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# Analysis of Rainfall and Groundwater Table Fluctuation in Mysore City Using ERDAS and ARCGIS

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**ABSTRACT:** This study employs geospatial technologies, namely ERDAS (Earth Resource Data Analysis System) and ARCGIS (Architectural Groundwater Information System), to conduct a comprehensive analysis of rainfall patterns and groundwater table dynamics in Mysore district. The objective is to gain insights into the temporal and spatial variations of rainfall and their impact on groundwater levels, contributing valuable information for sustainable water resource management. The study integrates satellite imagery processed with ERDAS to derive accurate and up-to-date information on land cover, land use, and vegetation indices. These parameters are crucial for understanding the factors influencing groundwater recharge and depletion. Additionally, RGIS is employed to collect, process, and analyze historical rainfall data, providing a robust foundation for assessing the relationship between precipitation patterns and groundwater fluctuations.

Spatial analysis techniques within ARCGIS help identify areas vulnerable to water scarcity or excess, facilitating targeted interventions for water resource management. Temporal analysis reveals trends and anomalies in both rainfall and groundwater table levels over a specified time period, shedding light on the impact of climate variability and land-use changes on the hydrological cycle.

The findings of this study are anticipated to contribute to evidence-based decision-making for water resource planning, particularly in the context of changing climatic conditions and urbanization. By employing advanced geospatial tools, the research aims to provide a holistic understanding of the intricate interplay between rainfall and groundwater dynamics in Mysore district, thereby supporting sustainable and informed water management practices.

**KEYWORDS:** Water, Rainfall, Groundwater, Mysuru city, ARCGIS.

## I. INTRODUCTION

### **Water necessity:**

Water is not just a convenience; it's a fundamental necessity for all life forms on Earth. From quenching our thirst to sustaining ecosystems, water plays an indispensable role in maintaining biological functions and supporting human activities. Beyond its role in hydration, water is essential for sanitation, agriculture, industry, and energy production. Moreover, it serves as a medium for transportation, recreation, and cultural practices across diverse societies. Access to clean water is a cornerstone of public health, helping prevent waterborne diseases and promoting overall well-being. As the global population grows and climate change alters precipitation patterns, ensuring equitable access to safe water sources becomes increasingly imperative for sustainable development and the preservation of life.

### **Water availability:**

Water availability refers to the presence and accessibility of water resources within a specific area or region. It encompasses both the quantity and quality of water sources, including surface water bodies like rivers, lakes, and reservoirs, as well as groundwater stored in aquifers. The availability of water varies geographically and temporally due to factors such as climate, geography, land use, and human activities. Regions with abundant rainfall and well-managed water systems typically have higher water availability, while arid and semi-arid regions often face water scarcity challenges. Sustainable management practices, such as water conservation, watershed protection, and efficient irrigation techniques, are essential for ensuring adequate water availability to meet the needs of people, ecosystems, and economies, particularly in the face of increasing water demand and climate variability. Addressing water availability

issues requires a holistic approach that integrates science, policy, and community engagement to achieve equitable and resilient water management solutions.

### **Groundwater Overview in Karnataka, Mysuru:**

Mysore district, located in the Indian state of Karnataka, experiences a typical tropical climate with distinct wet and dry seasons. Rainfall plays a vital role in shaping the region's environment and economy. The district receives its primary rainfall during the Southwest Monsoon, which typically occurs from June to September. During this period, the region witnesses heavy precipitation, contributing to agricultural growth and the replenishment of groundwater resources.

The groundwater table in Mysore district is closely linked to the monsoon rainfall. Adequate rainfall is essential for recharging underground aquifers, which serve as a critical source of freshwater for the region. However, the balance between rainfall and groundwater levels is delicate, and fluctuations can impact both agricultural practices and the availability of potable water.

The groundwater table in Mysore district. Proper management of this precious resource is crucial for the sustainable development of the district, ensuring reliable water sources for agriculture, industries, and daily life.

