

The Effect of Rainfall and Rain Days On Palm Oil Production

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ABSTRACT

One of the determining factors for water availability for palm oil plants that do not use irrigation systems is rainfall. The availability of water is a major factor that limits the level of production of palm oil plants. The availability of water for oil palm plants in the field is obtained from rainfall data. This research was conducted at PT. Mentohi Makmur Lestari, Lamandau Regency, Central Kalimantan Province, from June 2021 to July 2021. This study uses secondary data analysis including data on of fresh fruit bunches (TBS) production components in the form of components of the number of fruit bunchesg, average fruit bunches weight, number of productive principals, seed fruit bunches weight; data on the production of fres TBS; rainfall data; and monthly rainy day data in 2017, 2018 and 2019 in 6 Divisions. The results of the analysis showed that variable rainfall and rainy days had a real effect on the increase in TBS production at the age of 5 years. Correlation results in plants aged 12, 15 and 18 years with a two-way analysis at the test level of 1% showed the variable rainfall and rainy day had a strong, real and unidirectional relationship. The correlation value of rainfall and consecutive rainy days is 0.892; 0,887; and 0.855 with significance value of 0.000.

Keywords: determining factors, fresh fruit bunches, Kalimantan, water availability

INTRODUCTION

The demand for palm oil as a vegetable oil continues to increase around the world. This is because palm oil is not only for consumption by humans, but also for use as a fuel and as a raw material in the chemical industry. This increase in global consumption has resulted in continuous expansion or land expansion. There are several factors that affect the productivity of palm oil crops, namely climate, regional shape, soil conditions, planting materials, and cultivation techniques [1]. Furthermore, adding that the age of the crop, the number of crop populations per hectare, pollination

system, harvest coordination system, and so on also affect the productivity of palm oil [2].

Factors that affect the growth and productivity of TBS can be grouped into three factors, namely: (i) environmental factors: climate, soil, land ability, (ii) plant material factors: botany and propagation of plant material and (iii) tissue culture factors [3]. Nutrition plays an important role in bunch weight and is strongly related to soil fertility, fertilizer application and palm oil nutrient status [4]. Some studies show that rainfall factors and rainy days greatly affect agricultural production. Rainfall and rainy days will affect the process of plant growth and

production every year [5]. Rainfall and rainy days have a real effect on increasing the production of TBS of palm oil at the age of five years [6]. Rainfall has a strong, tangible and positive association to TBS production at 12, 15, and 18 months of age [7]. Meanwhile, the number of bunches per tree per year always decreases based on age, ranging from 28 bunches at the age of five years to approximately eight bunches at the age of 25 years, but the weight increases from 10 - 27 kg [8].

Before reaching the period of high production will be found bunches that develop and require high asimilat [9]. Changes in agricultural production due to rainfall will not only affect plantation commodities, but will have an impact on agricultural commodities in urban areas [10]. One of them is Lamandau City, its agricultural production was fruktuatif from 2011-2015. In addition, rainfall is a characteristic of land that cannot be repaired / changed. So there is also a change in land characteristics for every agricultural commodity in Lamadau City from very suitable (S1) to quite appropriate (S2), marginal (S3) even not appropriate (N) for the process of growth and crop production every year [11]. The wider the composition of the age of adolescent plants and rent, the lower the level of productivity. While the more mature and used plants the higher the level of productivity [12].

MATERIALS AND METHODS

This research was conducted at PT. Mentobi Makmur Lestari, Kujan Estate, Central Kalimantan Province, Kab Lamandau with a place height of 80-130 meters above sea level (dpl) which starts from June 2020 to September 2020. This research uses basic methods that are descriptive methods (descriptive analysis) quantitative and qualitative.

Secondary data taken is monthly data for 3 years (2018-2020) including rainfall data and rainy day data; production data; Data on the age of plants aged 12, 15 and 18 years after planting based on the age of planting years in the field, namely planting year 2004 (age 18 years), planting year 2007 (age 15 years) and planting year 2010 (age 12 years). The analytical methods used are multiple regression analysis and regression correlation. The functional influence of monthly rainfall variables and rainy days on TBS production is analyzed with mathematical functions:

$$Y = a + b_1X_1 + b_2X_2 + E. \quad (1)$$

Models tested for feasibility with classical assumption tests include normality tests, heteroskedasticity tests, multicollinearity tests, as well as autocorrelation tests using statistical aids SPSS.v.17. The observation materials in this study are components of TBS production including the number of fruit bunches, the number of productive trees, average fruit bunches weight and fruit bunches weight; rainfall (mm/month); rainy days (days/months) and TBS production (tons/months).

RESULTS AND DISCUSSION

Multiple linear analyses to find out if rainfall variables and rainy days will have an effect on palm oil production. The coefficient value (R) indicates the magnitude of the relationship of rainfall variables and rainy days to TBS production variables is 65.2% (somewhat weak), 66.3% (somewhat weak), 69.4% (somewhat weak). The coefficient of determination (R²) indicates that 42.5%, 44%, 48.1% variation in palm oil production can be explained by variations in rainfall variables and rainy days that occur and the rest of the 69.3%, 67%, 85% are explained by other variables that are not included in the model.

F-count values of 3.319, 3,539, and 4.177 with

F-table values of 4.26 and significance values on this test are 0.083, 0.073, and 0.052. The significance value on the F test is greater than the alpha of 5% ($\text{Sig} > \alpha 0.05$). This means that the variables of rainfall and rainy days in the model together have an unreal effect on TBS production in palm oil plants aged 12, 15, and 18 years.

