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CHANGES IN RAINFALL ON PLANTING AREA AND OIL PALM PRODUCTION IN THE HIGHLANDS OF DELI SERDANG DISTRICT, NORTH SUMATRA

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Abstract

The research was conducted from February to April 2024 in Deli Serdang Regency, North Sumatra Province. Rainfall is a very important climatic factor in influencing crop growth and production, including oil palm. The purpose of this study was to examine how rainfall affects the planting area and production of oil palm in the highlands of North Sumatra. The study used secondary data in the form of information on planting area and production in Deli Serdang Regency during 2019-2023, obtained from the Deli Serdang Regency Agriculture Office and the Food Security and Horticulture Office, as well as the Meteorology, Climatology and Geophysics Agency in Deli Serdang, North Sumatra. The results showed that there was a negative correlation between rainfall and oil palm planting area and production, with values of -0.599 and -0.645, respectively. This means that there is a moderate negative relationship between rainfall and oil palm planting area and production, where higher rainfall results in lower oil palm planting area and production, although this is not statistically significant.

Keywords: Oil_Palm, Climate_Change, Rainfall, Planting_Area, Production.

INTRODUCTION

Oil palm (Elaeis guineensis Jacq.) is one of the most promising oil-producing crops. Indonesia's palm oil production in 2019 reached 51.8 million tonnes of crude palm oil (CPO). This figure represents an increase of around 9 per cent from the 2018 production of 47.43 million tonnes (GAPKI, 2020). High demand for cooking oil from developing economies in Asia, such as India and China, as well as high domestic consumption levels, are the main driving forces behind the growth of the palm oil industry in Indonesia. Under certain conditions, the influence of climate on vegetation growing in a particular place is much stronger than the influence of soil. Knowledge of how plants can thrive in a particular climate requires more detailed climate information from several decades, including monthly averages and distribution patterns throughout the year, while daily weather information is needed to estimate plant diversity (Setiawan, 2009). Rainfall can be considered the main factor limiting the potential yield of oil palm (Goh et al., 2011) and because it is difficult to change, it is more practical to modify agronomic practices to adapt to existing climatic conditions so as to support the achievement of good potential yields in oil palm.

Paterson et al. (2015) explain that climate variability that can affect oil palm growth is drought stress and excess water stress (rainfall, rainy days, wet months, dry months, months Yuniasih et al. (2022) explain that between 2013 and 2022, Indonesia experienced several instances of climate anomalies. Normal climate conditions occurred in 2013, 2016, 2017, and 2018. El Niño occurred in mid-2014 and 2015 with strong El Niño intensity and in 2019 with weak El Niño intensity, while in mid-2020, 2021, and 2022, weak to moderate La Niña conditions were experienced. Based on the frequency of occurrence, La Nina is classified as less frequent than El Nino. La Nina usually occurs after an El Nino event (Information National Centers for Environmental, 2022). Yuniasih et al. (2022) explain that based on sea surface temperature anomaly data recorded using NOAA satellite imagery, the

last La Niña event occurred in June 2006 before reoccurring in August-November 2016 and November 2017-March 2018. Following the La Niña event in early 2018, a weak El Niño event occurred from October 2018 to March 2020. The 2019 El Niño event was then followed by another La Niña event from 2020 to 2022. Rainy and dry seasons are some of the main causes of fluctuations in palm oil production and productivity. Therefore, understanding the effect of weather on the growth and production of palm oil bunches can be used as a basis for predicting and evaluating the productivity of fresh fruit bunches (FFB). Based on this, it is necessary to conduct a study on 'The Effect of Rainfall on Planting Area and Oil Palm Production in the Highlands of Deli Serdang Regency, North Sumatra Province'.

