Region and forecasting of banana commodity in seroja agropolitan area lumajang

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Abstract. Banana commodity has a crucial role in supporting the economic growth of Lumajang Regency, especially in Seroja Agropolitan Area. One aspect that must be observed in the development of banana commodity is how to pay attention to regional conditions, bearing in mind that each region has different characteristics. The objectives of this study are to find out that Seroja, the Agropolitan area, is a banana commodity production base area and the forecast of banana commodity production in the next five years. The locations of the study are Senduro and Pasrujambe Subdistricts, with the consideration that the sub-district is the Seroja Agropolitan area Lumajang Regency. The research method applies an analytical approach. The data collection method uses secondary data, in which the available statistical data has been published by BPS. The data analysis method used is base and non-base sector analysis Location Quotient and Box-Jenkins Model (ARIMA) analysis. The results show that out of 21 districts in Lumajang Regency there are Pasrujambe and Senduro. The LQ value of Pasrujambe is 2.02 and Senduro is 2.01. This means that Pasrujambe and Senduro Subdistricts in the Seroja Agropolitan Area are centers of banana potential and must be managed as continuously as possible. The banana production forecast for 2018-2027 tends to be constant and decrease. This is consistent with the previous year of fluctuating production data and tends to decline.

1. Introduction

Lumajang Regency is one of the regions in which the agricultural sector is a driver of the local economy. One of the agricultural commodities in the horticulture sub-sector in Lumajang Regency that has great potential but still less to be concerned is banana commodity. Banana fruit is a horticultural plant that has a fairly high production rate and tends to increase from year to year. Bananas are planted in almost every yard of the main house in the villages, especially in the Seroja Agropolitan Area.

    Seroja Agropolitan Area is in the Districts of Senduro and Pasrujambe. Seroja Agropolitan area has superior commodities such as bananas, coffee, dairy cattle, vegetables, and albizia. In the Seroja Agropolitan area, based on its agro-ecological potential, tropical exotic yard plants such as durian, mangosteen, pulung orange, and avocado are also developed. The total area of the Seroja Agropolitan is 25,061 ha, consisting of a plant area of 22,653 ha (90.38%) and the remaining 2,408 ha (9.62%) is for road, river, and forest settlements (protected forest areas) [2]. The population in 2017 is 79,917 people with an annual growth rate of around 4%. The livelihoods of the population are dominated by farmers and farm laborers and the rest consists of civil servants (PNS), armed forces (ABRI),

pensioners, and traders. The topography of this area is hilly with an altitude of between 450 to 2,000 m above sea level.

As one of the horticultural commodities, banana has a crucial role in supporting the economic growth of Lumajang Regency, especially in the Seroja Agropolitan Area. The role of banana as a leading horticultural commodity cannot be replaced by other horticultural commodities, such as snake fruit and others. The data of banana production in Lumajang Regency, especially in Seroja Agropolitan area, can be presented as follows [2].

Table 1. Banana production in the seroja agropolitan area, lumajang regency from 2013-2017.

Agropolitan Seroja	Banana Production Data for 2013-2017 (Kw)				
	2013	**2014**	**2015**	**2016**	**2017**
Pasrujambe	45.900,00	45.900,00	57.600,00	30.400,00	39.375,00
Senduro	27.007,50	27.007,50	18.282,00	27.321,20	27.321,20
Total	**72.907,50**	**72.907,50**	**75.882,00**	**57.721,20**	**66.696,20**

The needs of Banana will continue to increase, especially to meet the needs of small industries in Lumajang Regency as raw materials for various processed products. Therefore, it is necessary to have appropriate handling of all lines starting from farmers and stakeholders so that they can increase production for the fulfilled future community needs. One aspect that must be observed in the development of the banana commodity is how to regard the regional conditions in which each region has different characteristics. Certain studies are needed so that the development of banana commodities can be carried out in suitable areas. Therefore, the objectives of this study are: (1) To find out whether the Seroja Agropolitan area is a banana commodity production base area, and (2) To determine the development of banana commodity production ten years to come.

