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Detection of Physico-chemical Analysis of Ground Water by Using GIS and RS

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***Abstract*— Abstract: In this project, the physicochemical analysis of various physico-chemical parameters is carried out for assessment of ground water quality. Total of 13 samples were collected from 13 locations of Maddur taluk viz., based on Polluted area, (Bharathinagara, Koppa, Gejjalagere, Maddur,) These 13 water samples were collected from sampling points whose connection was given to bore wells. Various physicochemical parameters tested were pH, alkalinity, acidity, total hardness, electrical conductivity, turbidity. For georeferencing of study arca, Toposheet No 57H/2 OF MADDUR, Mandya district in Karnataka, India, is situated approximately between 12.5228° N to 13.4227° N latitude and 76.3732° E to 77.2240° E longitude. The quality of groundwater is assessed in the study area based on water quality index model. The software's such as Google Earth Pro and ArcGIS 10.5 were used for the generation of Study Area Map, spatial variation maps of various physico-chemical parameters.**

***Keywords*: GIS and Remote Sensing.**

1. INTRODUCTION

1. Groundwater is the water under the earth's surface that flows freely through tiny pores and cracks in rocks and soils called aquifers and that can be pumped from wells. Groundwater contamination by anthropological activities and infiltration of polluted surface waters has become an ubiquitous problem in many aquifers across the world in recent decades, Sources of groundwater contamination are widespread and include accidental spills, landfills, storage tanks, pipelines, agricultural activities, and many other sources. Temperature indicates variations in the thermal characteristics of groundwater. Turbidity measures the clarity or cloudiness of water, often indicating suspended particles or colloidal matter. pH measures the acidity or alkalinity of water. It affects the solubility of minerals and the effectiveness of treatment processes. Electrical Conductivity indicates the water's ability to conduct electrical current, which correlates with the presence of dissolved ions. Nutrients includes compounds like nitrates and phosphates, which can lead to eutrophication and affect aquatic ecosystems. Physicochemical analysis helps in assessing water quality for drinking, irrigation, industrial use, and environmental protection. Monitoring groundwater quality is essential for ensuring public health, sustainable resource management, and pollution prevention. Regular sampling and analysis of groundwater from various locations are necessary to detect changes, trends, and potential contamination sources over time. Remote Sensing involves acquiring information about the Earth's surface without direct physical contact. It utilizes sensors mounted on aircraft, satellites, drones, or other platforms to collect data from a distance. Mapping Aquifers: Remote sensing techniques like satellite imagery and aerial photography can help identify and map geological features associated with aquifers, such as fault lines, fractures, and permeable rock formations Water Availability Monitoring remote sensing allows for the monitoring of surface water bodies such as lakes, rivers, and reservoirs, as well as groundwater levels. This information is crucial for assessing water availability and identifying areas prone to water scarcity or overabundance. Drought and Flood Monitoring remote sensing helps in the early detection and monitoring of drought conditions and potential flood events. By analysing precipitation patterns, soil moisture levels, and vegetation health, it enables timely intervention and preparedness measures to mitigate the impacts of extreme weather events. Water Quality Assessment remote sensing can assess water quality parameters such as turbidity, chlorophyll content, and pollutant concentrations in lakes, rivers, and coastal areas. This information is vital for monitoring water pollution, identifying sources of contamination, and implementing measures to safeguard water quality for human consumption and ecosystem health. Irrigation Management remote sensing provides valuable data for optimizing irrigation practices in agriculture by monitoring crop water requirements, assessing soil moisture levels, and identifying areas of water stress. This helps farmers make informed decisions to improve water use efficiency and maximize crop yields while conserving water resources. Geographic information system is a system designed to capture, store, manipulate, analyse, manage, and present spatial or geographic data. It integrates hardware, software, and data for capturing, managing, analysing, and displaying all forms of

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geographically referenced information. GIS allows users to visualize, question, analyse, interpret, and understand data to reveal patterns, relationships, and trends.

