



Rainfall Spatial Analysis using GIS

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Abstract: This research paper is made to understand the rainfall fluctuation with respect to spatial distribution in Bhilwara Tehsil of Bhilwara District in Rajasthan. It illustrates the practical approach towards classification of rainfall data over the study area. To achieve the aim, it is divided into three sections. The first section describes pre-processing, data collection, geo-referencing, digitization, database creation, and refinement of data has been accomplished. In the second section joining of spatial and non spatial data with map creation is accomplished. In the last section post processing part the final layout with various components is created.

Keywords: GIS, Rainfall, Join data, Layout, Spatial, Analysis.

I. INTRODUCTION

Over the last decade, use of GIS has grown dramatically in various sectors. GIS consists of computer based tools that are used to capture, store, update, manipulate, retrieve, analyze, display, print and otherwise large amounts of geographic and attribute data [9] [2].

Rainfall is a crucial agro climatological factor. It is important to analyse the rainfall for cropping and agriculture. India is a tropical country so water utilization and agricultural planning depends on monsoon rainfall. Mainly the heavy rainfall occurs during the monsoon season. Rainfall during the monsoon season is unequal both in time and space so it is important to analyse the rainfall variation [5].

ArcView is a product of ESRI (Environmental System Research Institute). ArcView is powerful GIS tool for spatial visualizing, querying, exploring and analyse spatial data. ArcView 3.2 provided new tools to facilitate our GIS operations as well as strategic updates to existing capabilities. To provide support for datum transformations and range of data projections the It introduced a new shape file projection utility. It supports several new data formats. ArcView 3.2 included significant database access improvements and an updated report writer [9]. These tools are helpful in analysing data.

This research analysed monthly rainfall, seasonal variation of rainfall, intensity of rainfall, humidity in rain water, annual rainfall, mean annual rainfall, variability and pH of rainfall. The present study also classifies the rainfall of the Bhilwara Tehsil.

II. STUDY AREA

Bhilwara is situated at 25⁰.00 to 27⁰.50 North Latitude and 74⁰.03 to 75⁰.25 East Longitude. It is 100 meters above the sea level. There are 7 sub-divisions in the district i.e. Aasind, Bhilwara, Gangapur, Gulabpura, Mandalgarh and Jahazpur and Shahpura and 15 tehsils i.e. Asind, Banera, Beejoliya, Bhilwara, Mandal, Mandalgarh,

Sahada, Kotri, Jahazpur, Raipur, Hurda, Badnor, Fuliyakalan, and Shahpura.

III. PREVIOUS WORK

The number of researchers worked on rainfall analysis using GIS software. Ishappa, Muniyappa Rathod Aruchamy Shave been performed spatial analysis of rainfall variation in Coimbatore (Tamilnadu) using GIS. They analysed variation of monthly rainfall, mean annual rainfall, variability of rainfall [5].

B. Gurugnanam, M. Suresh, M. Vinoth and S. Kumaravel describes high/low rainfall domain mapping using GIS was done at Salem district, Tamilnadu [1].

Zhiliang Wang and Chunyan Huang found the evidence of self-organized criticality (SOC) for rain data base on China by employing the theory and method of SOC [11].

IV. METHODOLOGY

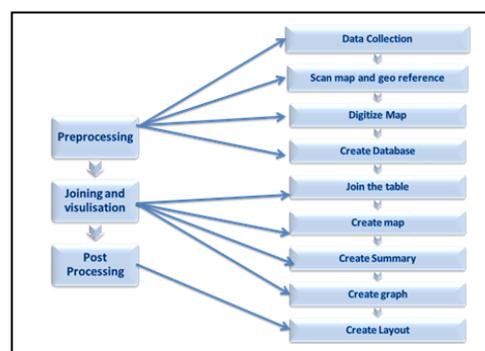


Fig.1. GIS Processing of rainfall data.