2. Reseach Methodology

The areas of the study are Senduro and Pasruhjambe Subdistricts, with the consideration that the sub-district is the Agropolitan Seroja Regency of Lumajang Regency. Seroja Agropolitan area has superior banana commodities. The research method uses an analytical approach. The data collection method is using secondary data, which is available statistical data that has been published by BPS. The data analysis method uses the base and non-base sector analysis (Location Quotient Analysis) and Box-Jenkins (ARIMA) analysis.

3. Banana Production Base Area in Lumajang Regency

The results of the calculation of the Location Quotient Analysis (LQ) are carried out using the indicator data on the amount of banana production with the total production in each region. Analysis conducted in this study was a study of the value of Location Quotient (LQ) for a period of five years starting from 2013 to 2017. Location Quotient Analysis (LQ) can also be used to determine the magnitude of the role of a sector in a region against the magnitude of the sector roles overall [11]. The following table is the result of the Location Quotient (LQ) analysis of the banana commodity in Lumajang Regency.

Table 2. Location quotient (LQ) analysis of banana commodity in lumajang regency**.**

| No	Sub-district	2013	2014	2015	2016	2017	Average	Notes
1.	**Tempusari**	**1,04**	**1,48**	**2,20**	**2,08**	**1,77**	**1,72**	**Basis**
2.	Pronojiwo	0,22	0,36	0,29	0,26	0,17	0,26	Non Basis
3.	Candipuro	0,56	0,74	0,58	0,65	0,41	0,59	Non Basis
4.	Pasirian	0,10	0,08	0,08	0,07	0,13	0,09	Non Basis
5.	Tempeh	0,10	0,16	0,13	0,16	0,16	0,14	Non Basis
6.	**Lumajang**	**1,04**	**1,37**	**1,05**	**1,81**	**1,05**	**1,26**	**Basis**
7.	Sumbersuko	0,85	0,42	0,25	0,23	0,22	0,39	Non Basis
8.	Tekung	0,35	0,40	0,38	0,35	0,29	0,36	Non Basis
9.	Kunir	0,48	0,39	0,55	0,77	0,84	0,60	Non Basis
10.	Yosowilangon	0,03	0,01	0,03	0,02	0,04	0,03	Non Basis
11.	Rowokangkung	0,51	0,40	0,75	0,65	0,45	0,55	Non Basis
12.	Jatiroto	0,26	0,09	0,58	0,32	0,36	0,32	Non Basis
13.	Randuagung	0,27	0,22	0,35	0,40	0,34	0,32	Non Basis
14.	Sukodono	0,32	0,55	1,14	0,87	0,58	0,69	Non Basis
15.	Padang	1,26	0,70	0,64	0,71	0,45	0,75	Non Basis
16.	**Pasrujambe**	**1,75**	**2,08**	**2,27**	**2,07**	**1,96**	**2,02**	**Basis**
17.	**Senduro**	**1,73**	**2,10**	**2,27**	**2,02**	**1,94**	**2,01**	**Basis**
18.	**Gucialit**	**1,59**	**1,79**	**2,01**	**1,84**	**1,95**	**1,84**	**Basis**
19.	Kedungjajang	0,94	0,82	0,55	0,35	0,23	0,58	Non Basis
20.	Klakah	0,78	0,76	0,99	1,02	1,00	0,91	Non Basis
21.	Ranuyoso	0,84	0,82	1,17	1,25	0,68	0,95	Non Basis

