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ANALYSIS OF RAINFALL VARIABILITY IN WEST SUMATRA

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ABSTRACT

Climate variability is closely related to climate change in a region. Rainfall is an element of climate that is highly variable, both in space and time scale. Change in rainfall patterns can have an impact on various sectors of human life and the environment. Analysis of rainfall variability is very useful for the first step in knowing climate change. This study examines the variability of rainfall in West Sumatra over a period of fifteen years, i.e 2010-2024 at 19 locations of the BMKG rain posts. West Sumatra has an equatorial or bimodal type of rainfall where the area between the rainy season and the dry season is not much different so that it has two rainy seasons in a year. The analysis result show that annual rainfall variability in West Sumatra is in the low to moderate category. The value of seasonal rainfall variability shows a range from low to vary high. The value of monthly rainfall variability shows a range from moderate to very high in each rain post location. Analysis of spatial rainfall variability found that elevation affects rainfall with a negative correlation relationship, where the higher the elevation of rain post location, the rainfall received tend to decrease.

Keywords : *Variability, rainfall , Sumatera Barat, Climate*

I. INTRODUCTION

Climate change is a phenomenon on a global scale that is currently in the spotlight.even though it occurs globally, its impact is different in each region depending local climate conditions [1]. One of the ways to identify these changes is through statistical analysis of changes in the mean and/or degree of variability of climate elements over long periods of time, typically a decade or more [2]. Climate change is impacting all sectors of human life and the environment [3]. The impact of climate change that often occurs today is climate anomaly that causes a higher frequency of extreme events such as floods and droughts. An increase in rainfall, especially in the wet months, increases the potential for flooding, while a reduction in rainfall in the dry season increases the potential for drought [4]

West Sumatra is one of the areas with topography dominated by highlands. This situation causes atmospheric movement from the Indian Ocean to the Sumatra plains which causes a lot of rainfall to occur on the West Coast of the island of Sumatra [5]. These topographic conditions affect air temperature and become one of the factors in the level of evaporation in the formation of clouds that produce rain [6]. West Sumatra has an equatorial rainfall type, which is an area where the rainy season and dry season are not much different so that it has two peaks of the rainy season or it can be said that it does not have a dry season [7]. Besides being influenced by regional factors, the weather in West Sumatra is influenced by local factors, namely the presence of sea breezes and the Bukit Barisan Mountains along the island of Sumatra. This makes West Sumatra one of the areas affected by climate change and climate variability. Climate variability, early season changes and extreme weather phenomena are indicator of climate change due to global warming [8].

The distribution of rainfall in mountainous areas such as West Sumatra is strongly influenced by topographic factors and atmospheric dynamics. The orographic rain mechanism during the active phase of the Madden-Julian Oscillation (MJO) is important in creating spatial variations in rainfall in the Sumatra region [9]. The contribution

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of topography to the spatial variability of rainfall can be more than half of the total monthly rainfall. One of the most obvious impacts of this process is the phenomenon of rain shadows, which are dry areas on the leeward side of mountains [10]. This phenomenon occurs when humid air rises up the side of a mountain and produces rain, while the air that descends on the opposite side becomes dry and causes a significant decrease in rainfall [11].

Climate variability or anomaly refer to deviations of climate conditions from mean values and other statistical parameters, such as standard deviation or extreme events, that occur in a given time and space, beyond a single weather event. Generally, climate variability is described as the deviation of the climate relative to its normal conditions (mean values) [12]. Climate variability indicates uncertainty and changes in weather and precipitation patterns [13], characterized by increased intensity of heavy rainfall in the rain season and extreme drought in the dry season [14]. This causes unpredictable and erratic rainfall fluctuations that result in damage to agricultural land [15].

Research on the analysis of rainfall variability has been conducted by many previous researchers. Satria et al [16] examined rainfall variability in Kebumen Regency using daily rainfall data over a 30-year period with spatial analysis using a statistical approach. The result show that coastal areas in Kebumen Regency have high rainfall variability with low average rainfall. Fanny [17] analyzed rainfall variability in West Kalimantan for the period 1991-2020. The result of the analysis show that annual rainfall variability in West Kalimantan is in the low-moderate category, while monthly variability values show a range that varies from low to extreme in each location.

Although research on rainfall variability has been done before, similar research conducted in West Sumatra region in rare. Therefore, it is necessary to conduct research on Variability analysis in West Sumatra. This research is expected to be useful in effective mitigation and adaptation strategies to overcome the increasing climate crisis.

II. METHOD

This research uses descriptive quantitative by analyzing monthly rainfall data. The data analyzed is rainfall data from 19 rain posts obtained from BMKG Climatology West Sumatra. The data analyzed covers monthly records for 15 years, from 2010

The rain posts used in this research are presented in Table 1.