Monthly rainfall data for the period of some years has collected from Indian Meteorological Department and Economics and Statistical Department.

Many rainfall stations take into consideration for analysing long term means monthly rainfall pattern, annual rainfall pattern and seasonal rainfall pattern has been calculated. The collected data has processed and analysed by



preparing various graphs, maps and figures using GIS software.

A. Pre-processing

- 1) *Data collection:* The attribute data of the rainfall are Intensity, Humidity, Annual Rainfall, Mean Annual Rainfall, Variability, pH, Hours of day etc.
- 2) *Scan the map and georeference it.*
- 3) *Digitize the maps and create shape files.*
- 4) *Creates VillID field in the dbf file of the shape file "Attributes of Village Boundaries".*

Attributes of Village boundaries .shp			
Shape	ID	VillID	
Polygon	1	1	
Polygon	2	2	
Polygon	3	3	
Polygon	4	4	
Polygon	5	5	
Polygon	6	6	
Polygon	7	7	
Polygon	8	8	
Polygon	9	9	
Polygon	10	10	

Fig. 2. Attribute table of Villages Shape file.

- 5) *Creates database for rainfall of Bhilwara (as shown in Fig. 3).*

Bhilwara					
ID	VillID	Village Name	Code	Tehsil	MapId
1	1	Kalsans	95521	Bhilwara	1
2	4	siyarda	95522	Bhilwara	2
3	3	Keeratpura	95523	Bhilwara	3
4	4	Kotri	95524	Bhilwara	4
5	5	Dariba	95525	Bhilwara	5
6	6	Samori	95526	Bhilwara	6
7	7	Salampura	95527	Bhilwara	7
8	8	Pansal	95528	Bhilwara	8
9	9	Malola	95529	Bhilwara	9
10	10	Dhool Khera	95530	Bhilwara	10

Fig. 3. Rainfall table for Bhilwara.

B. Joining tables and Visualisation

- 1) *Joining Data :*

Join the rainfall data table of Bhilwara with the shape file according to the common field VillID of both tables (as shown in fig. 4).

Attributes of Village boundaries .shp						
Shape	MapId	ID	VillID	Village Name	Code	Tehsil
Polygon	1	1	1	Kalsans	95521	Bhilwara
Polygon	2	2	4	siyarda	95522	Bhilwara
Polygon	3	3	3	Keeratpura	95523	Bhilwara
Polygon	4	4	4	Kotri	95524	Bhilwara
Polygon	5	5	5	Dariba	95525	Bhilwara
Polygon	6	6	6	Samori	95526	Bhilwara
Polygon	7	7	7	Salampura	95527	Bhilwara
Polygon	8	8	8	Pansal	95528	Bhilwara
Polygon	9	9	9	Malola	95529	Bhilwara
Polygon	10	10	10	Dhool Khera	95530	Bhilwara

Fig. 4. Joined table having all attributes from villages shape file table and Bhilwara rainfall table.

- 2) *Change the Symbology :*

To create classified map change the symbology of map to the graduated color according to the intensity of rainfall field (as shown in Fig. 6) and divide it into 5 categories very low, low, normal, moderate and high

Symbol	Value	Label
	3.399 - 12.78	Very low rainfall zone
	12.78 - 24.478	Low rainfall zone
	24.478 - 37.182	Normal rainfall zone
	37.182 - 55.353	Moderate rainfall zone
	55.353 - 98.887	High rainfall zone

Fig. 5. Classification of rainfall Intensity data.

