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Studies on Physico-Chemical Characteristics of Ground Water of Gurmitkal Town with GIS Mapping

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ABSTRACT: In India, most of people rely solely on groundwater as their source of drinking water. It is thought that groundwater is significantly cleaner and pollution-free than surface water. Groundwater can become contaminated either naturally or because of different types of human activities, residential, municipal, commercial, industrial and agricultural activities can also affect groundwater quality^[1].

Ground water samples were collected from Gurmitkal taluk of Yadgir District and was assessed for Physico-Chemical Characteristics like pH, CaH, MgH, TH, DO, Cl, SO₄, TALK, F and TS, Correlation Coefficients were determined to identify the highly correlated and interrelated water quality parameters and Water Quality Index was also worked out using Weighted Arithmetic Index method. The obtained values were compared with the BIS standards. ARC GIS software was used to produce Ground water Quality Map of the Gurmitkal Town.

KEYWORDS: Physico-Chemical Characteristics, Correlation, Water Quality Index, GIS Mapping, Ground water Quality, Gurmitkal Town

I. INTRODUCTION

Ground water quality is based upon the physical and chemical soluble parameters due to weathering from source rocks and anthropogenic activities. In general, the quality of groundwater rely on the composition of recharge water, the interaction between the water and the soil, the soil-gas, the rock with which it comes into contact in the unsaturated zone and the residence time and reactions that take place within the aquifer. Quality of water undergoes great change as the hydro geochemical processes are very slow and the change on the ground water quality may continue for decades.

Groundwater significantly changes its quality naturally and seasonally. Correlation analysis of the relationship between chosen independent and dependent variable. If the correlation coefficient is nearer to +1 or -1, it shows the probability of linear relationship between the variables x and y^[2].

A. Objectives

- To determine the quality and Physico-Chemical properties of the Groundwater in Gurmitkal Town, Yadgir District.
- To compare the Physico-Chemical Characteristics of Groundwater samples with BIS norms.
- To carryout Correlation analysis.
- To worked out WQI.

II. STUDY AREA

The Gurmitkal town lies between 16.87° N Latitude and 77.4° E Longitude with the elevation about 608m (1995ft) above MSL. It is among the Taluks of Yadgir District with the population of 20631 according to 2011 census, the town spread about 3.50Sq.m which is divided into 23 Wards.

It is situated at a distance of 650km from state capital Bangalore, 39.5km from Yadgir Headquarters. The main source of transport is by road there is no railway and the nearest Yadgir railway station. The average rainfall is 832mm, the average maximum and minimum temperature recorded are 45°C and 22°C respectively.

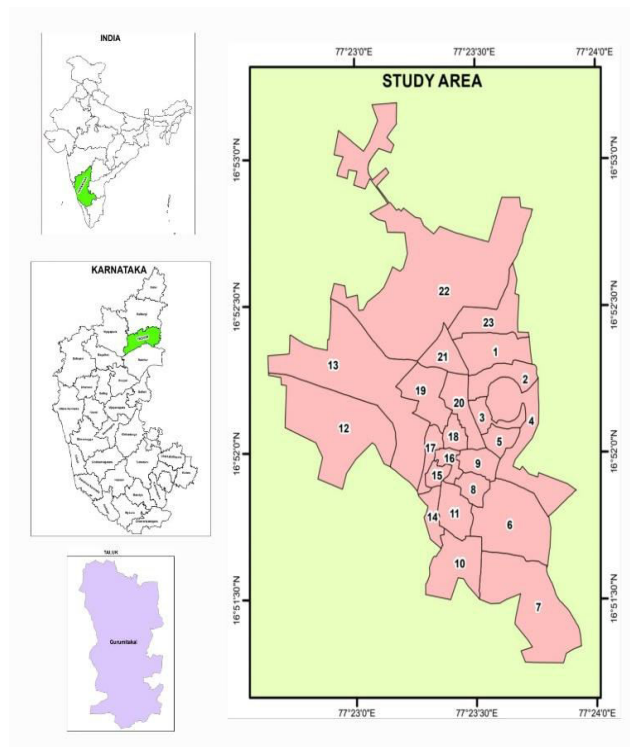


Fig.1. Location map of Gurmitkal town in ward wise

III. METHODOLOGY

The samples were collected 3 times from 23 wards of Gurmitkal town and every time the collected in sterilized tightly capped polyethylene bottles of one Litre capacity and analyzed in laboratory for their Physico-Chemical parameters, Samples collected from each wards were properly labelled.^[3]

