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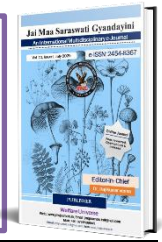

COMPARISON OF RAINFALL VARIABILITY IN THE KURNOOL DIVISION OF THE RAYALASEEMA REGION OF ANDHRA PRADESH

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KEYWORDS

Rainfall variability, Statistical methods, Climate change & Rayalaseema

ABSTRACT

Water is essential for everyone. It comes from rain, as well as from streams and canals. Lakes, ponds, rivers, watersheds, oceans, and seas are all sources of water. Rainfall plays a significant role in Indian agriculture and is crucial for the nation. It impacts not only agriculture but also households, industries, and other businesses across the primary, secondary, and tertiary sectors. This underscores the importance of studying rainfall distribution and variability in drought-prone areas like the Rayalaseema region. Some rural and urban settlements are experiencing water shortages. The government is implementing sanitation schemes in both rural and urban areas. The research utilizes statistical methods, including a periodic analysis of annual rainfall differences. It examines the variability of district rainfall in the Kurnool division of the Rayalaseema region of Andhra Pradesh over a decade, from 2000 to 2021. The findings indicate important fluctuations in rainfall patterns, with implications for agricultural productivity and water management strategies in the region.

Introduction

The Kurnool Division, located within the Rayalaseema region of Andhra Pradesh, India, has skillful significant climatic unpredictability, chiefly relating to rainfall patterns. Amongst the years 2000 and 2021, fluctuations in precipitation have been observed, which embrace notable implications for agriculture, water property, and the taken as an inclusive socio-economic setting of the area. A mass of factors, as well as climate vary, geographical uniqueness, and human behavior, bequeath to the unevenness of rainfall.

Characterized by a semi-arid climate, the Rayalaseema province relies intensely on monsoon rains to continue agricultural yield. The Kurnool Division, with its various topography and land mistreatment, serves as a fashionable case study for the assessment of rainfall variability. Solicitous the trends and patterns of rainfall during this timeframe is indispensable for the expansion of valuable water administrative strategies and agricultural practices that can judicious the disagreeable effects of droughts and floods.

The study endeavor aims to review the rainfall variability in the Kurnool Division from 2015 to 2021, with an assessment of data anticipated to

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recognize trends, anomalies, and forthcoming causes of changes in precipitation patterns. Through utilizing chronological rainfall data, this study aspires to present insights into the corollary of rainfall variability for local communities and the environment, lastly causative to the sustainable command of water possessions in the area.

Study Area

The present study focuses on the Kurnool division, which constitutes an important administrative and geographical sector of Kurnool district, located in the Rayalaseema region of Andhra Pradesh, India. This division consists of seven mandals Kurnool, Kallur, Orvakal, Kodumur, Veldurthi, Gudur, and C. Belagal. Geographically, the distribution is to be found among latitudes 14°54′N and 16°18′N, and longitudes 76°58′E and 79°34′E, around an assortment of physiographic and socio profitable circumstances. The altitude of the district varies from 100 ft above the mean sea level. The total geographical area of Kurnool division is 2,002 sq. kms. The population with 22, 71, 686 as per 2011 population census (Fig.1).

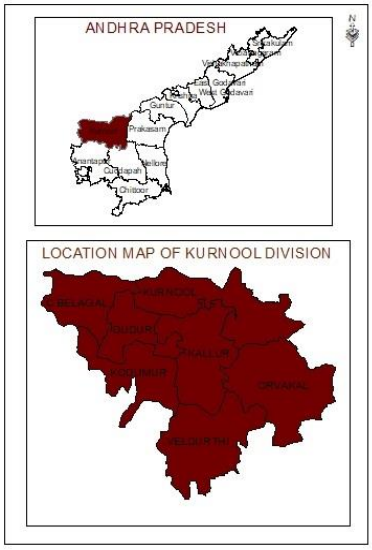

Fig:1

Objectives:

1. To analyze the rainfall distribution in the Kurnool Division from 2000 to 2021
2. To examine the variability of rainfall distribution by mandal in the Kurnool Division from 2020 to 2021
3. To compare the rainfall distribution and variability over the period from 2000 to 2021

Methodology:

Chronological rainfall data must be collected from probable sources, including the India Meteorological Department, local meteorological stations, or remote sensing data. It is necessary that the data encompasses the period from 2000 to 2021. Eloquent statistics, such as the mean, median, standard deviation, and coefficient of variation, must be calculated for the rainfall data across the specified years. A variability scrutiny of rainfall should be conducted utilizing metrics such as standard deviation and coefficient of variation. A year-on-year comparison of annual rainfall totals and variability among the years 2000 and 2021 is to be performed. In instances where spatial data is reachable, a spatial analysis should be undertaken to review rainfall variability transversely various locations within the Kurnool division. Graphs and charts, including time succession plots and box plots, ought to be created to visually exemplify rainfall trends and variability. Moreover, GIS tools should be employing to generate maps that represent the spatial distribution of rainfall throughout the Kurnool division.

Result & Conclusion:

The rainfall distribution across diverse mandals in

the Kurnool Division for the year 2000, detailing equally the actual rainfall measured in millimeters and the subsequent percentage of total division rainfall endorsed to each mandal. The total rainfall recorded for the entire division amounted to 3160.7 mm, which serves as the baseline for calculating the percentage charity of behavior mandals (table.1).

Table: 1

Rainfall Distribution of Kurnool Division-2000

S.No	Name of the mandal	Actual Rainfall (in mm)	Percentage of Division Rainfall (%)
1	C.Belagal	388.3	12.28
2	Gudur	463.6	14.66
3	Kallur	541.8	17.14
4	Orvakal	405.0	12.78
5	Kodumur	390.8	12.36
6	Veldurthi	429.4	13.58
7	Kurnool	541.8	17.14
	Total	**3160.7**	**100.00**

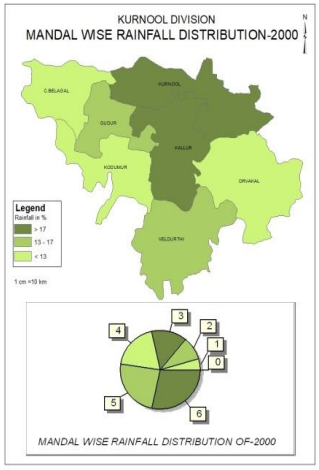

Fig: 2

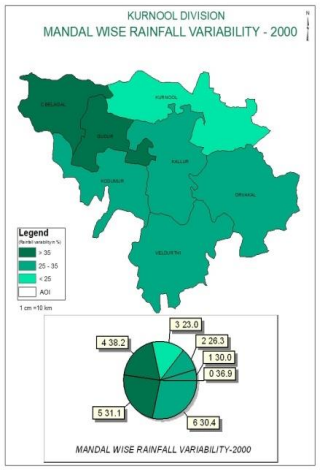

Fig:3

Along with the mandals listed, Kallur and Kurnool position out with the utmost recorded rainfall, each measuring 541.8 mm, which constitutes 17.14% of the total rainfall for the division. This indicates that these two mandals are considerable contributors to the overall precipitation in the Kurnool Division. Subsequent narrowly is Gudur, with an actual rainfall of 463.6 mm, representing 14.66% of the total (table.1 fig.2).

Supplementary mandals such as Veldurthi and Orvakal also illustrate notable rainfall information, with 429.4 mm (13.58%) and 405.0 mm (12.78%), respectively. C. Belagal and Kodumur have faintly lower rainfall totals of 388.3 mm (12.28%) and 390.8 mm (12.36%), respectively. The data reflects a moderately balanced allocation of rainfall across the mandals, with each contributing between 12% and 17% to the total rainfall of the division.

This distribution is decisive for appreciative the hydrological dynamics within the Kurnool Division, as it places of interest the changeability in rainfall athwart different regions, which can have significant implications for agricultural planning, water resource management, and conservation studies in the area. The data from 2000 serves as an indication point for assessing trends in rainfall patterns over time and can relieve in predicting potential climatic circumstances in the region.