Analysing rainfall and groundwater table data in Mysore district is essential for understanding the region's water resource dynamics. This study aims to examine the relationship between rainfall patterns and groundwater levels, which are critical for sustainable water management and agricultural practices in the region. By studying historical data, we can assess trends, seasonal variations, and potential impacts of climate change on groundwater resources. Such analysis will provide valuable insights for informed decision-making and the development of effective water resource management strategies in Mysore district.

**Remote Sensing and GIS Remote sensing (RS)** involves the collection of data about objects or areas from a distance, typically using sensors on aircraft or satellites. These sensors capture electromagnetic radiation reflected or emitted by the Earth's surface and atmosphere, allowing for the detection and analysis of various features and phenomena. Remote sensing data can include imagery, spectral measurements, and other geospatial information, which are used for a wide range of applications such as land cover mapping, environmental monitoring, agriculture, urban planning, and disaster management. **Geographic Information Systems (GIS)** are computer-based tools used to capture, store, manipulate, analyze, and visualize spatial data. GIS technology enables users to integrate different types of geographic information, such as maps, satellite imagery, and survey data, into a single database or platform. This spatial data can then be analyzed to derive insights, make informed decisions, and solve complex problems in diverse fields including urban planning, natural resource management, public health, transportation, and utilities management.

## **II. LITERATURE REVIEW**

**G Arvind [1]** carried out a work on "Statistic Analysis of 30 Years Rainfall Data in Musiri" in the year 2017 where he did the Annual and monthly analysis of the particular district's rainfall report calculated in mm per month and year separately.

**Dr. M.C. Manjunatha[2]** carried out a work on "Rainfall Variation and Its Impact on Groundwater Table Fluctuation in Mysore Taluk Karnataka, India using GIS Application" During the year 2019. He used two GIS Software which are ERDAS Image v2014 and ArcGIS v10.2. Also used GPS analysis systems including GRAMIN 12 – Ground Truth Check and Field survey.

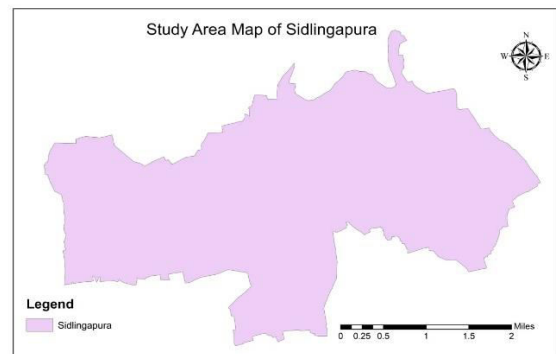
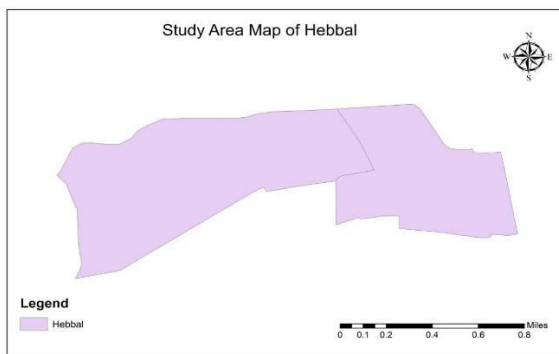
**Gangadhara G [3]** carried out a work on "Spatial Variation of Rainfall and Groundwater Fluctuation in Hebbahalla Watershed, Mysore" during the year 2017. In his thesis he made a tabular column regarding Average Rainfall Data of Hebbahalla watershed from year 2005- 2014 for every month of that particular year and magnitude was denoted using mm. With the collected data a trend chart was made with changing trend for every month. Maximum and Minimum rainfall was Segregated and fluctuation was Calculated.

**Bidisha Chakraborty [4]** carried out a work on "Analysis of Rainfall data Silchar, Assam" in the year 2008. Here she did a continuous project on Rainfall analysis near Silchar, Assam by collecting previous year data and calculating 'High Rainfall Events' of the particular region.