Table 1. Coordinates of Rain Post in West Sumatra

Rain Post	Elevation (m)	Longitude (°)	Latitude (°)	Year	
				Start	End
Baso	1020	100.48	-0.30	2010	2024
Muara Sikabaluan	100	98.98	-1.13	2014	2024
BP3K Bukit Barisan	893	100.52	-0.06	2014	2024
Staklim Padang Pariaman	134	100.30	-0.06	2010	2024
Bonjol	366	100.25	-0.55	2010	2024
Kinali	37	99.85	-0.70	2013	2024
Tarusan	12	100.47	-0.02	2011	2024
Muara Sijunjung	202	100.99	-0.60	2011	2024
Muara Panas	432	100.69	-0.85	2013	2024
Sangir Jujuan	363	101.32	-1.43	2014	2024
BPK X Koto Paninjauan	989	100.42	-0.44	2012	2024
Cubadak	380	100.54	-0.47	2013	2024
BPBD BukitHigh	911	100.37	-0.28	2017	2024
Teluk Bayur	8	100.36	-0.98	2010	2024
Stageof PPI	390	100.42	-0.47	2010	2024
Pariaman	25	100.13	-0.60	2013	2024
Payakumbuh Barat	512	100.62	-0.25	2010	2024
BPP Kolok	435	100.73	-0.60	2011	2024
Lubuk Sikarah	390	100.61	-0.77	2010	2024

Monthly rainfall data that has been obtained during the period 2010-2024 is then processed into cumulative monthly, seasonal and annual at each rain post. Furthermore, the processed data displays a monthly rainfall intensity graph to determine the rainfall pattern over time. Then, statistical analysis is carried out to determine the variability of rainfall.

Rainfall variability data is obtained through grouping and calculating monthly, seasonal and annual data by calculating the mean, standard deviation, and coefficient of variation. In this case, the objective is to test the dispersion statistics or measures of variation in monthly, seasonal and annual rainfall data. Statistical tests include using standard deviation which is one measure of dispersion/ deviation obtained from the positive square root of variance. Variance is the average of the strongest deviation of each observation from the average count [18]. The formula such as:

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N}(X_i - \bar{X}) \quad (1) \qquad CV = \frac{SD}{\bar{X}} \times 100\% \quad (2)$$

$$\sigma = \sqrt{\sum \frac{(X_i - \bar{X})}{N}}$$

(a) Standard Deviation

Where :

σ^2 = actual variant

σ = standart deviation

(b) Coefficient of Variation

Where :

CV = Coefficient of Variation

SD = Standart Deviation

$\bar{X}$ = mean aritmatic

According to Asfaw et al, in general, CV values are classified as follows:

Table 2. Classification Coefficient of Variation

Coefficient of Variation	Category
0 – 0.20	Low
0.20 – 0.30	Medium
0.30 – 0.40	High
>0.40	Very high

Sumber: Asfaw dkk [19]

Correlation analysis is a statistical test that measures the density of the relationship between two variables where in this research it is used to see the relationship between rainfall and elevation. Rainfall is called variable x and elevation is called variable y, then the correlation test is carried out using the Pearson product moment formula as shown in equation 3 below:

$$r = \frac{n\sum XY - (\sum X)(\sum Y)}{\sqrt{n\sum x^2 - (\sum x)^2 (n\sum y^2 - (\sum y)^2)}} \quad (3)$$

Where:

r = correlation coefficient

x = variable x

y = variable y

n = sum of data

according to Supranto [18], the reference for calculating the correlation shown in Table 3.

