The Impact of Seasonality on Rainfall Patterns: A Case Study

Priti Kaushik, Randhir Singh Baghel, Somil Khandelwal

Abstract—This study uses whole-year data from Rajasthan, India, at the meteorological divisional level to analyze and evaluate long-term spatiotemporal trends in rainfall and looked at the data from each of the thirteen tehsils in the Jaipur district to see how the rainfall pattern has altered over the last 10 years. Data on daily rainfall from the Indian Meteorological Department (IMD) in Jaipur are available for the years 2012 through 2021. We mainly focus on comparing data of tehsil wise in the Jaipur district, Rajasthan, India. Also analyzed is the fact that July and August always see higher rainfall than any other month. Rainfall usually starts to rise around week 25th and peaks in weeks 32nd or 33rd. They showed that on several occasions, 2017 saw the least amount of rainfall during a long span of 10 years. The greatest rain fell between 2012 and 2021 in 2013, 2019, and 2020.

Keywords—Data analysis, extreme events, rainfall, descriptive case studies, precipitation temperature.

I. INTRODUCTION

THE Rajasthan's capital and largest city is Jaipur, often known as the "Pink City." On November 18, 1727, Maharaja Sawai Jai Singh II, the monarch of Amber, built it. The Jaipur district is 390 meters above sea level. The city is famously known for historic forts such as Amber Fort, Jaigarh Fort, Hawa Mahal, etc. Jaipur district has an area of 11,117 sq km, with a population density of 470 people per sq km, while Jaipur city is a total of 467 sq. km [1], [3], [5], [6], [12], [14]. The district is around 180 kilometers long from east to west and 110 km wide from north to south. There are thirteen tehsils: Amber, Viratnagar, Bassi, Chaksu, Chomu, Phulera, Phagi, Dudu, Kotputli, Jaipur, Jamuwa Ramgarh, Sanganer, and Shahpura. It is flanked to the north by Sikar and Mahendrakar districts, to the south by Tonk district, to the east by Alwar, Sawai Madhapur, and Dauda districts, and to the west by Nagaur district. Jaipur has a total population of 3.9 million people, according to the 2011 census. Jaipur district is situated on the eastern boundary of the Thar desert- a semi-arid land. A distant place from the Arabian Sea as well as the Bay of Bengal gives rise to a continental climate [8], [11], [17], [19]. During the monsoon period from July to September and occasionally during the rest period of the year in the wake of western disturbances humidity, cloudiness and rainfall activities increase [2], [4], [10], [13], [15]. The year is broadly divided into four seasons namely - the winter season starts from December to February, the summer or hot weather season is from March to May, the monsoon season spreads from the end of June to mid-September, and October and November are known as transit period or post-monsoon period. Jaipur's winters are bitterly cold and its summers are tremendously scorching. In May, the highest temperatures typically range from 40 °C to 47 °C. A heat wave occurs during the season when daytime temperatures are 4 to 6 °C above average for a few days [7], [9], [16], [18], [28]. Winter lows typically range from 4 to 9 °C and are below 0 degrees. or when a cold, northerly wind comes out of the Himalayan region. Occasionally in the morning hours after the passage of western disturbances, mist, and fog also appear. The lowest recorded temperatures of -2.2 °C occurred on January 31, 1905, and January 16, 1964. The indirect effects of rainfall are caused by other ecological processes [21], [24], [26], [29], [30]. The yearly rainfall directly influences the quantity of soil water that is accessible, making it a key element in deciding where plants are found [20], [23], [27], [31], [32]. Nutrients in the soil may flow off if it is too wet or dry and not reach the roots of the plants, resulting in poor growth and general health [33], [34]. Furthermore, as previously indicated, excessive rain or overwatering can promote the growth of bacteria, fungi, and mold in the soil [22], [25].

