

Analysis of Rice Production Trends and Forecasting Using the Least Square Method in West Sumatra Province

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ABSTRACT

Rice is a strategic commodity that is the main food for most people in Indonesia. West Sumatra Province as one of the regions in Indonesia where most of the people consume rice is faced with fluctuations in rice production. Information on production trends and forecasts of future rice production is very important in efforts to maintain the availability of rice for the community. This study aims to identify rice production trends and predict rice production in West Sumatra Province. The data used in this study are secondary data obtained from the Central Statistics Agency, namely time series data on rice production in West Sumatra Province in 2018-2024. The data analysis used to identify rice production trends in West Sumatra Province is descriptive analysis and to predict rice production in West Sumatra, the Least Square method and Mean Absolute Percentage Error (MAPE) analysis are used to measure the level of accuracy of the forecast data. The results of the study show that throughout 2018-2024, rice production in West Sumatra Province showed a negative trend with an average decrease in production of 11,480.95 tons per year and it is predicted that in 2025-2029 rice production in West Sumatra Province will experience a decrease in production with an average decrease of 7,222.75 tons per year.



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1. Introduction

Food is an important primary need for humans. Fulfillment of food is one of the things that must be done to form quality human resources (Ariyanti et al., 2024). Development of the agricultural sector, especially in the food crop subsector, is very necessary because this subsector plays an important role in supporting the lives of most Indonesian people (Pusat Data dan Sistem Informasi Pertanian, 2020). In Indonesia, the fulfillment of carbohydrate food sources is still dominated by the rice group, especially rice (Badan Pusat Statistik, 2024). Rice has a variety of nutritional content including carbohydrates, protein, fat, vitamins, and fiber (Fitriyah et al., 2020). According to Pusat Data dan Sistem Informasi Pertanian, (2020) rice is the main food ingredient for people in Indonesia, which number more than 278 million people.

Rice is considered a strategic commodity because it can influence a country's policy that makes rice its staple food (Rahmasuciana et al., 2015). Rice produced from rice plants is the most widely consumed food commodity by the Indonesian people, where most people have made it their main food ingredient rather than other food commodities. West Sumatra Province is one of the regions in Indonesia with a population that mostly consumes rice as a staple food.

The needs of the people of West Sumatra Province for rice as a food ingredient are relatively high. Along with the increase in population, the community's need for rice as a food ingredient also increases every year. Therefore, the availability of rice in the community is something that must be considered to meet these needs. Fluctuating rice production in West Sumatra is one of the challenges in efforts to meet the need for rice as a staple food for the people of Indonesia, where along with the increasing population, the



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need for food ingredients will also increase. Rice production in West Sumatra Province is a concern in efforts to maintain the availability of rice in the community.

However, studies related to trend analysis and prediction of rice production in West Sumatra Province are still limited, especially those using a historical production data-based approach specifically in this region. Many previous studies have focused more on national or wider regional aspects, so that local and applicable information for regional planning has not been optimally explored. Therefore, this study aims to analyze trends and predict the amount of rice production in West Sumatra Province, so that it can provide a more accurate and relevant picture for regional policy making in maintaining food security.

2. Research Methods

This research was conducted from January to March 2025 with the scope of research in West Sumatra Province. The data used in this study are secondary data obtained from the Badan Pusat Statistik, namely time series data on rice production in West Sumatra Province in 2018-2024. Data collection was carried out by means of literature study, namely collecting data and information through various literature and relevant documents including Statistik Indonesia, Provinsi Sumatera Barat dalam Angka, and others.

The data analysis used to identify rice production trends in West Sumatra in this study is descriptive analysis, while the forecasting of rice production in West Sumatra in this study uses the Least Square method. The form of the Least Square equation used is as follows (Hamdiah et al., 2025):

$$Y = a + bX$$

To determine the constant value (a) and parameter value (b), the following calculation formula is used:

$$a = \frac{\sum Y}{n} \quad | \quad b = \frac{\sum XY}{\sum Y^2}$$

To see the level of accuracy of rice production forecasting in West Sumatra, this study calculated the percentage error value of rice production forecasting in West Sumatra using the Mean Absolute Percentage Error (MAPE) method. This method is a method used to see the accuracy of a forecast in the form of a percentage by providing information on how much the prediction error is compared to the actual value of a time series data (Nasution et al., 2024). The calculation of the error value of forecasting using the MAPE method uses the following formula (Maricar, 2019):

$$MAPE = \frac{1}{n} \sum_{t=1}^n \left| \frac{Y_t - F_t}{Y_t} \right| \times 100\%$$

Description:

Y_t : Actual Data

F_t : Forecast Data

N : Total Data

The criteria for determining the level of accuracy of rice production forecasting in West Sumatra using the Least Square method are analyzed using the Mean Absolute Percentage Error (MAPE) method. The MAPE value criteria can be seen in Table 1.

