

A TREND ANALYSIS OF ORANGE AND APPLE PLANTS AT BATU CITY, EAST JAVA, INDONESIA

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DOI: <https://doi.org/10.51193/IJAER.2022.8503>

Received: 27 Sept. 2022 / Accepted: 06 Oct. 2022 / Published: 17 Oct. 2022

ABSTRACT

Apple commodity in Batu city has experienced a decrease. The decrease is due to land shrinkage, significant unproductive plants, and uncertain weather conditions. On the other hand, the orange plant in the Batu area has been increasing as the plant can grow well in different land elevations. This research investigates the production trend of apple and orange plants, the area trend of both plants, and the comparison trend of the plants in Batu city. The research design used quantitative and qualitative methods and in-depth interviews with several informants to acquire important qualitative data. The data on production, crop area, and the number of plants for apples and oranges came from the Agricultural Office of Batu City and the Central Statistics Agency. The trend analytical technique used the ARIMA Box-Jenkins with Eviews software. The research's results show: (1) The apple production trend decreased, while oranges increased, (2) The crop plant for apples decreased, while oranges increased, (3) The plant number for apples experienced an extreme decrease in 2020, while orange experience the highest increase in 2021, (4) The factors that cause apple's crop area decreased were the increase of temperature, the decrease of humidity, the plants' age that was too old, excessive usage of pesticide, the increase of production cost, the decrease of apple production, and the low price of apple, (5) Orange experience an increase due to consumers demand, high price and low cost of maintenance, (6) The forecasting for apple production, crop area, and plants number showed a decrease, (7) The

forecasting for orange production, crop area, and plant number showed an increase.

Keywords: Apple, Orange, Trend.

1. INTRODUCTION

Batu city in East Java province, Indonesia, was established in 2001 as a part of the Malang regency. Even though the city is one of the youngest official areas in Indonesia, it has a relatively high economic growth. The city even surpasses East Java in terms of economic growth. Additionally, Batu has rapidly developed a decentralization policy and economy in Indonesia.

The significant potential of the city lies in its wide variety of crops. The most dominant fruits are apples and oranges. Further, Batu has become a city with the highest apple production in Indonesia. This fact has made the apple the icon of the city. In 2015, apple commodities significantly impacted the city's economic development and people's welfare.

The achievements are not only due to the fruit production but also the crop area that can be useful for tourism purposes. The beauty of apple trees provides an opportunity for the plantation owner to offer an experience for tourists enjoying the plantation's attractive view. The apple development reached its top from 1980 to 1990. Since then, the main commodity in the Batu area has shifted to another plant. The agricultural agency of Batu city has planned steps to overcome the issue as follows:

- a) The building of supporting facilities for the agricultural area
- b) The procurement of agricultural machinery
- c) The development of human resources related to the agricultural sector

The decrease in apple farmers is due to several factors, such as unpredictable rainfall and the shrinkage of the crop area. Besides, there is another factor adding to the decrease, which is the use of excessive pesticides. Apart from that, many crop plants in Batu have surpassed their productive age; therefore, the apple trees can no longer produce an optimum fruit as in those still in the effective period.

At present, the primary fruit commodity in Batu is orange. The apple crop area's shrinkage has increased the orange crop rapidly. Orange's becoming the primary product, its favorite fruit in Indonesia. The trees are also easy to grow; they can grow in areas with different elevations. Those findings make orange become an alternative to overcome the apple's decrease in Batu. The much cheaper planting and maintenance costs for the orange are assumed to encourage the farmers to choose oranges for apples.

Orange trees are also suitable for tropical climates, as in Batu. The use of pesticides has succeeded in exterminating the natural enemy of the plants; therefore, it can control the pest population. Nevertheless, it is more suggestible to use natural agriculture for orange production. Based on the Agricultural Agency data of Batu city, the area of the apple crop in 2015 was 1.768,27 Ha, with its production achieving 671,207 quintals. While in 2019, the area was 1.092,8 Ha, with its production reaching 505,252 quintals.