Mapping Aquifers GIS is used to create maps of aquifers, including their extent, depth, and characteristics. These maps help in understanding the spatial distribution of groundwater resources and identifying areas with high or low groundwater potential Monitoring Groundwater Levels GIS facilitates the collection, storage, and analysis of groundwater level data from monitoring wells. By visualizing temporal changes in groundwater levels spatially, GIS helps in assessing groundwater recharge rates, groundwater flow patterns, and identifying areas of groundwater depletion or recharge. Modelling Groundwater Flow GIS-based groundwater flow models simulate the movement of groundwater through aquifers based on hydrogeological parameters such as permeability, hydraulic conductivity, and recharge rates. These models help in predicting groundwater behaviour under different scenarios, assessing the impacts of pumping activities, and designing sustainable groundwater management strategies. Assessing Groundwater Quality GIS is used to integrate spatial data on groundwater quality parameters such as pH, conductivity, and contaminant concentrations with information on land use, geology, and hydrology. This spatial analysis helps in identifying sources of groundwater contamination, assessing the vulnerability of ` to pollution, and prioritizing areas for remediation efforts. Optimizing Well Placement and Design GIS tools are employed to identify suitable locations for drilling new wells based on factors such as hydrogeological conditions, proximity to recharge areas, and groundwater availability. GIS also assists in designing well networks, optimizing well spacing, and determining well depths to maximize groundwater extraction while minimizing the risk of aquifer depletion or interference between wells. Groundwater Resource Management GIS facilitates the development of groundwater management plans by providingdecision-makers with spatially explicit information on groundwater resources, demand, and sustainability.This includes mapping groundwater use patterns, allocating pumping quotas, implementing water conservation measures, and monitoring compliance with groundwater regulations. Emergency Response and Contingency Planning GIS supports emergency response efforts during groundwater-related incidents such as groundwater contamination, well failures, or drought conditions.

2.OBJECTIVES OF THE PRESENT STUDY

1. To Analyse the ground water quality of few areas of mandya urban by determining the physico-chemical parameters as shown below:

- Alkalinity
- Acidity
- pH test
- Turbidity
- Total hardness
- Electrical conductivity

2. To learn and apply the technique of GIS AND RS for ground water quality assessment.
3. One of the main objectives of the ground water quality monitoring is to assess the suitability of ground water for drinking purposes. The physical and chemical quality pf ground water is important in deciding its suitability for drinking purposes
4. To generate spatial variation maps of various physicochemical parameters
5. To generate ground water quality map by using ArcGIS Software on the basis of Water Quality Index Model.

3. METHODOLOGY

- Study area.
- Selection of sampling points
- Sampling of groundwater from selected sampling points
- Analysis of various physico-chemical parameters
- Application of REMOTE SENSING and GEOGRAPHIC INFORMATION SYSTEM technique parameters
- Generation of spatial variation maps of various physicochemical
- Discussion of Conclusion

3.1 Study area

Maddur Taluk is located in Mandya district, it lies between 12.5867° north to 77.0453°east. maddur Taluk cover an total area of 614sq.km. and it include 159 villages. Be hide the reason for selection of maddur taluk there are many industrial areas are located in these places. here he some of industrial area in maddur taluk K M Doddi village sugar cane industry (Chamundeshwari sugar Ltd), maddur taluk Koppa village NSL sugar Ltd, maddur taluk Gejjalagere industrial area (granite factory, textile industry, milk factory), and maddur taluk somanahalli village (Coconut industrial area (SLC cocount industry), Good power industry Pvt Ltd). this are the major industrial area those are causes the underground water pollution due to its unwanted waste disposal ground.