A.Physico-Chemical Characteristics

In situ measurement was adopted to determine unstable parameters, including pH, TDS, by portable instruments. All the parameters are expressed in mg/L except pH.

SI No.	Parameters	Methods	Equipments
1	pH	Electrometric	pH Meter
2	Fluoride	SPANDS method	Spectrophotometer
3	Total Hardness	Titration	-
4	Calcium	Titration	-
5	Magnesium	Titration	-

6	Dissolved Oxygen	Titration	-
7	Chloride	Titration	-
8	Sulphate	Turbidimetric method	Spectrophotometer
9	Alkalinity	Titration	-
10	TDS	Gravimetric	-

Table 1. Methods and equipments used to analyze the Physico-Chemical Characteristics

B. Correlation Coefficient

Correlation analysis measures the closeness of the relationship between chosen independent variables. If the correlation coefficient is nearer to +1 or -1, it shows the probability of linear relationship between the variables x and y. this analysis attempts to establish the nature of the relationship between the variables and thereby provides a mechanism for prediction or forecasting.^[4]

C. Water Quality Index

The WQI was calculated using weighted arithmetic method. The steps involved in calculating the WQI are as shown below.

$S_n = \text{BIS Standards}$

$K = 1/\sum(1/S_n)$

$W_i = K/S_n$

V_n/S_n

Where $V_n = \text{Mean Value obtained from result}$

$V_n \text{ for pH} = 7$

$V_n \text{ for D.O} = 14 \text{ and}$

$V_n \text{ for other considered parameters} = 0$

$Q_n = (V_n/S_n) \times 100$

$W_n \times Q_n$

$\sum W_n \times Q_n = \text{Water Quality Index.}$

D. GIS mapping

The Physico-Chemical Characteristics of the Ground water were integrated into GIS using ARC GIS software for mapping the Groundwater distribution.

IV. RESULTS AND DISCUSSION

A. Physico-Chemical Characteristics

The average values of physico-chemical parameters in the study area is as shown in table.

SL NO	PARAMETERS	AVERAGE VALUE	BIS STANDARDS
1	Cl	39.26	250-1000
2	TH	221.53	200-600
3	Ca-H	155.25	75-200
4	Mg-H	66.44	300-1000
5	T Alk	106.48	200-600
6	SO ₄	31.88	200-400
7	pH	7.5	6.5-8.5
8	D.O	6.9	6.8-8.5
9	F	0.78	1-1.5
10	TS	827.3	500-2000

Table 2. Obtained values with BIS standards

B. Water Quality Index

The Water Quality Index of the samples was analyzed by weighted arithmetic method and was found out be 79.521 and was of POOR quality. Which needs treatment before drinking.

Parameters	BIS	1/Sn	E(1/Sn)	K=1/E(1/Sn)	Wi=K/Sn	Vn	Vn/Sn	Qn =(Vn/Sn)*100	Wn*Qn
Cl (mg/l)	1000	0.001	1.265	0.791	0.001	39.263	0.039263	3.926	0.003104
TH(mg/l)	600	0.0017	1.265	0.791	0.001	221.537	0.3692283	36.923	0.048647
Ca-H(mg/l)	200	0.005	1.265	0.791	0.004	155.255	0.776275	77.628	0.306833
MgH(mg/l)	100	0.01	1.265	0.791	0.008	66.440	0.6644	66.440	0.525226
T Alk(mg/l)	600	0.0017	1.265	0.791	0.001	106.483	0.1774717	17.747	0.023383
So4(mg/l)	400	0.0025	1.265	0.791	0.002	31.886	0.079715	7.972	0.015754
pH	8.5	0.1176	1.265	0.791	0.093	7.500	0.8823529	88.235	8.206156
DO(mg/l)	8	0.125	1.265	0.791	0.099	6.935	0.866875	86.688	8.566094
F(mg/l)	1	1	1.265	0.791	0.791	0.780	0.78	78.000	61.66105
TS	2000	0.0005	1.265	0.791	0.004	827.300	0.41365	41.365	0.16546
									79.52171