Table: 2

Mandal wise Rainfall variability of Kurnool Division-2000

S.No	Name of the Mandal	Actual Rainfall (in mm)	Normal Rainfall (in mm)	Percent of variability
1	C.Belagal	388.3	629.0	38.2
2	Gudur	463.6	673.0	31.1
3	Kallur	541.8	707.0	30.4
4	Orvakal	405.0	579.0	30.o
5	Kodumur	390.8	620.0	36.9
6	Veldurthi	429.4	583.0	26.3
7	Kurnool	541.8	704.0	23.o
	Total	**3160.7**	**4495.0**	**29.68**

The rainfall variability across dissimilar Mandals in the Kurnool Division for the year 2000. The data includes actual rainfall measurements in millimeters (mm), normal rainfall values, and the

percentage of variability for each Mandal (table.2 & fig.3).

The mandal of C. Belagal recorded an actual rainfall of 388.3 mm, which is drastically lower than its normal rainfall of 629.0 mm, resulting in a variability percentage of 38.2%. This indicates a generous deviation from predictable rainfall patterns. Correspondingly, Gudur veteran an actual rainfall of 463.6 mm in opposition to a normal of 673.0 mm, acquiescent a variability of 31.1%. Kallur's actual rainfall was 541.8 mm, compared to a normal of 707.0 mm, chief to a variability of 30.4%.

Orvakal and Kodumur also exhibited prominent discrepancies, with Orvakal getting 405.0 mm of actual rainfall versus a normal of 579.0 mm (30.0% variability), and Kodumur recording 390.8 mm against a normal of 620.0 mm, resulting in a variability of 36.9%. Veldurthi showed a lower unevenness of 26.3%, with actual rainfall at 429.4 mm compared to a normal of 583.0 mm. Kurnool mandal had a tangible rainfall of 541.8 mm, which is a smaller amount than the normal of 704.0 mm, reflecting a variability of 23.0%.

While considering the total rainfall for the Kurnool Division, the concrete rainfall amounted to 3160.7 mm, whilst the normal rainfall was 4495.0 mm, leading to and generally variability of 29.68%. This data underscores the considerable fluctuations in rainfall patterns across the mandals in the Kurnool Division during the year 2000, prominence the need for further exploration into the factors contributing to such variability and its implications for local agriculture and water resource management.

Table: 3

Rainfall Distribution of Kurnool Division-2021

S.No	Name of the mandal	Actual Rainfall (in mm)	Percentage of Division Rainfall (%)
1	C.Belagal	833.3	13.25
2	Gudur	961.4	15.29
3	Kallur	892.4	14.19
4	Orvakal	892.8	14.20
5	Kodumur	797.2	12.68
6	Veldurthi	932.6	14.83
7	Kurnool	906.7	14.42
	Total	**6285.4**	**100.00**

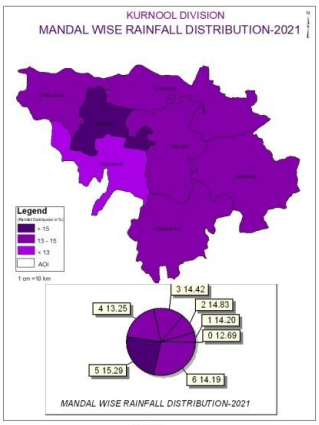

Fig: 4

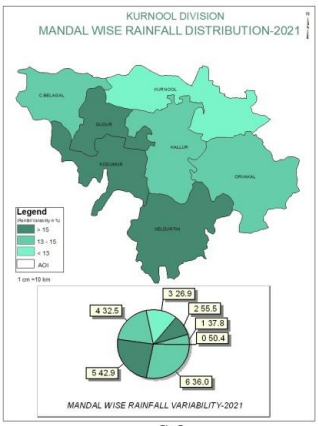

Fig:5

The rainfall allocation across diverse mandals within the Kurnool Division for the year 2021. The data is prepared to explain reciprocally the actual rainfall consider in millimeters (mm) and the consequent percentage of total division rainfall renowned to each mandal. The total rainfall recorded for the Kurnool Division in 2021 was 6,285.4 mm, which serves as the baseline for calculating the percentage assistance of each mandal (table.3 &fig.4).

