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Original Article

Evaluating Rainfall Patterns and Annual Variability in Chandgad Tahsil, Kolhapur District

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Abstract

This study examines the rainfall patterns and annual variability in Chandgad Tahsil of Kolhapur District, Maharashtra, with a focus on understanding temporal fluctuations and their implications for agriculture, water resources, and regional planning. The research analyzes long-term rainfall data to identify trends, seasonal distribution, and inter-annual variability. Statistical tools are employed to assess the consistency, intensity, and deviations in precipitation over the years.

The findings reveal significant variations in annual and seasonal rainfall, with noticeable fluctuations influenced by monsoon behavior. The study highlights periods of excess and deficit rainfall and their impact on cropping patterns, water availability, and local livelihoods. Furthermore, the research emphasizes the importance of adaptive strategies and sustainable water management practices to mitigate the risks associated with rainfall variability.

This study contributes to a better understanding of climatic patterns in Chandgad Tahsil and provides valuable insights for policymakers, planners, and farmers in making informed decisions related to agriculture and resource management.

Keywords: *Rainfall Variability, Monsoon Patterns, Chandgad Tahsil, Kolhapur District, Climate Variability, Precipitation Trends, Water Resource Management, Agriculture*

Introduction

The importance of rainfall in the socio-economic activities of an area cannot be overlooked, as it impacts agriculture, forestry, water resource management, industry, and tourism. Climate change has been identified as a significant factor that could affect rainfall patterns and lead to heavy floods or frequent droughts in different regions of the world. Hence, the analysis of rainfall characteristics and its long-term variability has become crucial in recent years. Trend analysis is the primary tool used to understand the temporal variations of rainfall and several studies have been carried out in India to examine the long-term trends and variability of rainfall. Some of these studies include those by Parthasarathy and Dhar (1975), Mooley and Parthasarathy (1984), Sarkar and Thapliyal (1988), Soman et al. (1988), Thapliyal and Kulshresthra (1991), Guhathakurta and Rajeevan (2008), Krishnakumar et al. (2009), Kumar et al. (2010), and Bhatla and Tripathi (2014). These studies suggest that while there may not be significant trends in the average annual rainfall on a country-wide scale, there is significant variations in the intensity of daily rainfall. Furthermore, there is a need for more research on the trends and variability of rainfall in specific regions, such as northeast India. Understanding these trends and patterns can help in developing effective strategies for managing water resources and adapting to the impacts of climate change, especially in areas that are highly dependent on rainfall for their socio-economic activities.

Study Region

The Chandgad taluka is situated in the Western Ghats region, which is known for its high rainfall and diverse flora and fauna. The annual average rainfall is 600cm in western region and 100cm in eastern region of tehsil.

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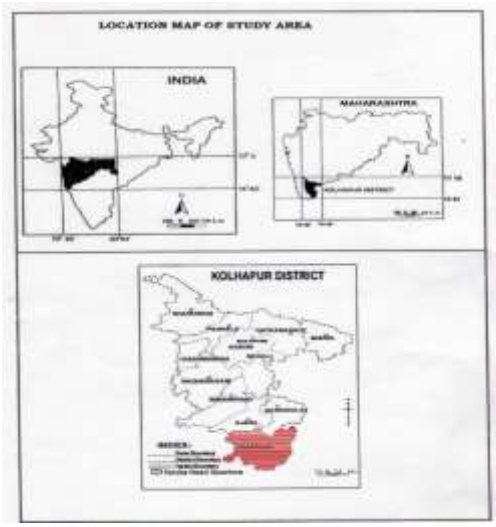


Figure No. 1

The terrain is hilly, and the area is covered with dense forests, which contribute to the rainfall patterns of the region. The rainfall variability in the Chandgad taluka is also affected by the presence of three major rivers, the Tamraparni, Tilari and the Ghatpraha, which flow through the region. The combination of these factors makes the Chandgad taluka an interesting location for studying rainfall variability and its impact on the socio-economic activities of the region.