Based on table 2, LQ calculation results were obtained within a period of five years, from 2013 to 2017 in Lumajang Regency for banana commodities. LQ values of less than one (LQ <1) were found in Pronojiwo, Candipuro, Pasirian, Tempeh, Sumbersuko, Tekung, Kunir, Yosirilangon, Rowokangkun, and Jatiroto Districts. LQ values of more than one (LQ> 1) were found in the Districts of Tempusari, Lumajang, Pasrujambe, Senduro, and Gucialit. LQ value of Banana commodities in Tempursari District is 1.72; Lumajang District is 1.26; Pasrujambe District is 2.02, Senduro District is 2.01 and Gucialit District is 1.84. As seen from the results of the LQ analysis, Tempusari, Lumajang, Pasrujambe, Senduro, and Gucialit Districts are the banana commodity base areas in Lumajang Regency. Graphically, the average LQ value of the banana commodity in Lumajang Regency for five years in a row can be determined through the following figure.
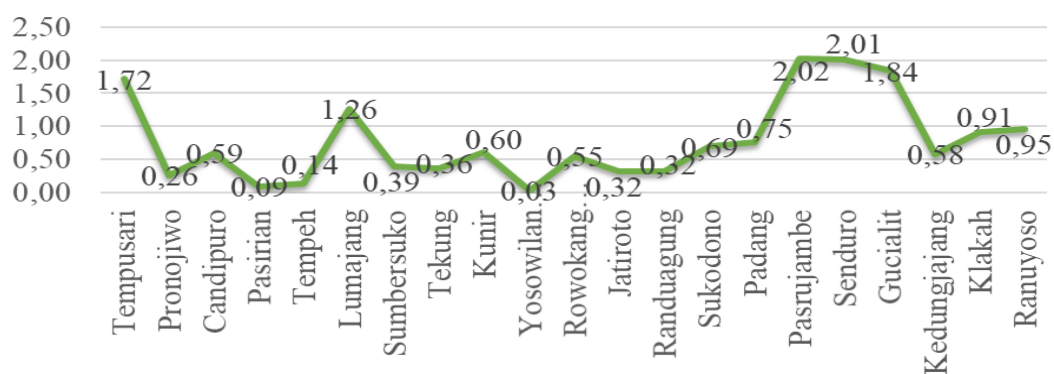
Figure 1. Average LQ value of banana commodity in lumajang regency.

Based on the results of the analysis, several banana commodity base areas in Lumajang Regency, especially in Pasrujambe District and Senduro District are in the Seroja Agropolitan Area. Each LQ value of these districts has the highest LQ value among the three other districts; they are respectively 2.02 and 2.01. Both districts in the Seroja Agropolitan area are the base sector and can meet the needs in the region and also can supply banana production out of the region.

4. Development of Banana Commodity Production in the Next 10 Years

Bananas are superior commodity crops in Indonesia because they have been already planted and are suitable for tropical climates. Almost all regions in Indonesia are suitable for banana plantations, but for commercial banana development, it is necessary to concern to the areas that are suitable for banana development.
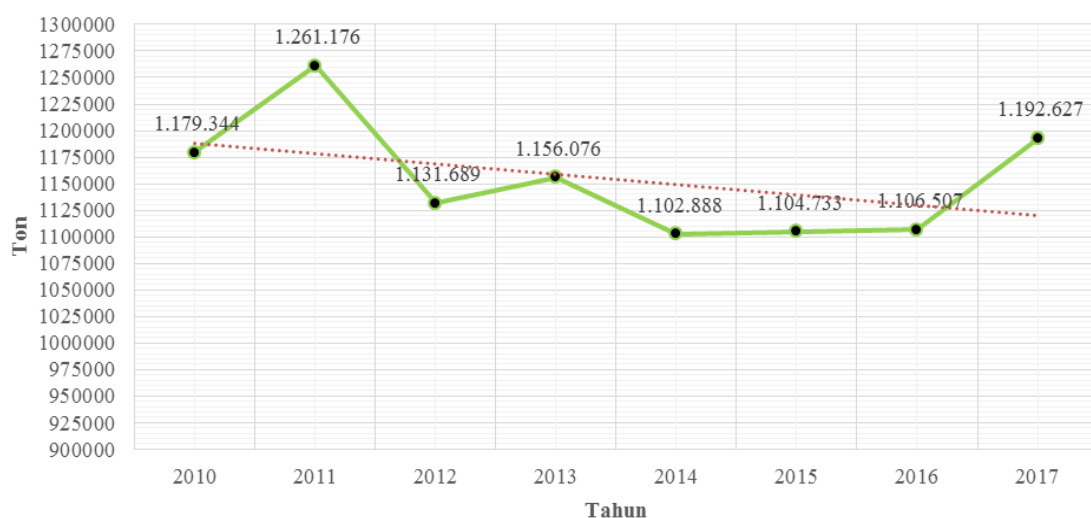
Figure 2. Banana production in lumajang regency in 2010-2017.

