase in the future. The increase in corn production forecasts is due to several factors, including increased productivity per hectare, increased demand, attractive prices for farmers and wider use of corn as animal feed, human food and industrial raw materials. In addition, the government is also encouraging increased production through intensification and extensification, including land expansion and the use of technology.

The results of this study are in line with the research by Yogautami *et al*. (2023), which predicts that there will still be an upward trend in corn production in the coming years, assuming an increase in planting area and crop index. This increase in production provides opportunities for businesses that use corn as a raw material for their production. Furthermore, the results of the ARIMA model for cassava production forecasting in Langkat Regency are shown in Table 3.

The ARIMA (2,1,2) model is the most effective ARIMA model, as Table 3 demonstrates with a small Schwarz Bayesian Criterion value, a small Akaike Info Criterion (AIC) value, a small Sum Squared Residuals (SSE) value and a large Adjusted R Squared value for forecasting cassava production. Furthermore, the results of cassava production forecasting in Langkat Regency are shown in Table 4.

Table 4 shows that cassava production is expected to increase moderately over the next decade. This increase could be due to higher productivity per hectare or an increase in land area, although there will be a slight downward trend in 2033. Cassava production can fluctuate due to various factors, including climate change, pest and disease attacks and inefficient land and labor use. Additionally, economic factors such as selling prices and production costs also influence farmers' decisions to grow cassava. Government policies supporting increased cassava production, such as subsidies for seeds and fertilizers, can also encourage increased cassava production.

The results of this study are in line with the research by Iswandari *et al*. (2021), which states that the linear regression method is the most appropriate method to use for forecasting cassava production in Lampung Province, with the results of cassava production forecasts continuing to increase and the results of financial feasibility analysis showing positive figures.

Corn production forecast results in north tapanuli regency

The following are the results of the ARIMA model for corn production forecasting in North Tapanuli Regency in Table 5.

The ARIMA (2,1,2) model is the most effective ARIMA model, as Table 5 demonstrates with a small Schwarz Bayesian Criterion value, a small Akaike Info Criterion (AIC) value, a small Sum Squared Residuals (SSE) value and a large Adjusted R Squared value for forecasting corn production in North Tapanuli Regency, North Sumatra. The results of corn production forecasting in North Tapanuli Regency are shown in Table 6.

Table 6 shows that corn production is expected to increase in the future. This increase could be attributed to many farmers already using high-quality seeds, resulting in higher yields. Additionally, economic factors also influence corn production, such as the availability of agricultural capital for corn farming, which enables farmers to purchase seeds, fertilizers and the necessary agricultural tools. The availability of labor can also make the harvesting process and crop maintenance more efficient, thereby influencing future increases in corn production.

The results of this study are in line with the research by Majidah *et al*. (2025), which states that the Weighted Moving Average method is used to forecast corn production in Indonesia from 2025 to 2030, which will continue to increase, thereby assisting decision-making on the management side for farmers, business actors and local governments in formulating policies to increase corn production. Next, the ARIMA model for forecasting cassava production in North Tapanuli Regency is shown in Table 7.

The ARIMA (2,1,1) model is the most effective ARIMA model, as Table 7 demonstrates with a small Schwarz Bayesian Criterion value, a small Akaike Info Criterion (AIC) value, a small Sum Squared Residuals (SSE) value and a large Adjusted R Squared value for forecasting cassava production in North Tapanuli Regency, North Sumatra. The

Table 7: ARIMA model for cassava production in North Tapanuli regency.

Model	AIC	SBC	SSE	Adjusted R squared	Var significant
(1,1,0)	1.091607	1.235589	3.654676	0.541075	Not significant
(2,1,0)	1.027128	1.219104	3.150853	0.587138	Significant
(0,1,1)	1.371883	1.515865	4.914236	0.382909	Not significant
(2,1,1)	0.997983	1.237953	2.560579	0.649232	Significant

Table 8: Cassava production forecasting with ARIMA (2, 1, 1) in North Tapanuli regency.

Year	Cassava production (Ton)
2023	33.825.89
2024	34.398.36
2025	34.688.65
2026	34.687.56
2027	34.442.73
2028	34.039.32
2029	33.575.67
2030	33.141.78
2031	32.805.15
2032	32.604.42
2033	32.549.34

results of cassava production forecasting in North Tapanuli Regency are shown in Table 8.

Table 8 shows that cassava production is expected to decline over the next decade. This decline could be due to a decrease in productivity per hectare or a reduction in the area of land used for cassava cultivation. It is estimated that many farmers still use local or low-quality seeds, resulting in lower yields. On the other hand, changes in consumption patterns could also contribute to the decline in cassava production. Changes in consumer patterns, such as an increasing preference for rice consumption due to its perceived health and nutritional benefits, could boost rice demand and consequently reduce cassava production in the future.

The results of this study are consistent with the research by Wulandari *et al*. (2025), which states that the harvest area and cassava production in West Nusa Tenggara Province from 2023 to 2028 will decline based on calculations using linear trend, double moving average and double exponential smoothing methods. This is attributed to economic factors such as high production costs, low selling prices and limited farmer access to technology, which also contribute to the anticipated decline in cassava production in the future.

CONCLUSION

The ARIMA (1,1,0) model is the most effective model for predicting maize production in Langkat Regency. Over the next ten years, maize output is expected to expand moderately, whereas the ARIMA (2,1,2) model is the most accurate model for predicting cassava production. Production of cassava will increase. The ARIMA (2,1,2) model is the most effective model for predicting maize output in North Tapanuli Regency. Future maize production is anticipated to rise, however the ARIMA (2,1,1) model is the most effective model for predicting cassava production. A small decline in cassava production is anticipated. For future corn and cassava cultivation, it is advisable to consider several things. First, use intercropping methods to maximize yields on limited land. Second, pay attention to the proper planting distance and fertilization for both crops. Third, choose superior varieties that are suitable for the environmental conditions and have high production potential.