Table 3. Type of Relationship Correlation Coefficient

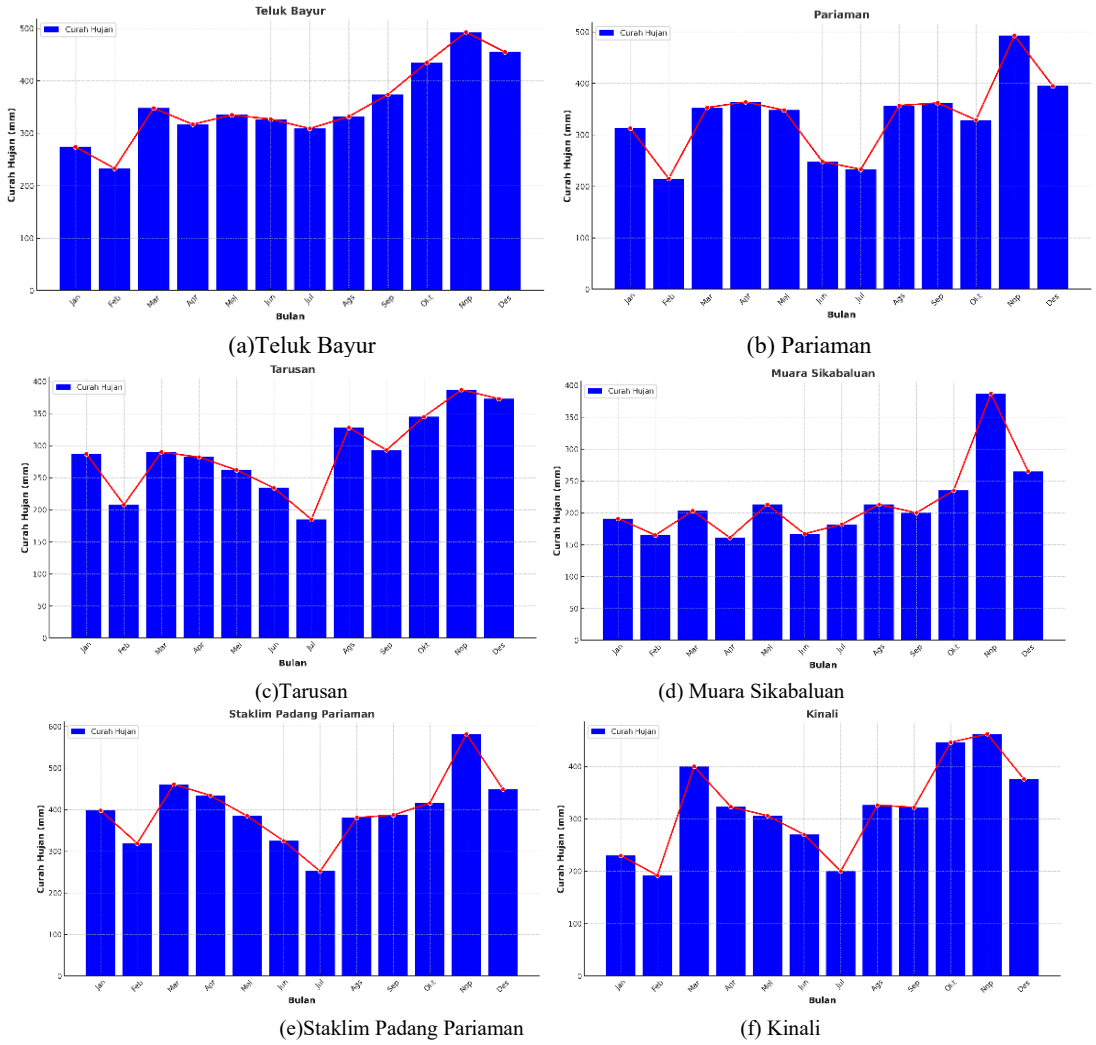
Correlation Coefficient	Category
0 – 0.19	Very Low
0.20 – 0.39	Low
0.40 – 0.59	Medium
0.60 - 0.79	Strong
0.80 – 1.00	Very strong

Sumber: Supranto[18]

III. RESULTS AND DISCUSSION

This research covers rainfall gauging posts in the West Sumatra region which is seen from 19 different rainfall posts. Data obtained from the BMKG West Sumatra Climatology in the form of monthly rainfall data. The result of the analysis of rainfall variability from statistical calculations can be seen in the description below:

