ANALYSIS OF RAINFALL VARIABILITY IN DANDA JAYA SWAMP IRRIGATION AREA DUE TO CLIMATE CHANGE

by Ahmad Saiful Haqqi

ANALYSIS OF RAINFALL VARIABILITY IN DANDA JAYA SWAMP IRRIGATION AREA DUE TO CLIMATE CHANGE

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ABSTRACT

Indonesia as an archipelago in between two oceans and located on the equator is prone to climate change. Climate change is characterized by changes in rainfall patterns that shift the beginning of rainy season and dry season. Therefore, it is necessary to conduct a test on the rainfall to determine the distribution pattern of rainfall in an area. This study aims to identify climate change through the tendency, distribution, and similarity of precipitation data with different timescales, by using precipitation data from 2000-2020. Precipitation data were obtained from the BMKG observation station in Karang Indah, Mandastana, Barito Kuala, South Kalimantan. The data were then grouped into 2 periods of observation year. Precipitation data for the rainy season in first period of 2000-2009 (October - June) and the dry season (July - September), rainy season in the second period of 2010-2020 (October - July), and the dry season (August - September). Determination of rainy season and dry season is based on Oldeman's classification to determine the wet and dry months in the two observation periods. Then, a normality test using Smirnov-Kolmogorov was conducted to determine if the data to use have a normal distribution based on its significant value. Statistical tests were carried out using regression analysis by using the relationship among quantitative variables where one of the variables can be predicted from other variables. This study aims to identify the existence of climate change through a tendency pattern using linear regression analysis. The analysis result conducted in Danda Jaya Swamp Irrigation Area using daily precipitation data from 2000-2020 showed a tendency to increase in rainfall intensity of 18.944 mm/year. The linear regression equation is Y = 18.944x + 2449.8 with a correlation coefficient of $R^2 = 0.0385$. Trend analysis of the annual average rainfall in rainy season in period I and II decreased by -2.663 mm/year and -11.542 mm/year respectively. In the dry season, the average value of annual rainfall increased in the first period of 4,886 mm/year and the second period of 3,083 mm/year.

Keywords: Rainfall Pattern, Climate Change, Rainy Season, Dry Season, Linear Regression

I. INTRODUCTION

Indonesia is an archipelago between two oceans: Indian Ocean and Pacific Ocean makes Indonesia has a lot of water vapor, and due to its location on the equator line, Indonesia is highly prone to climate change. This climate change has an impact on changes in rainfall patterns, floods, droughts, sea-level rise, and changes in temperature. The greenhouse effect results in climate change, fossil fuel burning (petroleum, coal, gas), and deforestation increase global warming [1].

This study aims to analyze the variability of rainfall in Danda Besar Swamp Irrigation Area in Rantau Badauh, Barito Kuala Regency. In a previous study by Kumagai et al. in 2013, an article entitled "Deforestation-induced Reduction in Rainfall" explained that in Kalimantan, there was a decrease in rainfall of -12.7 mm/year during the period of 1950-2007. In another study by M. Djazim Sayifullah et al. in 2014, the observation was in Martapura city, the tendency of annual rainfall to increase from 1915-2000 showed a pattern of increasing tendency by 4.5898 mm/year. This study aims to identify rainfall changes through the tendency pattern, distribution, and similarity of precipitation data at different timescales.

II. LITERATURE REVIEW

2.1 Rainfall

Daily rainfall is the rain that occurs and is recorded at the rainfall observation station every day (for 24 hours). The data is commonly used to simulate water demand and determine cropping patterns. Annual rainfall is the amount of monthly rainfall in one year of observation at a certain rainfall station [2].

2.2 Wet Month and Dry Month

Determination of wet and dry months in Indonesian territory can use Oldeman climate classification (Oldeman, Irsal, & Muladi, 1980) as follows:

Wet month (CH > 200 mm), Dry month (CH < 100 mm), Moist month (CH 100-200 mm).

2.3 Data Normality Test

The data normality test was conducted to determine if the data to use has a normal distribution. If the data is normal, it is considered to represent the population and it can be used for analysis [3]. One of the data normality test methods is Kolmogorov Smirnov technique.