Basavarajappa H.T [5] carried out a work on “Climatic Change and its Impact on Groundwater Table Fluctuation in Precambrian rocks of Chamrajnagara district, Karnataka, India using Geomatics technique” during the year 2021. Here Artificial Recharge Structures (ARS) were studied and stated that it is the effective and efficient techniques to overcome critical and overgroundwater exploited areas to augment the groundwater system. The Weighted Overlay Method was built in ArcGIS software wherein all the thematic layers were given as input parameters.

### III. METHODOLOGY

**STUDY AREA** The study area considered in this project is Hebbal and Siddalingapura of Mysuru district. The total plot area of both these areas combined is around 52sq kilometers(around 7sq kilometers of Hebbal and 45 sq kilometers of Siddalingapura).These are well developed regions in Mysuru and also falls under tire 2 category of development in Karnataka state. Rainfall seasons in these regions are fairly good when compared with other villages in mysuru.

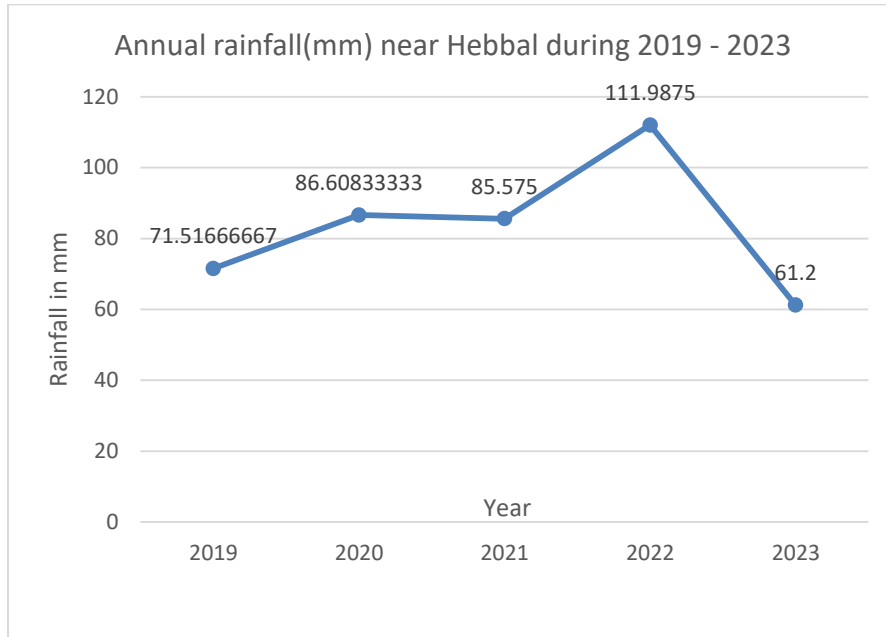


**SOURCE:** Shapefile Source : KRSRAC – KGIS,Image designed and presented using ARCGIS

**RAINFALL STATISTICS** :Previous Records of Rainfall Data The table shown below depicts the monthly rainfall analysis during 2019-2023 over a 5 year period. The average rainfall during this period was 74.11mm in Naganahalli (nearest station to Siddalingapura) and 66.71mm in Elawala (nearest station to Hebbal). Highest rainfall occurred monthly wise near siddalingapura was in the year 2021 in the month of october (392.8mm). The highest annual rainfall recorded after taking the average of all the months of the particular year was found out to be in the year 2022 with an average annual rainfall of 113.15mm.