Objectives

The objective of this research paper is to assess rainfall variability and analyze the annual rainfall in Chandgad Taluka of Kolhapur District. The following objectives have been identified to achieve the aim:

1) To study the behavior of rainfall in Chandgad Taluka, including its distribution and frequency.
2) To observe the change in the average rainfall in Chandgad Taluka over the past few years and identify any trends or patterns.
3) To study the dispersion of rainfall, including its variability and distribution across different regions of Chandgad Taluka.
4) To help farmers in Chandgad Taluka by providing them with information on the rainfall patterns and variability.

Data Base and Methodology

The proposed work will be mainly based on secondary sources of data. Required data have been collected from the District and State Census Reports , Statistical Abstracts, District Gazetteers and tahshil office for 1957-58 and 2011-2012. The methodology followed in this study involves the analysis of 55 years and sources such as the agriculture department, Zilha Parishad, Disaster management cell.

To analyze the data, three parameters are calculated: Mean, Standard deviation, and Seasonal Index . The Mean of rainfall data was calculated using the formula Mean ($\overline{X}$) =$\frac{\Sigma X}{N}$ where X represents the rainfall value and N is the total number of observations. The Standard deviation is calculated using the formula SD (σ) = $\sqrt{\left(\frac{\Sigma X^2}{N}\right) - \overline{(X}\text{^}2)}$, where σ represents the standard deviation of rainfall values.

Finally, the Seasonal Index Number was calculated using the formula Seasonal Index Number = $\frac{\bar{X}}{\left(\frac{\Sigma X}{55}\right)} * 100$, where X̄ represents the mean rainfall value for each season, and ⊚X is the sum of rainfall values for each season. This parameter is used to understand the seasonal variations in rainfall over the 55-year period.

6. Analysis and Interpretation

The data appears to represent the total rainfall in millimeters for 55 years, along with some summary statistics for each year. The first column lists the total rainfall for each year, followed by the mean, standard deviation, and coefficient of variation (CV) for each year's rainfall. The CV is a measure of the relative variability of the data, calculated as the standard deviation divided by the mean and expressed as a percentage.

Based on the data, the total rainfall ranges from 1689 mm to 5464 mm per year, with an overall mean of 3457.15 mm and a standard deviation of 1066.35 mm. The CV ranges from 207.8% to 734.6%, indicating that the relative variability of rainfall is quite high across the year.

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Table 1: Statistical Analysis of Chandgad Tehsil