Table 1. Mean Absolute Percentage Error (MAPE) Value Criteria

Number	MAPE Value Criteria (%)	Explanation
1	<10	Very Good
2	10-20	Good
3	20-50	Sufficient
4	>50	Poor

Source: (Zamahzari & Puryantoro, 2023)

3. Results And Discussion

3.1. Rice Production Trends in West Sumatra Province

Rice production in West Sumatra in 2018-2014 showed fluctuations from year to year. The data on rice production in West Sumatra for the period 2018-2014 can be seen in Table 2.

Table 2. Rice Production in West Sumatra

Number	Year	Production (Tons)	Growth (Tons)	Growth (%)
1	2018	854.311,40		
2	2019	854.265,01	-46,39	-0,01
3	2020	799.122,62	-55.142,39	-6,45
4	2021	762.694,10	-36.428,52	-4,56
5	2022	795.306,36	32.612,26	4,28
6	2023	858.383,18	63.076,82	7,93
7	2024	785.425,72	-72.957,46	-8,50
Average		815.644,06	-11.480,95	-1,22

Source: Secondary Data Processed (2025)

The data in Table 2 shows that rice production in West Sumatra Province in 2018-2024 ranged from 762,694.10 tons to 858,383.18 tons. The highest rice production in West Sumatra Province occurred in 2023 with a production of 858,383.18 tons, while the lowest production occurred in 2021 with a production of 762,694.10 tons. The average rice production in West Sumatra Province in 2018-2024 was 815,644.06 tons per year. The trend graph of rice production in West Sumatra Province in 2018-2024 can be seen in Figure 1.

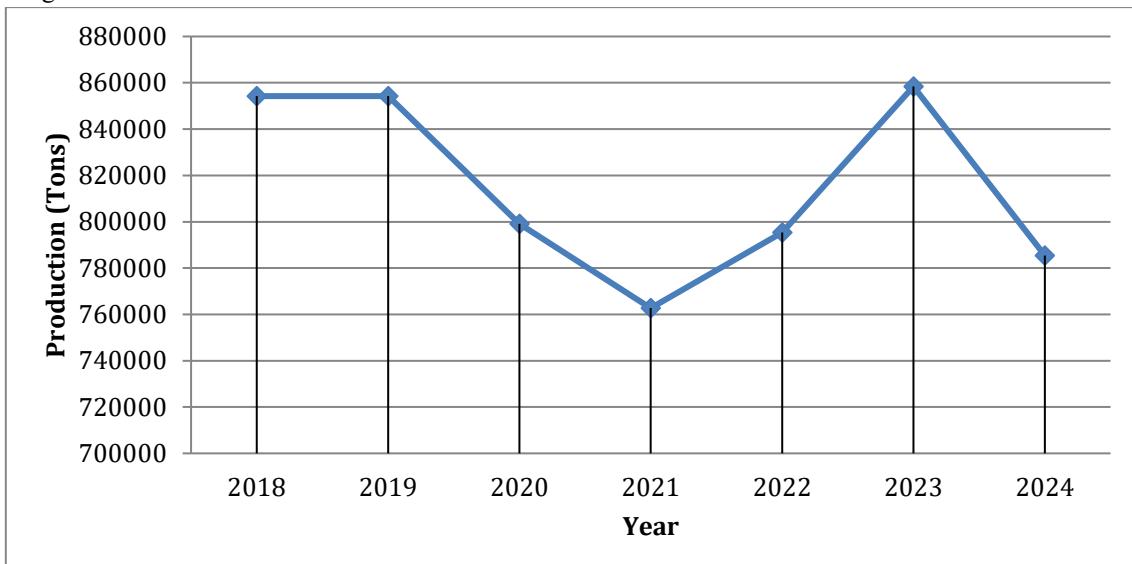
**Figure 1. Rice Production in West Sumatra Province**

Figure 1 shows a negative trend in rice production in West Sumatra in 2018-2024, where rice production has decreased despite increasing in certain years. Rice production in West Sumatra for the period 2018-2014 was 854,311.40 tons; 854,265.01 tons; 799,122.62 tons; 762,694.10 tons; 795,306.36 tons; 858,383.18 tons, and 785,425.72 tons, respectively. Throughout 2018-2014, a decline in rice production occurred in 2019, 2020, 2021, and 2024, while rice production in West Sumatra increased in 2022 and 2023. The average decline in the amount of rice production in West Sumatra Province in 2018-2024 was 11,480.95 tons per year or 1.22% per year.

