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Assessment of Spatial analysis of Rainfall in the Narihalla watershed of Sandur Taluk, Bellary District, Karnataka using GIS

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Abstract— **Rainfall is the most essential single component that influences the cropping pattern of an area in general, and it is the first index ever thought of by formers and climatic analyzers among the Climatic factors. The type of crop to be grown, as well as its success or failure. The current research focuses on the rainfall patterns in the Narihalla watershed of Sandur, Ballari District. The study will be based on rainfall data collected over Twenty five years from three rain gauge stations (1995-2020). The study area's long-term annual average rainfall is 573.21mm. The highest rainfall was 764.9 mm at the Sandur rain gauge station, while the lowest rainfall was 462.12 mm at the Chornur rain gauge station. The Mean annual rainfall variability in the research area is classified into majorly five types namely Very High, High, Moderate, Low, and Very Low. Which covers an area of about 25.42, 23.70, 17.99, 14.74, and 19 Percentage of the total study area respectively. Heavy rainfall was recorded in the middle portion of the study region, whereas the south and Northeast areas of the study area received the least rainfall. Using obtained rainfall data we were prepared a different Rainfall spatial analysis map of the study area which helps us to know about the variability of the rainfall in the Narihalla watershed.**

Keywords— Spatial analysis, Narihalla, IDW, Rainfall pattern

I. INTRODUCTION

Water is essential for all biological processes and cannot be substituted. Water is also used for transportation, as a source of energy, and for a variety of other residential, agricultural, and industrial uses. Rainfall is the most important source of water in any area, and it has a significant impact on agriculture. Plants take their water from both natural and artificial sources. Crop yield, particularly in rain-fed areas, is influenced by rainfall patterns. In dryland environments, rainfall is a scarce and significant hydrological variable. Because the demand for water in these places is growing daily as a result of population growth, economic development, and urbanization, water management using all available resources is becoming increasingly important. A major climatic issue confronting civilization today is changing precipitation patterns and their influence on surface water resources. There is significant evidence that rainfall changes are already occurring on both the global and regional stages as a result of global warming (India receives about 80 percent of its total rainfall during the summer monsoon season, from June to September)

Karnataka is classified into three meteorological regions due to climate differences Coastal Karnataka, North Interior Karnataka, and South Interior Karnataka Respectively. The Udupi, Uttara Kannada, and Dakshina Kannada districts make up the coastal Karnataka area. Tropical monsoons affect the entire coastal belt and surrounding places. The area receives a lot of rain. Coastal Karnataka receives an average annual rainfall of 3456 mm, which is significantly more than rainfall obtained in other parts of the state. The districts of Bagalkot, Belgaum, Bijapur, Bidar, Bellary, Dharwad, Haveri, Gadag, Gulbarga, Koppal, and Raichur make up the North Interior Karnataka region. This is an arid region that receives the lowest rainfall in the state, with an average annual rainfall of only 731 mm. in the interior south The districts of Bangalore Rural, Bangalore Urban, Chitradurga, Chamrajnagar, Chikmagalur, Hassan, Kodagu, Kolar, Mysore, Shimoga, and Tumkur make up the Karnataka area. A semi-arid climate prevails in this area. The average annual rainfall in South Interior Karnataka is 1286 mm.

In a year, Karnataka experiences four seasons Summer, Monsoon, Post-Monsoon, and Winter. The summer season begins in March and lasts through May. Karnataka's hottest months are April and May. During these two months, the weather in the state becomes extremely dry and miserable. June is the start of the monsoon season, which lasts until September. The state's humidity and temperature rise throughout June. It's also the month when the southwest monsoon winds blow, bringing rain to the state's southern regions. The heat is reduced to some amount by the rain from July to September, but the humidity remains high. The post-monsoon season starts in October and lasts until the end of December. The weather changes for the better during this time. The north-eastern monsoon, which impacts the south-eastern areas of Karnataka, brings a few rain spells to the state. During this time of year, the humidity levels drop dramatically. From January to February, the winter season begins. In most regions of Karnataka, these are the coldest months, with low temperatures. The weather is still comfortable because the humidity has fallen substantially.