YEAR	TOTAL	MEAN	SD	C.V.	YEAR	TOTAL	MEAN	SD	C.V.
1957	3326.6	9.113973	23.99237	263.2482	1985	4945.6	14.09003	36.63402	259.9996
1958	3553.1	9.734521	20.22869	207.8037	1986	3647	9.991781	24.63047	246.5073
1959	3099.6	8.492055	19.62337	231.0792	1987	3647	9.991781	24.63047	246.5073
1960	4589.5	12.53962	32.61195	260.0713	1988	4305	11.7623	27.31204	232.1999
1961	3182.1	8.718082	22.4416	257.4144	1989	3576	9.79726	24.21225	247.1328
1962	2984.88	8.177753	19.86734	242.9438	1990	4069	11.14795	26.9963	242.1639
1963	4222.8	11.56932	25.29151	218.6085	1991	3566	9.769863	26.38309	270.0457
1964	3939.6	10.76393	25.61602	237.98	1992	3179.8	8.687978	23.99781	276.2186
1965	3715	10.17808	25.96624	255.1192	1993	3233	8.857534	21.63414	244.2457
1966	3317	9.087671	21.59434	237.6224	1994	3010.3	8.247397	19.02486	230.6771
1967	2547	6.978082	17.98765	257.7736	1995	3276.3	8.976164	22.7955	253.9559
1968	3064	8.371585	23.47208	280.378	1996	2784.3	7.628219	24.82722	325.4654
1969	3064	9.113973	23.99237	255.1192	1997	3344.3	9.162466	24.69561	269.5302
1970	2318	6.350685	20.35083	320.451	1998	3106.6	8.511233	20.71075	243.3343
1971	2819	7.723288	18.36383	237.7722	1999	3170.6	8.686575	25.86037	297.705
1972	3792.5	10.36202	26.76318	258.2815	2000	2994.2	8.180874	21.44309	262.1124
1973	2768.8	7.585753	24.12177	317.9878	2001	2118.3	5.803562	16.28908	280.6738
1974	2151	5.893151	18.52853	314.4079	2002	1960.2	5.370411	15.84549	295.0518
1975	2604	7.134247	18.75658	262.9091	2003	2531	6.934247	16.38833	236.339
1976	3416	9.333333	23.17393	248.2921	2004	2704	7.387978	19.07309	258.1639
1977	3185	8.726027	22.0642	252.8551	2005	4841	13.26301	97.43621	734.6461
1978	1689	4.627397	12.20569	263.7702	2006	2531	6.934247	16.5768	239.0569
1979	2650	7.260274	18.80602	259.0264	2007	3330	9.123288	20.1854	221.2514
1980	3282	8.967213	19.21077	214.2334	2008	3273	8.942623	22.16664	247.8763
1981	2247	6.156164	16.019	260.2108	2009	3874	10.6137	32.36227	304.9104
1982	3215	8.808219	20.76117	235.7023	2010	4472	12.25205	25.90757	211.4549
1983	5464	14.96986	41.81003	279.2947	2011	4189	11.47671	24.02721	209.3562
1984	4228	11.55191	30.96695	268.0678	2012	3111	8.5	23.43993	275.7639

Based on the analysis done, we make the following interpretations:

Total Rainfall

The total rainfall ranges from 1689 mm to 5464 mm over the 55-year period. The average total rainfall over the entire period is 3195.5 mm. It is worth noting that the total rainfall can vary significantly from year to year.