TABLE I
AREAS OF DIFFERENT TEHSILS

Sr. No	Tehsils	Area (sq. km.)
1	Amber	891.22
2	Bassi	654.69
3	Chaksu	811.77
4	Chomu	683.61
5	Dudu	1338.56
6	Kotputli	814.34
7	Phagi	1114.34
8	Phulera	1470.38

II. METHODOLOGY AND DATA USED

To understand how the rainfall pattern has changed in the Jaipur district over the past ten years, we examined the data from each of the thirteen tehsils in the Jaipur district. IMD Jaipur has provided daily rainfall data for the period 2012-2021. After gathering the data, we arranged it correctly for the date and year and checked if any values were missing. We collected data on seasonal rainfall in the tehsils of Jaipur and analyzed it using descriptive methods. The analysis included weekly, monthly, and seasonal rainfall patterns. The results were informative and helped shed light on rainfall patterns in the region. Overall, it was a useful exercise in understanding

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weather patterns in Jaipur district.

Fig. 1 District map of Jaipur [35]

A. Annual Rainfall of Amber

From Fig. 2, it can be observed that 2013 received the maximum amount of annual rainfall of order 854 mm which is 65 mm higher than the maximum annual rainfall received by 2012 which is 789 mm. The year 2017 received the lowest amount of annual rainfall of order 302 mm.

B. Annual Rainfall of Viratnagar

From Fig. 3, it can be observed that 2013 received the highest total rainfall of order 931 mm which is 200 mm higher than the total rainfall Viratnagar received in 2021 which is of order 731 mm.

C. Annual Rainfall of Bassi

The annual rainfall of Bassi is shown in Fig. 4. The year 2019 received an annual rainfall of 1027 mm which makes 2019 the year that received the maximum rainfall in 10 years. From 2015 to 2018, the total annual rainfall is in the range of 590 mm to 400 mm.

D. Annual Rainfall of Chaksu

From Fig. 5, it can be observed that in 2019, Chaksu received a total annual rainfall of order 927 mm which is 126 mm greater than the annual rainfall of 2016 which is of order 846 mm.

E. Annual Rainfall of Chomu

From Fig. 6, it can be depicted that 2020 received the maximum amount of annual rainfall of order 753 mm 54 mm greater than the maximum amount of annual rainfall received in the month of 2014. Since 2012, 2015 and 2017 received annual rainfall of less than 500 mm.

F. Annual Rainfall of Phulera

From Fig. 7, it can be observed that 2021 received the maximum amount of rainfall of order 744 mm. Most of the time the average rainfall is always greater than 300 mm.

G. Annual Rainfall of Phagi

From Fig. 8, the total annual rainfall in 2021 is 1087 mm, which is 200 mm more than the total annual rainfall received in any year.

H. Annual Rainfall of Dudu

During the analysis period, Fig. 9, the annual rainfall is in the range of 250 mm to 550 mm, but 2021 received a total annual rainfall of 830 mm which broke the barrier of 550 mm.