ACKNOWLEDGEMENT

We would like to thank the Rector of Universitas Sumatera Utara for funding this study under the 2024 Government Collaboration Research scheme, which was awarded on May 30, 2024, under contract number 18589/UN5.1.R/PPM/ 2024. Furthermore, we express our gratitude to the Universitas Sumatera Utara Research Institute for its material and ethical support in carrying out this study.

Disclaimers

This article's results and opinions are those of the writers alone and do not reflect those of the organisations they are affiliated with. The authors bear responsibility for the quality and correctness of the information they present, but they disclaim all liability for any direct or indirect losses resulting from the use of this content.

Informed consent

This study is supported by accurate, trustworthy and pertinent data from the Central Statistics Agency. The Central Statistics Agency of North Sumatra and Indonesia has approved all secondary data collection techniques utilised in this study.

Conflict of interest

Regarding the publication of this work, the authors declare that they have no conflicts of interest. The study design, data collection, analysis, publication selection and article authoring were all unaffected by funding or sponsorship.

REFERENCES

Al Qarazi, M.I., Sukardi, S. and Anwar, A. (2021). Analysis of corn production, consumption and price forecasting in West Nusa Tenggara Province. *Agrimansion Journal.* **22(1):** 49-60.

Central Statistics Agency. (2025). *North Sumatra in Figures 2025*. Medan, North Sumatra.

Darnila, E., Dinata, R.K. and Ramadani, S. (2023). Prediction of food crop commodity prices in North Aceh during the Covid-19 Pandemic using Chen's Fuzzy Time Series Model. JTIK (*Kaputama Journal of Information Technology*). **7(1):** 17-26.

Fattah, J., Ezzine, L., Aman, Z., El Moussami, H. and Lachhab, A. (2018). Forecasting of Demand Using ARIMA Model. *International Journal of Engineering Business Management.* **10(1):** 1-9.

Iswandari, R. *et al.* (2021). Analysis of cassava production forecasting and financial feasibility of mocaf agroindustry in lampung province. *Pro Bisnis Journal*. **14(1):** 615-627.

Krisnamurthi, B. (2020). *Definition of Agribusiness*. Department of Agribusiness, Faculty of Economics and Management, Bogor Agricultural University, Puspa Swara Publishing House, Depok, West Java.

Laia, K. (2019). Forecasting Crude Palm Oil (CPO) Production in Riau Province Using the ARIMA (Autoregressive Integrated Moving Average) Model Approach. *Thesis,* Agribusiness Study Program, Faculty of Agriculture, Riau Islamic University, Pekanbaru.

Lestari, F. (2020). Forecasting the Exchange Rate of the Rupiah Against the US Dollar Using the ARIMA Method*. Final Project*, Faculty of Economics and Business, University of North Sumatra, Medan.

Majidah, A.S. *et al.* (2025). Implementation of Corn Production Experience 2025-2030 in Indonesia Using POM QM Application. *Journal of Sustainable Agroindustry.* **4(1):** 115-123.

Murat, M., Malinowska, I., Gos, M. and Krzyszczak, J. (2018). Forecasting Daily Meteorological Time Series Using ARIMA and Regression Models. *Int Agrophys.* **32(2):** 253-264.

Nasirudin, F. and Dzikrullah, A.A. (2023). Modeling Indonesian Chili Prices Using the Seasonal ARIMAX Method. *Journal of Statistics and Its Applications.* **7(1):** *105-115*.

Oktiani, D. (2020). Arima Modeling of International Corn Prices. *Agro Industrial Technology Magazine (TEGI).* **12(1):** 7-14.

Pandit, P. *et al.* (2024). ARIMA-genetic algorithm approach for forecasting milk production in India. *Asian Journal of Dairy and Food Research.* **43(4):** 784-789. doi: 10.18805/ajdfr.DR-1782.

Perdana, D.S. (2022). Application of the K-means clustering method for grouping food security. *Journal of Information Systems.* **3(2):** 67-76.

Shankar, S.V. *et al*. (2023). Modeling and forecasting of milk production in the western zone of Tamil Nadu. *Asian Journal of Dairy and Food Research.* **42(3):** 427-432. doi: 10.18805/ajdfr.DR-2103.

Sinha, R. (2023). An Assessment of Maize and its Value Chain in Bihar. *Asian Journal of Dairy and Food Research.* 42(2): 187-195*.* doi: 10.18805/ajdfr.DR-2062.

Wardah, S. and Iskandar. (2016). *Sales Forecasting Analysis of Packaged Banana Chips (Case Study: Arwana Food Home Industry in Tembilahan)*. Department of Industrial Engineering, Faculty of Engineering and Computer Science, Indragiri Islamic University, Tembilahan, Riau, Pekanbaru.

Williams, G.A. *et al.* (2023). Influence of Processed Cassava Peel-leaf Blend as Replacement for Maize on Growth Performance and Serum Parameters of Growing Pigs. *Asian Journal of Dairy and Food Research.* **42(2):** 161-167. doi: 10.18805/ajdfr.DRF-278.

Wulandari, B.W. *et al*. (2025). Analysis of forecasting harvest area, production and consumption of cassava in West Nusa Tenggara Province. *Thesis*, Agribusiness Study Program, Faculty of Agriculture, Mataram University, Mataram.

Yogautami *et al*. (2023). Corn production forecasting in lampung province with POM QM Aplication. *Journal of Agricultural Economics and Agribusiness*. **7(4):** 1299-1308.