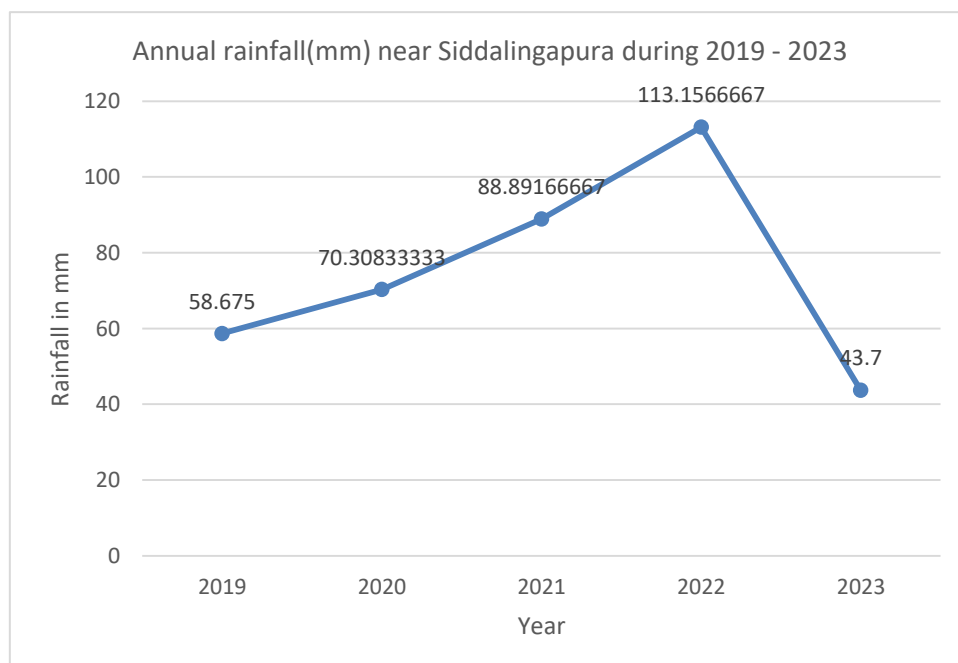
Rainfall data during year of 2019 to 2023 in mm													
Elawala	2019	0.00	2.80	0.00	18.00	114.70	52.2	84.2	183.7	107.6	194.8	95.8	4.4
	2020	0.0	0.0	11.8	72.0	213.0	63.0	104.8	70.0	173.3	279.0	42.4	10.0
	2021	40.2	20.2	0.0	22.0	54.2	50.6	111.0	62.4	57.7	357.6	216.6	34.4
	2022	0.0	0.0	15.0	40.2	324.4	153.2	133.8	215.2	177.8	218.2	38.0	28.1
	2023	10.0	0.0	1.0	76.4	189.5	37.2	66.8	21.2	103.8	98.1	130.4	0.0
	Avg	10.04	4.60	5.56	45.72	179.16	71.24	100.12	110.50	124.04	229.54	104.64	15.37