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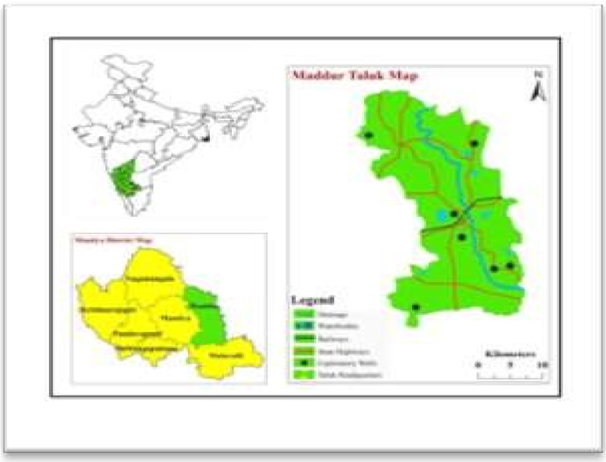

FIG: 1 LOCATION OF STUDY AREA

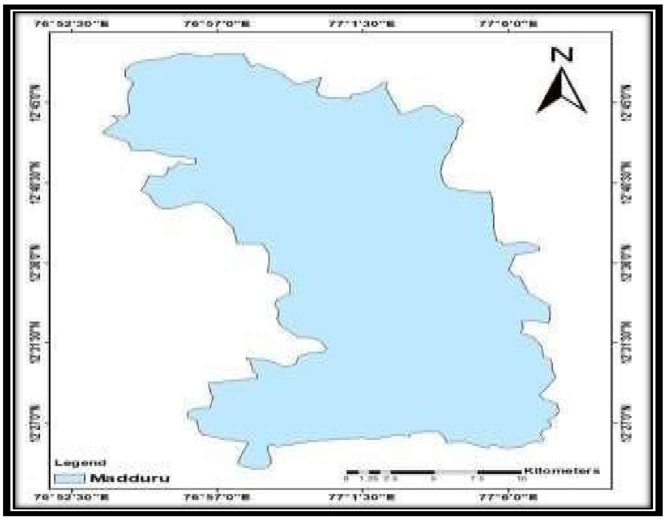

Fig: Boundary of maddur taluk map.

3.2 Collection of water sample.

A total of 13 ground water samples were collected from bore wells. Global positioning system (GPS) was used to located the water sample locations and mapping of water quality was done using a water quality index (WQI) in interpolation technique in ArcGIS 10.2.2. Each sample collected by 5-liter acid washed polyethylene HDPE bottle. The bottle was totally filled with water taking care that no air bubble was stuck within the water sample. Then to avoid evaporation, the double plastic caps of the bottles were sealed. Precaution was also taken to avoid sample disturbance during transfer to the laboratory. Electrical conductivity (EC) was determined on the field itself using digital meters.

3.3 Software used

Arc GIS is of software based on geographic information system (GIS) for working on maps and geographic data kept up by the environment systems research institute (ESRI). It used for creating and utilizing maps, assembling geographic data, analysing mapped data also for sharing and finding geographical information, using maps and geographic data in a scope of uses and overseeing geographic data in a database.

3.4 INSTRUMENTS USED

Si No	**parameters**	**Instruments**
1	pH	Ph paper
2	Electrical conductivity	Digital conductivity meters
3	Total hardness	Titrimetric method (with EDTA)
4	Alkalinity	Titrimetric method (with Phenolphalein)
5	Acidity	Titrimetric method (with
		Methyl orange indicator)
6	Calcium hardness	Titrimetric method (with Muroxide)

Table 1: Instruments used for determination of parameters

4. RESULTS AND DICUSSION

Ground water quality parameters

The major ground water quality parameters such as

1 pH

2 Electrical conductivity

3 Total hardness

4 Alkalinity

5 Acidity

6 Calcium hardness

Have been estimated in 13 locations throughout the maddur taluk block. The statistical parameters of ground water samples of study area are summarized in table-2

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SAMPLES	pH value	Alkalinity(p) Mg/l Caco3	Alkalinity (m) Mg/l Caco3	Acidity (P) Mg/l Caco3	Acidity (m) Mg/l Caco3
1	Basic (9)	Absent	213.40	Absent	30
2	Basic (9)	Absent	90.00	Absent	69
3	Basic (9)	Absent	70.00	Absent	84
4	Basic (9)	Absent	85.00	Absent	45
5	Basic (9)	Absent	75.00	Absent	35
6	Basic (9)	Absent	80.00	Absent	22
7	Basic (9)	Absent	84.00	Absent	33
8	Basic (9)	Absent	186.00	Absent	43
9	Basic (9)	Absent	78.00	Absent	52
10	Basic (9)	Absent	176.00	Absent	33
11	Basic (9)	Absent	220.00	Absent	56
12	Basic (9)	Absent	190.00	Absent	69
13	Basic (9)	Absent	184.00	Absent	31