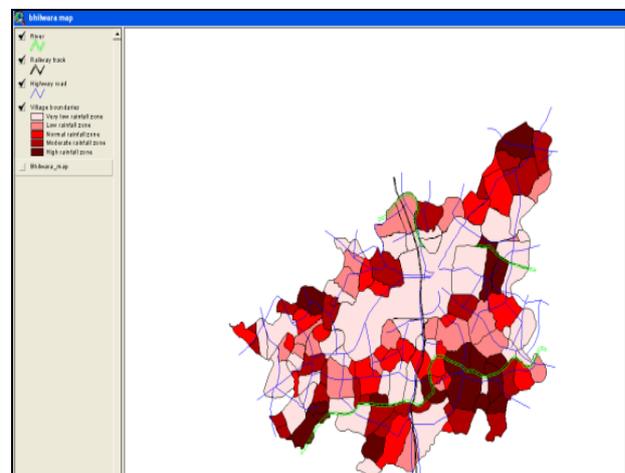


Fig. 6. Classified Map of Rainfall Intensity data.

- 3) *Create Summary table for statistics of whole Tehsil (as shown in Fig. 7).*

cat	Count	Ave_Intensity	Count_Intensity
1	39	7.0409	39.000000
2	22	18.3803	22.000000
3	27	29.9879	27.000000
4	28	45.6771	28.000000
5	19	72.8650	19.000000

Fig. 7. Summarized Rainfall Intensity data.

- 4) *Create graph (chart) according to given data as shown in Fig. 8.*

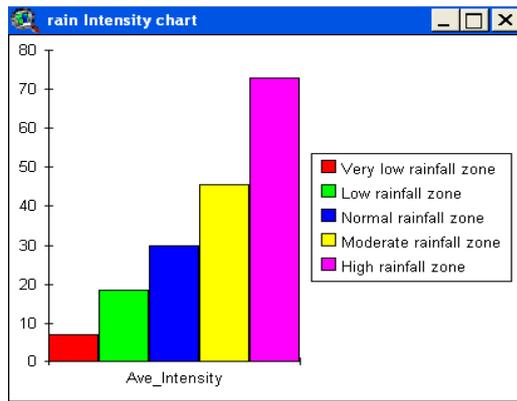


Fig. 8. Rainfall Intensity distribution in Bhilwara tehsil.

C. Post processing

5) Creates Layout for better visualisation of all results by adding view, table, chart, north arrow etc. altogether.

Layout is a place where map contents are arranged in a proper way to visualise

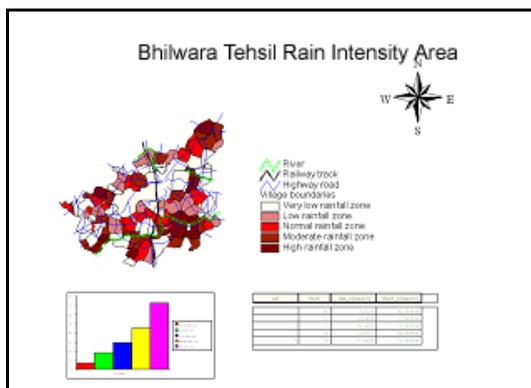


Fig. 9. Layout of Rainfall data for end user.

V. RESULTS

A. pH

pH is a measure of power of the concentration of the Hydrogen ion. pH scale ranges from 0 to 14 and the 7 is neutral condition. Above the 7, the solution is basic and below the 7 solution is acidic. Summarized pH table is as given in fig. 9 and the graph for various categories is as given in fig. 10. Normal water has pH approx 7 at 25°C. From table and chart it is clear that pH level in Bhilwara Tehsil is alkaline.

pHcat	Count	Ave_ph_lev	Count_ph_l
4 to 4.9	19	4.4105	19.000000
5 to 5.9	28	5.4786	28.000000
6 to 6.9	58	6.4379	58.000000
7 to 7.9	23	7.2609	23.000000
8 to 8.9	5	8.0800	5.000000
9 to 9.9	2	9.1000	2.000000

Fig. 10. Summarized Rainfall pH data.