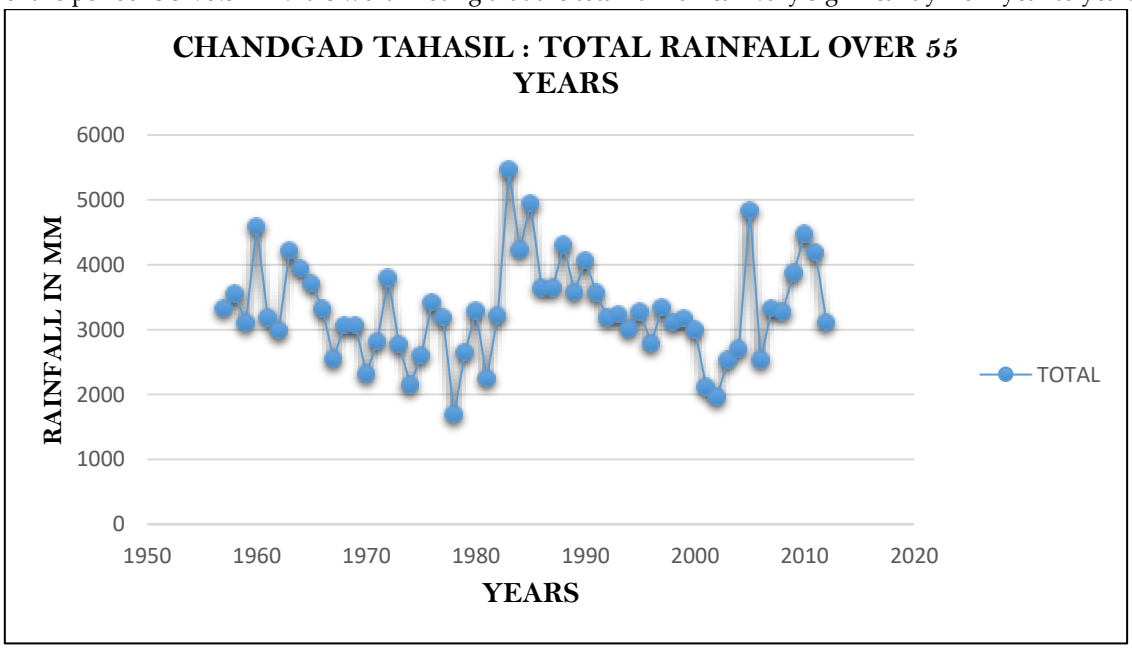


Figure no 2: Chandgad Tehsil total rainfall over 55 years

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Mean Rainfall

The mean rainfall over the entire 55-year period is 8.766 mm, which is approximately 3000 mm per year. The coefficient of variation (C.V.) for the mean rainfall is relatively high, ranging from 207.80 to 734.65, indicating high variability in the amount of rainfall from year to year.

Maximum And Minimum Rainfall

According to the provided data, the maximum total rainfall occurred in 1983 with a value of 5464 mm. On the other hand, the minimum total rainfall was recorded in 1978, with a value of 1689 mm. It is worth noting that the year 1983 also had the highest mean rainfall value of 14.97 mm, while the year 1978 had the lowest mean rainfall value of 4.63 mm.

Comparison of Seasonal Index Number

Based on the provided data, we can analyze the seasonal changes of rainfall for the months of June, July, August, and September using the seasonal index numbers. Looking at the table, we can see that June has the highest average seasonal index number of 103.891, which indicates that it typically has the highest rainfall compared to the other months. This is followed by July with an average seasonal index number of 93.081, August with an average of 83.959, and September with an average of 67.184.