1. Monthly average rainfall pattern in a year.

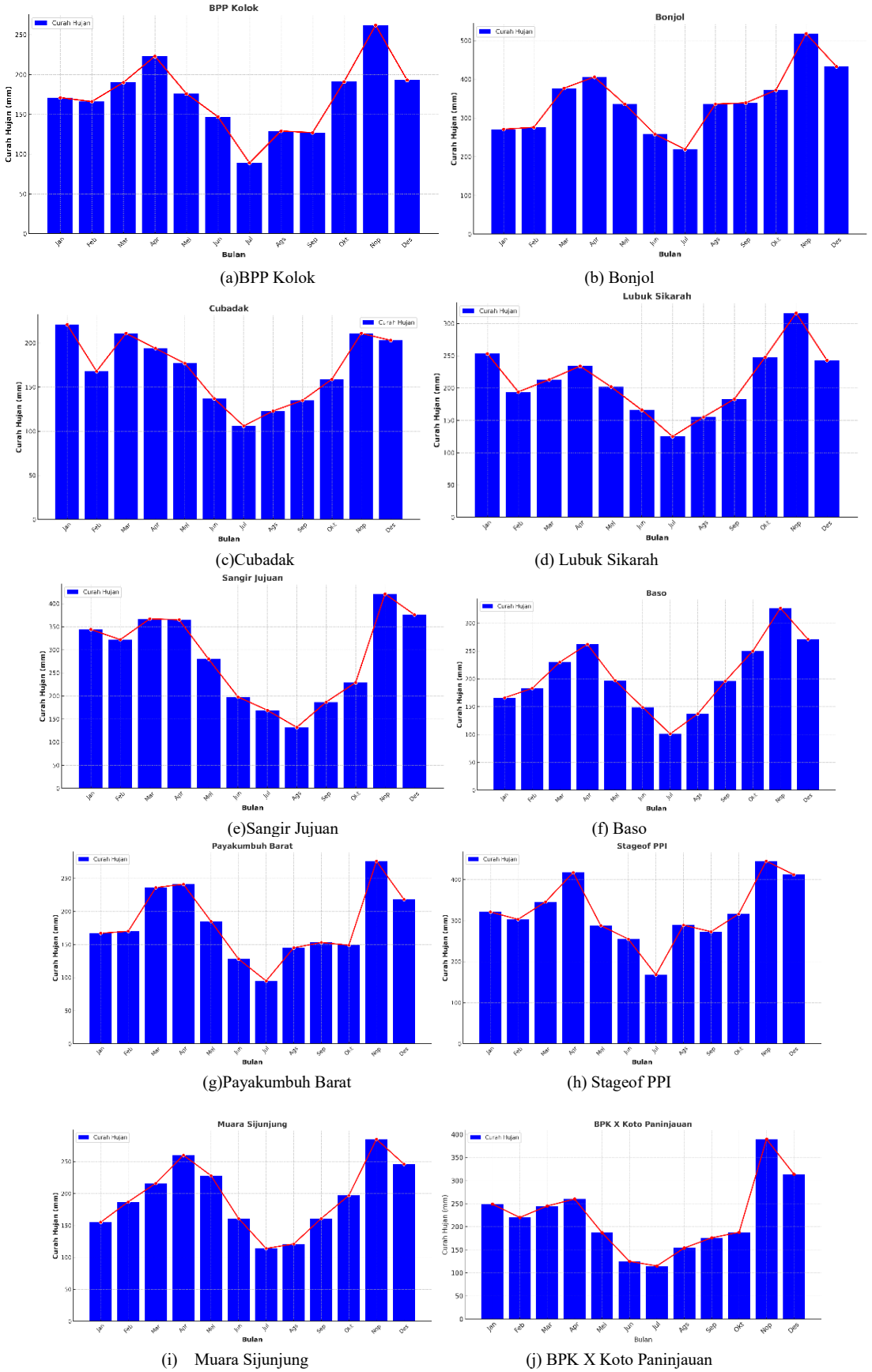


(a)Teluk Bayur (b) Pariaman

(c)Tarusan (d) Muara Sikabaluan

(e)Staklim Padang Pariaman (f) Kinali

Figure 1. Monthly average rainfall patterns in the Coastal/ Lowland regions of West Sumatra (a) Teluk Bayur, (b) Pariaman, (c) Tarusan, (d) Muara Sikabaluan, (e) Staklim Padang Pariaman dan (f) Kinali



(a)BPP Kolok (b) Bonjol

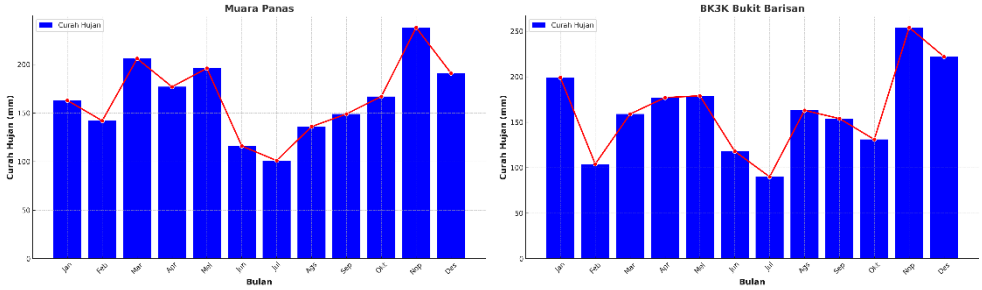
(c)Cubadak (d) Lubuk Sikarah

(e)Sangir Jujuan (f) Baso

(g)Payakumbuh Barat (h) Stageof PPI

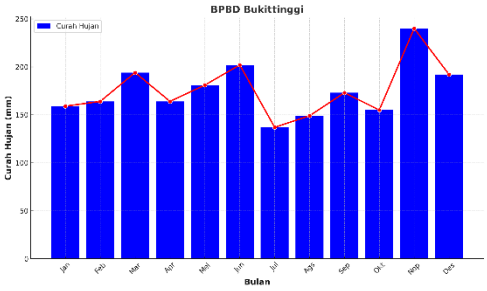
(i) Muara Sijunjung (j) BPK X Koto Paninjauan

Figure 2. Monthly average rainfall patterns in the highland/ hill region of West Sumatra (a) BPP Kolok, (b) Bonjol, (c) Cubadak, (d) Lubuk Sikarah, (e) Sangir Jujuan, (f) Baso, (g) Payakumbuh Barat, (h) Stageof PPI, (i) Muara Sijunjung, (j) BPK X Koto Paninjauan



(k)Muara Panas

(l) BK3K Bukit Barisan



(m)BPBD Bukittinggi

Figure 3. monthly average rainfall patterns in the highland/hill region of West Sumatra (i) Muara Sijunjung, (j) BPK X Koto Paninjauan, (k) Muara Panas, (l) BK3K Bukit Barisan and (m) BPBD Bukittinggi

Based on the above figure, it can be seen that the monthly average pattern in a year in West Sumatra is shown in Figure 1. From the research conducted, the six rain posts in the coastal/ lowland region of West Sumatra have relatively different monthly average rainfall patterns. Coastal/ lowland regions such as Pariaman, Tarusan, Kinali, and Staklim Padang Pariaman have an equatorial rainfall pattern with rain peaks in March-April and October - Nopember. However, not all regions have a uniform pattern. Some coastal regions such as Teluk Bayur and Muara Sikabaluan tend to experience monomodal patterns with high rainfall formed from convergence between land breeze at night and surface westerlies. This interaction is one of the dominant factors in the formation of offshore rain that then propagates to the coastal land and produces a single rain peak at the end of the year [20].

