Projection of rice production and consumption in Maros regency, South Sulawesi

A N Hikmah¹, L Asrul² and D Rukmana³

¹Department of Agribusiness, Graduate School Of Universitas Hasanuddin, , Jl. Perintis Kemerdekaan km 10, Makassar, South Sulawesi
²Department of Agronomy, Faculty of Agriculture, Universitas Hasanuddin, Jl. Perintis Kemerdekaan km 10, Makassar, South Sulawesi
³Social-Economy of Agriculture Study Program, Faculty of Agriculture, Universitas Hasanuddin, Jl. Perintis Kemerdekaan km 10, Makassar, South Sulawesi

E-mail : Aulianurulhikmah@gmail.com

Abstract. Rice is the main food source for most of the population in Maros regency. Maros regency is one of the rice producing district in South Sulawesi, but has experienced a very intensive conversion of agricultural land to infrastructure development compared to other regency in the province of South Sulawesi. This will lead to a decrease in production, which will have an impact on food security in the future. In addition to increasing the amount of rice production, an analysis of rice food requirements in Maros regency is also needed. Therefore, research and projection on the production and consumption of rice in Maros regency is needed in the future. With this projection, we can estimate the quantity of rice available in Maros regency. This research aims to determine the estimated quantity of rice production and consumption in Maros regency from 2019 to 2023. The data used in this research are secondary data, time series for the period 2007-2018. This research was a descriptive qualitative and quantitative research. Data processing in this research using software Minitab 17 and Microsoft Office Excel. The analysis showed that the development of production in Maros regency from 2019 to 2023 has increased every year. The forecast result showed, Maros regency has a surplus of rice in 2019 as big as 247,395 ton up to 2020 as big as 284,168 ton. While rice consumption in Maros regency in 2019 as big as 33,569 ton and 2023 as big as 32,106 ton.

1. Introduction
Rice is a staple food for most of the world population, especially in Asian Countries. The role of rice, in addition to being a staple food, is also a source of income for farmers and daily necessities for millions of residents. Although the government has sought food diversification, it has so far been unable to change the population preference for rice. Therefore, the availability of rice should be maintained, sustainability, and even increased [1-3].

South Sulawesi is a province that has an influence in the Indonesian economy, especially in economic growth. In 2017, the economic growth of South Sulawesi was 7.23 % [3]. This is inseparable from the development of the agricultural sector, especially the subsector of food crops. Agriculture is one of the main sectors of South Sulawesi province. The Ministry of Agriculture of the
Republic Indonesia has even made South Sulawesi Province the largest rice production and distribution area in eastern Indonesia, with a total production of 5.74 million tons in 2018.

One of the areas in the province of South Sulawesi that makes agriculture one of the main sectors of its economy is Maros regency. It can be seen in the contribution of the agricultural sector to the PDRB of the regency of Maros, which is 17% [4].

Demographically, the regency of Maros had a population of 331,846 people in 2013 and increased to 349,882 people in 2018. On the physical aspect, the area of paddy field in Maros regency has decreased in 2015 of 26,002 Ha to 25,952 Ha in 2017. These conditions will affect the production of rice commodities in Maros regency. Rice production in Maros regency in 2007-2018 has fluctuated. The highest rice productivity achieved in 2014, was 71 quintals / Ha. In 2015-2016 rice productivity has decreased, which had an impact on the decline of rice production in Maros regency. In 2017, production increased significantly as big as 372,950 quintals/Ha and in 2018, rice production further decreased as big as 345 quintals/Ha. Increase and decrease in production can occur due to changes in harvested area and productivity. An effort that can be made to anticipate this is an analysis projected of rice production in Maros regency in the future. The research was conducted considering that Maros regency is one of the rice producing areas of South Sulawesi province, but has experienced a very intensive conversion of agricultural land due to the development of infrastructure compared to other regencies of South Sulawesi province.