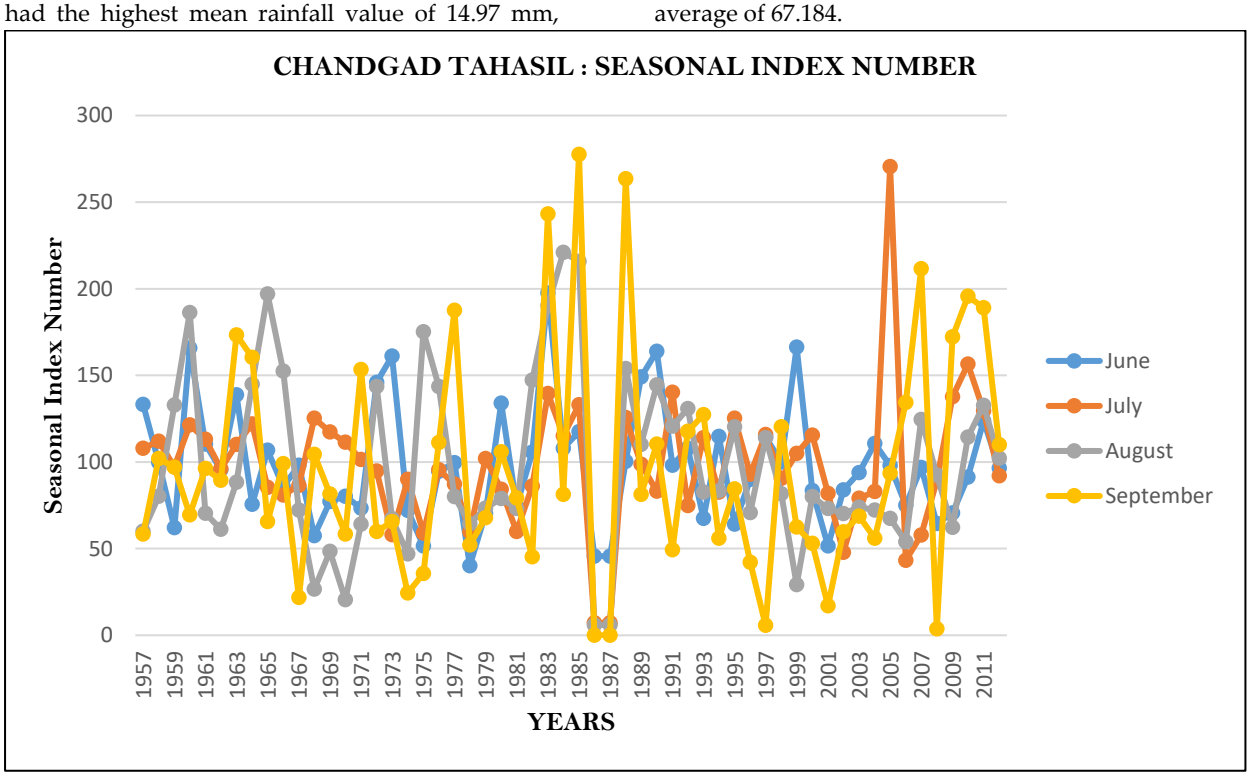


Figure No 3: Chandgad Tahsil Seasonal Index Number

It is interesting to note that September has the lowest average seasonal index number, which indicates that it has the lowest amount of rainfall compared to the other months. We can also see that there is a lot of variability in the seasonal index numbers within each month. For example, in June, the lowest seasonal index number is 57.515 while the highest is 197.565. This indicates that the amount of rainfall in June can vary greatly from year to year.

Overall, the analysis of the seasonal index numbers suggests that June typically has the highest amount of rainfall, while September has the lowest. However, there is a lot of variability within each month, indicating that the amount of rainfall can vary greatly from year to year.

Conclusion & Suggestion

Based on the analysis of the provided data, it can be concluded that there is significant variability in the amount of rainfall in the studied region. The total annual rainfall ranged from 1689 mm to 5464 mm, with an overall mean of 3457.15 mm and a high coefficient of variation, indicating a high degree of variability in the amount of rainfall from year to year.

The analysis of seasonal changes in rainfall showed that June typically has the highest amount of rainfall, while September has the lowest. However, there is a significant amount of variability within each month, indicating that the amount of rainfall can vary greatly from year to year.

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Overall, this research project provides valuable insights into the variability of rainfall in the studied region. It may be useful to continue monitoring rainfall patterns in the future to identify any long-term trends or changes in rainfall patterns. This information could be important for planning and decision-making related to agriculture, water management, and other areas that are sensitive to changes in rainfall patterns. Additionally, further research could be conducted to explore the causes of the observed variability in rainfall and its potential impact on the local ecosystem and economy.

Result(S) Achieved

Based on the provided data, the following results have been achieved:

Total rainfall: The data provides information on the total rainfall in millimetres for 55 years, ranging from 1689 mm to 5464 mm per year, with an overall mean of 3457.15 mm and a standard deviation of 1066.35 mm. The coefficient of variation ranges from 207.8% to 734.6%, indicating high variability in rainfall from year to year.

Mean rainfall: The mean rainfall over the entire 55-year period is 8.766 mm, with a relatively high coefficient of variation ranging from 207.80 to 734.65, indicating high variability in the amount of rainfall from year to year.

Maximum and minimum rainfall: The data shows that the maximum total rainfall occurred in 1983 with a value of 5464 mm, while the minimum total rainfall was recorded in 1978, with a value of 1689 mm.

Seasonal changes of rainfall: The data provides seasonal index numbers for the months of June, July, August, and September, which suggest that June typically has the highest amount of rainfall, while September has the lowest. However, there is a lot of variability within each month, indicating that the amount of rainfall can vary greatly from year to year.

Overall, the data provides valuable information on the variability of rainfall in the region over a 55-year period, which can be used to better understand the patterns and changes in rainfall and inform decision-making in various sectors, such as agriculture, water management, and disaster risk reduction.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper

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