Based on Figure 2 and Figure 3 above, it can be seen that the monthly average rainfall pattern in a year in West Sumatra in the highland/hills regions such as BPP Kolok, Bonjol, Cubadak, Lubuk Sikarah, Sangir Jujuan, Baso, Payakumbuh Barat, Stageof PPI, Muara Sijunjung, BPK X Koto Paninjauan and Muara Panas have and equatorial rainfall pattern with two dominant rain peaks. In contrast, highland/hill region such as BK3K Bukit Barisan and BPBD Bukittinggi have erratic rainfall patterns and tend not to have dominant rainfall peaks. This is caused by mountainous topographic factors (such as the Bukit Barisan row) that strengthen the influence of orographic rainfall which causes large fluctuations due to differences in atmospheric conditions and rainfall factors that are sensitive to changes in wind direction and intensity, or are in the rain shadow effect, so that slight changes in atmospheric conditions can trigger large rainfall fluctuations [21].

2. Temporal Rainfall Variability

Table 4. CV Result (Staklim Padang Pariaman)

Category		CV	Conclusion
Monthly Rain	January	0.26	Medium
	February	0.40	High
	March	0.38	High
	April	0.35	High
	May	0.37	High
	June	0.44	Very High
	July	0.54	Very High
	August	0.31	High
	September	0.41	Very High
	October	0.39	High
	Nopember	0.32	High
	December	0.37	High
Hujan Musiman	DJF	0.20	Low
	MAM	0.21	Medium
	JJA	0.21	Medium
	SON	0.21	Medium
Annual Rain		0.09	Low

Table 5. CV Result (BPP Kolok)

Category		CV	Conclusion
Monthly Rain	January	0.56	Very High
	February	0.53	Very High
	March	0.49	Very High
	April	0.26	Medium
	May	0.50	Very High
	June	0.54	Very High
	July	0.58	Very High
	August	0.54	Very High
	September	0.46	Very High
	October	0.59	Very High
	Nopember	0.48	Very High
	December	0.70	Very High
Hujan Musiman	DJF	0.31	High
	MAM	0.18	Low
	JJA	0.25	Medium
	SON	0.37	High
Annual Rain		0.12	Low

Table 6. CV Result (Teluk Bayur)

Category		CV	Conclusion
Monthly Rain	January	0.39	High
	February	0.44	Very High
	March	0.39	High
	April	0.29	Medium
	May	0.49	Very High
	June	0.51	Very High
	July	0.47	Very High
	August	0.59	Very High
	September	0.55	Very High
	October	0.50	Very High
	Nopember	0.47	Very High
	December	0.38	High
Hujan Musiman	DJF	0.23	Medium
	MAM	0.26	Medium
	JJA	0.40	High
	SON	0.39	High
Annual Rain		0.18	Low

Table 7. CV Result (Bonjol)

Category		CV	Conclusion
Monthly Rain	January	0.35	High
	February	0.45	Very High
	March	0.37	High
	April	0.33	High
	May	0.33	High
	June	0.41	Very High
	July	0.41	Very High
	August	0.24	Medium
	September	0.33	High
	October	0.34	High
	Nopember	0.30	Medium
	December	0.36	High
Hujan Musiman	DJF	0.21	Medium
	MAM	0.26	Medium
	JJA	0.19	Low
	SON	0.20	Low
Annual Rain		0.11	Low

Table 8. CV Result (Cubadak)

Category		CV	Conclusion
Monthly Rain	January	0.51	Very High
	February	0.37	High
	March	0.48	Very High
	April	0.38	High
	May	0.46	Very High
	June	0.66	Very High
	July	0.72	Very High
	August	0.85	Very High
	September	0.61	Very High
	October	0.67	Very High
	Nopember	0.41	Very High
	December	0.55	Very High
Hujan Musiman	DJF	0.29	Medium
	MAM	0.36	High
	JJA	0.53	Very High
	SON	0.29	Medium
Annual Rain		0.19	Low

Table 9. CV Result (Lubuk Sikarah)

Category		CV	Conclusion
Monthly Rain	January	0.68	Very High
	February	0.44	Very High
	March	0.84	Very High
	April	0.20	Low
	May	0.69	Very High
	June	0.57	Very High
	July	0.83	Very High
	August	0.56	Very High
	September	0.64	Very High
	October	0.77	Very High
	Nopember	0.53	Very High
	December	0.75	Very High
Hujan Musiman	DJF	0.45	Very High
	MAM	0.45	Very High
	JJA	0.46	Very High
	SON	0.46	Very High
Annual Rain		0.24	Medium

Table 10. CV Result (Muara Sikabaluan)

Category		CV	Conclusion
Monthly Rain	January	0.38	High
	February	0.26	Medium
	March	0.40	High
	April	0.58	Very High
	May	0.44	Very High
	June	0.59	Very High
	July	0.58	Very High
	August	0.42	Very High
	September	0.66	Very High
	October	0.74	Very High
	Nopember	0.52	Very High
	December	0.52	Very High
Hujan Musiman	DJF	0.26	Medium
	MAM	0.25	Medium
	JJA	0.36	High
	SON	0.54	Very High
Annual Rain		0.30	Medium