2.4 Statistical Test

Statistical test was carried out to prove that there is a change in rainfall patterns as a sign of climate change through hypothesis test by comparing each rainfall period. Regression analysis is a statistical analysis by using the relationship among quantitative variables where one of the variables can be predicted from the other variables [1]. In general, linear regression model uses the following formula [4]:

$$Y = a + bx$$

III. METHODOLOGY

3.1 Research Location

The research took place in Danda Jaya Swamp Irrigation Area, Geographical location: 03°06′16″ to 03°09′01″ latitude and 114°35′58″ to 114°39′ east longitude, Danda Besar is administratively included in Rantau Badauh District, Barito Kuala Regency, South Kalimantan as shown in Figure 1.

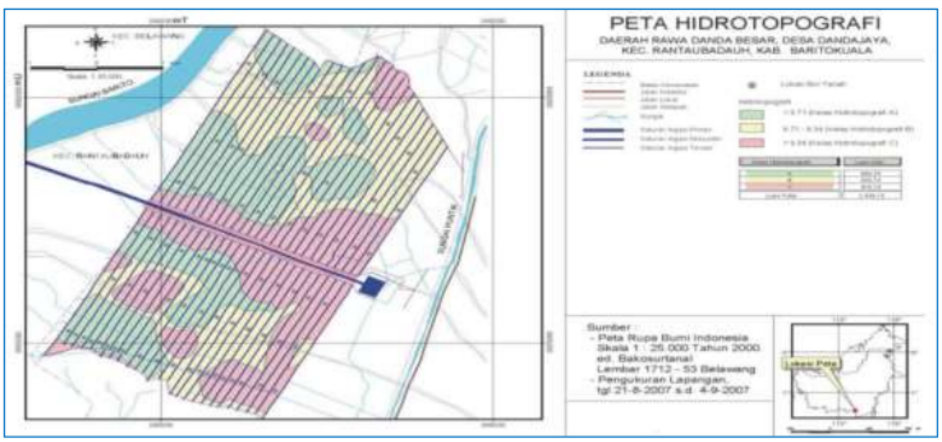

Figure 1. Topographic map of Danda Besar Swamp Irrigation Area
Source : Balai Rawa, 2007

3.2 Data

The variability of precipitation data used BMKG data from 2000-2020 obtained from BMKG data from observations at Karang Indah Mandastana station, Barito Kuala Regency.

3.3 Analysis Phases

Data analysis phases in this thesis are as follows:

1. Data grouping is divided into rainy season data and dry season data, then both are grouped into period I (2000-2009) and period II (2010-2020), but the data of period II in 2014-2016 is empty.
2. Determination of rainy season and dry season is based on Oldeman classification. The criteria are used to determine the wet month, wet month, and dry month.
3. Data normality test with Smirnov Kolmogorov test was carried out to determine if the data to use has a normal distribution.
4. Analysis of precipitation trends to determine the existence of a trend is the tendency of changes in the value of climate parameters to increase or decrease in a certain period.

IV. RESULT AND DISCUSSION

Based on the temporal distribution result in the following graph, it shows that the peak of rainy season in the first period of 2000-2009 is in March and November, and for the second period of 2010-2020 is in January and December. Peak of dry season occurs in August and September in period I, while period II in July and September.