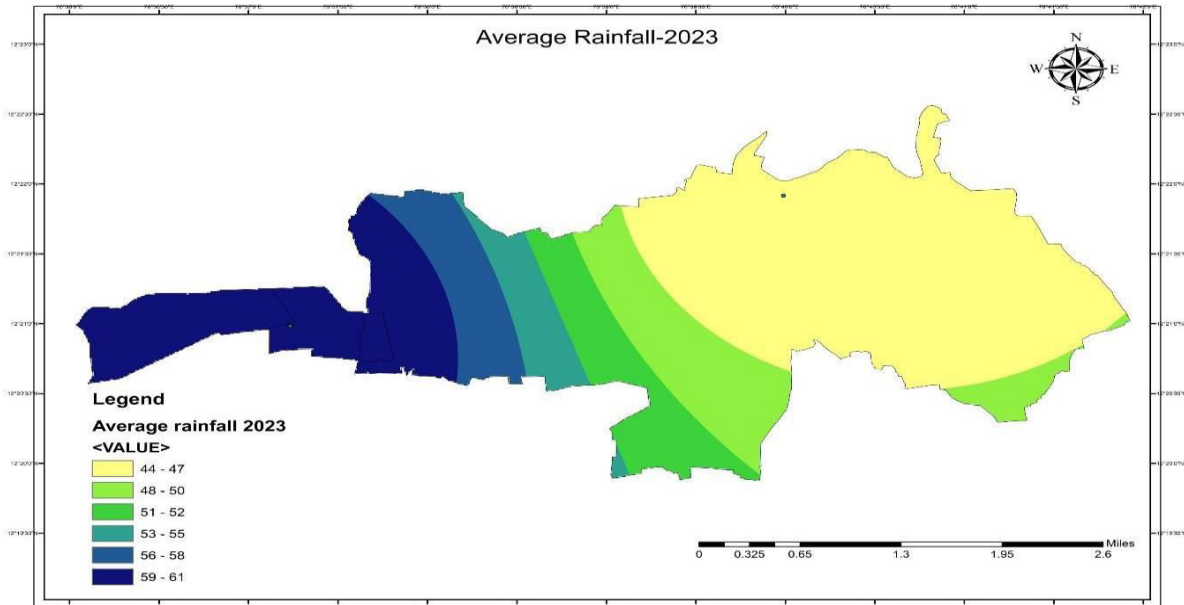




Rainfall data during year of 2019 to 2023 in mm

Location	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Naganahalli	2019	0.0	4.6	0.0	66.0	135.2	28.0	47.6	128.5	82.6	145.9	58.2	7.5
	2020	0.0	0.0	42.4	63.4	142.4	49.0	107.5	40.0	148.5	196.9	49.0	4.6
	2021	7.0	10.0	0.0	44.6	27.0	23.3	135.8	115.2	33.6	392.8	250.0	27.4
	2022	0.0	0.0	1.2	65.1	364.2	96.4	99.1	321.8	89.4	281.8	22.6	16.3
	2023	0.8	0.0	4.0	40.4	123.6	61.6	44.5	21.4	48.7	58.6	120.8	0.0
	Avg	1.56	2.92	9.52	55.90	158.48	51.66	86.90	125.38	80.56	215.20	100.12	11.16





**SOURCE: Shapefile Source: KRSRAC – KGIS, Image designed and presented using ARCGIS**

The above map is created using ARCGIS software which shows the average rainfall pattern during the year 2023. This map is essential in determining the depth of Groundwater table as we know rainfall plays a crucial role in recharging ground water table. The data is taken from the district board which provided monthly rainfall report of mysuru for the year 2023. The average was taken out of all the twelve months of the year and the map was designed accordingly using ARCGIS software.

**\*Concept of Heavy Rainfall Event**

Heavy Rainfall Event is a time period where the region experiences a large amount of rainfall of around 100mm per day. The month of this particular event is noted and considered for further calculations like determining flood years and drought years etc.

- First we take the monthly values of rainfall and from the graph plotted we take rain gauge values exceeding 100mm and highlight it as a HRE (Heavy Rainfall Event).
- Next we count the number of HRE’s occurring in the particular year and determine that year as either drought year or a flood year.
- For flood year the number of HRE’s must exceed at least 10, and anything below that would be considered as a drought year.

Year	Total Annual Rainfall (inmm)	Average Annual Rainfall (inmm)	No. of HRE
2019	704.1	58.68	3
2020	843.7	70.3	4
2021	1066.7	88.9	4
2022	1337.9	113.2	3
2023	524.4	43.7	2

**Heavy Rainfall Event Table (Siddalingapura)**

- From the above table the number of HRE’s from the years 2019, 2020, 2021, 2022, 2023, were 3, 4, 4, 3 and 2 respectively. As none of these years exceed the limit set by flood year, all these years are considered as drought years since practically there hasn’t been a much floods in Siddalingapura from the past half decade.
- The same way in Hebbal the number of HRE’s from the years 2019, 2020, 2021, 2022, 2023 were 4, 4, 3, 6 and 3 respectively.
- Just like Siddalingapura as none of these years exceed the limit set by flood year, all these years are considered as drought years since practically there hasn’t been a much floods in Hebbal from the past 5 years.

