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FORECASTING ANALYSIS OF RICE AVAILABILITY AND DEMAND IN LAMPUNG PROVINCE

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ABSTRACT

Lampung Province's population is growing yearly at an average rate of 1.10%. The need for rice in the province of Lampung will continue to increase as the population increases. However, the increase in rice production needs to be balanced with the population growth rate. This study aims to describe the availability and needs of rice in Lampung Province and project the availability and needs of rice in Lampung Province. The method used in this research is descriptive quantitative with a secondary data analysis approach using time series data from 2002 – 2022. The data analysis method used is descriptive quantitative and forecasting using ARIMA. The results showed that the availability and needs in Lampung Province over the past 20 years have always experienced a surplus. The increase in the amount of rice was achieved through the programs launched by the Ministry of Agriculture, including the UPSUS program and the Farmers Success Card. Rice availability and demand in Lampung Province will increase from 2022 - 2032. The results of the forecast of rice availability in Lampung Province increased significantly, where in 2022, it was 1,967,866.72 tons, and in 2032, it could reach 2,075,982.18 tons. Lampung Province's rice demand is predicted to increase significantly, where in 2022, it was 1,005,054.35 tons to 1,314,276.61 in 2032.

Keywords: *demand, availability, secondary data, forecasting*

BACKGROUND

Food grains are an absolute necessity for human survival. Its availability must be accompanied by affordable pricing and acceptable quality. One of the staple foods in Indonesia is rice. Rice as the main crop in rice production makes it very important in meeting the food needs of the population. The main factor in the availability of rice is the production of grain (Abdullah et al., 2021). Lampung is one of the rice production centers outside Java. In 2021, Lampung Province's rice contribution reached 2.49 million tons of GKG or 4.56% (Central Bureau of Statistics of Lampung Province, 2021), which ranks seventh in Indonesia and ranks fourth as a rice production center outside Java. But, according to the data of the Central Bureau of Statistics (2020), the variance in the rate of development of the production of pepper crops from 2016 to 2019 in the Province of Lampung decreased by an average of 24.35% per year.

In addition to rice paddy production, the available land area affects the potential of rice paddy production in Lampung Province. The increase and decrease of rice paddy land area in Lampung Province is in line with rice paddy production. The drastic reduction in rice paddy production and rice harvest area from 2017 to 2018 was caused by changes in the methodology of calculating rice harvest area through the application of objective measurement known as the Area Sample Framework (ASF) method (Directorate General of Food and Crops, 2020). ice productivity

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is one of the critical indicators to evaluate the efficiency of rice production. In Figure 1, the highest rice productivity in Lampung Province occurred in 2015, with 5.15 tons per hectare. The highest rice productivity occurred in 2015 because the Ministry of Agriculture implemented a policy known as Special Efforts (UPSUS) to Increase Production, Corn and Soybean, one of which focuses on efforts to increase rice production. According to Khodijah et al (2022), the Special Efforts (UPSUS) to Increase the Production of corn and Soybeans have increased production yields and productive rice land. Implementing appropriate technology packages specifically for technology application and development, the GP3K movement to increase business-based food production, food crop protection against pests and disturbances, reducing yield loss, and increasing rice yield are all activities that can encourage increased rice productivity (Zainul et al, 2021).

Figure 1. Rice Productivity of Lampung Province 2010-2022
Source: Lampung Province Central Bureau of Statistics (2023)

Consumer needs will vary from one consumer to another. This difference in rice needs is influenced by several factors, including income, consumer taste, rice quality, and price (Yusuf et al., 2018). According to Aji & Widodo (2010) the rice consumer segment differs between upper, middle, and lower-income consumers. However, about 60% of the population prefers cheap low to moderate-quality rice, while the remaining 40% prefer good-quality rice. In order to fulfill the total demand for rice consumption, the availability of rice must be considered so that there is no shortage in its production. In the last 20 years, Lampung province has been a significant increase in population growth from 6.77 million people in 2001 to 9.08 million people in 2021 (Central Bureau of Statistics, 2022). However, grain productivity in Lampung Province continues to decline to reach 4.86 tonnes/ha by 2022 (BPS, 2023).