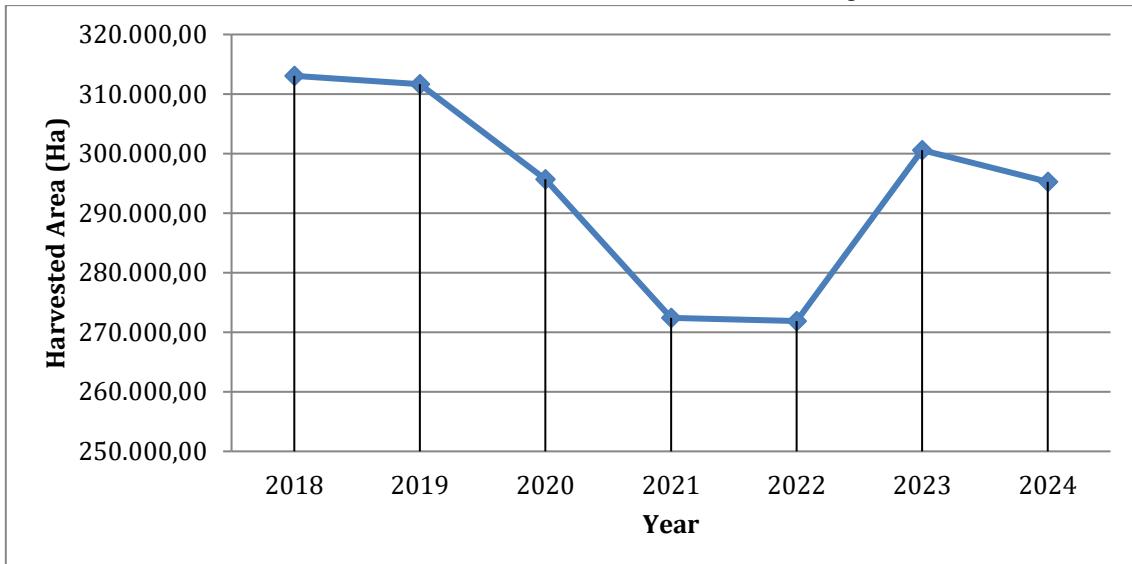
The decline in rice production in West Sumatra Province is related to land area and paddy harvest area. Previous studies that examined the factors influencing rice production reported that land area has an influence on rice plant production. The results of research conducted by Opu et al. (2022), Tarisa & Hutajulu (2022), and Walis et al. (2021) reported that land area has an influence on paddy production. In line with this statement, the rice harvest area in West Sumatra Province in 2018-2024 also fluctuated from year to year. The area of rice harvest in West Sumatra Province can be seen in Table 3.

Table 3. Paddy Harvest Area in West Sumatra Province

Number	Year	Harvest Area (Ha)	Growth (Ha)	Growth (%)
1	2018	313.050,82		
2	2019	311.671,23	-1.379,59	-0,44
3	2020	295.664,47	-16.006,76	-5,14
4	2021	272.391,95	-23.272,52	-7,87
5	2022	271.883,11	-508,84	-0,19
6	2023	300.564,77	28.681,66	10,55
7	2024	295.278,98	-5.285,79	-1,76
Average		291.242,42	-2.961,97	-0,81

Source: Secondary Data Processed (2025)

The data in Table 3 shows that the paddy harvest area in West Sumatra Province in 2018-2024 ranges from 271,883.11 Ha to 313,050.82 Ha. In sequence, the paddy harvest area in West Sumatra Province in 2018-2024 is 313,050.82 Ha; 311,671.23 Ha; 295,664.47 Ha; 272,391.95 Ha; 271,883.11 Ha; 300,564.77 Ha; and 295,278.98 Ha. Throughout 2018-2024, the paddy harvest area has decreased like the decrease in paddy production with an average decrease of 2,961.97 Ha per year or 0.81% per year. The graph of the area of rice harvest in West Sumatra Province in 2018-2024 can be seen in Figure 2.

