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Analysis Of Rainfall Skewness In East Kalimantan Province

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ABSTRACT
Climate change has brought changes to the characteristics of the rainfall, in general, there is a dynamic monthly rainfall cumulative annual rainfall.This study aims to describe regional pattern and trend of rainfall based on monthly rainfall for period 1975 to 2016 in East Kalimantan Province. Descriptive statistics analysis was performed to obtain centralization, variation and distribution of maximum precipitation data. Data skewness analyses were conducted based on the third Moment (α_3) value. In addition, skewness used to obtain shape the distribution of rainfall data. The results showed a positive monthly rainfall Trend α_3 of 0.4-3.85 with the most monthly rainfall in the range of 121-300 mm.

Keywords*: Rainfall, trend, skewness, climate change*

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I. INTRODUCTION

In a tropical area like Indonesia, precipitation had a more significant impact on climate change rather than the changing temperature. Warmer air holds more water vapor, and that tends to cause an increase in extreme 72 precipitation intensities at the 6-7% (O'Gorman 73 and Muller, 2010). Rainfall can indicate climate change because precipitation has a direct impact on nature environment that implicate economical sector. The most common precipitation in Indonesia is rainfall. Rainfall plays a core role in every agricultural activity in Indonesia. Moreover, as the basics need for the human with such huge number of population in Indonesia made the detailed rainfall variability and trend study important.

Average change of annual and seasonal rainfall data represented the modification of climatic variability in future climate change. Annual rainfall data depicted each year data of rainfall in accumulative. The annual rainfall data were chosen as the fundamental of scientific thought that annual variability is better (than mean value) and one of the most important indicators of reliability of rainfall. Monthly rainfall data depicted the availability water in a month that is very important to determine the season and agricultural commodities. The rainfall received in an area is an important factor in deter-mining the amount of water available to meet various demands such as agricultural, industrial, domestic water sup-ply and for hydroelectric power generation. The pattern and amount of the rainfall (Gajbhiyeet al.,2016) are among themost vital factors that affect agricultural production and livelihood of itspeople (Kumar and Gautam, 2014).This study aims to analyze the variability of monthly and annual rainfall in 40 years from each rainfall type in Indonesia. The data used as a tool to characterize which rainfall type have most variability due to climate change issue. This study expected as the reference of detailed rainfall study and basic study of climate change impact on the specific rainfall type for further research in rainfall and climate change.

II. MATERIALS AND METHODES

2. Materials

The research object observed was the condition and extent of forest cover along with the condition of climate elements "in situ" from 1975 to 2015 from 76 Meteorological Stations in East Kalimantan Province. Rainfall data collected both primary and secondary data related to the research. Rainfall is made exclusive period can be statistically known according to the maximum annual daily rainfall data (maximum annual series data) Long-term more than 20 years using frequency distribution analysis (Wood et al, 2021). Before processing the precipitation data, it is necessary to assess the reliability and quality of the observations available and then to correct for unreliable data. If there are missing data, they can be filled in from observations by considering at least three stations close to the target station (Wood et al, 2021; Sipayung, 2009)

3. Methods

Trend Analysis is conducted to obtain information on the trend of grouping high rainfall intervals and low rainfall intervals in each period, if the physical environment of the climate observation station changes(Gajbhiye et al 2016; Jain and Kumar. 2012). In this study using the analysis of the a measure of the skewness of the curve. The data skewness measure is a measure that shows whether the distribution of data against the average value is symmetrical or not. The slope measure is basically a measure that explains the magnitude of data deviation from a symmetrical shape. This causes the curve shape to tilt to the right or left analysed by the formula(Spiegel et al., 2006):

$$\alpha_3 = \frac{M_3}{S^3} = \frac{1}{n S^3} \sum_{i=1}^{n} \left(X_i - \overline{X} \right)^3$$

Where: α_3 = moment of Coefficient of Skewness

M_3 = class midpoint

C = class interval

S = Standard deviation

n = number of data

f = frequency of each class interval

The pattern of distribution data will measured by skewness and kurtosis, skewness value of normal distribution is zero, when data have extends distribution to right with a long tail to the higher value that mean the data have positive value skewness, in another hand if the data have distribution with a long tail to the lower value that mean the data has a value skewness negative (Steinhorst, et al 2004).