Rice demand is defined as the amount of rice that individuals are willing and able to buy at various prices across time. Price, consumer income, commodity prices, customer tastes, population, and other factors all influence rice demand (Kassali et al, 2010). The population of Lampung Province increased every year with an average increase rate of 1.10% each year. The amount of rice consumed by households can describe household-level rice demand (Aido et al., 2021). However, as the population growth in Lampung increases, its rice productivity continues to decline yearly. If this problem is addressed after some time, in the next few years, Lampung will likely experience a shortage of food availability, especially rice. The level of adequacy in providing food needs is fundamental in improving the welfare of Lampung residents. The need for rice consumption will be

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refined later if the availability of rice can meet the rice consumption of Lampung residents. Furthermore, anticipating food crop output is critical to assisting government programs in addressing food difficulties, particularly rice (Rianti et al., 2023). Due to changes in production capacity between regions and seasons, the rice distribution process from the point of production (farmers in rice producing/surplus areas) to the point of consumption (end consumers) is supposed to be able to balance rice demand. Rice demand must be suspended due to differences in production capacity between locations and seasons. Rice-producing regions are likely to assist rice-producing regions (Lubis et al., 2022).

By considering the above problems, it is necessary to balance the availability of rice with the need for rice in Lampung Province as well as forecast the rice available and needed in the future, the objectives of this study are to describe the availability and need for rice in Lampung Province from 2002-2021, and project the availability and need for rice in Lampung Province in 2022-2032. It can be used as a reference for further research and as a consideration for the government's policies regarding food security in Lampung Province.

RESEARCH METHODS

The research method used a quantitative descriptive research method with a secondary data analysis approach that takes the research area, namely in Lampung Province for the period 2002-2021 on an annual time-series basis. The secondary data used comes from the Central Bureau of Statistics, the Ministry of Agriculture, and other related institutions. The data used include rice production, population, and national rice consumption in Lampung Province from 2002-2021. The analytical tools used include Microsoft Excel 2010 to analyze the first objective and E-Views 12 to analyze the second objective.

First Objective Analysis

According to Food Security Agency (2021), rice availability can be calculated through the formula attached to the technical guidelines for preparing food security statistics as follows:

$$R_{net} = (P \times (1-S+F+W+I)) \times C$$

Information:

R_{net} : Net rice production (tons per year)
P : Dried Milled Grain (GKG) rice output (tons per year)
S : Seed (0.9%)
F : Feed (0.44%)
W : Scattered (4.92%)
I : Industrial Materials (0.56%)
C : Conversion of paddy to rice (64.02%)

Net rice production is assumed to be rice availability. The 0.9% figure is the seed provision figure, the 0.44% figure is the feed provision figure, the 4.92% figure is the scattered provision figure, and the 0.56% figure is the industrial material provision figure. The 64.02% figure is the conversion rate of milled dry grain to rice, which means that every 100 tons of GKG will produce 64.02 tons of rice (Central Bureau of Statistics of Lampung Province, 2021). The analysis of rice

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demand is carried out by processing statistical data in the form of population and conversion of rice consumption needs of the population in Indonesia per month, the value of which differs depending on the standards of each year. The equation used is as follows:

$$KB = (\text{Total Population} \times C)/1000$$

Information:
KB : Rice demand (tons)
JP : Total population of Lampung province (people)
C : Rice consumption in each year (kg/capita/year)

The per capita consumption value is obtained from the National Socio-Economic Survey (2021) with different total consumption each year. The results of the calculation using the rice supply and demand equation are then subtracted, so that the category of rice surplus or deficit areas will be known.

Rice Supply > Rice Demand : Surplus of Rice
Rice Supply < Rice Demand : Deficit of Rice

Second Objective Analysis

Based on Waeto et al., (2017), The Box-Jenkins model combines autoregressive (AR), moving average (MA), autoregressive moving average (ARMA), and autoregressive integrated moving average (ARIMA). For stationary time series data, AR, MA, and ARMA models are utilized, whereas ARIMA models are used for non-stationary time series data. Time series data is not stationary and must be differentiated to become so. In this research, the data analysis method used is Autoregressive Integrated Moving Average (ARIMA) using time series with the help of Eviews 12 software. Data projection and analysis were carried out for the period 2022 - 2032. Rice availability and demand were projected using the ARIMA approach till 2032. The Box-Jenkins model is commonly written as ARIMA (p,d,q), where p represents the order/degree of Autoregressive (AR), d represents the order/degree of Differencing, and q represents the order/degree of Moving Average (MA) (Sugiarto & Harijono, 2000).