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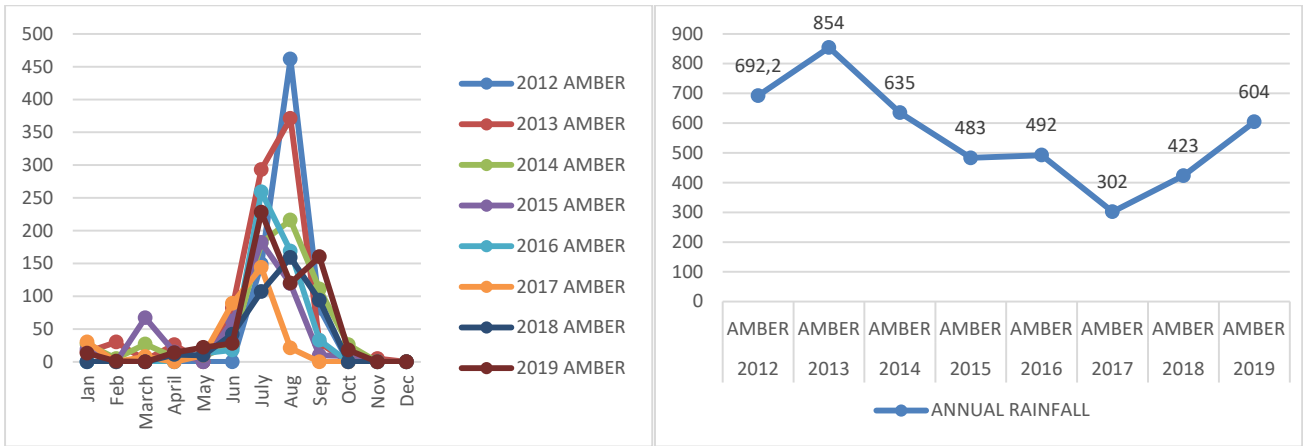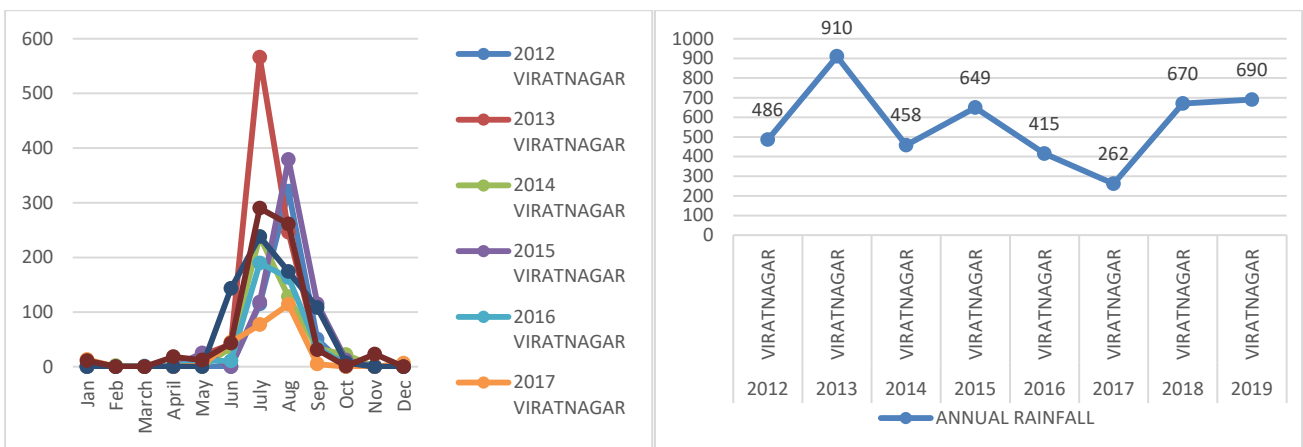Vol:17, No:10, 2023