The crop area for apples and their production has been decreasing continuously. In 2017, orange production reached 141,253 quintals, 2018 got 141,253 quintals, and in 2021 the production was 238,436 quintals. The data show that orange has increased annually. Therefore, farmers have shifted their activity from apples to oranges.

Based on the given background, this research is essential for (1) analyzing the production trend for apples and oranges in Batu, (2) analyzing the crop area trend for apples and oranges in Batu, (3) analyzing the comparison of plant amount trend between apples and oranges in Batu.

2. LITERATURE REVIEW

2.1 Trend

A trend is a pattern in a series of development that appears and moves towards a specific direction in a period, which can show an increase or decrease (Albert Posma, 2020). Trend gives information on the value change of a relatively stable variable, a change in population, price, and productivity increase; otherwise, when the average is about a decrease, it is a negative trend or a trend that has a potential decline.

2.2 Forecasting

Forecasting is a process of making predictions about an event that might occur in the future by reviewing the present data (Utami et al., 2020). Forecasting is a scientific prediction of a product for the coming period. Forecasting is making compelling predictions and planning management within a modern organization (Unggara, Musdholifah & Sari, 2019).

2.3 Estimation

According to Salam (2012), estimation is a series of processes using estimators to produce an estimation of a particular parameter. Estimation is also an alternative in the presentation of an existing activity.

2.4 Auto regressive Integrating Moving Average (ARIMA)

Arima Method is a form of a specified time-series method of Box-Jenkin that defies independent variables during the forecasting process. The values in ARIMA are of the past and present of the dependent variables to produce an accurate short-term prediction. The ARIMA Box-Jenkins model is a result of the following formula.

$$\Phi p(B)dZt=\mu+ \theta q(B)t).$$

2.5 Horticulture

Horticulture is a science that discusses crop cultivation. It is a branch of agriculture with potential for development and good product. The finding is due to the high economic value. The horticultural crops are perishable, seasonal product, have aesthetical value, and requires a vast space. Horticulture consists of plants of various types, including vegetables, flowers, and fruits.

3. RESEARCH METHOD

Research design is a planning procedure and technique to guide development strategies to produce a research model (Hasibuan, 2007). After the research undergoes data analysis, it seems that it also requires significant qualitative data. Therefore, the research design applied both quantitative and qualitative methods.

The research subject is the data from the Agricultural Agency of Batu city as the official and valid source about land and the production of apple and orange crops in Batu. The research object is the orange and apple forecasting trend in Batu. This research applied a time series of secondary data where another party collected and arranged the data for this research purpose (Ibrahim, J, T, 2020).

4. RESULT AND DISCUSSION

4.1 Apple and Orange Production Yield during 2011-2021

Apple production during 2011-2021 is fluctuating. The highest apple production occurred in 2018, with an average of 684204.29 quintals, and the lowest was in 2017; the average was 413909.06 quintals. The apple production trend shows a decrease. This result is in line with Ruminta (2015) stated that apple production in Batu had the inclining potential in the future due to temperature increases and rainfall until 2030.