Based on the graph above, the production of banana commodity in Lumajang Regency from 2010 to 2017 has fluctuated. In 2011, banana production in Lumajang Regency tended to increase. In 2012, banana production in Lumajang Regency decreased to 1,131,689 kw. In 2013, banana production increased to 1,156,076 kw. In 2014, banana production decreased to 1,102,888 kw. In 2017, banana production in Lumajang Regency increased to 1,192,627 kw.

The selected model is used to predict banana production in Lumajang Regency from 2018 to 2027. The results obtained from forecasting banana production in 2018 to 2027 tend to decrease. The results of this forecast accord with the data used and the resulting plot values of banana production in Lumajang Regency using annual data from 2000 to 2017 tends to fluctuate. The results of forecasting banana production in Lumajang Regency were obtained from the ARIMA method by conducting a stationary data test.

Stationary data testing is salient because the ARIMA method requires the criteria of the analyzed data must be stationary first [8]. It can translate data and economic models well because stationary data is not too varied and tends to approach the average value. The stationarity of the data used can be determined using the value of Augmented Dickey-Fuller (ADF). According to Yuliadi in Nurjayanti (2011), stationary data has the value in which the statistical test ADF is smaller than the value of the critical value of the level of confidence. The ADF value of banana production is presented in the following table.

Table 3. ADF value and critical value data of lumajang banana production data in order 1 ferrencing

Notes		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.597446	0.0004
Test critical values:	1% level	-3.920350	
	5% level	-3.065585	
	10% level	-2.673459	

The ADF value in table 1 is used for first-order differencing because the ADF t-statistic value is greater than 1%, 5%, and 10% on t-test critical value. After differentiating on the zero-order level, the value still did not meet stationary data criteria so that the first-order differencing is used to get stationary data. In this table, the ADF value for banana production data is -5.597446. The ADF value is lower than the critical value of 1% (-3.920350). Moreover, the ADF value is lower than the critical value of 5% (-3.065585) and the ADF value is also lower than the critical value 10% (-2.673459). These values indicate that the banana production data used is well stationary at critical values of 1%, 5%, and 10%.

The next step to be done after analyzing the plot and stationary data is eliminating inappropriate models. Estimation can be made if the ARIMA model has formed an AR (autoregressive) model from the autocorrelation function pattern and the MA (Moving Average) model is formed from partial autocorrelation. ACFPACF plot estimations are carried out on previously identified production data. The results of the ACF-PACF plot analysis are presented in the following table.

Table 4. ACF-PACF value of banana production data in lumajang regency

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |***** |	. |***** |	1	0.694	0.694	10.208	0.001
. |**** |	. |* . |	2	0.538	0.109	16.730	0.000
. |*** |	. | . |	3	0.439	0.060	21.360	0.000
. |**. |	. *| . |	4	0.302	-0.093	23.703	0.000
. |* . |	. *| . |	5	0.184	-0.071	24.635	0.000
. | . |	. *| . |	6	0.067	-0.098	24.770	0.000
. *| . |	. *| . |	7	-0.072	-0.153	24.941	0.001
.**| . |	.**| . |	8	-0.234	-0.217	26.914	0.001
.**| . |	. |* . |	9	-0.228	0.116	29.001	0.001
***| . |	***| . |	10	-0.404	-0.350	36.363	0.000
***| . |	. |* . |	11	-0.390	0.152	44.192	0.000
.**| . |	. | . |	12	-0.342	-0.003	51.219	0.000

The step taken in estimating is by looking at ACF and PACF tables so that the ARMA or ARIMA model will be formed. The estimation process is analyzed using the formula Z 0.05 $\sqrt{(1/n)} = \pm 1.96\sqrt{(1/n)}$ which the calculation result is ± 0.49. This value is used to eliminate the AC and PAC models where the best model is seen from values outside ± 0.46. ARIMA models that have been obtained include ARIMA (1,0,1), ARIMA (1,0,0), ARIMA (1,0,2), ARIMA (0,0,1) and ARIMA (0,0,2).

