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# Rainfall Analysis for Agricultural Planning in Mungeli Region of Chhattisgarh Plain

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**Abstract** In rainfed agriculture regions, distribution analysis of rainfall keep a better role for suitable crop planning. Since the more than the half area rainfed agriculture is still dependent on rainfall it is imperative that the prediction of rainfall pattern must be appropriate and reliable. In respect of this, an attempt has been under to analyze rainfall distribution patterns i.e. weekly, seasonal and annual rainfall based on 39 years (1978-2016) data of Mungeli, Chhattisgarh. The analysis showed that the average rainfall is 84.45 mm was found to be highest for 29th week. From monthly analysis, it was found that maximum average monthly rainfall (328.78 mm) and minimum (7.01 mm) were recorded in the months of July and December, respectively. Average annual rainfall of the study area is 1080.0 mm.

**Keywords** Rainfall analysis, Rainfall distribution, Rainfed agriculture, Crop planning, Agricultural planning.

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## Introduction

Rainfall is the main source of water. Its play a major role in rainfed agriculture. The distribution pattern of rainfall varies region to region and year to year. Sixty per cent of the tota cropped land in the country is rain dependent [1]. Singh et al. [2], Sarkar et al. [3] analyzed the daily rainfall data for suitable crop planning. In the recent years with large scale utilization of water resources, there is a need for judicious use of water for proper agricultural management and to minimize drought risk. Pali and Thakur [4] analyzed the rainfall data for agricultural planning to overcome the problem of continuous maximum dry days. Rainfall play a very crucial role for designing the water conservation structures, agricultural drainage system, irrigation for crops and planning of agricultural operations. Conservation of water virtually reduces the soil erosion. Thus, the scope of conservation is very wide, encompassing all the measures of soil conservation, moisture retention and nutrient preservation in the soil. Pilare and Durbude [5] stated that realistic rainfall analysis is prerequisite for proper designing of any soil and water conservation structure. Sinha [6] found that improper design of structures without considering the expected miximum daily rainfall and consequent peak runoff for the design return period often lead to hydrological/hydraulic/structural failure of these structures causing loss of valuable time, labor and money. Keeping this in mind, an effort has been made in the present study to interpret available daily, weekly, monthly, seasonal and annual rainfall of 39 years (1978—2016) data of Mungeli, Chhattisgarh.

**Table 1.** Weekly monsoon rainfall characteristic at Mungeli during 1978-2016.

| SMW | Average rainfall | Percentage of annual rainfall | Max rainfall | Min rainfall | SD | CV (%) | Skewness |
|---|---|---|---|---|---|---|---|
| 25 | 49.03 | 4.54 | 168.70 | 0.00 | 43.82 | 89.36 | 1.23 |
| 26 | 65.69 | 6.08 | 171.90 | 0.00 | 53.25 | 81.06 | 0.67 |
| 27 | 69.52 | 6.44 | 140.20 | 0.00 | 38.04 | 54.72 | -0.23 |
| 28 | 72.01 | 6.67 | 187.60 | 0.00 | 51.58 | 71.63 | 0.43 |
| 29 | 84.45 | 7.82 | 235.40 | 11.40 | 50.43 | 59.72 | 1.00 |
| 30 | 76.92 | 7.12 | 237.00 | 3.00 | 54.58 | 70.96 | 1.07 |
| 31 | 64.85 | 6.00 | 165.90 | 0.00 | 48.17 | 74.28 | 0.54 |
| 32 | 70.28 | 6.51 | 179.20 | 1.70 | 48.94 | 69.64 | 0.73 |
| 33 | 50.20 | 4.65 | 159.80 | 0.00 | 33.33 | 66.39 | 1.16 |
| 34 | 53.09 | 4.92 | 176.60 | 0.00 | 40.43 | 76.14 | 1.11 |
| 35 | 66.67 | 6.17 | 282.50 | 0.00 | 59.95 | 89.92 | 1.61 |
| 36 | 54.66 | 5.06 | 182.20 | 0.00 | 46.72 | 85.48 | 0.93 |
| 37 | 47.78 | 4.42 | 238.00 | 0.00 | 51.53 | 107.83 | 2.07 |
| 38 | 31.53 | 2.92 | 165.00 | 0.00 | 41.86 | 132.76 | 1.76 |
| 39 | 23.20 | 2.15 | 166.60 | 0.00 | 35.03 | 150.99 | 2.53 |

## Materials and Methods

Mungel district covers an area of 2750.36 km$^2$ and lies between North latitudes 21$^0$ 48´35´´ to 22$^0$ 40´30´´ and East longitudes 81$^0$29´45´´ to 82$^0$ 02´ 10´. In this region there are wide variations in the climate. Mungeli has a tropical wet and dry climate, temperatures remain moderate throughout the year, except from March to June, which can be extremely hot. The winter commences from November and last till the end of February. The summer season begins from March and continues till the second week of June. Monsoon season commences from middle of June and remains till the end of the September. The information about normal values of climatic parameters was taken from Meteorological Department of College of Agriculture, IGKVV, Raipur.

