**Average Rainfall Trend in Northern Samar, Philippines during 2010 to 2019**

**ABSTRACT**

Rainfall is one of the most crucial elements in the climatic cycle that could significantly affect mostly the sustainability of our ecosystems, agriculture, human activity, and livelihood. This study focused on the analysis of the average rainfall trend in Northern Samar, Philippines 2010 to 2019. The researcher collected the data through the PAG ASA Catarman Northern Samar after which the annual average rainfall and monthly rainfall was analyzed. Results showed that the rainy months with higher average rainfall recorded were during the months of September, October, November, December, January, February, and March with 206.754 mm, 302.154 mm, 416.618 mm, 823.539 mm, 691.73 mm, 284.11 mm, and 409.71 mm, respectively. June and July were also found to have an average rainfall of 216.2 mm and 259.75 mm. A scatter plot was also used to graph the trend of the rainfall in the province.

**Keywords**

 Average rainfall, scatter plot, rainfall trend, Climate Analysis, Annual Rainfall

**INTRODUCTION**

Rainfall is the most important climatic element in the Philippines. Rainfall distribution throughout the country varies from one region to another (Villafuerte II et al., 2014). The growing concern about climate change has been a major problem around the globe (Matsumoto et al., 2020). The Philippines, like many of the world’s countries, is among the most vulnerable to the impact of climate change (De Asis & Varela, 2020; Pullen et al., 2015). Climate data for the past 50 years already show trends of rising temperatures by about 0.0110C annually, changes in the rainfall pattern and increasing number of extreme climate events, like cyclones, flooding and drought (Paje, 2014). Independent studies and climate modeling of the Philippine Atmospheric, Geophysical and Astronomical Services (PAG-ASA) projects the rise of the mean annual temperatures of the country by about 0.90C to 1.40C by 2020 and 1.70C to 2.40C by 2050.

 The continued rise in air temperature causes changing rainfall patterns in the country (Veloria et al., 2021; Gren & Helander, 2017). Furthermore, understanding rainfall patterns and trends is essential in providing effective water resource management, agricultural management planning, disaster risk reduction, and climate change adaptation. However, rainfall patterns are highly variable across spatial and temporal scales due to both natural climate variability and human-induced climate change. It has been noted that the Philippines has a humid equatorial climate characterized by high temperatures and heavy rainfall. Average annual rainfall is approximately 2,348 millimeters (mm), but this varies geographically, from 960 mm in southeast Mindanao to over 4,050 mm in central Luzon. Temperatures are generally high, particularly in the valleys and plains, averaging 27°C throughout the year. Humidity levels are high, averaging around 82% due to the warm moist trade winds that flow through the archipelago, as well as sea surface temperatures, a rich and vibrant vegetative cover and abundant rainfall (The World Bank Group, 2021). Northern Samar in particular has a significant rainfall throughout the year. Even the driest month still has a rainfall. Recently, severe flooding continues to be the major problem of the province.

 In this study, the researcher tried to analyze the average annual and monthly rainfall trend in the province and its corresponding graph using scatter plot.

**METHODOLOGY**

The researcher utilized only the rainfall data recorded by the PAG ASA Catarman Northern Samar. Annual and monthly rainfall data from 2010 to 2019 were analyzed by computing the average annual rainfall and monthly rainfall. Data were also graphed using scatter plot to identify the average trend of the rainfall.

**RESULTS AND DISCUSSION**

 Table 1 shows the average monthly rainfall in Northern Samar with corresponding average annual rainfall. Results showed that 2011 has the highest amount of annual average rainfall of 590.28 mm. This result is in accordance to the report of NASA Earth Observatory that heavy rains, flash floods, and landslides in the Philippines that had affected more than 450,000 people and killed at least 18 by January 5, 2011. The heaviest precipitation is concentrated along the eastern coasts, southeast of Manila. It was also revealed that during the years 2014, 2017, and 2018 have also a great amount of annual average rainfall of 426.84 mm, 348.98 mm, and 382.06 mm, respectively. It could be inferred that the average annual rainfall varies intermittently from 2010 to 2019.

On the other hand, the average monthly rainfall varies also year after year. It can be noted on Table 1 that the average monthly rainfall with highest amount of precipitation had been found out to start from the months, October, November, December and January with an average monthly rainfall of 302.154, 416.648, 823.539, and 691.73, respectively.From these, the most rainy months with highest amount of rainfall were December and January with average rainfall of 823.539 mm and 691.73 mm, respectively. This result conforms to the mean annual rainfall of the Philippines that varies from 965 to 4,064 millimeters annually where Baguio City, Eastern Samar, and Eastern Surigao receive the greatest amount of rainfall and the fact, that the province is bounded by southeast of Eastern Samar. Table 1 also showed that dry months starts from February and slightly increases its rainfall amounts from August to September.

Results also showed that the amount of rainfall per year slightly decrease from 2010 to 2019. In relation to this, as seen on figures 1, 2, and 3, the scatter plot of the annual rainfall tends to decrease year after year from 2010 to 2019.