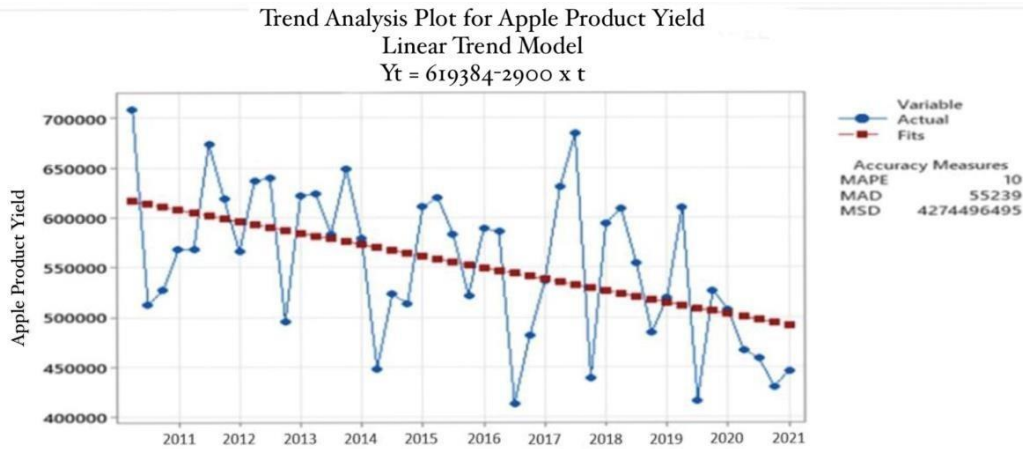


Figure1: Time Series Plot of Apple Production Yield

The forecasting of apple products experienced a decrease. The forecasting for apple production yield from 2022 to 2025 based on the model identification, parameter estimation, and ARIMA verification model shows the SC value of 25.410, AIC of 25.250, and the Adjusted R-Square of 0.476 with the probability of $0.661 > 0.05$. Apple requires an optimum temperature for its fertilization (Wardani, 2020).

The orange production yield fluctuated from 2011 to 2021. The highest yield was in 2019, with an average product of 77576.29 quintals, and the lowest was in 2010, with 8105.3 quintals. The graph trend with the upper and lower bounds shows an increase. The factors that affect the increase in orange production in Batu include capital, land area, labor, humidity, consumer demand, and cheap maintenance cost.

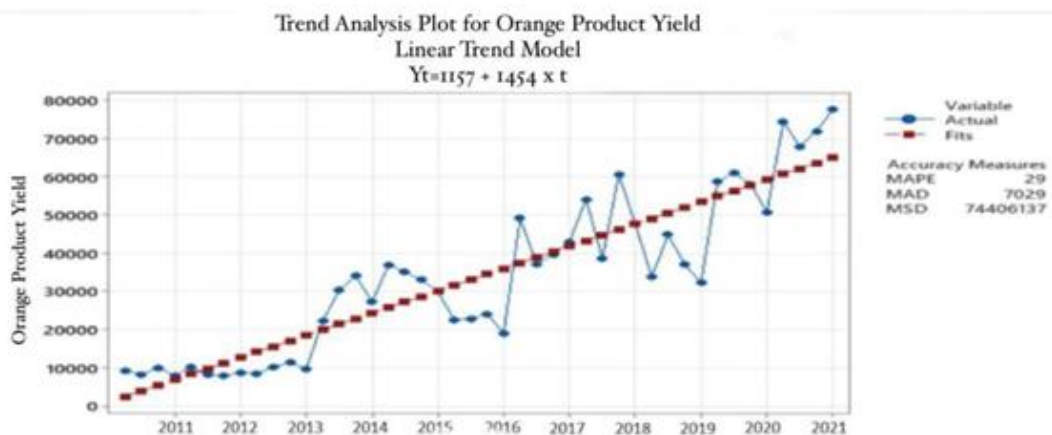


Figure 2: Time Series Plot of Orange Production Yield

The forecasting of orange products experienced an increase. The forecasting for apple production yield from 2022 to 2025 based on the model identification, parameter estimation, and ARIMA verification model shows the SC value of 21.291, AIC of 21.127, and the Adjusted R-Square of 0.2613 with the probability of $0.475 > 0.05$. The orange productivity depends on rainfall, land area, and cheap maintenance cost (Mashudi, 2019).

4.2 Land Area of Apple and Orange from 2011-2021

The highest average movement of apple land area from 2011 to 2021 occurred in 2010 with 2617.85 hectares; the lowest was in 2019, 973.38 hectares.