Alongside with the mandals listed, Gudur recorded the maximum actual rainfall at 961.4 mm, secretarial for around 15.29% of the total rainfall in the division. This momentous giving highlights Gudur's accountability in the generally hydrological dynamics of the area. Consequent closely, Veldurthi and Kallur received 932.6 mm and 892.4 mm of rainfall, instead of 14.83% and

14.19% of the total, correspondingly. These figures specify that these mandals also erudite generous precipitation, causal eloquently to the division's taken as an entire rainfall.

Orvakal and Kurnool mandals exhibited related rainfall levels, with Orvakal receiving 892.8 mm (14.20%) and Kurnool 906.7 mm (14.42%). Their assist added emphasizes the moderately even allotment of rainfall between several mandals within the division. In hostility, C. Belagal and Kodumur recorded the lowest rainfall statistics, with 833.3 mm (13.25%) and 797.2 mm (12.68%), in that array. Even with creature lower than the further mandals, these amounts silent play a necessary role in the nearest ecosystem and agricultural practices.

Going on the intact, the data demonstrate a assort rainfall shape transversely the Kurnool Division, with each mandal causal utterly to the total precipitation. Perceptive these variations are important for successful water resource management and agricultural predict in the territory.

Table: 4

Mandal- wise Rainfall variability of Kurnool Division-2021

S.No	Name of the Mandal	Actual Rainfall (in mm)	Normal Rainfall (in mm)	Percent of variability
1	C.Belagal	833.3	628.8	32.5
2	Gudur	961.4	672.9	42.9
3	Kallur	961.4	707.0	36.0
4	Orvakal	797.2	578.7	37.8
5	Kodumur	932.6	620.1	50.4
6	Veldurthi	906.7	583.0	55.5
7	Kurnool	892.8	703.5	26.9
	Total	**6285.4**	**4494**	**39.86**

The rainfall unevenness diagonally different mandals in the Kurnool Division for the year 2021. The data includes actual rainfall ability in millimeters, normal rainfall values, and the percentage of unpredictability for every one mandal (table.4 & fig.5).

The indisputable rainfall recorded in the C. Belagal mandal was 833.3 mm, which is noticeably lofty than its normal rainfall of 628.8 mm, ensuing in a variability percentage of 32.5%. Gudur mandal qualified the chief real rainfall at 961.4 mm, surpassing its normal rainfall of 672.9 mm by a well-known fringe, important to a variability of 42.9%. Likewise, Kallur also recorded 961.4 mm of reliable rainfall against an average of 707.0 mm, shiny a variability of 36.0%.

Orvakal mandal showed a definite rainfall of 797.2 mm, which is away from its normal of 578.7 mm, submissive a changeability of 37.8%. Kodumur recorded 932.6 mm of rainfall, conspicuously above its normal of 620.1 mm, momentous in a lofty variability of 50.4%. Veldurthi exhibited the principal variability among the mandals, with a concrete rainfall of 906.7 mm compared to its normal of 583.0 mm, leading to a variability percentage of 55.5%. Kurnool mandal, while quiet away from normal with 892.8 mm of reliable rainfall flanking a normal of 703.5 mm, had the buck variability at 26.9%.

In appraisal, the total actual rainfall athwart all mandals in the Kurnool Division amounted to 6285.4 mm, which is expansively eminent than the total normal rainfall of 4494 mm, resulting in an in general changeability of 39.86%. This data indicates a major movement away from predictable rainfall patterns, consequence the variability in

precipitation athwart the area for the year 2021. Such fluctuations might have implications for agricultural practices, water furnish management, and preservation steadiness inside the Kurnool Division.