Table 11. CV Result (Sangir Jujuan)

Category		CV	Conclusion
Monthly Rain	January	0.60	Very High
	February	0.32	High
	March	0.36	High
	April	0.35	High
	May	0.39	High
	June	0.53	Very High
	July	0.51	Very High
	August	0.42	Very High
	September	0.65	Very High
	October	0.76	Very High
	Nopember	0.40	High
	December	0.67	Very High
Hujan Musiman	DJF	0.25	Medium
	MAM	0.18	Low
	JJA	0.27	Medium
	SON	0.33	High
Annual Rain		0.17	Low

Table 12. CV Result (Muara Sijunjung)

Category		CV	Conclusion
Monthly Rain	January	0.64	Very High
	February	0.49	Very High
	March	0.28	Medium
	April	0.27	Medium
	May	0.48	Very High
	June	0.58	Very High
	July	0.64	Very High
	August	0.57	Very High
	September	0.57	Very High
	October	0.67	Very High
	Nopember	0.44	Very High
	December	0.77	Very High
Hujan Musiman	DJF	0.20	Low
	MAM	0.21	Medium
	JJA	0.21	Medium
	SON	0.21	Medium
Annual Rain		0.16	Low

Table 13. CV Result (Kinali)

Category		CV	Conclusion
Monthly Rain	January	0.57	Very High
	February	0.49	Very High
	March	0.36	High
	April	0.38	High
	May	0.32	High
	June	0.39	High
	July	0.59	Very High
	August	0.48	Very High
	September	0.29	Medium
	October	0.39	High
	Nopember	0.29	Medium
	December	0.31	High
Hujan Musiman	DJF	0.29	Medium
	MAM	0.21	Medium
	JJA	0.28	Medium
	SON	0.18	Low
Annual Rain		0.14	Low

Table 14. CV Result (Tarusan)

Category		CV	Conclusion
Monthly Rain	January	0.48	Very High
	February	0.41	Very High
	March	0.45	Very High
	April	0.41	Very High
	May	0.40	High
	June	0.42	Very High
	July	0.47	Very High
	August	0.46	Very High
	September	0.64	Very High
	October	0.46	Very High
	Nopember	0.53	Very High
	December	0.55	Very High
Hujan Musiman	DJF	0.27	Medium
	MAM	0.33	High
	JJA	0.26	Medium
	SON	0.44	Very High
Annual Rain		0.18	Low

Table 15. CV Result (Baso)

Category		CV	Conclusion
Monthly Rain	January	0.61	Very High
	February	0.59	Very High
	March	0.45	Very High
	April	0.42	Very High
	May	0.69	Very High
	June	0.57	Very High
	July	0.74	Very High
	August	0.63	Very High
	September	0.61	Very High
	October	0.82	Very High
	Nopember	0.62	Very High
	December	0.75	Very High
Hujan Musiman	DJF	0.37	High
	MAM	0.39	High
	JJA	0.49	Very High
	SON	0.47	Very High
Annual Rain		0.22	Low

Table 16. CV Result (Payakumbuh Barat)

Category		CV	Conclusion
Monthly Rain	January	0.54	Very High
	February	0.54	Very High
	March	0.40	High
	April	0.30	Medium
	May	0.40	High
	June	0.47	Very High
	July	0.65	Very High
	August	0.50	Very High
	September	0.48	Very High
	October	0.59	Very High
	Nopember	0.50	Very High
	December	0.75	Very High
Hujan Musiman	DJF	0.36	High
	MAM	0.23	High
	JJA	0.33	Very High
	SON	0.28	Very High
Annual Rain		0.15	Low

Table 17. CV Result (Pariaman)

Category		CV	Conclusion
Monthly Rain	January	0.39	High
	February	0.38	High
	March	0.31	High
	April	0.29	Medium
	May	0.27	Medium
	June	0.42	Very High
	July	0.38	High
	August	0.59	Very High
	September	0.40	High
	October	0.43	Very High
	Nopember	0.48	Very High
	December	0.45	Very High
Hujan Musiman	DJF	0.22	Medium
	MAM	0.27	Medium
	JJA	0.32	High
	SON	0.33	High
Annual Rain		0.17	Low

Table 18. CV Result (Stageof PPI)

Category		CV	Conclusion
Monthly Rain	January	0.33	High
	February	0.42	Very High
	March	0.52	Very High
	April	0.37	High
	May	0.31	High
	June	0.56	Very High
	July	0.41	Very High
	August	0.36	High
	September	0.43	Very High
	October	0.39	High
	Nopember	0.47	Very High
	December	0.28	Medium
Hujan Musiman	DJF	0.14	Low
	MAM	0.24	Medium
	JJA	0.30	Medium
	SON	0.28	Medium
Annual Rain		0.12	Low

Table 19. CV Result (BPK X Koto Paninjauan)