The importance of rainfall analysis is in the proper planning of agricultural activities, the planning and design of water conservation and recharge structures, design of water conservation and recharge structures, and examining the Probability of Droughts and Floods.

The main purpose of this study is to use the GIS Platform to compute and depict the average mean and southwest monsoon rainfall of the Narihalla watershed in Sandur Taluk, Bellary District, Karnataka.

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II. STUDY AREA

The present study is carried out for the Narihalla watershed which lies in the Sandur taluk of Ballari district in the State of Karnataka. it is located between 15° 13' 39.45"N and 14° 52' 33.15"N in latitude and 76° 25' 23.03"E and 76° 40' 31.50"E in longitude, and is covered by an area of 56039.2 Hectares. Fig.1 depicts a location map of the Study area with rain gauge stations. Three rain gauge stations distributed across the study area have been used in the present study. The study area receives rainfall from both Southwest and Northeast on an average (25years) of 352.43mm and 39.62mm respectively.

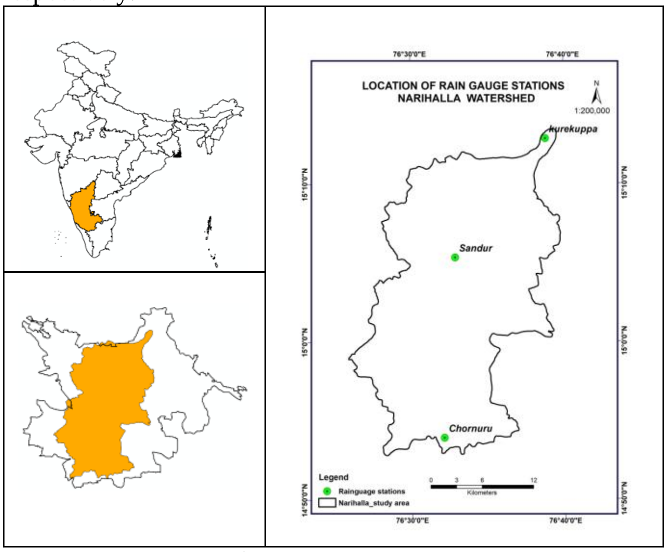

Figure 1: Map of Study area with Rain gauge Stations.

III. METHODOLOGY

The base map of the study area has been prepared from the 1:50,000 scale Survey of India (SOI) toposheets number 57 A/8, 57 A/12, 57 B/5, and 57 B/9. Monthly rainfall data for the period of 25 years from 1995 to 2020 has been collected from the Economic and Statistical Department of Ballari district. three gauge stations (in the study area) have been taken into consideration for calculating mean monthly, seasonal and annual rainfall patterns and these have been processed and analyzed using Inverse Distance Weighted method in ArcGIS software and relevant maps were prepared.

IV. RESULT AND DISCUSSION

A. Annual Mean rainfall:

The average monthly rainfall for the three rainguage stations understudy for a span of 25 years shows an increasing trend from January to December as shown in Fig.2. it reaches its peak during the Northeast monsoon season. From Table 1 Annual mean rainfall varies from 462.12 mm to 764.9 mm. High mean annual rainfall was recorded in Sandur Rainguage Station (764.9 mm) which is located in the middle of the study area, very low rainfall is recorded in the Chornuru Rainguage station (462.12mm) which is in the south part of the study area, Kurekuppa Rainguage station (492.62mm) Northeast part of the study area experience average rainfall during the period of 1995 to 2020 the annual mean rainfall of all three stations is 573.21mm as shown in Fig. 3 and Table 1.

For the last 25 years, the mean seasonal variations of the southwest monsoon are observed with a maximum rainfall intensity of 471.3mm in Sandur and minimum rainfall intensity of 276.75mm in Kurekuppa. The mean seasonal variations of the northeast monsoon are observed and it is recorded with a maximum of 148mm at Sandur and a minimum rainfall intensity of 80.62mm at Chornuru. The mean seasonal variation of the summer is observed with the maximum rainfall intensity of 1444.8mm at Sandur and the minimum rainfall intensity of 72.87mm at Chornuru. The mean seasonal variation of the winter is observed with the maximum rainfall intensity of 2 mm at Kurekuppa and the minimum low intensity of less than 0.5mm at Chornuru.