2. Research methods

This research was conducted in Maros regency, South Sulawesi province based on purposive method. The data used in this study are secondary data. Secondary data was collected through desk study from BPS, Department/Institution, Research Institutes and scientific publications such as books, journals, dissertations, and research reports. The analytical method used the forecasting analysis technique with the Box Jenkins ARIMA model. The ARIMA method makes full use of past and present data to produce accurate forecasting. The ARIMA method will work good if the time series data used depend or statistically related to each other [3]. In addition, the forecasting rice production figures in Maros regency for 2019-2023 can also be obtained using the formulas in equations (1), (2) and (3).

2.1. Process autoregressive (P,0,0)

\[ X_t = \mu' + \phi_1 X_{t-1} + \phi_2 X_{t-2} + ... + \phi_p X_{t-p} + \epsilon_t \] .................................(1)

2.2. Process moving average (0,0,q)

\[ X_t = \mu' + \epsilon_t - \theta_1 \epsilon_{t-1} - \theta_2 \epsilon_{t-2} - ... - \theta_q \epsilon_{t-k} \] .................................(2)

2.3. Process autoregressive dan moving average, (p,0,q) atau (p,d,q)

---

**Picture 1.** Box-Jenkins forecasting scheme (ARIMA).
\[ X_t = \mu' + \phi_1 X_{t-1} + \ldots + \phi_p X_{t-p} + \epsilon_t - \theta_1 \epsilon_{t-1} - \ldots - \theta_q \epsilon_{t-k} \] 

\( (3) \)

3. Results and discussion

3.1. Results of rice production and consumption projection in Maros regency

The projection of rice production and consumption in Maros regency is obtained by the ARIMA method, in which the model obtained meets the best requirements of the model. The Arima model is considered good if it meets the several criteria such as: (a) The model chosen is the simplest model, which has the smallest number of parameters, (b) P-value less than 0.05 (real level) in the final estimate from parameters, (c) the coefficients of AR and MA are less than 1, (d) there is a statement of relative change in each estimate less than 0.0010, (e) and has the smallest MSE value [5]. The tool used to make model projections ARIMA is using the Minitab 17 software. The data used in this analysis are time series with observation periods from 2007 to 2018.

Table 1. Development of rice production and consumption in Maros regency 2007-2018.

| Year | Production of rice (Ton) | Consumption of rice (Ton) |
|------|--------------------------|---------------------------|
| 2007 | 148,334.30               | 27,170.86                 |
| 2008 | 126,324.48               | 28,788.07                 |
| 2009 | 164,763.40               | 28,745.63                 |
| 2010 | 184,314.44               | 29,200.17                 |
| 2011 | 183,606.73               | 28,364.97                 |
| 2012 | 206,471.69               | 28,302.08                 |
| 2013 | 198,787.30               | 34,724.37                 |
| 2014 | 230,092.05               | 33,993.19                 |
| 2015 | 220,323.43               | 34,429.45                 |
| 2016 | 196,986.03               | 31,037.03                 |
| 2017 | 233,988.83               | 34,084.09                 |
| 2018 | 220,316.19               | 31,993.21                 |

Source : [4].

3.1.1. Projection of rice production in Maros regency. Based on data processing using the ARIMA method, the best model for rice production in Maros Regency is ARIMA (0,1,1). The results of the data processing indicate that the model has met the requirements and best model criteria in the ARIMA method. The equation of the ARIMA function (0,1,1) for the projection of rice production in Maros regency is as follows:

\( (Y_t - Y_{t-1}) = 9193,4 + 1,2960 (\epsilon_{t-1} - \epsilon_{t-2}) + \epsilon_t. \)

Based on the equation of the ARIMA function for rice production in the Maros regency (0,1,1), it shows that rice production from 2019 to 2023 will grow positively. The average growth of rice production in Maros regency from 2019 to 2023 is 3.53%.