Fig. 2 Monthly and annual rainfall analysis of Amber

Fig. 3 Monthly and annual rainfall analysis of Viratnagar

Fig. 4 Monthly and annual rainfall analysis of Bassi

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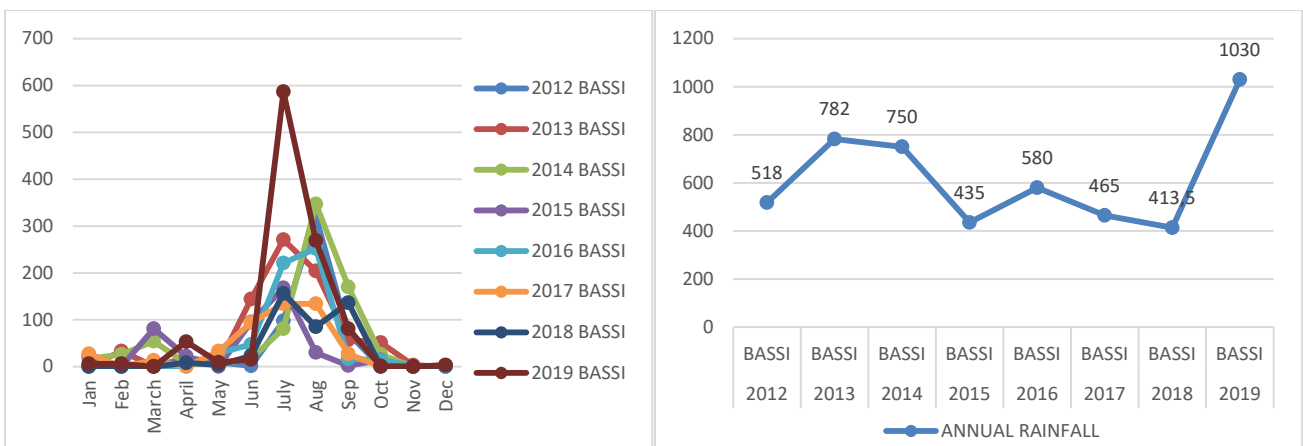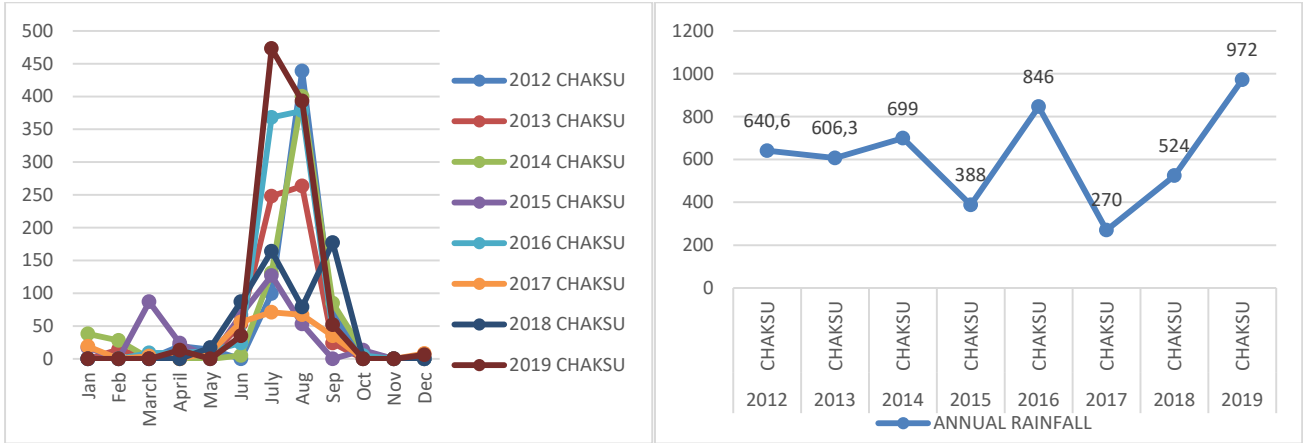Vol:17, No:10, 2023

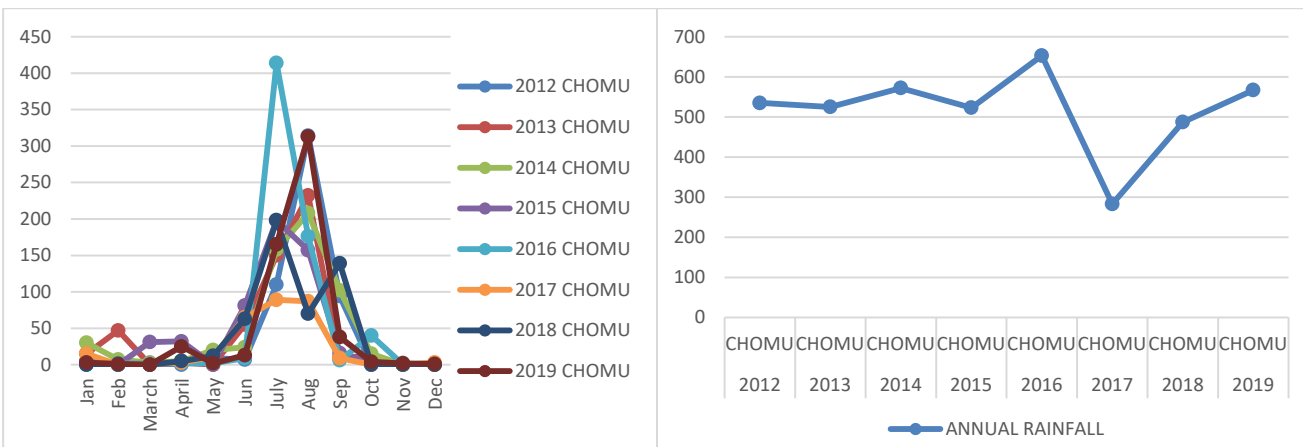Fig. 5 Monthly and annual rainfall analysis of Chaksu