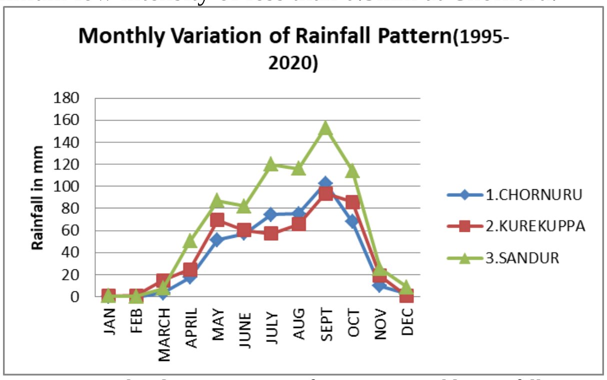

Figure 2. Graphical representation of Average Monthly Rainfall Variation of the Study Area.

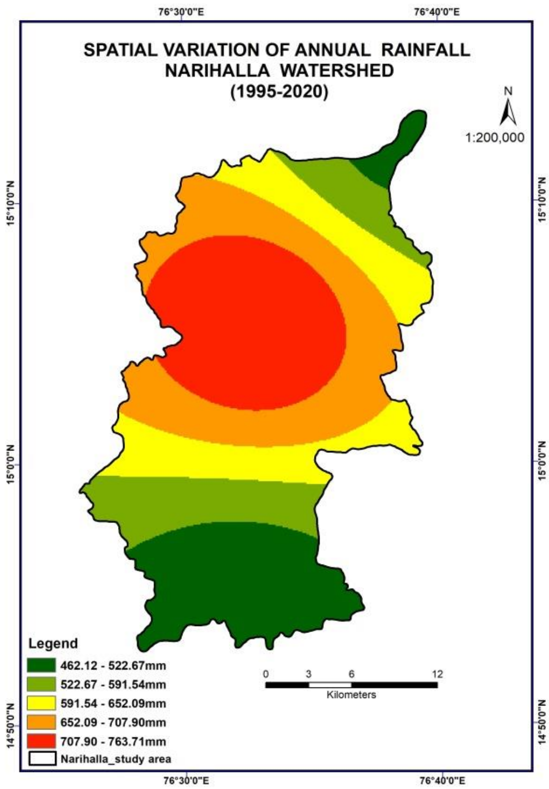

Figure 3. Spatial Variation of Mean Annual Rainfall

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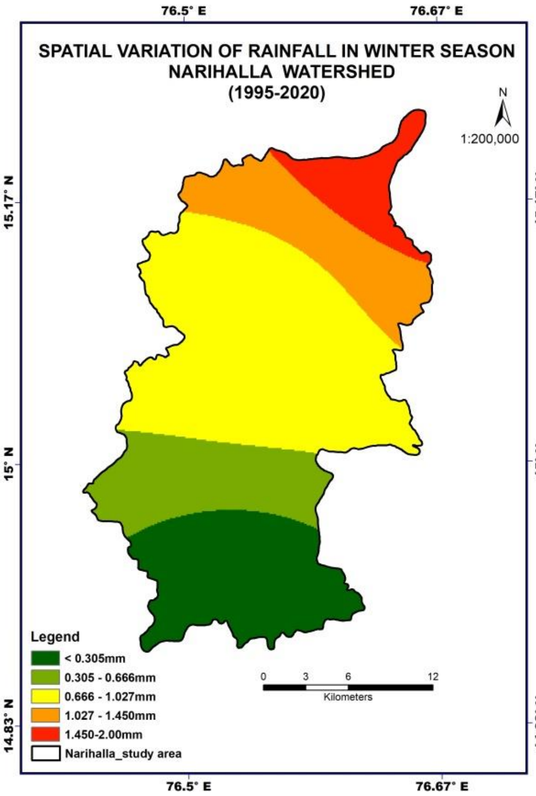

Figure 4. Spatial Variation of rainfall in the winter season.