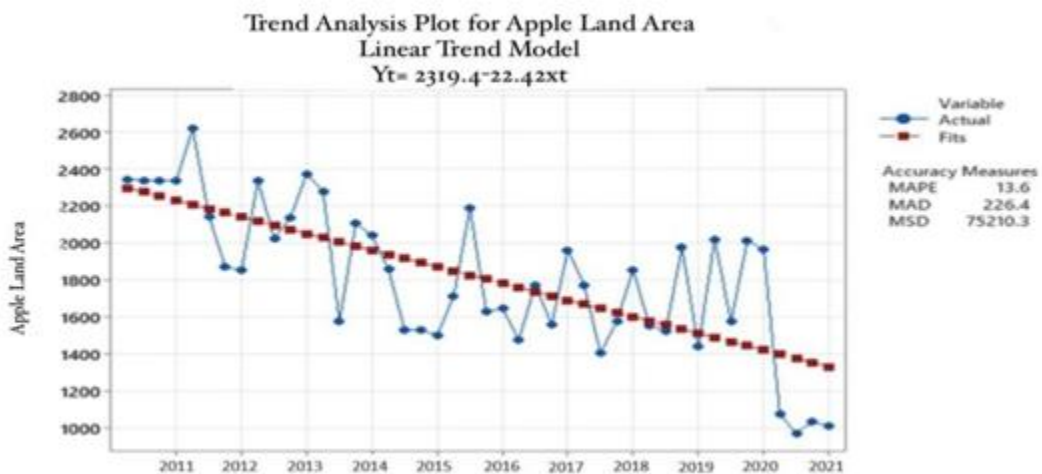


Figure 3: Time Series Plot of Apple Land Area

The above trend analysis result shows that the apple land area's upper and lower bounds tend to decrease. The land shift of usage in Batu from 2006 to 2018 occurred primarily due to the shifting of forest area to non-forest area (50%) and farmland to building sites (5.2%). Land expansion in apple farming at Batu is not feasible as it will take more capital to do so (Ananda, 2022).

The forecasting of land shift purpose in 2030 at Batu shows a decrease of 7,106.6 hectares (35.7%), and the building site increases by 20.7% (Kreshna, 2020). The change affects the increasing potential of natural disasters and the decreasing availability of apple land area in Batu. The land purpose shifting of apple area in Bumiaji did not occur merely due to land selling but also due to the plant switch, as the previous one did not produce an expected result (Wahyudi, 2015).

The forecasting result of apple land area experienced a decrease. The prediction of apple land area from 2022 to 2025 based on the model identification, parameter estimation, and ARIMA verification model shows the SC value of 14.50196, AIC of 14.33813, and the Adjusted R-Square of 0.29464 with the probability of $0.652 > 0.05$. The apple land area is decreasing due to land shifting to building sites.

The highest orange land area occurred in 2020, with an average land area of 1637.17 hectares, and the lowest was in 2011, with an average of 257.94 hectares. The Adjusted R-Square value was 0.240962, expressing the significance value. The forecasting result of the orange land area with the upper and lower bounds shows an increase. The QStatistic probability value is more than 0.05; therefore, the data forecasting of the orange land area has a random residual.

The orange cultivation area at Punten village in Batu reaches 14 hectares, which has potential development. The interest shifting in farmers from apple to orange is due to the decreasing production of apple yield (Gusti, 2022). The decrease is due to environmental and meteorological factors. The rising temperature in Batu, unpredictable weather and the number of non-productive apple plants cause less yield productivity. The unpredictable rainfall also affects the maintenance issue for apples, which becomes more difficult. The more manageable maintenance cost and higher price of orange yield bring more economic benefits than apples (Winasis, 2016).



Figure 4: Time Series Plot of Orange Land Area

The forecasting result of the orange land area experienced an increase. The prediction of the orange land area from 2022 to 2025 based on the model identification, parameter estimation, and ARIMA verification model shows the SC value of 12.0048, AIC of AIC 11.8410, and the

Adjusted R-Square of 0.240962 with the probability of $0.118 > 0.05$. The orange land area is increasing due to cheap maintenance costs, high selling prices, and consumer demand.