Table 2. Multiple linear regression equations in palm oil plants aged 12, 15, and 18 years for 3 years

Age	Source of Diversity	Degrees of Freedom	Degrees Square	Middle Square	F-count	Sig.
12 Year	Regression	2	646085.3	323042.7	3.319775	0.083
	Residual	9	875777.4	97308.6		
	Total	11	1521863			
15 Year	Regression	2	821842.9	410921.4	3.53883	0.073
	Residual	9	1045061	116117.9		
	Total	11	1866904			
18 Year	Regression	2	722081.5	361040.8	4.17682	0.052
	Residual	9	777951.5	86439.06		
	Total	11	1500033			

Regression equation model: $Y = 1.245,89 - 2.335 \text{ rainfall} - 6.076 \text{ days of rain} + E$, it means that each addition of one unit of rainfall value will decrease the tbs production value by -2.335 units and each addition of one unit of rain day value will decrease the tbs production value by 6.076 units. Regression equation model: $Y = 872,876 - 3,707 \text{ rainfall} + 8,255 \text{ days of rain} + E$, meaning that each addition of one unit of rainfall value will increase the value of TBS production by 3.707 units and each addition of one unit of rain day value will increase the value of TBS production by 8.255. Regression equation model: $Y = 724.010 + 4.501 \text{ rainfall} - 8.388 \text{ days of rain} + E$, meaning that each addition of one unit of rainfall value and rainy day will decrease the tbs production value by 4.501 units and 8.388 units.

The results of the above correlation analysis test on palm oil plants aged 12, 15 and 18 years showed a strong synergy relationship between rainfall variables and consecutive rainy days of 0.895; 0.887

Table 1. The coefficient value of the double linear regression equation in palm oil plants is 12, 15, and 18 years old for 3 years.

Age	Coefficient Value		
	R	R2	Adjusted R2
12 Year	0.652	0.425	311.943
15 Year	0.663	0.440	340.760
18 Year	0.694	0.481	294.005

and 0.911. The strong relationship shows the effect between rainfall variables and rainy days on the achievement of TBS production. Significance values smaller than 1% alpa ($\text{Sig} < \alpha 0.01$) and other correlations show a weak correlation found in tbs production variables with rainfall in 12- and 15-year-old plants of 0.285 and 0.136. A weak correlation is also found in the tbs production variable with rainy days in 18-year-old plants, which is 0.369 years old.

The results of the analysis showed that rainfall and rainy days had an unreal effect on TBS production in palm oil crops aged 12 years, 15 years and 18 years. Rainfall too high will also have a less good effect because vegetative growth is more dominant than generative growth so that flowers or fruit are formed relatively less. The amount of rainfall that is too high will interfere with garden activities such as plant maintenance, smooth transportation, and erosion. High rainfall will not cause negative effects if soil drainage and solar

irradiation are good enough.

Low rainfall causes water deficits in palm oil crops. Rain that does not fall for 3 months causes the growth of leaf buds to be inhibited until it rains (the leaf or young leaf can not break down). Long rain does not fall also has a lot of influence on fruit production, because the fruit that is old enough does not want to threshed until it rains. Good rainfall for the growth and production of palm oil crops is above 2000 mm and evenly distributed throughout the year. Rain that does not fall for 3 months causes the growth of leaf buds to be inhibited, leaf children or young leaf can not break down [13]. Long rain does not fall affects the production of fruit, because the fruit that is old enough does not want to cook until it rains.

High rainfall in palm oil plants can inhibit pollination of flowers by insects and rotten fruit in trees so that TBS production becomes low. The low

production of TBS produced is caused because the flowers at the time of pollination do not become fruit because of the high number of rainy days and cause the fruit to fall. Excess water due to high rainfall can cause the failure of ripe bunches in flowers that have experienced anthesis. Many rainy days result in a decrease in the intensity of solar irradiation so that the rate of photosynthesis drops. The relationship between rainfall, rainy days and production only takes place when palm oil plants undergo a pollination process. Palm oil plants undergo a pollination process, the high number of rainy days can affect pollination in the next year because the flowers in pollination do not become the fruit that causes the fruit to fall. Excessive rainy days result in a decrease in the intensity of solar irradiation so that the rate of photosynthesis drops and causes decreased productivity.

Table 3. Multiple linear regression analysis testing models in 12, 15, and 18-year-old palm oil plants

Age	Variabel	Koefisien regresi	Sig.
12 Year	constant	1,245.89	0.000
	Rainfall	2.335	0.182
	Rainy day	-6.076	0.862
15 Year	constant	872.876	0.063
	Rainfall	3.707	0.105
	Rainy day	8.255	0.831
18 Year	constant	724.01	0.065
	Rainfall	4.501	0.162
	Rainy day	-8.388	0.861

Table 4. Tabel of Anova

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	649005.733	2	324502.867	3.339	.082 ^a
	Residual	874681.934	9	97186.882		
	Total	1523687.667	11			

a. Predictors: (Constant), Rainy Day, Rainfall

b. Dependent Variable: Production

CONCLUSION

The results of various linear regression equations show that rainfall and rainy days have an unreal effect on the increase in TBS production in palm oil

plants aged 12, 15, and 18 years. The results of the classical assumption test conducted to find out whether the multiple regression equation is feasible or not to be used show that the regression equation in

oil palm plants aged 12, 15, and 18 years has qualified. The correlation test results between variable TBS production, rainfall and rainy days in palm oil crops aged 12, 15 and 18 years have a strong, real and unidirectional (positive) relationship and are interrelated to the achievement of TBS production. Further research is needed in addition to rainfall and rainy days related to other climate factors such as the influence of temperature (temperature), humidity, the intensity of sunlight on palm oil production with data over three years.

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