The next step is conducting a diagnostic test to see whether the model is still feasible to use by looking at the criteria of Adjusted R-squared, Akaike info criterion, Schwarz criterion, S.E of regression, and Sum Square Residual [3]. The adjusted R squared value must be higher than all selected models. On the other hand, the value of *Akaike* info criterion, Schwarz criterion, S.E of regression, and Sum Square Residual must be lower than all existing models. The model that best meets the criteria will be selected as the best model for forecasting the banana production in Lumajang

Regency. Based on these criteria, the best forecasting model was chosen, namely ARIMA (1,0,1). The results of the forecasting test with the ARIMA model (1,0,1) are presented in the following table.

Table 5. ARIMA model estimation results (1,0,1) on banana production data in lumajang regency

Model	Adj R-Square (greatest)	*Akaike* info criterion (smallest)	S.E Regression (smallest)	Sum Squared Residual (lowest)
ARIMA (1,0,1)	**0.536790**	**27.62237**	**211296.0**	**6.25E+11**
ARIMA (1,0,0)	0.533775	27.57228	211982.4	6.74E+11
ARIMA (1,0,2)	0.500652	27.68327	219383.5	6.74E+11
ARIMA (0,0,1)	0.310789	27.93436	257738.0	9.96E+11
ARIMA (0,0,2)	0.178047	28.11343	281465.8	1.19E+12

Based on table 5, the ARIMA model (1,0,1) was selected as the best model because the value is suitable with the Adjusted R-squared criteria, *Akaike* info criterion, Schwarz criterion, S.E of regression, and Sum Square Residuals. The Adjusted R-squared ARIMA (1,0,1) value is 53.67% with R2 of 61.85% and this is the greatest value. *Akaike* info criterion is seen in the ARIMA model (1,0,1) of 27.62237 which is smaller than the value of *Akaike* info criterion of other models. The values of S.E of regression and Sum Squared Residual in the ARIMA model (1,0.1) are 211296.0 and 6.25E + 11 respectively. These values are smaller than the other models.

The selected model is used to forecast banana production from 2018 to 2027. The results of the forecasting of banana production in 2018 to 2027 fluctuations tend to increase. The following graph is the result of banana production forecasting in Lumajang Regency in 2018 until 2027:
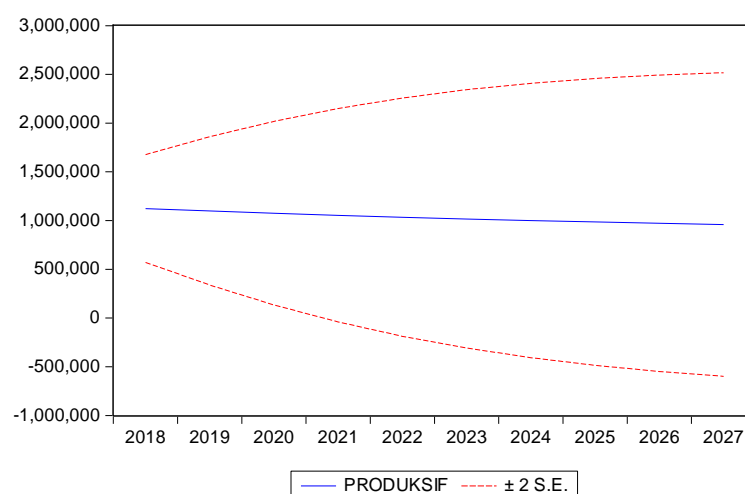
Figure 3. Chart of forecasting of banana production in lumajang regency 2018-2027

Figure 3 shows that the development of banana production in 2018-2027 tends to be constant and declining. It is consistent with the previous year of fluctuating and declining production. The results of banana production forecasting in Lumajang Regency in 2018-2027 are presented in the following table.