Table 3. Water Quality Index Calculation

C. Geological Information System

The spatial and non spatial data bases were integrated for the generation of the spatial distribution of all of our physico chemical parameters. The GIS mapping of each parameter in gurmitkal town with their area coverage in terms of percentage is mentioned in the legend of the map.

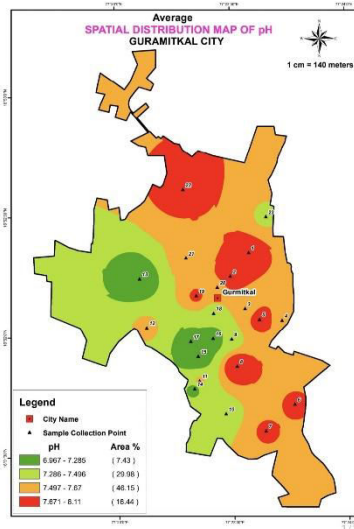


Fig.2. GIS map of pH

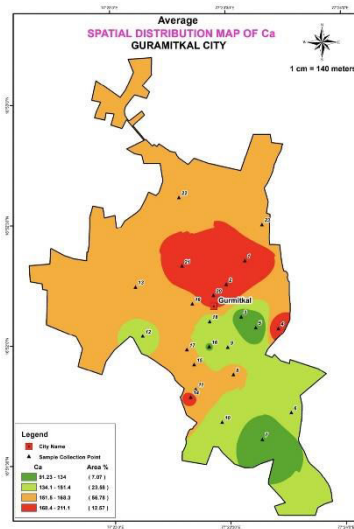


Fig.3. GIS map of Ca Hardness

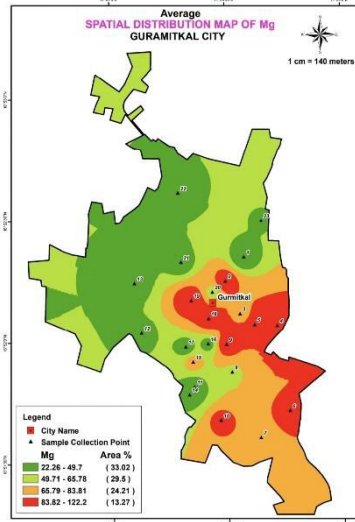


Fig.4. GIS map of Mg Hardness

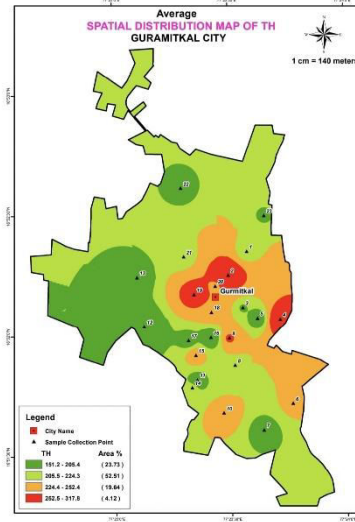


Fig.5. GIS map of Total Hardness

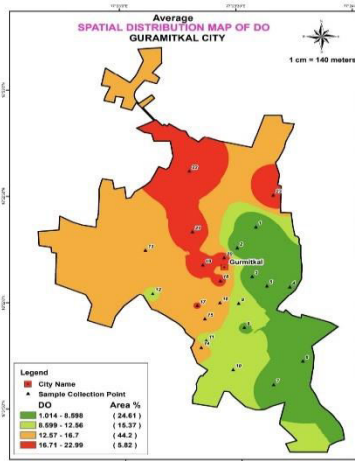


Fig.6. GIS map of D.O

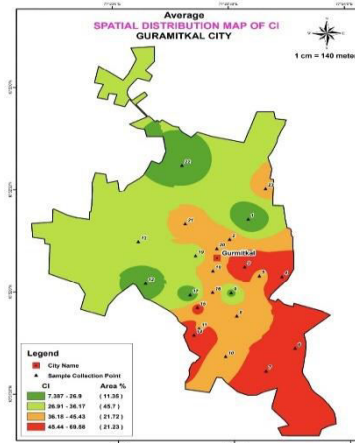


Fig.7. GIS map of Chloride

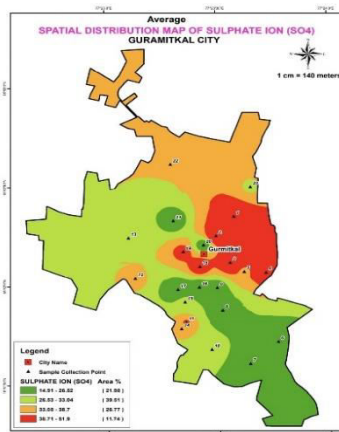


Fig.8. GIS map of Sulphate

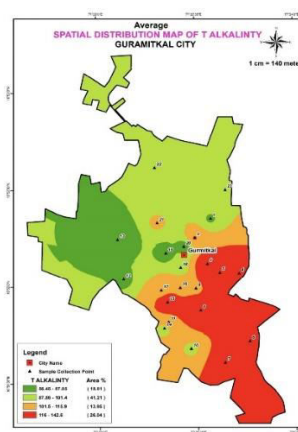


Fig.9. GIS map of Alkalinity