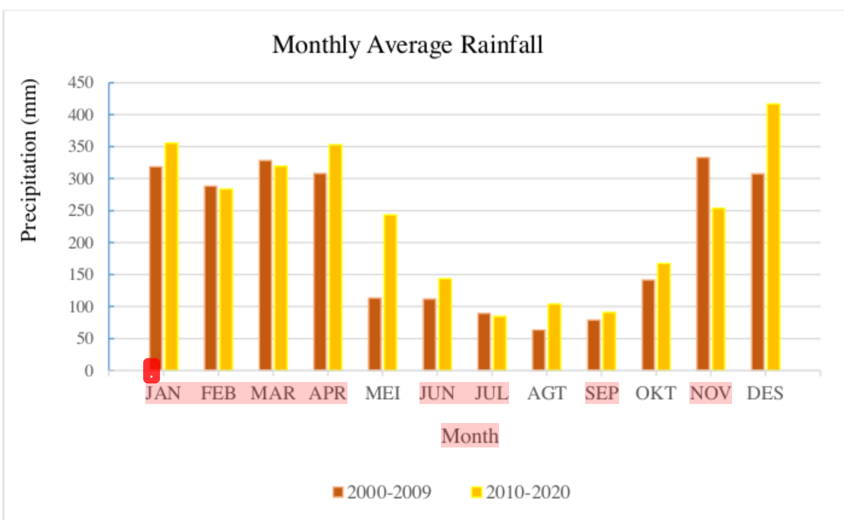

Figure 2. Average monthly rainfall in Karang Indah Station for 2 Periods

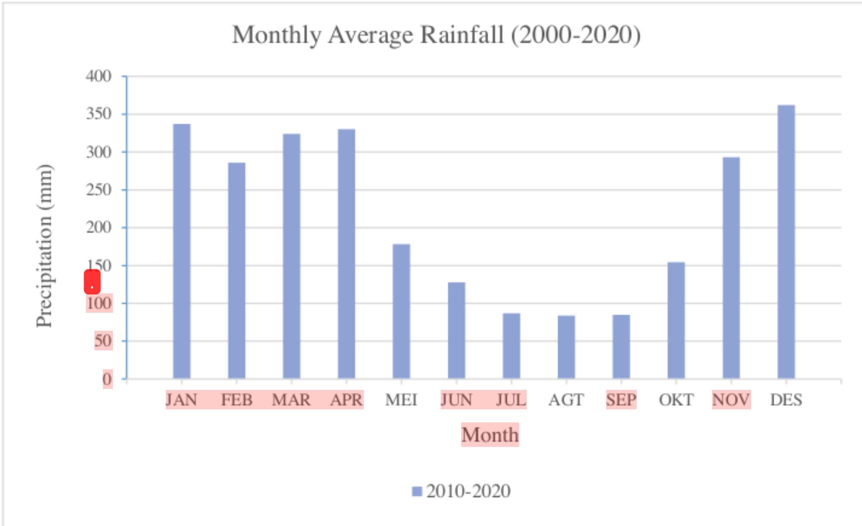

Figure 3. Average monthly rainfall in Karang Indah Station 2000-2020

4.1 Wet Month and Dry Month Shift

Analysis result of wet and dry months based on Oldeman classification is shown in Figure 4 below.

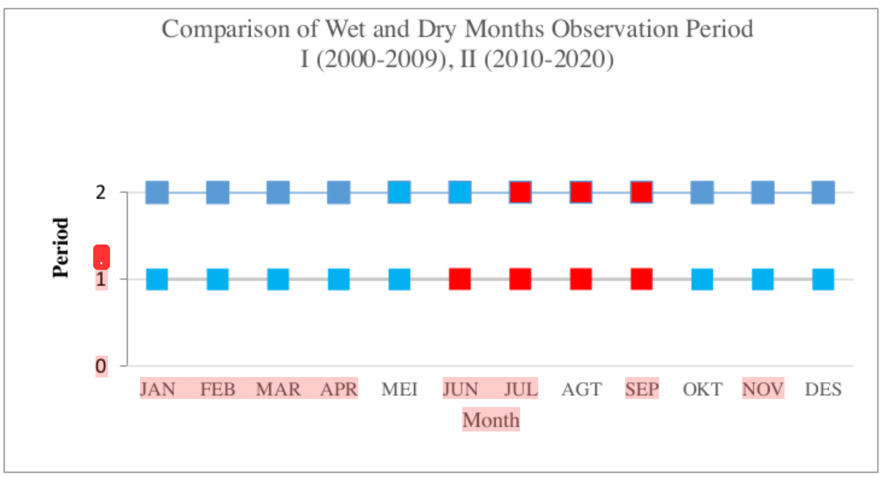

Figure 4. Comparison of wet and dry months of the two observation periods

Based on Figure 4, wet months occurred from October to May in period of 2000-2009. Changes occurred in the second period of 2010-2020, there was a shift in wet months start from October to May. The number of wet months increased in the second period of 2010-2020 up to 9 months, which previously in 2000-2009 period was only 8 months.

4.2 Data Normality Test

Kolmogorov-Smirnov test result for rainy season cycle obtained a significant value for period I and period II of 0.200. All rainy season cycles have a significant value > 0.05, so the regression model residuals are normally distributed. Kolmogorov-Smirnov test result for the dry season cycle obtained a significant value for the first period of 0.014 and 0.029 for the second period. All dry season cycles have a significant value > 0.05, so the regression model residuals are normally distributed.