4.3 Apple and Orange Plants Number from 2011-2021

The number of apple plants reached its highest in 2013 with an average tree amount of 2,468,895 trees, and the lowest was in 2021, which were 1,548,019 trees. The trend on apple plant numbers from 2011 to 2021 tends to experience a decrease. One of the reasons for this decrease is the lack of organic provision to the plants. The apple land area in Batu has been polluted by chemical matters, which causes damage to the land structure (Rasyid, 2016). The decrease of productive apple plants results in the low competitiveness of apples with other yield products (Isnain, 2014).

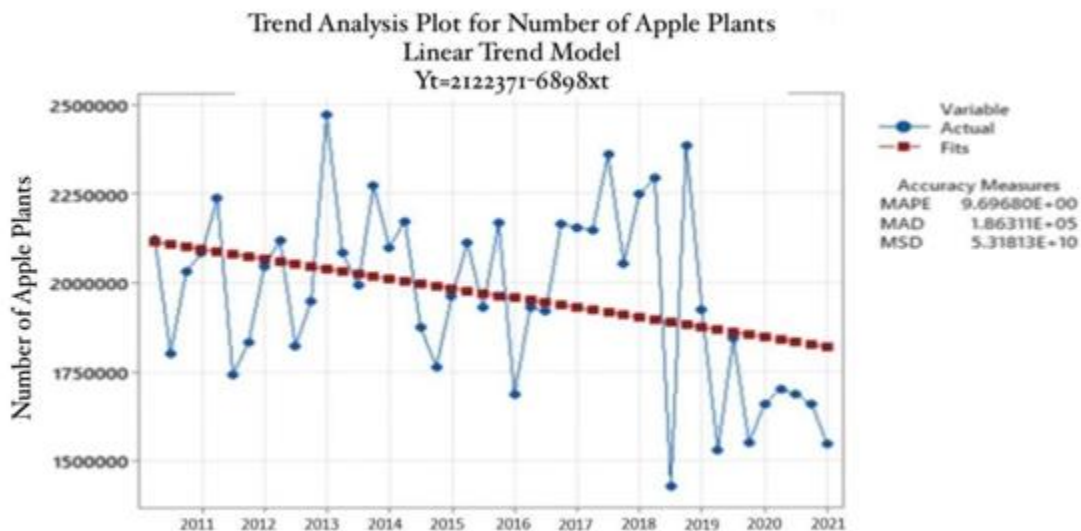


Figure 5: Time Series Plot of Apple Plants Number

The forecasting result of apple plants number experienced a decrease. The prediction of the apple plants number from 2022 to 2025 based on the model identification, parameter estimation, and ARIMA verification model shows the SC value of 27.896, AIC of AIC 27.728, and the Adjusted R-Square of 0.05 with the probability of $0.926 > 0.05$. The apple plant age in Batu is more than 25 years; therefore, apple yield is less productive.