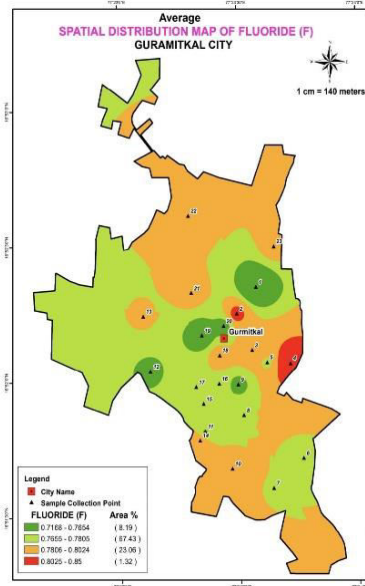


Fig.10. GIS map of Fluoride

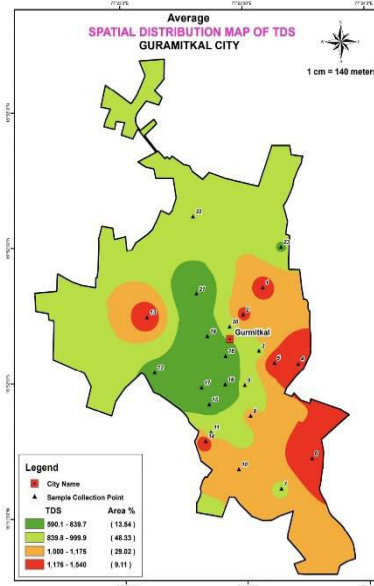


Fig.11. GIS map of TDS

D. Discussion

- In the present work, analysis of Physico chemical characteristics of ground water of Gurmitkal town was done, corresponding to the obtained results correlation coefficient, WQI were also analyzed. The integration of GIS mapping with the help of Arc GIS was done.
- The obtained Physico-chemical characteristics were compared with the BIS standards.

V. CONCLUSION

- On comparing it was found that Total Hardness, Calcium hardness, Magnesium hardness, pH and Total dissolved solids were complying with the BIS standard.
- The WQI indicated that the groundwater of Gurmitkal town falls under the “POOR QUALITY” which indicates that ground water can be used for drinking but treatment is needed before drinking.

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