Analysis of rainfall data

Rainfall data of daily, weekly, monthly, seasonally and annual of past 39 years of Mungeli were used for analyses. The analysis of rainfall characteristics involved determination of statistical parameters such as maximum, minimum, mean, standard deviation, coefficient of variation and skewness of weekly, monthly, seasonal and annual value of rainfall. The analysis was done by using computer program in MSexcel 13.0. The maximum and minimum value of rainfall was determined on accounting the highest and lowest rainfail in the respective week, month, season and year.

## Results and Discussion

The rainfall characteristic of the region was analyzed on the basis of quantitative measures such as maximum, minimum, mean, standard deviation and coefficient of variation, skewness and percentage deviation of weekly, monthly, seasonal and annual value of rainfall. The results of quantitative measures are discussed as under.

Weekly rainfall analysis

The analysis of weekly monsoon rainfall data of 39 years (1978–2016) is presented in Table 1. The analysis revealed that the rainfall of different years of the standard meteorological weeks (SMW) varies among the rainfall.Rainfall was found during 25$^{th}$ to 39$^{th}$ SMW as monsoon weeks in which period greater concentration of rainfall occur. It was found that about 91% of rainfall occurs during 25$^{th}$ to 39$^{th}$ SMW. It is clear from the data that the highest rainfall of 282.50 mm was observed in the 35$^{th}$ SMW in 2002. The maximum weekly monsoon rainfall variation is observed in the range of 140.20 mm to 282.50 mm, whereas, minimum rainfall varied between 0.0 mm and 11.40 mm. The av-

**Table 2.** Rainfall characteristics of monthly, seasonally and yearly during 1978-2016.

| SMW | Average rainfall | Percentage of annual rainfall | Max rainfall | Min rainfall | SD | CV (%) | Skewness |
|---|---|---|---|---|---|---|---|
| Jan | 20.27 | 1.88 | 98.00 | 0.00 | 26.98 | 133.13 | 1.30 |
| Feb | 18.55 | 1.72 | 125.00 | 0.00 | 25.67 | 138.36 | 2.19 |
| Mar | 14.68 | 1.36 | 71.40 | 0.00 | 17.85 | 121.56 | 1.16 |
| Apr | 15.46 | 1.43 | 94.20 | 0.00 | 22.28 | 144.08 | 1.94 |
| May | 14.89 | 1.38 | 125.40 | 0.00 | 24.69 | 165.75 | 2.96 |
| Jun | 158.22 | 14.65 | 336.70 | 45.00 | 80.53 | 50.90 | 0.38 |
| Jul | 328.78 | 30.44 | 511.60 | 99.40 | 109.80 | 33.40 | -0.09 |
| Aug | 267.64 | 24.78 | 442.80 | 348.20 | 71.58 | 26.74 | 0.34 |
| Sep | 175.87 | 16.28 | 387.70 | 29.00 | 94.16 | 53.54 | 0.48 |
| Oct | 44.46 | 4.12 | 234.20 | 0.00 | 46.58 | 104.76 | 2.09 |
| Nov | 14.15 | 1.31 | 133.30 | 0.00 | 26.95 | 190.43 | 2.84 |
| Dec | 7.01 | 0.65 | 78.70 | 0.00 | 16.28 | 232.08 | 3.08 |
| Climatic season | | | | | | | |
| Winter | 45.84 | 4.24 | 176.76 | 0.00 | 39.98 | 87.22 | 1.09 |
| Summer | 45.04 | 4.17 | 152.50 | 0.00 | 37.68 | 83.67 | 1.44 |
| Monsoon | 930.50 | 86.16 | 1440.50 | 573.20 | 169.93 | 18.26 | 0.47 |
| Post-monsoon | 58.61 | 5.43 | 234.20 | 0.00 | 34.98 | 93.81 | 1.26 |
| Yearly | 1080.0 | - | 1671.0 | 693.0 | 201.28 | 18.60 | 0.48 |

erage weekly rainfall was found to be highest of 84.45 mm in 29$^{th}$ SMW while the lower was 23.20 mm in 39$^{th}$ SMW. The variation in standard deviation (SD) was ranged from 33.33 to 59.95, whereas coefficient of variation (CV) varied in between 54.72% and 150.99% respectively. Higher value of standard deviation and lower value of coefficient of variation indicates dependability. This also shows the uniform and consistent rainfall pattern during the weeks.Skewness found to be varied between -0.23 and 2.53. This analysis shows there is wide variations in quantitative measures which indicates that the rainfall received in region are highly erratic.