RESULT AND DISCUSSION

Balance Analysis of Rice Availability and Needs

Rice availability is an important aspect in the development of national food security, so its availability needs to be considered. The availability of rice cannot be separated from the milled dry grain produced. The greater the production of milled dry grain, the greater the availability of rice. The analysis of rice availability was conducted by calculating the net production of rice in Lampung Province over the last 20 years.

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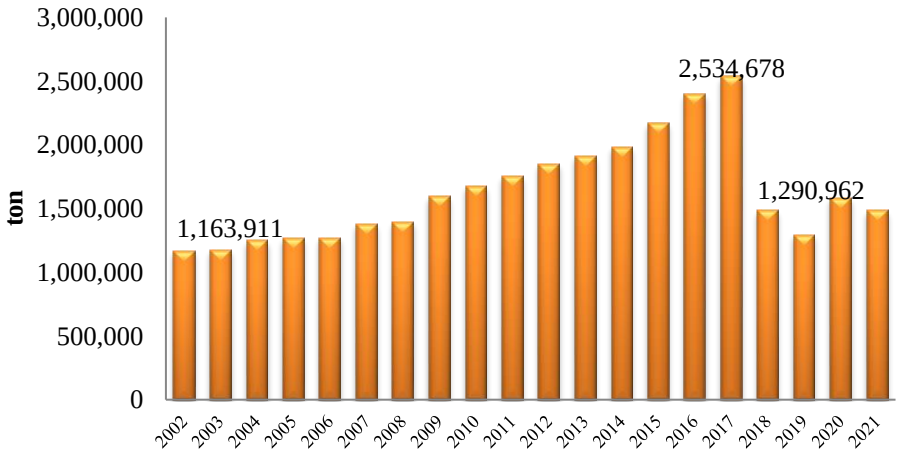

Figure 2. Graph of Rice Availability in Lampung Province 2002-2021

Figure 2 shows that rice availability rose considerably between 2002 and 2017. However, in 2018 it decreased drastically due to changes in the calculation method used from previously using the agricultural survey method to the ASF (Area Sample Framework) method (Ministry of Agriculture, 2021). The highest rice availability occurred in 2017 at 2,534,678 tons per year, while the lowest rice availability occurred in 2002 at 1,163,911 tons per year. The availability of rice has increased to the highest point in 2017 with the Special Effort Program for Increasing Production, Corn, and Soybeans and the program to Increase Production, Productivity, and Quality of Food Crop Products until finally rice production in Lampung Province is at its highest point. Rice output must be maintained in order to balance the social and economic sectors. As a result, ensuring sustainable rice production in the country is critical (Rahim et al, 2017).

Rice demand is one of the important aspects to measure how much rice is needed to meet the consumption needs of the population according to the existing population. The calculation of rice demand is done using the national rice per capita consumption approach multiplied by the total population. The coverage of consumption data is consumption in the form of rice and rice-based processed foods in households. In order to obtain total rice consumption figures, rice-based processed foods are converted to the original form of rice with a conversion factor Analysis of rice demand over the past 20 years can be seen in Figure 3.