Table 2. Projection of rice production in Maros regency 2019-2023.

| Year | Projection results | Growth (%) |
|------|--------------------|------------|
|      | Production (Ton)   |            |
| 2019 | 247,395            | 0          |
| 2020 | 256,588            | 3.72       |
| 2021 | 265,781            | 3.58       |
| 2022 | 274,975            | 3.46       |
| 2023 | 284,168            | 3.34       |
| Average | 265,781          | 3.53       |
3.1.2. *Projection of rice consumption in Maros regency.* Based on data processing using the ARIMA method, the best model for rice consumption in Maros Regency is ARIMA (1,2,0). The results of the data processing indicate that the model has met the requirements and best model criteria in the ARIMA method. The equation of the ARIMA function (1,2,0) for the projection of rice consumption in Maros regency is as follows:

\[
(Y_t - Y_{t-1}) = -154 - 0.7436 (Y_{t-1} - Y_{t-2}) + \epsilon_t.
\]

The results of rice consumption projections in Maros regency through the ARIMA model (1,2,0), shows that rice consumption from 2019 to 2023 will experience negative growth with an average growth of -1.078%.

| Year | Projection results |  
|------|--------------------|
|      | Consumption (Ton)  | Growth (%)  |
| 2019 | 33,569             | 0           |
| 2020 | 32,264             | -3.888      |
| 2021 | 32,946             | 2.116       |
| 2022 | 31,997             | -2.882      |
| 2023 | 32,106             | 0.343       |
| Average | 32,576        | -1.078      |

3.1.3. *Analysis of projection results of rice production and consumption in Maros regency.* The results of the ARIMA model show that rice production in Maros regency from 2019 to 2023 will increase every year. Rice production in Maros regency until 2023 will continue to meet the consumption needs of the population in Maros regency. This is seen because the consumption line is below the rice production line.

![Projection of rice production and consumption 2019-2023.](image)

**Picture 2.** Projection of rice production and consumption 2019-2023.

Projection of rice consumption in Maros regency show that data have a fluctuating trend. Increases and decreases in rice consumption can be caused by a various of factors including population, income per capita, and the price of rice. Income influences the purchasing power of the population, while the population influences the quantity of rice consumed. Price is one factor that influences the amount of consumption an item. In normal goods, the higher price of an item, the lower consumption of the community. When prices rise, people tend not to reduce their consumption of rice, because rice is a
basic requirement in daily life. The existence of these three factors will affect rice consumption in Maros regency.

4. Conclusion
Based on the results of projections of rice production and consumption in Maros regency from 2019 to 2023, which were conducted using the ARIMA method, it can be concluded that rice production will increase every year and continue to meet the needs of society rice consumption in Maros regency. The consumption of rice in the regency of Maros fluctuates every year.

References
[1] Badan Ketahanan Pangan 2014 *Pedoman Sistem Ketahanan Pangan dan Gizi Tingkat Kabupaten/Kota* (Jakarta: Kementerian Pertanian)
[2] Mardianto M F F, Tjahjono E and Rifada M 2019 Statistical Modelling For Prediction Of Rice Production In Indonesia Using Semiparametric Regression Based On Three Forms Of Fourier Series Estimator *ARPN J. Eng. Appl. Sci.* 14 2763–70
[3] Haryanto T, Talib B A and Salleh N H M 2016 Technical Efficiency and Technology Gap in Indonesian Rice Farming *Agris On-line Pap. Econ. Informatics* 8 29–38
[4] BPS 2017 *Statistik daerah Provinsi Sulawesi Selatan* (Makassar: Badan Pusat Statistik Sulawesi Selatan)
[5] BPS 2018 *Kabupaten Maros dalam Angka Tahun 2018* (Maros: Badan Pusat Statistik Kabupaten Maros)
[6] Zhang G 2003 Time series forecasting using a hybrid ARIMA and neural network model *J. Neurocomputing* 50 159–75
[7] Firdaus M 2011 *Aplikasi Ekonometrika Untuk Data Panel dan Data Time Series* (Bogor: IPB Press)