SAMPLES	Total hardness	Calcium hardness	Magnisum hardness	Electrical conductivity
1	70.6	33.6	37	3.729
2	54.6	52.8	1.8	2.265
3	85	36.8	48.2	2.147
4	142	67.2	74.8	2.731
5	112	66.4	45.6	3.627
6	42	18.4	28.6	3.297
7	96	52	44	2.475
8	43.6	32.8	10.8	3.718
9	132	36.8	95.2	2.945
10	62.2	52.8	9.4	3.326
11	80	33.6	46.4	2.164
12	76	22	54	3.726
13	81	36	45	3.841

Table-2 Water quality analysis of the collected ground water samples

1. pH.

the ph value of the analysed samples from 9 (table-2) which the permissible limits prescribed by BIS. The ranges are classified in the spatial variation map in figure in 1.

2. Electrical conductivity.

Electrical conductivity represents the salt content of water. By analysis electrical conductivity electrical conductivity pollution status can be ascertained. The ranges ranged are classified in the spatial variation map in figure in 4.

3. Total hardness (TH).

Hardness is the property of water avoids lather formation with soap and increases the boiling point of water. Hardness of water mainly depends upon the divalent cation. the hardness varies from 30mg/l to 120 mg/l (table-2). Spatial distribution of total hardness is shown in figure 3.

4. Alkalinity.

The alkalinity varies from 50 mg/l to 230 mg/l (table-3). Spatial distribution of alkalinity is shown in figure 2.

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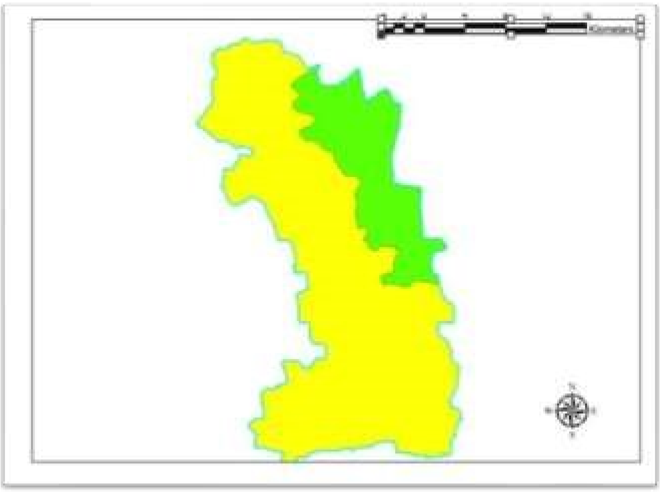


Fig-1: Spatial distribution map of pH

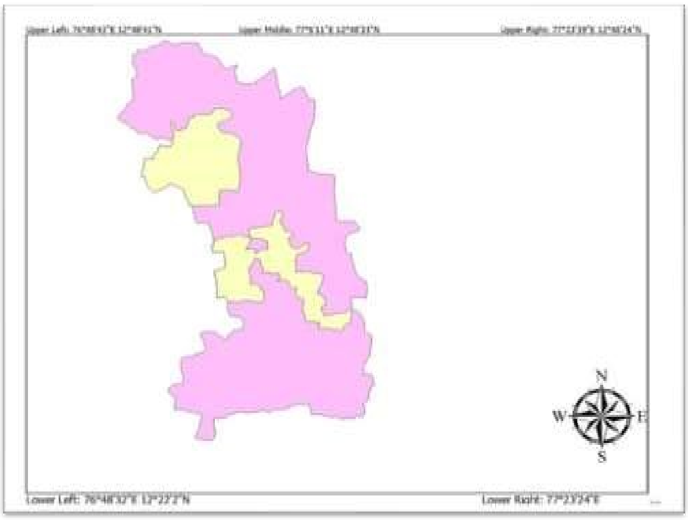
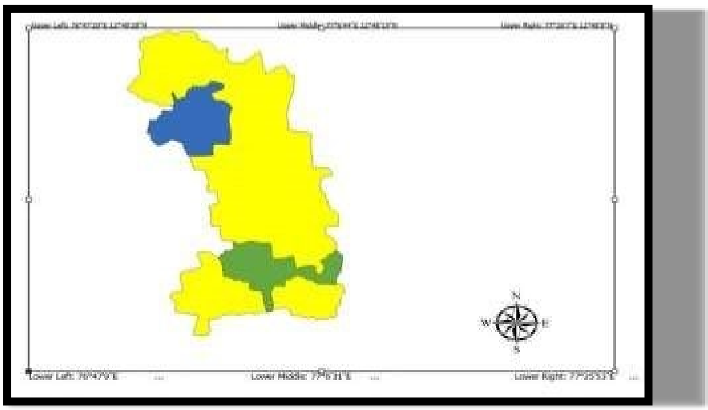