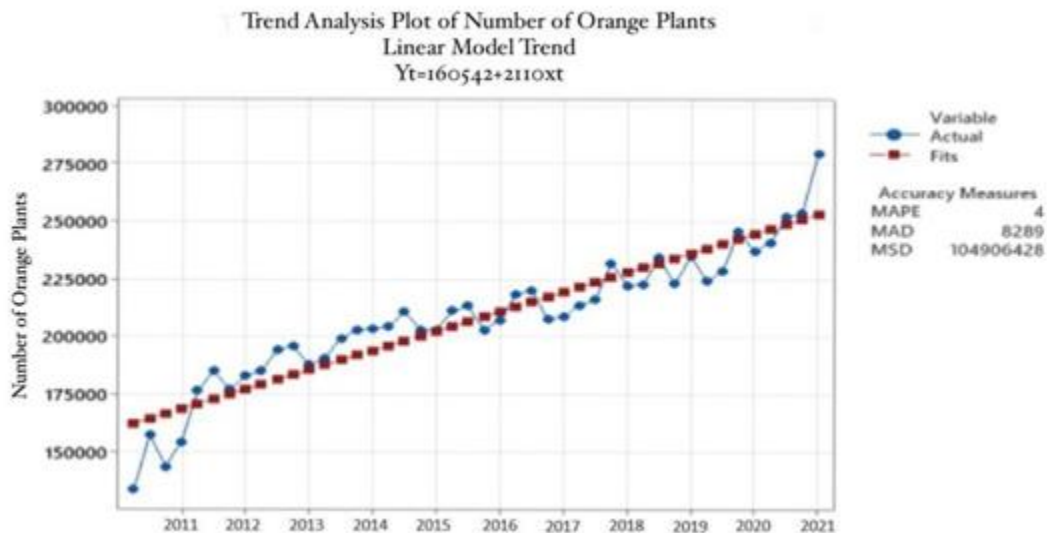


Figure 6: Time Series Plot of Orange Plants Number

The number of orange plants reached its highest in 2021, with an average tree amount of 279,697 trees, and the lowest was in 2011, with 134,031 trees. The trend on orange plant numbers from 2011 to 2021 tends to experience an increase. The orange cultivation development in Batu shows an increase based on production in 2021, which reached 1,626 tons or around 7%. Apple production decreased in 2021 by 4,006 tons. The demand for oranges in Batu is reaching 18,760 tons in 2022, which is in line with the orange production target from the Agricultural Agency (Gusti, 2022).

The forecasting result of orange plants number experienced an increase. The prediction of the orange plants' number from 2022 to 2025 based on the model identification, parameter estimation, and ARIMA verification model shows the SC value of 27.896, AIC of AIC 21,472, and the Adjusted R-Square of 0.1067 with the probability of $0.190 > 0.05$. The increase is due to the cheaper maintenance cost for oranges and the consumers' demand.

4.4 Land Area Trend Comparison of Apple and Orange Plants

Based on the following figure 7, the apple land area trend from 2011 to 2021 experienced a decrease, with the most extreme land inclination in 2015. On the contrary, the orange land area appeared to increase with the highest average in 2020. A trend is a pattern in a series of development that appears and moves towards a specific direction in a period, which can show an increase or decrease (Postma & Papp, 2020).

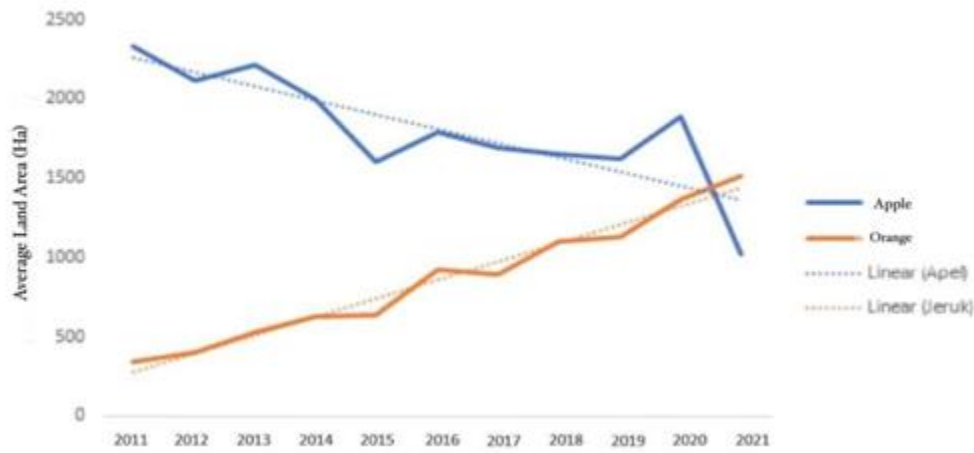


Figure 7: Land Area Trend Comparison of Apple and Orange Plants from 2011 to 2021

One hectare of apple land produces 40 tons at its maximum extent. Apple production is high, but the price on the farmers' level often experiences a decrease up to Rp 3,000 to Rp 4,000 per kilogram. The factors that affect the apple land suitability are the high level of rainfall, effective rooting depth, slope, and erosion of the apple cultivation area.