**Table 1. Rainfall Data for Ten Years in Northern Samar (2010-2019)**

**(in millimeters)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **YEAR** | **JANUARY** | **FEBRUARY** | **MARCH** | **APRIL** | **MAY** | **JUNE** | **JULY** | **AUGUST** | **SEPTEMBER** | **OCTOBER** | **NOVEMBER** | **DECEMBER** | **ANNUAL** | **AVERAGE** |
| 2010 | 468 | 32.4 | 93.2 | 87.5 | 20.2 | 91.8 | 251.2 | 139.6 | 229.1 | 324.8 | 374.9 | 1129.7 | 3242.4 | **270.20** |
| 2011 | 1524.2 | 511.1 | 1516.7 | 273.3 | 855.9 | 273.7 | 442.4 | 158.3 | 86.3 | 224.2 | 495.8 | 721.4 | 7083.3 | **590.28** |
| 2012 | 618.6 | 423.2 | 526.9 | 147.8 | 188.9 | 132.4 | 359.1 | 42.7 | 342.4 | 355.3 | 285.6 | 409.9 | 3832.8 | **319.40** |
| 2013 | 372.8 | 438.5 | 459.9 | 47.9 | 70.8 | 355.9 | 214 | 234.8 | 147.3 | 151.9 | 511.9 | 576.5 | 3582.2 | **298.52** |
| 2014 | 734.5 | 200.3 | 414.7 | 387.8 | 31.7 | 371.8 | 428.1 | 286.9 | 286.3 | 479.5 | 448.3 | 1052.2 | 5122.1 | **426.84** |
| 2015 | 603.5 | 96.3 | 160.3 | 162.4 | 22.5 | 151.2 | 106.1 | 161.3 | 161.1 | 216.5 | 285.9 | 548.4 | 2675.5 | **222.96** |
| 2016 | 328.4 | 342.9 | 61.4 | 38.7 | 66.8 | 236.5 | 474.2 | 62.9 | 182.7 | 535.6 | 520.3 | 764.9 | 3615.3 | **301.28** |
| 2017 | 754 | 146.5 | 263.1 | 84.4 | 213.8 | 233.7 | 206.8 | 99.7 | 273.9 | 286 | 414.2 | 1211.6 | 4187.7 | **348.98** |
| 2018 | 1134 | 624.8 | 569.7 | 171.9 | 53.9 | 121.6 | 11.8 | 151.6 | 154.3 | 152.7 | 424.3 | 1014.1 | 4584.7 | **382.06** |
| 2019 | 379.3 | 25.1 | 31.2 | 81.4 | 62.3 | 193.4 | 103.8 | 157.77 | 204.14 | 295.04 | 405.28 | 806.69 | 2745.42 | **228.78** |
| **AVERAGE**  | **691.73** | **284.11** | **409.71** | **148.31** | **158.68** | **216.2** | **259.75** | **149.557** | **206.754** | **302.154** | **416.648** | **823.539** |  |  |

**Figure 1. Monthly Rainfall**

**Figure 2. Annual Rainfall**

**Fig. 3. Average Annual Rainfall for the last ten years**

**CONCLUSION:**

* The researcher concludes that the annual average rainfall in the province was 590.28 mm.
* The average annual rainfalls with higher amounts were 426.84 mm, 348.98 mm, and 382.06 mm in 2014, 2017, and 2018, respectively.
* The average monthly rainfall with highest amount of precipitation had been found out to start from the months, October, November, December and January with an average monthly rainfall of 302.154, 416.648, 823.539, and 691.73, respectively.
* The most rainy months with highest amount of rainfall were December and January with average rainfall of 823.539 mm and 691.73 mm, respectively.
* The scatter plot graph of the annual rainfall tends to decrease year after year from 2010 to 2019.

**RECOMMENDATION:**

* Further study is highly recommended to determine the significant impact to the production of agricultural products in the province.
* The abrupt change of rainfall year after year is also recommended for further study using Mann Kendal’s Test.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

**REFERENCES**

1. Basconcillo, J. (2016). Statistically Downscaled Projected Changes in Seasonal Mean Temperature and Rainfall in Cagayan Valley, Philippines. February. DOI: 10.2151/jmsj.2015 -058
2. De Asis, C. A., & Varela, B. D. (2020). Development of an Equation to Estimate the Monthly Rainfall: A Case Study for Catarman, Northern Samar, Philippines. *Development*, *5*(1).
3. Gren, S., & Helander, S. (2017). Why do people live in high-risks areas?-A field study in Samar, Philippines.
4. Matsumoto, J., Olaguera, L. M. P., Nguyen‐Le, D., Kubota, H., & Villafuerte, M. Q. (2020). Climatological seasonal changes of wind and rainfall in the Philippines. *International Journal of Climatology*, *40*(11), 4843-4857.
5. Pullen, J., Gordon, A. L., Flatau, M., Doyle, J. D., Villanoy, C., & Cabrera, O. (2015). Multiscale influences on extreme winter rainfall in the Philippines. *Journal of Geophysical Research: Atmospheres*, *120*(8), 3292-3309.
6. Veloria, A., Perez, G. J., Tapang, G., & Comiso, J. (2021). Improved rainfall data in the Philippines through concurrent use of GPM IMERG and ground-based measurements. *Remote Sensing*, *13*(15), 2859.
7. The World Bank Group. (2021). Climate Change Knowledge Portal. <https://climateknowledgeportal.worldbank.org/country/philippines/climate-data-historical>
8. Villafuerte II, M. Q., Matsumoto, J., Akasaka, I., Takahashi, H. G., Kubota, H., & Cinco, T. A. (2014). Long-term trends and variability of rainfall extremes in the Philippines. *Atmospheric Research*, *137*, 1-13.
9. <https://en.climate-data.org/asia/philippines/northern-samar/catarman-20196/#climate-graph>
10. <https://www.travelonline.com/philippines/weather.html>
11. <https://www1.pagasa.dost.gov.ph>