LITERATURE REVIEW

The classification of oil palm according to Apriyaldi (2015) is as follows: Kingdom: Plantae; Division: Embryophyta Siphonagama; Class: Angiospermae; Order: Monocotyledonae; Family: Arecaceae; Subfamily: Cocoideae; Genus: Elaeis; Species: Elaeis guineensi Jack. The requirements for optimal oil palm growth are largely determined by effective soil depth (soil solum >75 cm) and good drainage. Oil palms can grow on land with varying levels of soil fertility, ranging from fertile to marginal land. Oil palms grow optimally at a pH of 5.0-6.5 (Djaenudin et al. 2000). Oil palms grow well at an air temperature of 27°C with a maximum temperature of 33°C and a minimum temperature of 22°C throughout the year. The average annual rainfall required for oil palm growth is 1,250–3,000 mm, evenly distributed throughout the year, with optimal rainfall ranging from 1,750 to 2,500 mm. The optimal altitude for oil palm cultivation is less than 400 metres above sea level. The suitable terrain for oil palms is an area with a slope of 0-8%. If an area has undulating to hilly topography (slope of 8-30%), oil palms can still grow and produce well, but certain management measures must be taken, such as the creation of terraces (Buana et al. 2006).

Climate change is the alteration of the physical conditions of the Earth's atmosphere, including temperature and rainfall distribution, which has a widespread impact on various aspects of human life. (Ministry of Environment, 2001 in LAPAN). According to Law No. 31 of 2009 on Meteorology, Climatology and Geophysics, climate change is a change in climate caused, directly or indirectly, by human activities that result in global changes in atmospheric composition and changes in natural climate variability observed over a comparable period of time (Putri, 2012). Rain is an important weather component for the life of organisms on the earth's surface. Rainfall is one of the climate elements that can be used as an indicator in food crop production. Rainfall has a significant influence and is a climate element with high fluctuations. The total amount of rainfall is very important in determining yields, especially as rising temperatures can reduce yields. (Cahyaningtyas, 2017). Rainfall and temperature are very important climate elements for life on Earth. A rainfall amount of 1 mm indicates the height of rainwater covering the surface by 1 mm, if the water does not seep into the ground or evaporate into the atmosphere (Indrawan, 2017).

METHOD

The research was conducted from February to April 2024 by collecting data in several sub-districts with highland topography in Deli Serdang Regency, such as the sub-districts of Gunung Meriah, Sinembah Tanjung Muda Hulu, Sibolangit, Biru-biru and Kutalimbaru. This study used secondary data in the form of information on planting area and production in Deli Serdang Regency during 2019-2023, obtained from the Deli Serdang Regency Agriculture Office and the North Sumatra Province Food Security and Horticulture Office's Food and Horticulture Crop Control Unit. Rainfall data for 5 years was obtained from the Meteorology, Climatology and Geophysics Agency in Deli Serdang, North Sumatra. The collected data was then analysed using simple linear regression, correlation coefficients and determination coefficients using SPSS software.

RESULTS AND DISCUSSION

1. Planting Area

Based on (Table 1), it can be seen that the linear regression equation obtained is Y = 9421.970 - 26.119 X, where Y is the dependent variable, namely Planting Area. The regression coefficient for Rainfall is -26.119, which means that every 1 unit increase in Rainfall will result in a decrease of 26.119 units in Planting Area. The significance value (Sig.) of 0.286 is greater than the significance level of 0.05, indicating that the relationship between rainfall and planting area is not statistically significant. In addition, the t-value of -1.295 is smaller than the t-table value (2.35336), so the alternative hypothesis (H_1) stating that rainfall has a significant effect on planted

area is rejected, and the null hypothesis (H_0) is accepted. Therefore, it can be concluded that rainfall does not have a statistically significant effect on crop area.

Table 1. Linear Regression of Rainfall on Crop Area in the Highlands of Deli Serdang Regency

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	9421,970	4464,713		2,110	,125
	Curah Hujan	-26,119	20,164	-,599	-1,295	,286

a. Dependent Variable: Luas Tanam

The extent to which rainfall percentage (%) affects oil palm cultivation area in the highlands of Deli Serdang Regency can be seen in (Table 2.). The coefficient of determination result, where R Square is 0.359, means that rainfall affects oil palm production in the highlands of Deli Serdang Regency by 35.9%, while the remaining 64.1% is influenced by other factors.