Apple plants need a significant amount of water but not excessively flooding as it cause the plant cannot reach its maximum development (Aditiyas, 2016). The high maintenance cost of apple farms causes an increased production cost for the yield. Therefore, the farmers cannot meet the maintenance cost to its maximum extent. Besides, the apple farmers' motivation to grow the plants has decreased.

The lack of organic material used for the crops can damage the soil structure. The phenomenon causes a decrease in the soil microorganism, hardens the soil, and decreases soil fertility. The soil organic material is significant in maintaining an area's physical and chemical characteristics.

According to figure 8, apple plant numbers from 2011 to 2021 tend to decrease, with the most extreme average occurring in 2020. The trend of orange plant numbers relatively increases, with the highest average in 2021. The decrease in apple plant numbers is due to the climate change from dry-cold to dry-hot, a massive pest attack, and the low product price (Yuliastika, 2014).

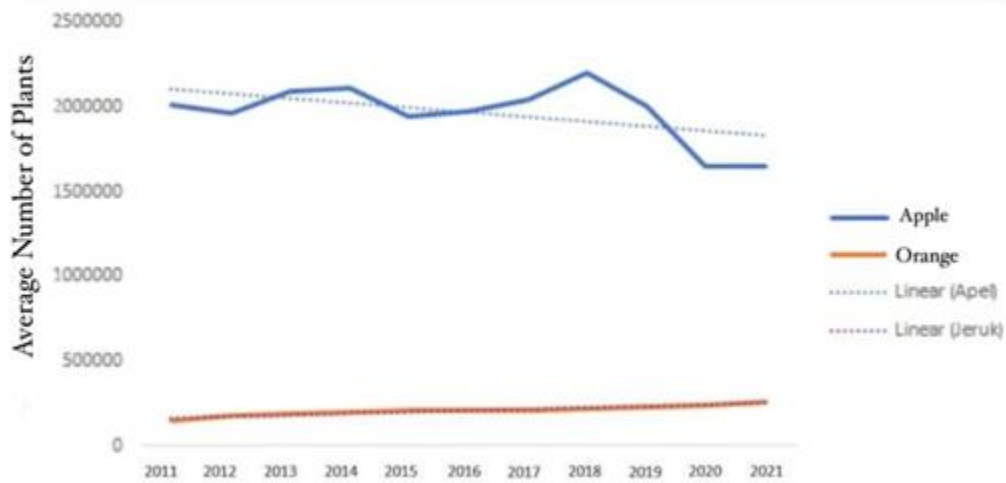


Figure 8: The Trend Comparison of Apple and orange Plants Number from 2011 to 2021

The temperature change in Batu is available in the following figure 9:



Figure 9: Average Temperature in Batu

Climate change causes a decrease in apple yield production. The decrease is also due to the non-climate factor, which includes the land shifting purpose of apple farm area, unproductive apple trees due to old age, and insufficient cultivation methods.

High temperature causes transpiration on apple trees, making the plant dry and drought-deciduous. The apple tree has a short taproot; therefore, it needs an adequate water supply on the surface level of the land. The maximum temperature for the orange plant is between 25°C to

30°C; nevertheless, the plant can still grow well at 35°C. The temperature for baby orange is between 13°C to 35°C, with the ideal temperature being between 22°C-23°C.

4.5 Production Trend Comparison of Apple and Orange Plants from 2011 to 2021

The apple production trend from 2011 to 2021 tends to decrease with the most extreme average in 2017 and 2021. On the other hand, the trend for orange tends to increase with the highest average in 2021.