**Figure 2. Paddy Harvest Area in West Sumatra Province**

3.2. Rice Production Forecasting in West Sumatra Province

Forecasting the amount of rice production in West Sumatra in this study uses the Least Square method. The calculation of the values of Y, X, XY, and X^2 to predict the amount of rice production in West Sumatra Province using the Least Square method can be seen in Table 4.

Table 4. Calculation of Y, X, XY, and X^2 Values

Number	Year	Y	X	XY	X^2
1	2018	854.311,40	-3	-2.562.934,20	9
2	2019	854.265,01	-2	-1.708.530,02	4
3	2020	799.122,62	-1	-799.122,62	1
4	2021	762.694,10	0	0,00	0
5	2022	795.306,36	1	795.306,36	1
6	2023	858.383,18	2	1.716.766,36	4
7	2024	785.425,72	3	2.356.277,16	9
Total		5.709.508,39	0	-202.236,96	28

Source: Secondary Data Processed (2025)

Table 4 shows the values of Y, X, XY, and X² that will be used to determine the values of a and b in forecasting rice production in West Sumatra Province. The values of a and b are as follows:

$$a = \frac{\sum Y}{n}$$

$$a = \frac{5.709.508,39}{7}$$

$$a = 815.644,06$$

$$b = \frac{\sum XY}{\sum Y^2}$$

$$b = \frac{-202.236,96}{28}$$

$$b = -7.222,75$$

From the calculation of the values a and b using rice production data in West Sumatra Province in 2018-2024 using the Least Square method, the following equation is obtained:

$$Y = a + bX$$

$$Y = 815.644,06 + (-7.222,75)X$$

$$Y = 815.644,06 - 7.222,75X$$

The results of the rice production forecast using the Least Square method were analyzed for accuracy using the Mean Absolute Error Percentage Error (MAPE) analysis. The results of the MAPE value calculation for the rice production forecast in West Sumatra Province can be seen in Table 5.

Table 5. Calculation of MAPE Value of Rice Production Forecast in West Sumatra

Year	Y	X	Y'	Y _t - F _t	MAPE (%)
2018	854.311,40	-3	837.312,30	16.999,10	1,99
2019	854.265,01	-2	830.089,55	24.175,46	2,83
2020	799.122,62	-1	822.866,80	-23.744,18	2,97
2021	762.694,10	0	815.644,06	-52.949,96	6,94
2022	795.306,36	1	808.421,31	-13.114,95	1,65
2023	858.383,18	2	801.198,56	57.184,62	6,66
2024	785.425,72	3	793.975,81	-8.550,09	1,09
Average					3,45

Source: Secondary Data Processed (2025)

The data in Table 5 shows that the average MAPE value of the rice production forecast in West Sumatra Province in 2018-2024 has a value of 3.45%. This value is in the criteria range of <10%, which means that the level of accuracy of the rice production forecast in West Sumatra Province using the Least Square method is classified as very good so that it can be used to predict rice production in West Sumatra Province in the future. The comparison of actual data and rice production forecast data in West Sumatra Province can be seen in Figure 3.