Monthly rainfall analysis

Monthly rainfall analysis is shown in Table 2. The analysis shows that this region receives more than 91% of annual rainfall during the month of June to September. July is the wettest month with an average of 328.78 mm followed by August of 267.64 mm. It is also found from the analysis of 39 years data that the maximum value of average monthly rainfall511.60 mm and minimum value 71.40 mm were recorded in the months of July and March respectively, amounting to 30.44%and 1.36% of the average annual rainfall with coefficient of variation of 33.40% and 121.56% respectively. High value of standard deviation of 109.80 in the month of July indicates its dependability. The variation in minimum monthly rainfall was observed in the range of 0.0 to 148.20 mm. It was also observed that the value of coefficient of variation was found to be lowest of 26.74% followed by 33.40% respectively in the month of August and July and skewness was found to be lowest of -0.09 in the month of July which indicates less variation in rainfall distribution of the region and has a consistent and uniform rainfall pattern. December is the driest month with rainfall of 7.01 mm. It is due to receiving of lowest amount of rainfall throughout the year and contributes 0.65% to the annual rainfall which is also a negligible amount. It is also having the highest value of coefficient of variation of 232.08%, which shows the erratic pattern of rainfall of the region.

Seasonal rainfall analysis

It is evident from the analysis that the Mungeli region receives 86.16%, 5.43%, 4.24% and 4.17% of average annual rainfall during the monsoon (June-Sep-

tember), post monsoon(October-November),winter (December–February) and summer (March–May) season, respectively (Table 2). The maximum rainfall for season monsoon, post monsoon, winter and summer are 1440.50, 234.20, 176.76 and 152.50 mm respectively. The highest average rainfall equal to 930.50 mm was observed in the monsoon season of the region while the lowest of 45.04 mm was in the summer season. A major part of rainfall is generally lost through runoff, which can be stored through *in situ* or *ex-situ* water harvesting structures and used during *kharif* season as life saving irrigation when long dry spell occur or *rabi* season for growing crop. The minimum value of rainfall of the region varied between 0.0 to 573.20 mm. The standard deviation, coefficient of variations and skewness of the monsoon season were 169.93, 18.26% and 0.47 respectively which indicates its dependability. The lower value of coefficient of variation depicted consistent occurrence of rainfall in monsoon season.

Annual rainfall analysis

The analysis of rainfall data of Mungeli region is shown in Table 2. The annual rainfall showed a significant variation in the range of 693.0 to 1671.0 mm with an average value of 1080.0 mm. Standard deviation and coefficient of variation and skewness were found to be 201.28 mm, 18.60% and 0.48 respectively. The highest annual rainfall was observed in the year 2003, whereas it was found lowest in the year 2000. About 44% of the total years received highest rains than that of the average annual rainfall and 56% of the total years received lesser rains than that of the average annual rainfall.

## Conclusion

The following conclusions may be drawn on the basis of rainfall analysis of Mungeli. Weekly rainfall varies in the range from 0.00 mm to 282.5 mm with highest rainfall 511.6 mm received in the July months contributing to about 30.44% to the average annual rainfall and the lowest values of rainfall 7.01 mm received in the month December contributing the 0.65% to the total annual rainfall. The seasonal rainfall varied 1440.50 mm highest in monsoon season contributing to about 86.16% to the average annual rainfall, the lowest value of rainfall received in summer season which is 152.5 mm contributing to about 4.17% to the average annual rainfall. The annual rainfall varies from 693.0 to 1671.0 mm with an average value of 1080.0 mm. The results shows that there is a great possibility to collect the surplus surface runoff in the water storage bodies and recycling the same for qualitative and quantitative production of different crop in the region. The valuable information obtained from the rainfall analysis in present study can be used for crop planning, designing of water harvesting potential and agricultural drainage system in the Mungeli region.

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