Fig. 6 Monthly and annual rainfall analysis of Chomu

Fig. 7 Monthly and annual rainfall analysis of Phulera
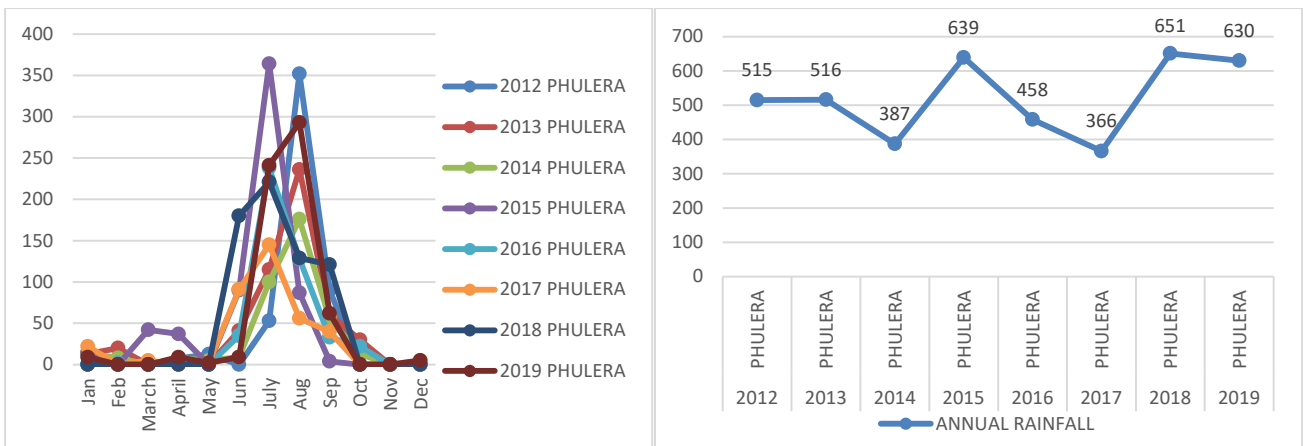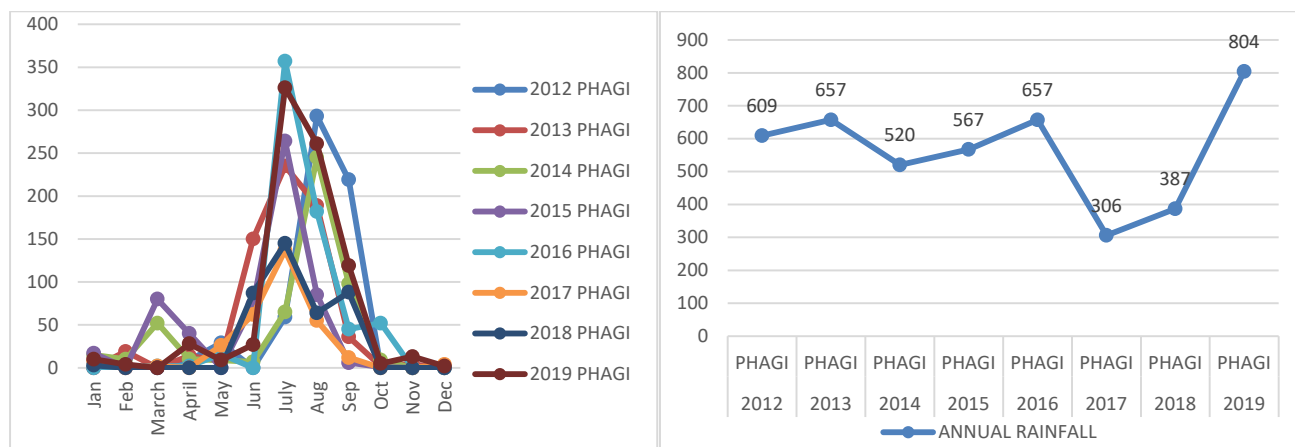
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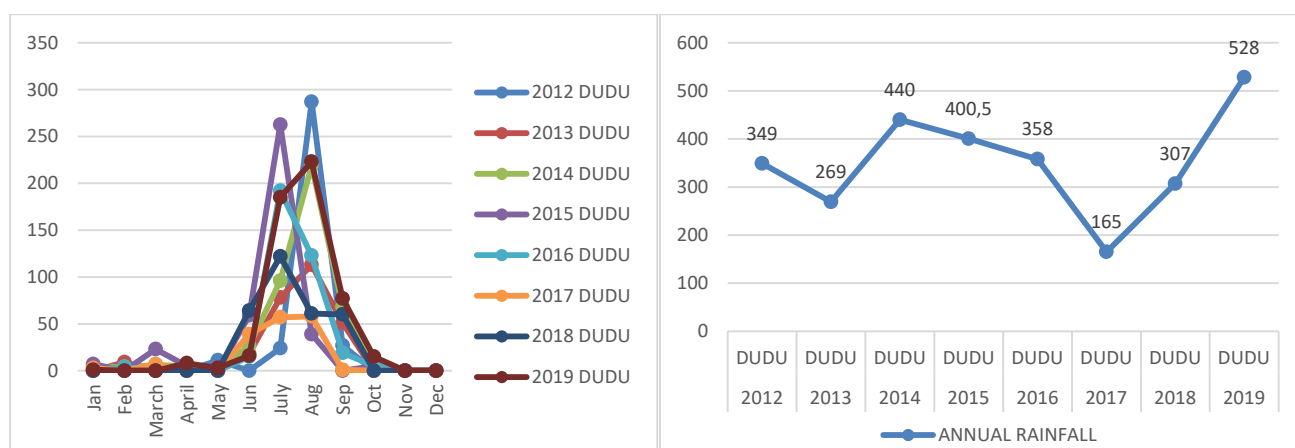
Fig. 8 Monthly and annual rainfall analysis of phagi