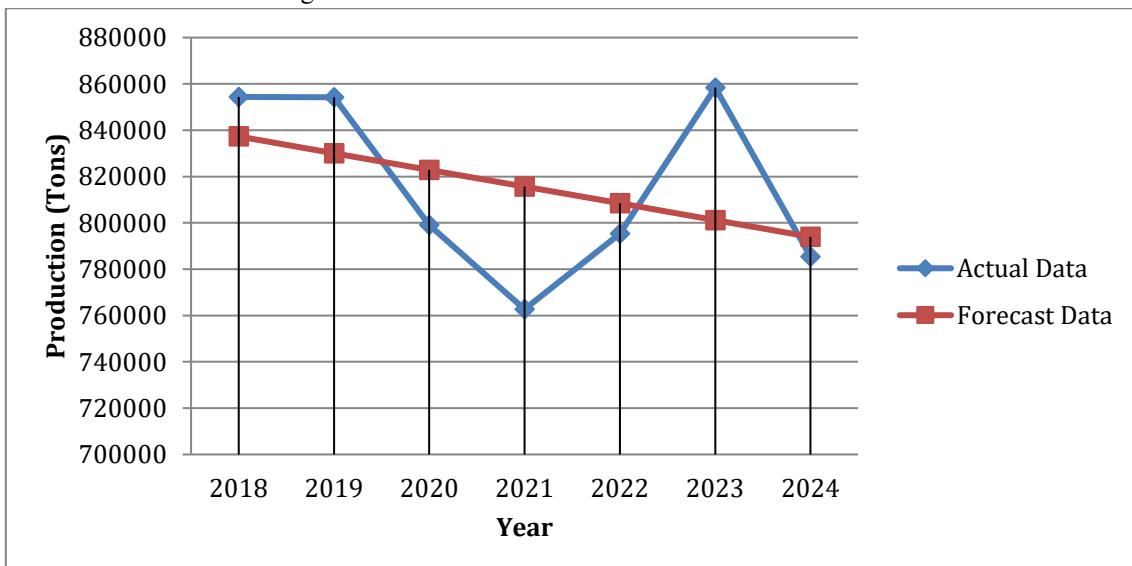


Figure 3. Comparison of Actual Data and Forecast Data on Rice Production in West Sumatra Province

Rice production forecasting in West Sumatra Province in this study was conducted to predict the amount of rice in West Sumatra Province in 2025-2029. The results of the rice production forecast in West Sumatra Province in 2025-2029 can be seen in Table 6.

Table 6. Rice Production Forecast in West Sumatra Province

Number	Year	a	b	X	Y'
1	2025	815.644,06	-7.222,75	4	786.753,06
2	2026	815.644,06	-7.222,75	5	779.530,31
3	2027	815.644,06	-7.222,75	6	772.307,56
4	2028	815.644,06	-7.222,75	7	765.084,82
5	2029	815.644,06	-7.222,75	8	757.862,07

Source: Secondary Data Processed (2025)

Table 6 shows the forecast of rice production in West Sumatra Province in 2025-2029. Rice production in West Sumatra Province in 2025-2029 is predicted to decline. Consecutively, rice production in West Sumatra Province in 2025-2029 is 786,753.06 tons; 779,530.31 tons; 772,307.56 tons; 765,084.82 tons; and 757,862.07 tons. The average decline in rice production in West Sumatra Province is predicted to be 7,222.75 tons per year.

The decline in rice production in West Sumatra Province has the potential to threaten the availability of rice to meet community needs. Strategies to increase paddy production that produce rice need to be implemented. Fuqara & Tanjung (2023) explained that strategies that can be implemented to increase paddy production include government involvement in socializing appropriate technology for paddy cultivation, ensuring the availability of superior variety seeds, and maintaining the availability of fertilizers and agricultural tools and machinery. Nafi'ah & Royani (2021) explains the use of organic fertilizers rich in organic materials in paddy cultivation has benefits for paddy plant growth and improves soil quality so that it can be used as a strategy to increase paddy production. Other strategies that can be implemented to increase paddy production and productivity are the implementation of integrated pest control, planning appropriate rice planting season patterns based on climate data, providing quality production facilities, increasing the adoption of technology in rice cultivation and post-harvest, and increasing the competence of paddy farmers (Ebrila et al., 2025).

4. Conclusion

This study shows that rice production in West Sumatra Province during the period 2018–2024 experienced fluctuations with a downward trend, although it had increased in certain years. The average rice production during this period was 815,644.06 tons per year, with an average decrease in production of 11,480.95 tons per year or around 1.22%. This decrease in production is closely correlated with fluctuations in harvested area and rice production which also showed a downward trend. Forecasting using the Least Square method shows that rice production in West Sumatra in the period 2025–2029 is predicted to continue to decline, with an average decrease of 7,222.75 tons per year. The results of this prediction have a very good level of accuracy based on the Mean Absolute Percentage Error (MAPE) value of 3.45%. This shows that the forecasting model used is worthy of being used as a basis for decision making and regional policy planning.

The results of this study have significant implications for planning and policy-making in the agricultural sector, especially in efforts to maintain food security in West Sumatra Province. The prediction of a decline in rice production during the 2025–2029 period is an important signal for local governments to immediately formulate appropriate strategies to anticipate potential staple food availability crises. The government needs to increase support for the agricultural sector by providing superior seeds, fertilizers, and adequate agricultural machinery, as well as expanding farmers' access to efficient and environmentally friendly rice cultivation technology. In addition, increasing farmer capacity through ongoing training and extension is also an important step in encouraging existing land productivity. On the other hand, the prediction results that have a high level of accuracy indicate that a quantitative analysis approach based on historical data can be a reliable tool in designing evidence-based policies. Therefore, the integration of the results of this study in the regional development planning process is expected to strengthen food security while improving the welfare of farmers in West Sumatra Province.

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