Fig-2: Spatial distribution map of Alkalinity



Legend

Fig-3: Spatial distribution map of Total hardness

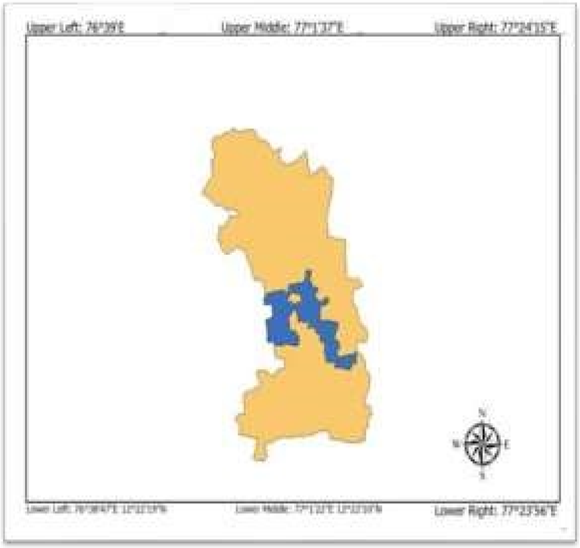


Fig-4: Spatial distribution map of Electrical conductivity.

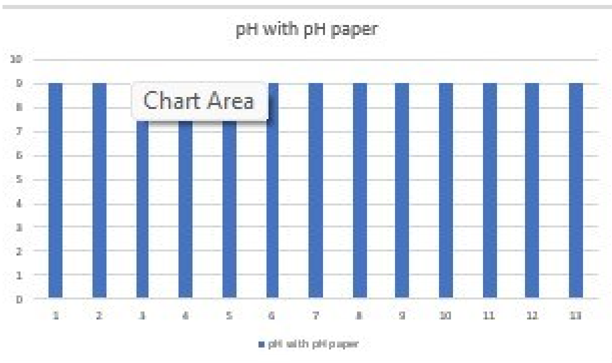


Chart -1 variation Ph in maddur taluk.

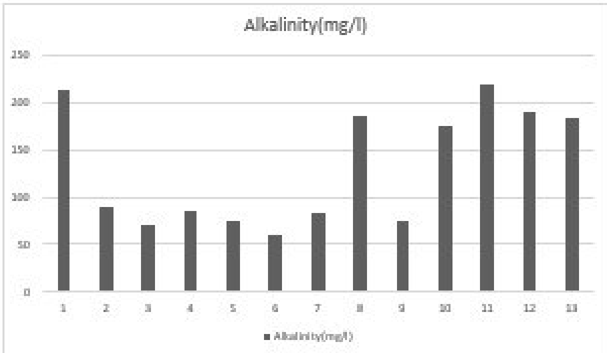


Chart -2 Variation alkalinity in maddur taluk.