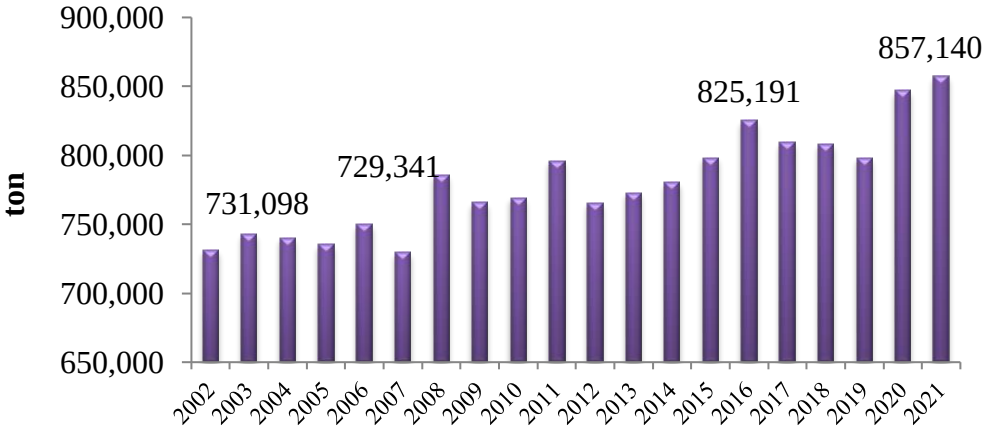

Figure 3. Graph of Rice Demand in Lampung Province 2002-2021

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From the graph in Figure 3, it can be seen that the need for rice in Lampung Province fluctuates, the highest rice demand occurred in 2021 with a value of 857,140 tons per year. The lowest rice demand occurred in 2007 with a value of 729,341 tons per year. According to the agriculture ministry (2021), fluctuations in rice demand data are produced by an increase in population, which coincides with a drop in the annual growth rate of rice consumption per capita. The balance of the rice balance can be seen from the balance of the availability and needs of rice in Lampung Province. If the availability of rice is greater than the need for rice consumption, the region is said to be a rice surplus, while if the availability of rice is less than the need for rice consumption, the region is said to be a rice deficit (Isnawati, 2022). The surplus of availability and demand is calculated by finding the difference between the availability and demand of rice. The balance of the rice balance can be seen in Table 1.

Surplus availability and needs are calculated by finding the difference between the availability and needs of rice over the past 20 years. The availability and needs in Lampung Province have always experienced a surplus, which means that the availability of rice in Lampung is far greater than its needs. Lampung Province managed to achieve the highest surplus in 2017 with a balance value of 1,646,844.35 tons per year. The lowest surplus occurred in 2019 with a surplus value of 375,970.25 tons per year. The surplus was successfully achieved every year due to the programs launched by the Ministry of Agriculture including the Special Efforts (UPSUS) program to Increase Production, Corn, and Soybeans from 2014 to 2017, the program to Increase Production, Productivity, and Quality of Food Crops from the Directorate General of Food Crops in 2017, to the Berjaya Farmer Card Program in 2020.

Table 1. Balance of Rice Balance of Lampung Province 2002-2021

Year	Availability	Needs	Difference	Description
2002	1,163,911.36	731,098.21	432,813.15	Surplus
2003	1,172,969.20	742,865.09	430,104.11	Surplus
2004	1,247,955.86	739,937.49	508,018.37	Surplus
2005	1,267,133.38	735,243.83	531,889.55	Surplus
2006	1,270,575.40	749,932.83	520,642.58	Surplus
2007	1,377,051.54	729,341.19	647,710.35	Surplus
2008	1,396,541.04	785,829.90	610,711.14	Surplus
2009	1,595,050.51	765,751.49	829,299.02	Surplus
2010	1,674,886.44	769,126.00	905,760.43	Surplus
2011	1,754,297.03	795,793.47	958,503.55	Surplus
2012	1,850,136.88	765,117.83	1,085,019.05	Surplus
2013	1,913,099,71	772,589.66	1,140,510.06	Surplus
2014	1,980,545.53	780,386.55	1,200,158.98	Surplus
2015	2,172,530.07	798,333.31	1,374,196.76	Surplus
2016	2,398,334.75	825,191.03	1,573,143.72	Surplus
2017	2,534,677.77	809,394.30	1,725,283.47	Surplus
2018	1,484,570.42	808,254.03	676,316.39	Surplus
2019	1,290,962.10	798,057.71	492,904.39	Surplus

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2020	1,580,999.44	846,917.87	734,081.57	Surplus
2021	1,482,667.93	857,139.53	625,528.40	Surplus

Forecasting Analysis of Rice Availability and Needs in Lampung Province

Forecasting is a notion or practice of forecasting future values based on current or historical data. It is vital in analysis to predict what will happen in the world in the future (Margi & Pendawa, 2015). Over time, historical data is collected, researched, analyzed, and correlated. Forecasting, as suggested by the time factor in analysis, is the art and science of projecting the future using past data sets and anticipating them in the future using mathematically approximated models (Heizer et al, 2011). The following are the forecasting results of rice availability in Lampung Province.

Unit Root Test

In the unit root test, the data will be differenced if the probability result is greater than 0.05. The results of the unit root test calculation at the level and first difference can be seen in Table 2.