Table 2. Effect of Rainfall on Oil Palm Planting Area in the Highlands of Deli Serdang Regency

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,599[a]	,359	,145	2088,65584

a. Predictors: (Constant), Curah Hujan

Good oil palm plantations require fertile soil influenced by several criteria, namely rainfall, topography, slope, texture, and water depth (Hatta et al., 2017). Rainfall itself can increase environmental humidity, which will be followed by an increase in the development of pathogens that will reduce or inhibit the growth of cultivated plants, ultimately reducing the planting area of the commodity being cultivated (Radiah et al. 2025). Table 3 below presents data on the relationship between rainfall and oil palm planting area in the highlands.

Table 3. Correlation between Rainfall and Oil Palm Planting Area in the Highlands of Deli Serdang District

Based on the results of the correlation analysis in (Table 3), a Pearson Correlation value of -0.599 was obtained, indicating that there is a moderate negative relationship between rainfall and planted area, where the higher the rainfall, the lower the land area. However, the significance value (Sig. (2-tailed)) of 0.286 is greater than the significance level of 0.05, meaning that the relationship is not statistically significant.

Correlations

		Curah Hujan	Luas Tanam
Curah Hujan	Pearson Correlation	1	-,599
	Sig. (2-tailed)		,286
	N	5	5
Luas Tanam	Pearson Correlation	-,599	1
	Sig. (2-tailed)	,286	
	N	5	5

2. Production

Based on the regression analysis results (Table 4), the linear regression equation Y = 29213.089 - 87.267 X was obtained. The regression coefficient value for Rainfall is -87.267, indicating that every 1 unit increase in Rainfall will decrease Production by 87.267 units. The significance value (Sig.) of 0.240 is greater than the significance level of 0.05, indicating that the relationship between rainfall and production is not statistically significant. In addition, the t-value of -1.462 is smaller than the t-table value (2.35336), so the alternative hypothesis (H_1) stating that rainfall has a significant effect on oil palm production is rejected, and the null hypothesis (H_0) is accepted. Therefore, it can be concluded that rainfall does not have a statistically significant effect on oil palm production.

Table 4. Linear Regression of Rainfall on Production in the Highlands of Deli Serdang Regency

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	29213,089	13218,657		2,210	,114
	Curah Hujan	-87,267	59,698	-,645	-1,462	,240

a. Dependent Variable: Produksi

The extent to which rainfall percentage (%) affects oil palm production in the highlands of Deli Serdang Regency can be seen in Table 5 below. The coefficient of determination, where R Square is 0.416, means that rainfall affects oil palm production in the highlands of Deli Serdang Regency by 41.6%, while the remaining 58.4% is influenced by other factors.

Table 5. Effect of Rainfall on Oil Palm Production in the Highlands of Deli Serdang Regency

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,645[a]	,416	,221	6183,87496

a. Predictors: (Constant), Curah Hujan

According to (Harahap et al., 2021), oil palms require rainfall of around 1,500 to 1,700 mm per year to achieve optimal yields. Therefore, analysing the correlation between rainfall and oil palm production is crucial to understanding these dynamics and formulating better management strategies. Table 26 below presents data on the relationship between rainfall and oil palm production in the highlands of Deli Serdang Regency.

Table 6. Correlation between Rainfall and Oil Palm Production in the Highlands of Deli Serdang Regency

Based on the results of the correlation analysis in (Table 6), the Pearson Correlation value is -0.645, indicating a strong negative relationship between rainfall and production, whereby higher rainfall results in lower production. However, the significance value (Sig. (2-tailed)) is 0.240, which is greater than the significance level of 0.05, meaning that the relationship is not statistically significant.

Correlations

		Curah Hujan	Produksi
Curah Hujan	Pearson Correlation	1	-,645
	Sig. (2-tailed)		,240
	N	5	5
Produksi	Pearson Correlation	-,645	1
	Sig. (2-tailed)	,240	
	N	5	5

CONCLUSION

There is a negative correlation between rainfall and oil palm planting area and production, with values of -0.599 and -0.645, respectively, which means that there is a moderate negative relationship between rainfall and oil palm planting area and production, where higher rainfall results in lower oil palm planting area and production, although this is not statistically significant, with Sig. (two-tailed) of 0.286 and 0.240, respectively.

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