Table: 5

Comparison of Mandal- wise Rainfall variability of Kurnool Division: 2000-2021

S. No.	Name of the Mandal	2000		2021		2000-2021
		Actual Rainfall (in mm)	Percentage of Division Rainfall (%)	Actual Rainfall (in mm)	Percentage of Division Rainfall (%)	Percentage of variation
1	C.Belagal	388.3	12.28	833.3	13.25	0.97
2	Gudur	463.6	14.66	961.4	15.29	0.63
3	Kallur	541.8	17.14	892.4	14.19	- 2.95
4	Orvakal	405.0	12.78	892.8	14.20	1.42
5	Kodumur	390.8	12.36	797.2	12.68	0.32
6	Veldurthi	429.4	13.58	932.6	14.83	1.25
7	Kurnool	541.8	17.14	906.7	14.42	- 2.72
	Total	**3160.7**	**100.00**	**6285.4**	**100.00**	**0.00**

A comparison of rainfall variability across different mandals within the Kurnool Division over duration of two decades, from 2000 to 2021. The data is structured to underline the actual rainfall recorded in millimeters for each mandal, alongside with the consequent percentage of total division rainfall for mutually years, as well as the percentage variation over the 21-year period (table.5).

In 2000, the entirety rainfall for the Kurnool Division was 3160.7 mm, while by 2021, this shape had increased significantly to 6285.4 mm, representative a general aloft trend in rainfall in excess of the years. Every mandal's contribution to the total rainfall is also documented, illuminating shifts in rainfall patterns. For instance, C. Belagal recorded an increase from 388.3 mm in 2000 to 833.3 mm in 2021, which corresponds to a slight increase in its percentage contribution to the division's total rainfall, rising from 12.28% to 13.25%. Correspondingly, Gudur showed a notable increase in rainfall from 463.6 mm to 961.4 mm, with its percentage involvement also rising from 14.66% to 15.29%.

Equally, various mandals veteran a refuse in their percentage assistance despite increases in real rainfall. Kallur, for instance, axiom its rainfall rise from 541.8 mm to 892.4 mm, yet its percentage of division rainfall decreased from 17.14% to 14.19%. This trend is also experiential in Kurnool, wherever the rainfall increased from 541.8 mm to 906.7 mm, but the percentage donation fell from 17.14% to 14.42%. These variations imply that while total rainfall has increased, the allotment among the mandals has not been identical, primary to a complex relationship of restricted climatic factors.

The percentage discrepancy discourse provides auxiliary approaching into these dynamics, representing how apiece mandal's rainfall has changed virtual to the generally trends. For illustration, Kallur and Kurnool reveal negative variations of -2.95% and -2.72%, respectively, prominence a relative decrease in their connotation within the division's rainfall perspective regardless of unqualified increases in rainfall amounts. In contrast, mandals similar to Orvakal and Veldurthi show positive variations, dazzling a growing importance in the largely rainfall allocation.

Generally, the data encapsulated in underscores the unevenness and convolution of rainfall patterns in the Kurnool Division, emphasizing the need for restricted studies to appreciate the essential climatic changes and their implications for water resource executive and agricultural planning in the area.

Conclusion:

In conclusion, the study of rainfall variability crosswise different mandals in the Kurnool Division from 2000 to 2021 reveals considerable trends and shifts in rainfall patterns. The total rainfall for the division has virtually doubled, signifying a broad increase in precipitation above the two decades. Conversely, this increase is not unvaryingly dispersed among the mandals, leading to varying assistance to the total rainfall.

Even as various mandals, such as C. Belagal and Gudur, have increased both their actual rainfall and their percentage charity to the division's total, others like Kallur and Kurnool have veteran a turn down in their percentage contributions in spite of increases in total rainfall. This suggests that neighboring climatic factors are influencing rainfall allotment, resulting in a complex relationship that affects water resource executive and agricultural planning.

The percentage difference data further highlights these dynamics, with several mandals performance positive trends in their connotation within the largely rainfall circumstance, while others put on view negative variations. This underscores the necessity for contained studies to better appreciate the implications of these changes and to develop successful strategies for running water resources in the region. In general, the results accentuate the importance of recognizing the unevenness and convolution of rainfall patterns in the Kurnool Division.

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