4.3 Precipitation Trend Analysis

Precipitation trend analysis for annual rainfall from 2000-2020 for Karang Indah Station, Mandastana shows an increasing tendency by 18,944 mm/year as shown in the following graph with the linear regression equation Y = 18.944x + 2449.8 dengan R^2 = 0.0385

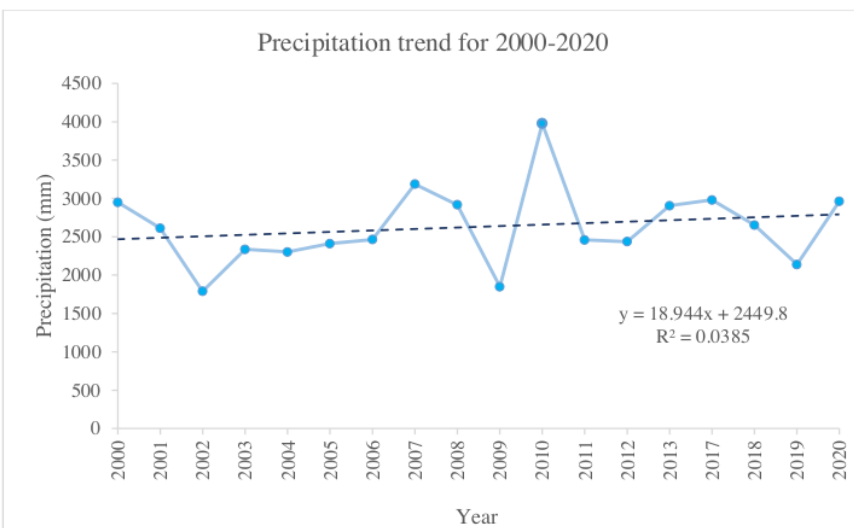

Figure 5. Annual precipitation trend graph for 2000-2020

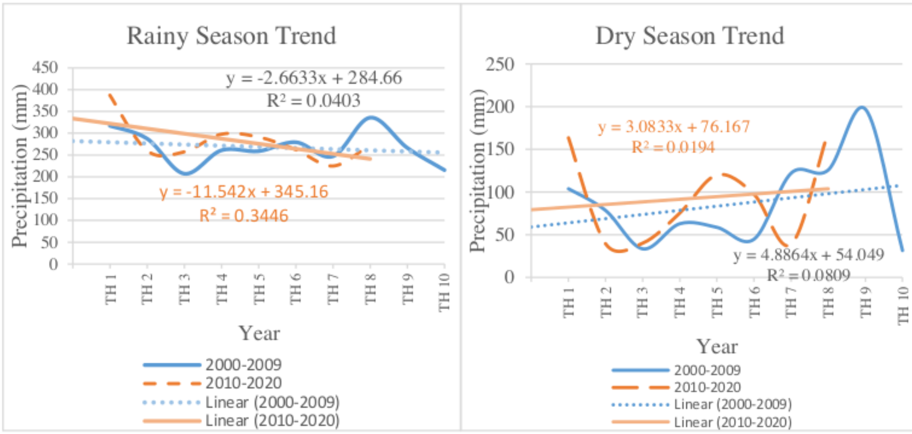

Figure 6. Precipitation trend graph of rainy season and dry season

From the graph of rainfall pattern in rainy season, the average annual rainfall decreased, as shown from the negative value in regression equation. As for the dry season in 2 periods, the average annual rainfall increased.

V. CONCLUSIONS

From the analysis result of precipitation data for Mandastana rain station from 2000-2020 divided into 2 periods, several conclusions can be drawn:

1. The result of regression analysis model of rainfall from 2000-2020 shows an increasing tendency pattern by 18,944 mm/year.
2. There was a shift in dry season in period II. 8 months of rainy season in period I start from October to May, and 9 months in period II start from October to June, and dry season from July to September.
3. Trend analysis of annual average rainfall in rainy season in period I and II decreased by -2.663 mm/year and -11.542 mm/year respectively. In dry season, the value of annual average rainfall increased in period I by 4.886 mm/year and period II by 3.083 mm/year.

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