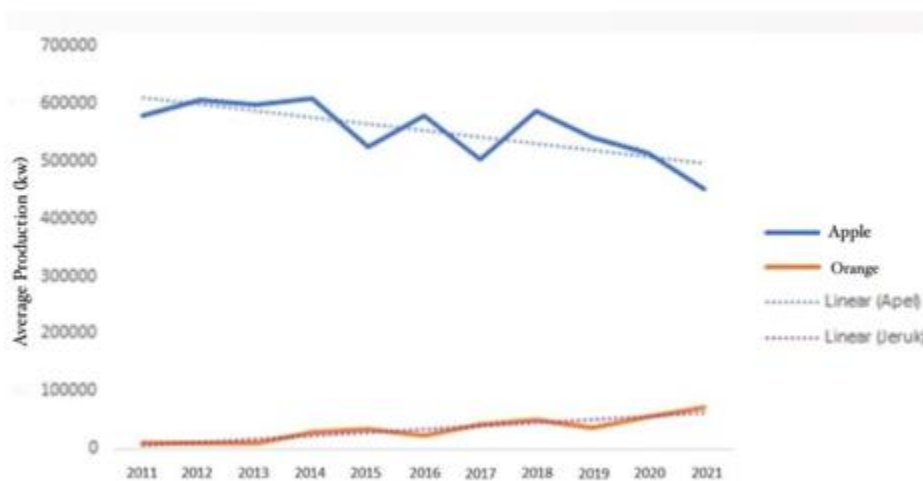


Figure 10: Production Trend Comparison of Apple and Orange Plants from 2011 to 2021

Old apple trees need revitalization. The land's functional purposes have caused the temperature increase in Batu. Another issue is the apple farmers' difficulty finding good seeds, which decreases productivity. The findings are in line with an interview result with Bapak Kibul:

"My apple trees are now 34 years old, so my yield has decreased. Other things that cause my yield to decrease are the excessive usage of fertilizer and pesticides. The usage damages the soil, which is why the yield's quality and productivity are decreasing. My apple trees are smaller than they used to be. The fruits also become smaller, taste less than they used to, and basically, my yield has dropped."

5. CLOSING

5.1 Conclusion

Apple's yield production from 2011 to 2021 fluctuated. The highest production occurred in 2018,

with the production average reaching 684,204.29 quintals, and the lowest was in 2017 at 413,909.06 quintals. The orange yield production was also fluctuating from 2011 to 2021. The highest production occurred in 2019, with the production average reaching 77,576.29 quintals, and the lowest was in 2010, at 8,105.3 quintals.

The apple farm shifting occurred from 2011 to 2021; its highest average was in 1020 by 2617.85 hectares and the lowest in 2019 by 973.38 meters. The land shift in Batu from 2006 to 2018 was primarily due to the change of forest area to non-forest area (5.0%) and agricultural land to the building site (5.2%).

Based on the stationary test result, the apple plant number from 2011 to 2021 reached the highest in 2013 at 2,468,895 trees and the lowest in 2021 at 1,548,019 trees. The highest number of the orange plant was in 2021, with 279,697 trees on average, and the lowest was in 2011, with 134,031 trees. The land area trend for apple from 2011 to 2021 tends to decrease with the most extreme average in 2015.

Unlike the trend of orange land area that reached its highest increase in 2020, the number of apple plants from 2011 to 2021 tends to decrease with its lowest in 2020/ The trend of orange plant number increased with its highest average in 2021.

Factors that cause the decrease of apple land area are the temperature increase, humidity decrease, excessive usage of pesticides, inadequate age of trees (too old), increasing maintenance cost, decreasing production, low price of apple products, and the frequent loss experienced by the farmers. On the other hand, the orange land area is increasing due to the low maintenance cost, the high price of the orange product, the increasing production, and consumers' demand.

5.2 Suggestion

The government of Batu city is expected to help the farmers develop their apple and orange commodities. Therefore, the farmers can cultivate their farmland well and to the maximum extent, eventually increasing the yield for both crops. It is believed that the efforts can make the apple the main commodity in Batu as it used to be. Thus, it will increase the economy of people in the Batu area.

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