Table 6 reveals that banana production in 2018-2027 tends to be fluctuating. Banana production at Lumajang Regency in 2018 was 1,123,139.87 kw, it decreased in 2019 to 1,097,963.59 kw. In 2020, banana production is 1,074,884.78 kw and then it decreases again in 2021 to 1,053,728.69 kw. Banana production in Lumajang Regency continues to decrease until 2027 to 959,073.43 kw. The available data is graphed to find out the patterns of the data used more clearly. The graph of the development of banana production in Lumajang Regency is presented as follows.

Table 6. Forecasting of banana production in lumajang regency in 2018-2027.

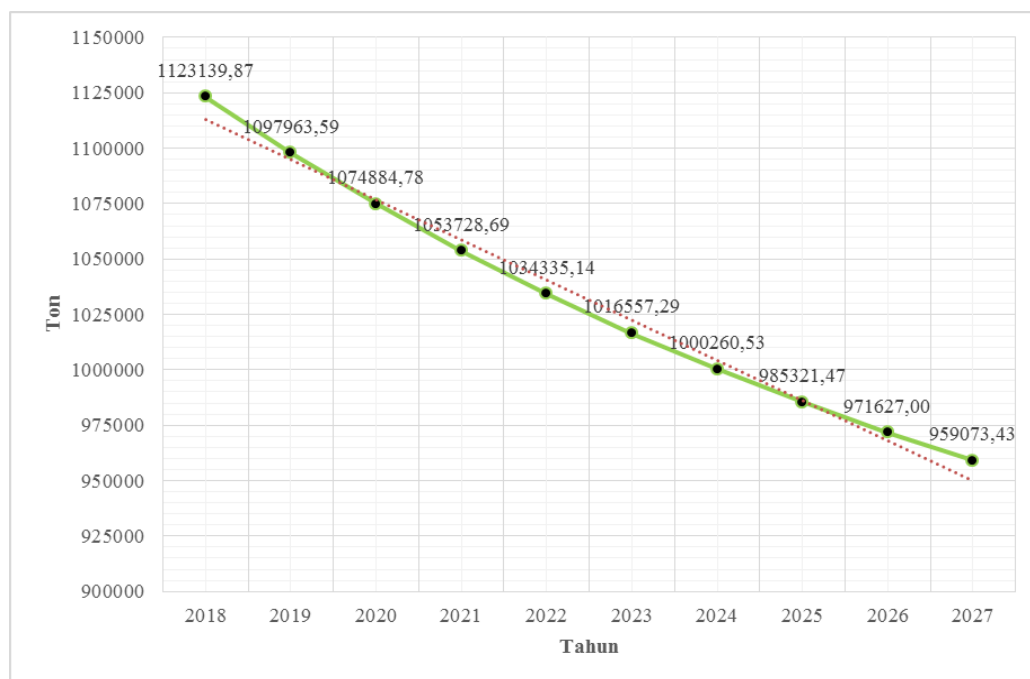| Year	Production (Kw)
2018	1.123.139,87
2019	1.097.963,59
2020	1.074.884,78
2021	1.053.728,69
2022	1.034.335,14
2023	1.016.557,29
2024	1.000.260,53
2025	985.321,47
2026	971.627,00
2027	959.073,43

Figure 4. The development of banana production in lumajang regency

Figure 4 shows that the results of the forecasting of banana production in Lumajang Regency from 2018 to 2027 have decreased. This can be seen on the graph that the line from left to right tends to decrease from top to bottom every year.

5. Conclusion
Potential production bases are Tempusari District with the LQ value of 1.72; Lumajang with the LQ value of 1.26; Pasrujambe with the LQ value of 2.02; Senduro with the LQ value of 2.0; and Gucialit with the LQ value of 1.84. It means that Pasrujambe and Senduro Districts in the Seroja Agropolitan Area are banana potential centers.

The development of banana production in 2018-2027 is fluctuating. Lumajang banana production in 2018 was 1,123,139.87 kw, it decreased in 2019 to 1,097,963.59 kw. In 2020 banana production is 1,074,884.78 kw and then it decreases again in 2021 to 1,053,728.69 kw. Banana production in Lumajang Regency continues to decrease until 2027 to become 959,073.43 kw.

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