Fig. 9 Monthly and annual rainfall analysis of Dudu

III. CONCLUSION

If we compare every tehsil in the Jaipur district, we can infer that in 2021, Phagi received 1087 mm of annual rainfall, which is 3 mm more than the total annual rainfall received by Jaipur City in 2012. In 2012, Jaipur had approximately 1084 mm of yearly rainfall. During the analysis period, Jaipur recorded the maximum one-day rainfall of order 300 mm, which is far beyond any other tehsil. According to Table I, rainfall higher than 204.5 mm or extremely heavy rainfall is highly rare, similar to a supermoon, as only four times in 10 years does rainfall surpass the 204.5 mm barrier. Only Biratnagar and Bassi, out of the 13 tehsils, experience rainfall that exceeds 64.4 mm five times per ten years. Heavy rains occurred only twice in the last ten years in Viratnagar, Bassi, and Chaksu. During the analysis period, it can be observed that Chomu received the lowest rainfall of order 140 mm whereas, Jaipur City received the highest rainfall of order 300 mm which is 160 mm greater than the total rainfall received by Chomu. The total rainfall received by Dudu in 10 years is of order 344.38 mm which is the lowest as compared to any other tehsils. During the monsoon month, the Sanganer receives a total rainfall of order 628.65 mm with a standard deviation of 108.97 mm which is the highest as compared to any other subdivision whereas,

Dudu in monsoon months receives a total rainfall of order 381.65 mm with a standard deviation 64.461 mm. During 10 years, in monsoon months.

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