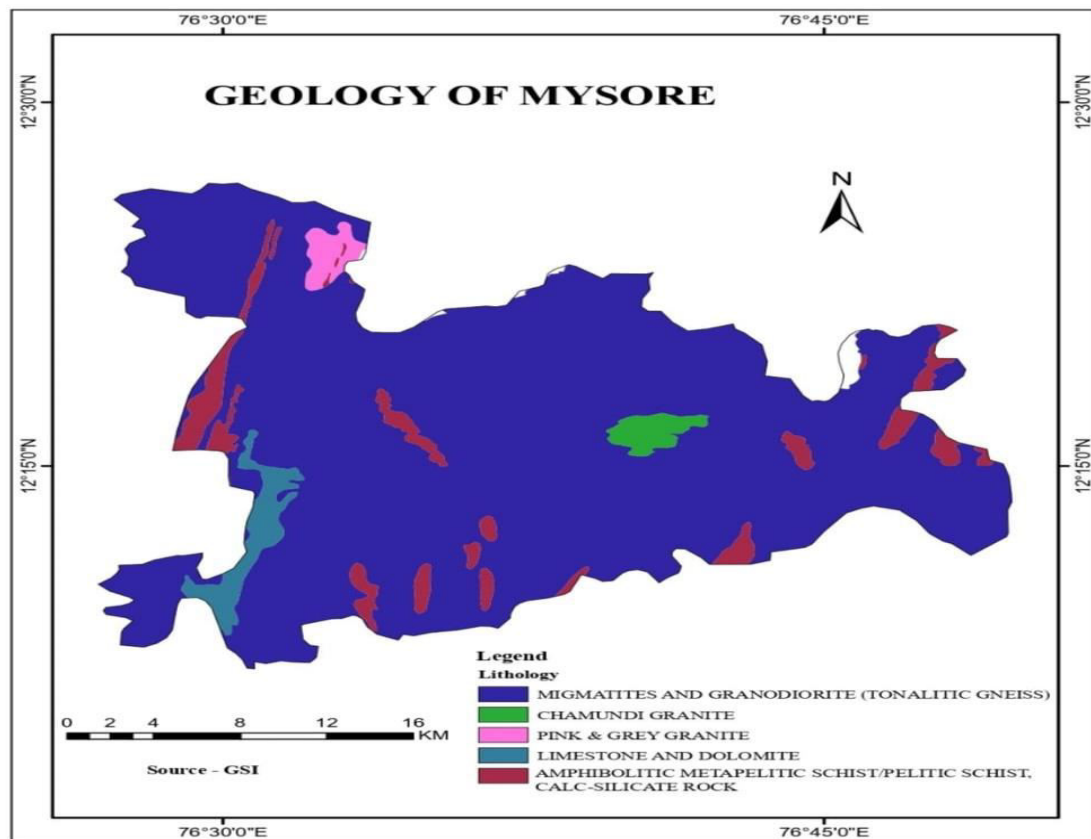
**Heavy rainfall event (Hebbal)**

In conclusion we can say that Siddalingapura and Hebbal regins faced fairly decent rainfall over the course of 5 years but not as much as what we experience in north east India. Since Mysuru is located near south side of India which is close to the equator, rainfall experienced is fairly less or sometimes moderate. Hence the result 'Drought year' is seen in these regions.

Year	Total Annual Rainfall (in mm)	Average Annual Rainfall (in mm)	No. of HRE
2019	858.2	71.52	4
2020	1039.3	85.55	4
2021	1026.9	88.9	3
2022	1343.9	111.98	6
2023	734.4	61.2	3

**\*Geological View of Mysuru**

The geological formation of an area determines the type and characteristics of the underlying rock or sediment layers. In Mysuru, the geological formations may include sedimentary rocks, alluvial deposits, and weathered formations. These formations influence the movement and storage of groundwater. The geology of soil and its porosity directly affect groundwater recharge and discharge processes. In areas with high porosity and permeability, such as sandy aquifers, rainfall can infiltrate quickly, replenishing groundwater reserves. Conversely, in regions with low porosity or impermeable layers, recharge rates may be limited. Similarly, the ability of groundwater to discharge into rivers, lakes, or springs is influenced by the geological characteristics of the subsurface materials.



Source :Shapefile Source : KRSAC – KGIS , Image presented using ARCGIS tool

#### IV. CONCLUSION

- A deficiency in rainfall was seen in both the regions of Mysuru which led to an increase in depth at which Groundwater was found.
- Rainfall along with several other natural parameters like Geology of the land, soil type are the main cause for fluctuation in Groundwater table.
- During the years 2019 to 2023, Hebbal and Siddalingapura experienced Drought years through, with number of Heavy Rainfall Events (HRE's) per year ranging between 2 and 6.

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