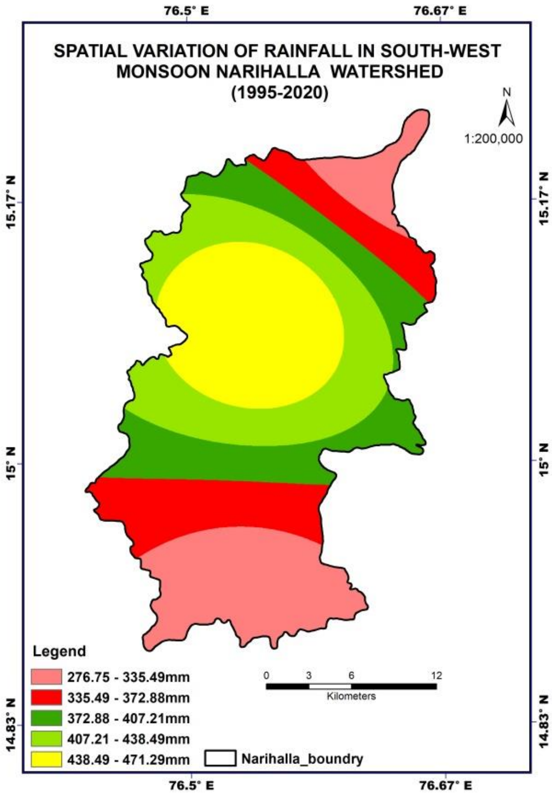

Figure 6. Spatial Variation of rainfall in South West Monsoon.

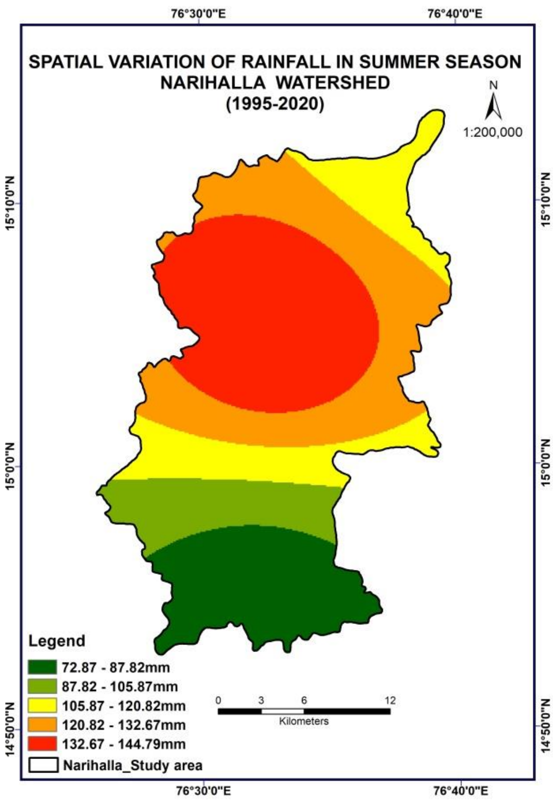

Figure 5. Spatial Variation of rainfall in the Summer season.