Table 2. Unit Root Test of Rice Availability

Grade	ADF Result	Tes critical values 5%	Prob
Level	-1.747345	-3.029970	0.3932
1st difference	-3.696650	-3.040391	0.0138
2nd difference	-3.911066	-3.081002	0.0109

At the grade level, the results obtained are not stationary, so differencing needs to be done where at the 1st difference and 2nd difference levels, the data shows data stationarity because it shows a probability value of 0.0138 and 0.0109 which is smaller than 0.05. The 1st difference grade has a critical value at the α=5% level of -3.040391 which is smaller than the Augmented Dickey Fuller test Statistic (ADF) or T-statistic value of -3.696650. Similarly, the 2nd difference grade has a critical value at the α=5% level of -3.081002 which is smaller than the Augmented Dickey Fuller test Statistic (ADF) or T-statistic value of -3.911066.

Data on Rice Availability in Lampung Province from 2002 - 2021 can now be said to be stationary at the 1st difference and 2nd difference. After the experiment, no significant ARIMA model was found at the 1st difference level. This shows that 1st differencing does not completely eliminate trends or patterns in the data or differencing alone does not sufficiently capture the underlying patterns or trends in the data. In that case, it is worth considering a higher differencing level. Then the ARIMA model used is the model at the 2nd difference level, taking 2nd differencing can help remove any residual trends from the pattern that may exist after 1st differencing.

Correlogram Test

The results of this unit root test produce a value of d in ARIMA (p,d,q) of 2. After obtaining the value of d, the value of p and q will be sought. To get the value of p and q, it can be seen from the identification of ACF and PACF using the correlogram test (Adebayo et al., 2014). This research also agrees with Adhikari & Agrawal (2013) both ACF and PACF can be used to identify models that aid in the generation of a tentative model that can be estimated to determine the optimal model. In the third stage of the Box-Jenkins diagnostic testing methodology, ACF and PACF are

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also used. Following the correlation of residuals and correlation of squares diagnostic tests, the ACF and PACF values are examined to ensure that they are flat and within the error bounds. As a result, this study concludes that the ACF and PACF play a significant role in developing the best ARIMA model; otherwise, the proper model cannot be created. Judging from the results of the ACF and PACF bars in the colleogram test, it can be predicted that the possible models are ARIMA (1,2,0), ARIMA (4,2,4). The possible models are called tentative models. It is called tentative models because the best fit model is still unknown (Farooqi, 2014). The results of the model signification test can be seen in Table 3.

Tabel 3. Signification of ARIMA model of Rice Availability

Model	Type	Prob	Significance
(1,2,0)	AR(1)	0.0917	Significant*
(4,2,4)	AR(4)	0.0000	Significant
	MA(4)	0.0000	Significant

Based on the tentative model experiments, the best model that is most suitable is then found by looking at the Akaike info criterion (AIC), Schwarz Info Criterion (SIC), and Adjusted R square values.

Tabel 4. Possible Best ARIMA Model of Rice Availability

Model ARIMA	*Adj. R square*	AIC	SIC
(1,2,0)	-0.039902	28.79484	28.94323
(4,2,4)	-0.193577	28.98690	29.18746

Based on Table 4, the ARIMA (1,2,0) model can be the best model that is most suitable for forecasting. In addition to the significant model. The Adjusted R square value owned by the ARIMA (1,2,0) model is the largest value compared to the adjusted R square value owned by other models. The AIC and BIC values owned by the ARIMA (1,2,0) model are the smallest values when compared to the AIC and SIC values owned by other tentative models. Therefore, the ARIMA (1,2,0) model can be said to be the next model. The ARIMA model with the lowest forecasting performance outcomes is the best model since it demonstrates that the model has the lowest error in both size and direction. This remark is consistent with the findings of Klimberg et al (2010), who indicate that if the amount of bias is close to zero, the model is the best.

Diagnostic Test of the Best ARIMA Model

Based on the adjusted R Square, AIC, and BIC values, Because the ARIMA (1,2,0) model is the best, the diagnostic test used in this study is based on it. The ARIMA (1,2,0) scale diagnostic test results are greater than 0.05 on each lag, the bars in the ACF and PACF columns do not exceed the standard error line. The results of the diagnostic test on the ARIMA (1,2,0) model show that the ARIMA (1,2,0) model is a suitable model for forecasting with the formula for the Lampung Province rice availability forecasting equation as follows:

$$\Delta^2 \hat{Y}_t = -2097.460 - 0.2801\ AR(1)$$

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Forecasting

The result of forecasting rice availability in Lampung Province from 2022 to 2032 are presented in Figure 4. Based on Figure 4, the availability of rice in Lampung Province is predicted to increase every year. This can be seen from the graph which is getting higher to the right. The forecast results of rice availability in Lampung Province increased significantly where in 2022 it was 1,967,866.72 tons per year until in 2032 it could reach 2,075,982.18 tons per year.