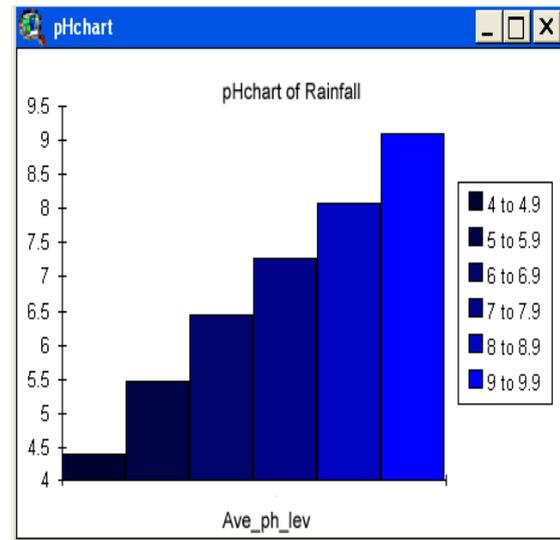


Fig. 11. Rainfall pH level in Bhilwara tehsil.

B. Humidity

Humidity represents the amount of water vapour in the air. Summarized humidity table is as given in Fig.12 and the graph for various categories as shown in fig.13.

humdtycat	Count	Ave_Humidity(%)
0 to 15 %	2	15.0000
16 to 35 %	60	43.2333
56 to 75 %	61	65.0328
76 to 100 %	12	85.7500

Fig. 12. Summarized Rainfall Humidity.

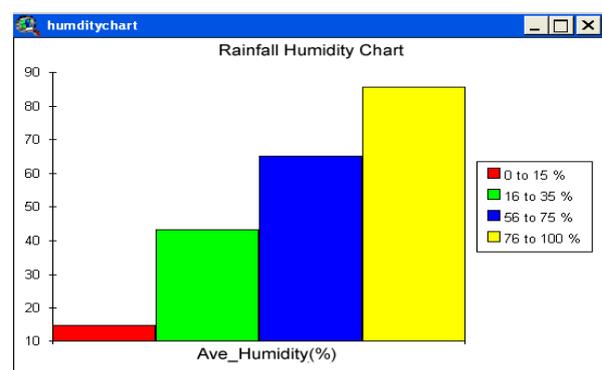


Fig.13. Rainfall Humidity level in Bhilwara Tehsil.

C. Volume

It is volume of rain water. Summarized volume table is as given in fig. 14 and the graph for various volume categories is as given in fig. 15.



volume cat	Count	Ave Volume(mm)2012	Count	Volume(mm)2012
0 to 199 (mm)	41	149.9756	41	
200 to 399 (mm)	61	279.1475	61	
400 to 599 (mm)	32	450.2188	32	
600 to 1000 (mm)	1	852.0000	1	

Fig. 14. Summarized Rainfall Volume data.

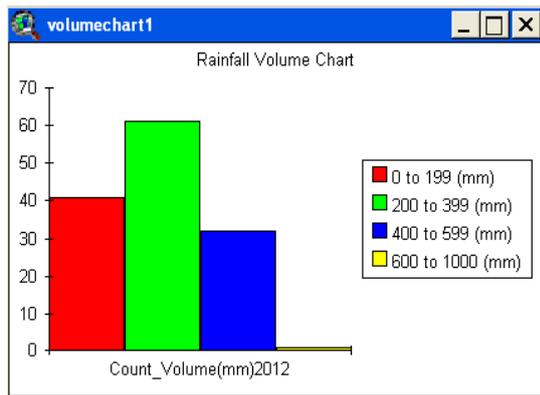


Fig. 15. Rainfall Volume Distribution in Bhilwara Tehsil.

VI. CONCLUSION

This paper has been design using ArcView and stratified contributed in querying and analyzing rainfall data for Bhilwara Tehsil. This paper is useful in various application areas for management of water resources, hydrogeology, rainfall variability etc. The conclusion of the research is: the methodology and graphs with collected data can help expert to make future decision. It is the major limitation of GIS that its software is too costly. If it could available to the open source then many researcher around the world can collaborate whereas student can participate.

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