Category		CV	Conclusion
Monthly Rain	January	0.44	Very High
	February	0.49	Very High
	March	0.51	Very High
	April	0.48	Very High
	May	0.48	Very High
	June	0.71	Very High
	July	0.46	Very High
	August	0.55	Very High
	September	0.55	Very High
	October	0.45	Very High
	Nopember	0.41	Very High
	December	0.34	High
Hujan Musiman	DJF	0.36	High
	MAM	0.23	Medium
	JJA	0.33	High
	SON	0.28	Medium
Annual Rain		0.11	Low

Table 20. CV Result (Muara Panas)

Category		CV	Conclusion
Monthly Rain	January	0.50	Very High
	February	0.40	High
	March	0.47	Very High
	April	0.65	Very High
	May	0.68	Very High
	June	0.60	Very High
	July	0.54	Very High
	August	0.50	Very High
	September	0.52	Very High
	October	0.57	Very High
	Nopember	0.44	Very High
	December	0.73	Very High
Hujan Musiman	DJF	0.30	Medium
	MAM	0.49	Very High
	JJA	0.35	High
	SON	0.31	High
Annual Rain		0.18	Low

Table 21. CV Result (BK3K Bukit Barisan)

Category		CV	Conclusion
Monthly Rain	January	0.50	Very High
	February	0.36	High
	March	0.49	Very High
	April	0.27	Medium
	May	0.56	Very High
	June	0.51	Very High
	July	0.50	Very High
	August	0.58	Very High
	September	0.39	Very High
	October	0.45	Very High
	Nopember	0.41	Very High
	December	0.72	Very High
Hujan Musiman	DJF	0.72	Very High
	MAM	0.92	Very High
	JJA	1.08	Very High
	SON	0.81	Very High
Annual Rain		0.18	Low

Table 22. CV Result (BPBD Bukittinggi)

Category		CV	Conclusion
Monthly Rain	January	0.32	High
	February	0.14	Low
	March	0.55	Very High
	April	0.52	Very High
	May	0.54	Very High
	June	0.36	High
	July	0.32	High
	August	0.30	Medium
	September	0.43	Very High
	October	0.53	Very High
	Nopember	0.43	Very High
	December	0.57	Very High
Hujan Musiman	DJF	0.23	Medium
	MAM	0.45	Very High
	JJA	0.22	Medium
	SON	0.28	Medium
Annual Rain		0.15	Low

This CV value provides information about the stability of rainfall between times, the higher the CV value, the greater the level of fluctuation that occur. Based on the general classification, CV value < 0.20 indicate low variability (stable rain), CV values 0.21-0.30 indicate Medium variability, and CV values 0.31-0.40 indicates high variability and CV >0.40 indicate very high variability or highly variable or unstable rainfall [19].

Based on Table 4 to Table 22, it can be seen that the variability value of monthly rainfall as seen from the CV value is the range of 0.30-0.40 and >0.40 which indicates the range of high to very high variability. In theory, the highest variability values usually occur in months with low rainfall, with CV values often exceeding 0.30. this is due to wind changes from northwest to southeast, as the weather system during this period is unstable [22]. However, the local geographical and atmospheric conditions in West Sumatra create complex dynamics. Where West Sumatra is dominated by a landscape consisting of the Bukit Barisan Mountains, valley, and the west coastal region directly facing the Indian Ocean. This complex topography produces different microclimate between regions, so that rainfall patterns and intensity vary greatly, both spatially and temporally [23].

Thus, the high variability of rainfall in West Sumatra is not only influenced by seasonal transitions, but also by complex interactions between variable topographic conditions and local pressure systems. The existences of the Bukit Barisan Mountains that stretch along the island of Sumatra plays an important role in shaping the orographic pattern of rainfall, where the slope area tends to receive more rain that the rain shadow [11]. In addition, land and ocean temperature differences along the west coast of Sumatra trigger land-sea wind circulation that contributes to the distribution of monthly and seasonal rainfall [24]. The combination of these factors explains why CV values in some months can exceed >0.40, indicating high to very high rainfall fluctuations in most regions of West Sumatra.

On a seasonal scale, rainfall variability in West Sumatra generally show a lower value than monthly variability, but can still be categorized as high depending on the season and characteristics of the region. In the context of Indonesian Climatology, season are usually divided into four categories: dry season I (December-February), rainy season I (March-May), dry season I (June-August) and rainy season II (September-November) [25]. On a seasonal scale, CV values are usually more stable because rainfall data is averaged over three months, so that extreme fluctuations from one month do not dominate too much, but some regions of West Sumatra, especially coastal regions and highland that are influenced by sea breezes and mountainous topography, seasonal CV values can still show the high category [26].

In the result of the research, the value of seasonal rain variability ranges from >0.20 to >0.40 which indicates moderate to very high variability at several rain post locations. Where almost all rain posts show the transitional season and the dry season has higher variability compared to the rainy season. In parallel with the research of Khoiruluswati et al [27] showed that the dry season has the highest seasonal value compared to other seasons, this reflects very high variability due to the lack of rainfall and local influences such as wind and topography. In contrast, the rainy season generally shows a lower CV values because is more stable and consistent in large amounts, so the fluctuation is relatively small against the seasonal average.