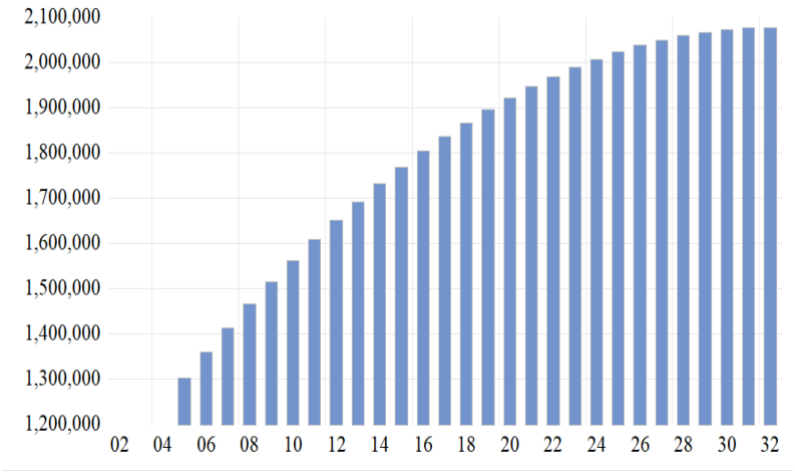

Figure 4. Data Graph of Rice Availability Forecasting Results

This increase in rice availability in Lampung Province will occur due to the increasing number of new programs launched by the Ministry of Agriculture and the Food Security Office to ensure food availability. Programs that are currently being intensified by the Lampung Provincial government include the Berjaya Farmer Card Program with guaranteed availability of seeds, seedlings, and fertilizers, the Crop Production and Horticulture Improvement Program with the movement to accelerate rice planting and expansion of new planting areas, the Food Availability Improvement Program through local food diversification. The Ministry of Agriculture also promotes the increase of rice in Lampung Province through the Planting Index Movement (IP) 400 or a cropping system harvested fours times a year (Directorate General of Food Crops, 2020). The following are the forecasting results of rice demand in Lampung Province:

Unit Root Test

At the grade level, the results obtained are not stationary where the probability value obtained is more than 0.05, namely 0.9816. Because at the grade level, the results obtained are not stationary, it is necessary to do differencing where at the 1st difference and 2nd difference grades, the data shows data stationarity because it shows a probability value of 0.0069 and 0.0172 which is smaller than 0.05. Data on rice demand in Lampung Province from 2002 to 2021 can now be said to be stationary at the 1st difference and 2nd difference grades. After the experiment, no significant ARIMA model was found at the 1st difference grade This indicates that 1st differencing does not sufficiently capture the underlying pattern or trend in the data. In that case, it is worth considering a higher differencing level. So, the ARIMA model used is the model at the 2nd difference grade.

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Table 5. Unit Root Test for Rice Needs

Grade	ADF Result	Tes critical values 5%	Prob
Level	0.529737	-3.081002	0.9816
1st difference	-4.159431	-3.081002	0.0069
2nd difference	-3.701930	-3.098896	0.0172

Colleogram Test

The results of this unit root test produce a value of d in ARIMA (p,d,q) of 2. After obtaining the value of d, the value of p and q will then be sought. To get the value of p and q can be seen from the identification of ACF and PACF by using the correlogram test. get the value of p and q. Judging from the results of the ACF and PACF bars, it can be predicted that the possible models are AR (1,2,0) and ARIMA (1,2,3) because there is a cut-off at the 2nd lag on q and a cut-off at lag 3 on p. The results of the Significance Test can be seen in Table 6 below.

Table 6. Significance of ARIMA Model of Rice Demand

Model	Type	Prob	Significance
(1,2,3)	AR (1)	0.0082	Significant*
	MA (3)	0.8175	Not Significant
(1,2,0)	AR (1)	0.0042	Significant

Based on the tentative models experiment, the best model is then sought by looking at the value of the Akaike info criterion (AIC), Schwarz Info Criterion (SIC), and Adjusted R square. The best model will show a large value on the Adjusted R square and a small value on the AIC and SIC. The values of AIC, BIC, and Adjusted R square for each tentative model are presented in Table 7.