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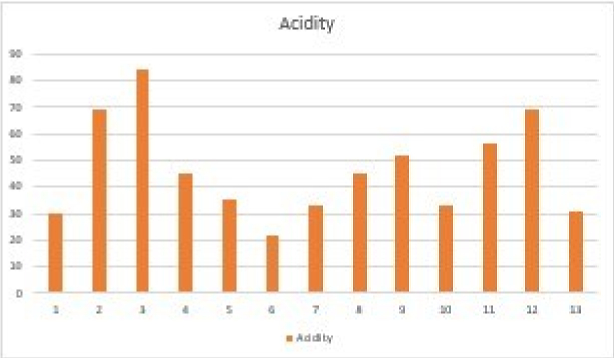

Chart -3 variation acidity in maddur taluk.

Chart -6 Variation Magnesium hardness in maddur taluk.

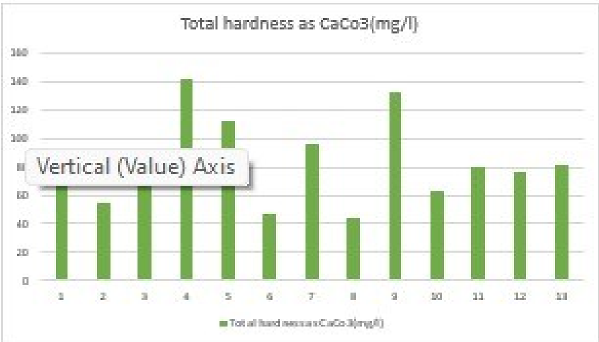

Chart-4 variation Total hardness in maddur taluk

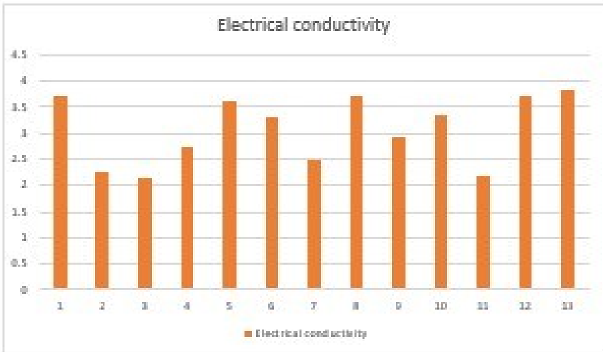

Chart -7 Variation electrical conductivity in maddur taluk.

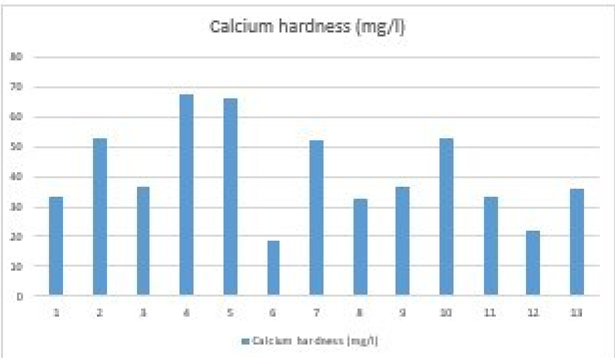

Chart-5 variation calcium hardness in maddur taluk

4.1 RESULTS AND DISCUSSION

1. The assessment of physico-chemical characteristics of groundwater is done by collecting representative groundwater sample.
2. The status of groundwater quality is identified in all the sample location of the study area with respect to physical and chemical parameters using ArcGIS software.
3. In the study area all water quality parameters (ph, electrical conductivity, total hardness, alkalinity, acidity, magnesium hardness and calcium hardness) the values show within the permissible limit (IS code).it is safe for human being.

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Table-3 Results

SI NO	PLACE	WQI	GWQ BASED ON WQL MODEL
1	Alabujanhalli	74.23	POOR
2	Annur	52.16	POOR
3	Melahalli	79.733	VERY POOR
4	K M doddi	100.0	VERY POOR
5	Somanahalli factory inside	82.52	VERY POOR
6	Somanahalli town	64.95	POOR
7	Rudrashipura	78.58	VERY POOR
8	Koppa	57.00	POOR
9	Eregowdanahalli	100.0	VERY POOR
10	Naganadoddi	54.24	POOR
11	Gejjalagere rural	80.23	VERY POOR
12	Gejjalagere factory inside	83.45	VERY POOR
13	Hankere	79.28	VERY POOR

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