On the annual scale of rainfall variability in West Sumatra, it was found that most of the rain stations showed CV values <0.20, indicating that the fluctuations in rainfall from year to year were classified as low and relatively stable. This reflects the consistency of the annual rain pattern in many regions, which can be influenced by factors such as geographical position, as well as the existence of wind circulation pattern and topography that support the stability of the distribution of annual rain. However, there are some rain stations that show CV values >0.20, such

as Lubuk Sikarah, Baso and Muara Sikabaluan. These higher CV values indicate greater annual fluctuations, which can be caused by local influences such as complex orographic effect, extreme topographic variations, or a position that is more exposed to annual climate anomalies.

3. Spatial Rainfall Variability

This section will discuss the relationship between the amount of annual cumulative rainfall and the elevation of the rain post using correlation analysis. The result of this correlation test are presented in the form of Tables and graphs to clarify the pattern of the relationship formed.

Table 23. Result of Correlation analysis between elevation and rainfall

Correlations

		Elevation	Rainfall
Elevation	Pearson Correlation	1	-0.555*
	Sig. (2-tailed)		0.014
	N	19	19
Rainfall	Pearson Correlation	-0.555*	1
	Sig. (2-tailed)	0.014	
	N	19	19

*. Correlation is significant at the 0.05 level (2-tailed).

The Pearson correlation test results show that there is a medium negative correlation relationship between elevation and rainfall, meaning that the higher the elevation of a rain post location, the lower the rainfall received. The significance value (p-value) of 0.014 which shows < 0.05, indicates that relationship between the two variables is statistically significant at the 95% confidence level. Thus, it can be concluded that there is a medium correlation relationship between elevation and observed rainfall.

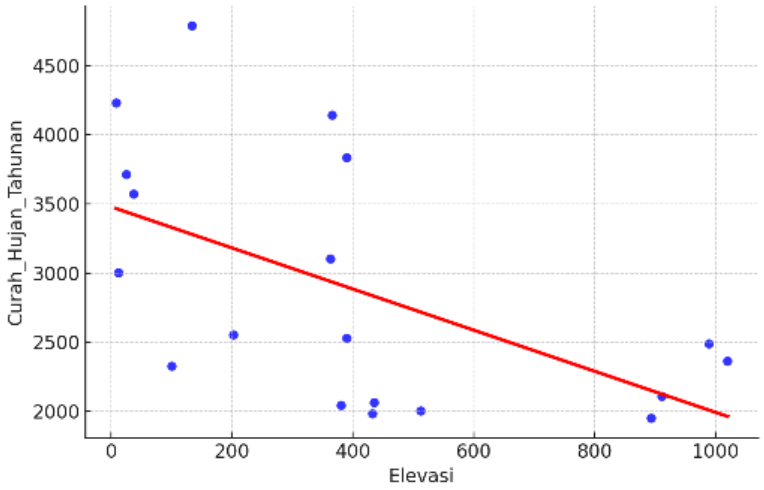


Figure 4. Relationship between elevation and rainfall

This pattern is clearly visible in the scatter plot graph shown in Figure 4, where the observation points form a downward trend as elevation increase. Rain posts such as Staklim Padang Pariman, Teluk Bayur and Pariaman located at low elevation have high rainfall, while rain post locations such as Baso, BPBD Bukittingi and BK3K Bukit Barisan located at highland show more lower rainfall

This defies the common understanding of the influenced of orographic, where highland/hill regions are often associated with higher rainfall due to uplift of moist air masses. This anomaly in spatial variability can be explained by several complex interacting factors. One mechanism that may play a role is the rain shadow effect. In this phenomenon, moist air masses moving across mountains release most of their moisture on the windward side, causing the leeward side to received less rain [21].

The complex topography of West Sumatra, especially the Bukit Barisan Mountains, greatly influences the regional distribution of rainfall. Highland region facing the sea, such as the western slopes of Bukit Barisan,

generally receive high rainfall due to the orographic effect, where moist air from the Indian Ocean rises, cools and then condenses into rain. Conversely, regions on the eastern slopes or behind the Bukit Barisan mountains or are in the rain shadow zone so that even though they have high elevations, the rainfall received is actually lower because the air has lost its moisture as it descends the mountains [9]

IV. CONCLUSION

The average monthly rainfall pattern of West Sumatra generally shows an equatorial or bimodal type rainfall pattern that has two rain peaks in a year, but there are several areas that have monomodal rainfall patterns such as Teluk Bayur, Muara Sikabaluan, BP3K Bukit Barisan and BPBD Bukittinggi due to the influence of local and topographic factors. Temporal variability of rainfall in West Sumatra also shows significant differences. Rainfall variability shows a range of >30% and >40% in the High to Very High category which indicates unstable or variable rainfall. Seasonal variability shows a range of >20% and >40% in the Medium to Very High category. Annual variability shows a range of <20% to >20% in the Low to Medium category indicating more consistent rainfall. Spatial variability shows the distribution of rainfall in West Sumatra, the higher the elevation or the higher the location of a rain post, the lower the rainfall received

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