Table 7. Possible Best ARIMA Model of Rice Demand

ARIMA Model	Adj. R square	AIC	SIC
(1,2,0)	0.411998	23.66939	23.81779
(1,2,3)	0.371102	23.77725	23.97511

Based on Table 7, the ARIMA (1,2,0) model can be the best model that is most suitable for forecasting. The adjusted R square value owned by the ARIMA (1,2,0) model is the largest value compared to the adjusted R square value owned by other models. The AIC and BIC values owned by the ARIMA (1,2,0) model are the smallest values when compared to the AIC and BIC values owned by other tentative models. Therefore, the ARIMA (1,2,0) model can be said to be the next model.

Diagnostic Test of the Best ARIMA Model

The probability value owned by the ARIMA (1,2,0) model is greater than 0.05 for each lag. It also shows that the bars in the ACF and PACF columns do not exceed the standard error line. The results of the diagnostic test on the ARIMA (1,2,0) model show that the ARIMA (1,2,0) model is a suitable model for forecasting with the formula for the Lampung Province rice demand forecasting equation as follows: $\Delta^2 \hat{Y}_t = 1166.980 - 0.680964$ AR(1)

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Forecasting

The data graph of the results of forecasting the availability of rice in Lampung Province from 2023 to 2032 is presented in Figure 5. Based on Figure 5, Lampung Province's rice demand is predicted to increase significantly for 10 years where in 2022 it will increase by 1,005,054.35 tons per year until it reaches 1,314,276.61 tons per year in 2032. This increase will occur as the population increases which affects the need for rice consumption. This is in line with Mahdalena (2015) research which states that changes in consumption can be caused by changes in population. If the population increases, then rice consumption will increase because rice is a staple food.

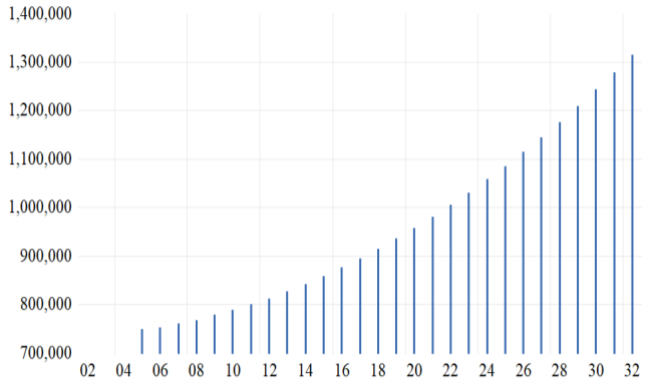

Figure 5. Data Graph of Rice Demand Forecasting Results

CONCLUSION AND SUGGESTION

Based on the findings of the research, it is possible to deduce that the availability of rice from 2002-2017 has increased every year and has decreased from 2018-2021 due to changes in the calculation method using the Area Sampling Framework (ASF). The highest rice availability occurred in 2017 at 2,534,678 tons per year. Likewise, the need for rice fluctuates every year. The highest rice demand occurred in 2021 with a value of 857,140 tons per year. The availability and demand in Lampung Province in the 2002-2021 period always experienced a surplus, which means that the availability of rice in Lampung is far greater than its needs. The surplus was successfully achieved by the programs launched by the Ministry of Agriculture. The availability of rice in Lampung Province is predicted to increase every year. The forecast results of rice availability in Lampung Province increased significantly where in 2022 it was 1,967,866.72 tons per year until in 2032 it could reach 2,075,982.18 tons per year. This increase in rice availability in Lampung Province will occur due to the increasing number of new programs launched by the Ministry of Agriculture and the Food Security Office to ensure food availability. The need for rice in Lampung Province is also predicted to increase significantly in 2022 by 1,005,054.35 tons per year until it reaches 1,314,276.61 tons per year in 2032.

Suggestions for the government, particularly the Ministry of Agriculture and the Food Crops and Horticulture Resilience Office, are It is hoped that it can maximize the programs that have been launched, such as making it easier for farmers to obtain fertilizers and pesticides, as well as providing a sense of security for rice farmers during the big harvest because sufficient markets have been provided by the government so that the availability and demand for rice in Lampung Province can be maximized and The rice surplus can be maintained, and it is hoped that this research can

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become a reference and provide understanding so that Lampung's potential can be increased. Other researchers' calculations of availability and needs should adhere to the most recent government formulas and provisions.

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