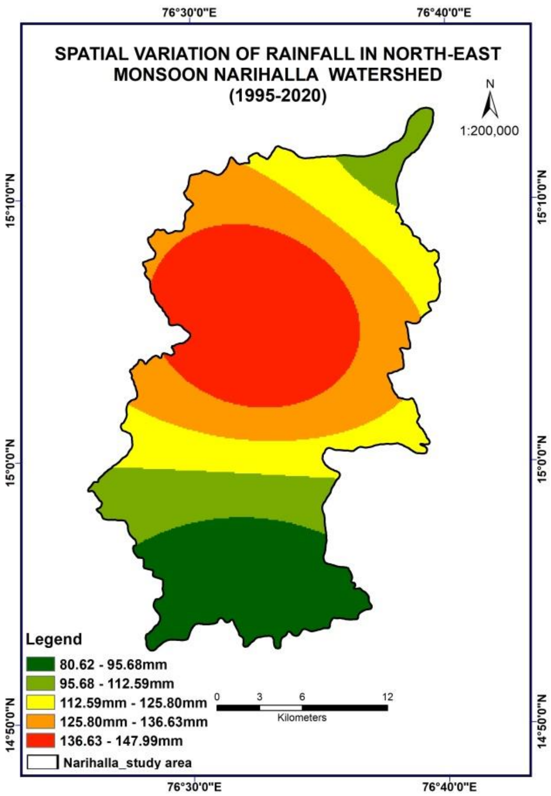

Figure 7. Spatial Variation of rainfall in North-East Monsoon.

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Table 1. Annual Mean and seasonal Mrainfall

Rain gauge station	Winter	Summer	South-West Monsoon	North-East Monsoon	Annual rainfall
Chornuru	0	72.87	309.25	80.62	462.12
Kurekuppa	2	109	276.75	105.37	492.62
Sandur	0.83	144.8	471.3	148	764.9
Mean	0.94	108.89	352.43	111.33	573.21

Table 2. Mean Monthly rainfall Variation pattern of the study area

RG_Stations	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Chornuru	0	0	3.25	17.37	51.62	57.25	74.25	75	102.8	68	10	2.62
Kurekuppa	0.62	0.87	14.75	24.75	69.5	60.25	57.25	65.62	93.62	86	18.87	0.5
Sandur	0.5	0.3	7.5	50.2	87.1	82.2	119.8	116.2	153.1	114	25.5	8.5

B. Seasonal Mean rainfall:

Winter Mean Rainfall:

During this period, very low rainfall is recorded which contributes 0.16% of the total rainfall as shown in Fig.4. the minimum and maximum rainfall are recorded at Sandur(0.83mm) and Kurekuppa respectively(2.0mm) respectively. the annual mean rainfall of this season is 0.94mm.

Summer Mean Rainfall:

The summer season starts in March and ends in May In this period the study area experiences very hot weather. It contributes to 18.99% of the total mean rainfall having a mean of 108.89mm as shown in Fig.5. the minimum and the maximum rainfall have recorded during this season are 72.87mm at Chornuru and 144.8mm at Sandur.

South West Monsoon Mean Rainfall:

India gets the major parts of rainfall during this season, it starts from June to September. in the present study area, Southwest rainfall varies from 276.75mm to 471.3mm. high rainfall is recorded in the Sandur rain gauge station(471.3mm), moderate rainfall is recorded in the Chornuru rainguage station and the lowest rainfall is recorded in the Kurekuppa which is situated in the north portion of the study area. Fig.6 Shows southwest rainfall is gradually increasing toward the central part of the study area from the northeast and south directions. this season contributes 61.48% of the mean annual rainfall. The mean rainfall of this season is 352.43mm.

North-East Monsoon Rainfall Variation:

Northeast monsoon Rainfall is less compared to southwest monsoon rainfall in the present study area. North East rainfall varies from 34.41mm to 49.33mm.in this season Sandur rainguage station receives more rainfall(148mm) next to the Kurekuppa rain gauge station(105.37mm) and the Chornuru Rainguage station received rainfall of 80.62mm. Fig.7 shows the Northeast rainfall variations in the present study area. the mean annual rainfall of this season is 111.33mm and it contributes to 19.42% of the total mean annual rainfall.

Conclusion:

In the present study, 25 years of rainfall data of the Narihalla watershed for the period from1995-2020 has been analyzed to know the rainfall variability. The central region of the research area receives more rainfall than the north and south portions. The current statistical analysis provides a clear picture of rainfall data, and it is observed that the rainfall available in the region is insufficient for wet crop production. Use of surface water in combination. The analysis helped us in understanding the rainfall pattern of the Narihalla watershed, as well as efficient crop planning and water availability in the area.

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