III. RESULT AND DISCUSSION

Skewness is a measure of the asymmetry of a probability distribution. A perfectly symmetrical dataset will have a skewness of zero. If the data is skewed to the right, the skewness will be positive, and if it is skewed to the left, the skewness will be negative. Understanding the direction of skewness is important because it can impact the interpretation of our results. For example, if we are analyzing the monthly rain fall distribution of a area, a positive skewness indicates that there are more month with lower rainfall levels, and a negative skewness indicates that there are more month with high-rain fall levels(Addisu et al 2015; Al-Houri. 2014; Chakraborty et al 2013).

A variability analysis of meteorological parameters is ofgreat importance for researchers and policy makers in theirdecision making as rainfall plays dominant role in decidingthe use of the water availability in the areas. According to literature, coefficient of variation (CV) is used to classify the degree ofvariability as less (CV < 20%), moderate (20 < CV < 30%),high (CV > 30%), very high (CV > 40%) and CV > 70%indicate extremely high inter-annual variability of rainfall.Based on this, from the observed data considered that all themonths had above 30% of CV highlighting the high variability of precipitation over the area(Komalasari et al 2017; Benyamin et al, 2020). The result indicated thathe amount of rainfall in the region is extremely variable.Then, if the kurtosis values are analyzed, then it can beunderstood that during monsoon (July, August, September)the kurtosis values are less and also the skewness valuewhich explains that the data set are light tailed during monsoon months and follows a symmetric pattern. In otherwords, we can say that rainfall in the study area follows asymmetric pattern during monsoon months

All of data have positive skewness that indicate skewness distribution curve have tail at value above the median, and mean is on the right of the peak value (Addisu, et al 2015; Pujiastuti and E Nurjani. 2018; Komalasari et al 2017).The skewness parameter showed the positive value. This means the distribution of the data is positively skewed in East Kalimantan means the tendency of rainfall above the averageTrend analysis results show the value of the third Moment of Skewness (α3), as shown in Table 1.

Table 1. East Kalimantan Rainfall Trend Analysis 1975-2015

Periode	Trend α_3	Keterangan
1975-1985	0.44	Sloping to the right, 54% monthly rainfall 121-240 mm
1986-1995	1,84	Sloping to the right, 58% monthly rainfall 121-240 mm
1996-2005	2.41	Sloping to the right, 58% monthly rainfall 121-240 mm
2006-2015	3.85	Sloping to the right, 64% monthly rainfall 121-240 mm

a. Period 1975-1985;

Trend analysis results show a positive Moment of Skewness (α3) value of 0.44 which means the cumulative monthly rainfall data of East Kalimantan is skewed to the right, indicating 54% of the monthly rainfall of East Kalimantan Province is in the range of 121-360 mm. This indicates that the average monthly rainfall of East Kalimantan province in the period before 1985 was always humid-wet month.

b**. Period 1986-1995**

Trend analysis results show a positive Moment of Skewness (α3) value of 1.84 which means the cumulative monthly rainfall data of East Kalimantan is skewed to the right, can be seen in Figure 14, showing 54% of the monthly rainfall of East Kalimantan Province is in the range of 121-400 mm, while 150 months (32%) show dry-humid months.

c. Period 1996-2005;

Trend analysis results show a positive Moment of Skewness (α3) value of 2.41 which means the cumulative monthly rainfall data of East Kalimantan is skewed to the right, can be seen in Figure 5, shows 58% of the monthly rainfall of East Kalimantan Province is in the range of 121-300 mm.

d. Period 2006-2016;

Trend analysis results show a positive Moment of Skewness (α3) value of 3.85 which means the cumulative monthly rainfall data of East Kalimantan is skewed to the right, can be seen in Figure 6 shows 68% of monthly rainfall of East Kalimantan Province is in the range of 121-300 mm.

We found that there did seem to be more skewness for regions with little rainfall in the month of July than for a region of average rainfall, but positive skewness also seemed to be greater for regions with greater than normal rainfall. The distribution is right-skewed because it's longer on the right side of its peak. There is a long tail on the right, meaning that every few decades there is a year when the number of sunspots observed is a lot higher than average.Themonthly rainfall pretends to increase since the skewness showed the positive value. The most increasing value is in monsoonal rainfall type in September and local rainfall type in November. Because the relative position of the sun, resulted in more precipitation in September.It also should be noted that positive skewness seems to be the normal condition for the distribution of rainfall for almost all localities a

IV. CONCLUSION

All of data have positive skewnesswith value 0.44-3.85 that indicate skewness distribution curve have tail at value above of the median, and mean is on the right of the peak value.The annual rainfall value showed that East Kalimantan as the representative of equatorial rainfall type has the lowest variability rainfall with the skewness is the lowest.

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