International Journal of Applied and Natural Sciences (IJANS)
ISSN(P): 2319-4014; ISSN(E): 2319-4022
Vol. 3, Issue 5, Sep 2014, 53-58

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

WQI BASED WATER QUALITY ASSESSMENT IN UDUTOREHALL SUB BASIN, KARNATAKA, INDIA

P. C. NAGESH

Department of Geology, Bangalore University, Bangalore, Karnataka, India

ABSTRACT

Safe drinking water is essential to humans and other life forms even though it provides no calories or organic nutrients. Changing climate patterns are threatening lakes and rivers, and key sources that we tap for drinking water are being overdrawn or tainted with pollution. Polluted water is the world's biggest health risk, and continues to threaten both quality of life and public health. Hence it is essential for continuous monitoring of the quality of groundwater so that pollution can be minimized. In the study area the computed WQI value ranges from 28.7 to 257.47 with an average of 76.78. Analysed and WQI is calculated for total 114 samples in the study area. Out of which about 9 samples (7.89%) are excellent, 87 samples (76.31%) are good, 17 samples (14.91%) are poor and only one sample (0.87%) is in Very poor category. The WQI in poor category is mainly due to high nitrate, chloride, bicarbonate in the groundwater. The results obtained from the study indicate that groundwater is suitable for both drinking and domestic purpose in general, except in few cases.

KEYWORDS: Climate, Groundwater, Monitor Water Quality

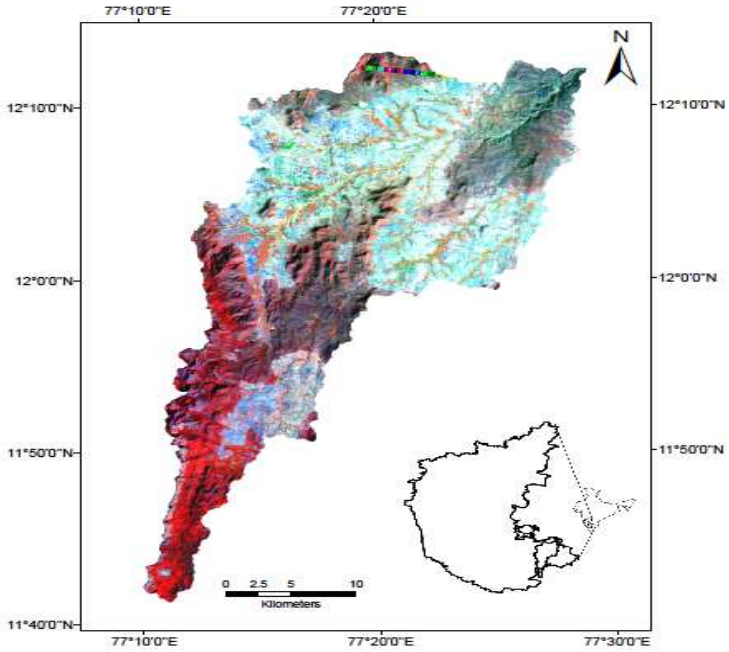
INTRODUCTION

Water is an important natural resource. It plays an important role in the world economy, as it functions as a solvent for a wide variety of activities. Water on earth moves continually through the water cycle of evaporation, condensation, precipitation, and runoff, usually reaching the sea. Evaporation and transpiration contribute to the precipitation over land. Safe drinking water is essential to humans and other life forms even though it provides no calories or organic nutrients. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water. Clean and plentiful water provides the foundation for prosperous communities. Changing climate patterns are threatening lakes and rivers, and key sources that we tap for drinking water are being overdrawn or tainted with pollution. Polluted water is the world's biggest health risk, and continues to threaten both quality of life and public health. Thus it becomes imperative for regular monitoring of water quality. Water quality index is a mean by which assessment and management of groundwater can be made. It provides communicative information over different water quality parameters[2&6]. The current work attempts towards reflecting the suitability of groundwater for domestic and drinking purpose in the study area.

Study Area

The investigated area is enclosed between latitudes 11^{o} 40'N–12^{o} 15'N and longitudes 77^{o} 10'E–77^{o} 30'E, covering an area of 809 sq. kms (Map-1) falling in Survey of India (SOI) toposheet Nos: 57 H/4, H/8, 58E//1, E/2, and E/5 on 1:50,000 scale .Geologically, the area under study is occupied by Archean rocks with unclassified crystalline formations, phyllites, schist belongs to Dharwar craton, in addition there are metasediments, and younger dykes (Map-3).

The area is well represented by structural hills, denudational hills, burried pediments, valley fills and alluvial plains forming soil covers of silty clay, red sandy and red loamy and alluvium. The area enjoys tropical climate of semi arid in nature and the temperature ranges from 13.3 to 16.1º C in December and 19.7 to 35.1º C in May. The average annual rainfall in the basin is 71.64 cm with maximum contribution from southwest monsoon. Monsoon depressions in the Bay of Bengal also cause heavy precipitation.



Map 1: Study Area

METHODOLOGY

Groundwater samples were collected from 114 various locations (Map-2). The samples were analyzed for pH, EC, major cations *viz.*, Calcium, Magnessium, Sodium, Potassium and anions *viz.*, Sulpate, Chloride, Nitrate and Bicarbonate by adopting standard analytical procedures. The analyzed data has been used in the computations. The standards for drinking purposes as recommended by BIS have been considered for the calculation.

RESULTS AND DISCUSSIONS

The computation of water quality index involves different stages *Viz.*, assigning weights to quality parameters, computation of relative weight, calculation of quality rating scale and finally computing the water quality index.

Relative Weight (*Wi*)

Each Chemical parameter is assigned a weightage by keeping its impact on human health into consideration. The range of numerical magnitude of Relative weight ranges from 1 to 5 (Table 1). The lower values of *Wi* indicates lesser impact of respective chemical parameters on health and higher values have more impact over human health. The relative weight is calculated by

$$\mathrm{Wi} = wi \Big/ \sum_{i=1}^{n} \mathrm{Wi}$$

Where Wi is the weighted parameter and wi is the relative weight.

Table 1: Relative Weight of Chemical Parameter

Constituents (Mg/L.)	Relative Weight(Wi)	Weighted Parameter(Wi)	Drinking Water Standards
Ca	2	0.057	75
Mg	2	0.057	30
Na	4	0.114	200
K	1	0.028	10
Cl	3	0.085	250
SO_4	5	0.142	150
NO_3	5	0.142	45
F	4	0.114	1.20
HCO_3	3	0.085	300
EC (ms/cm)	2	0.057	1400
pH	4	0.114	7.5

Quality Rating Scale (Qi)

Quality rating scale is the ratio of concentration of each water quality measure of every water sample (Ci) to its respective drinking water quality standards (Si). The *Sc* of each water quality measure is computed by the equation;

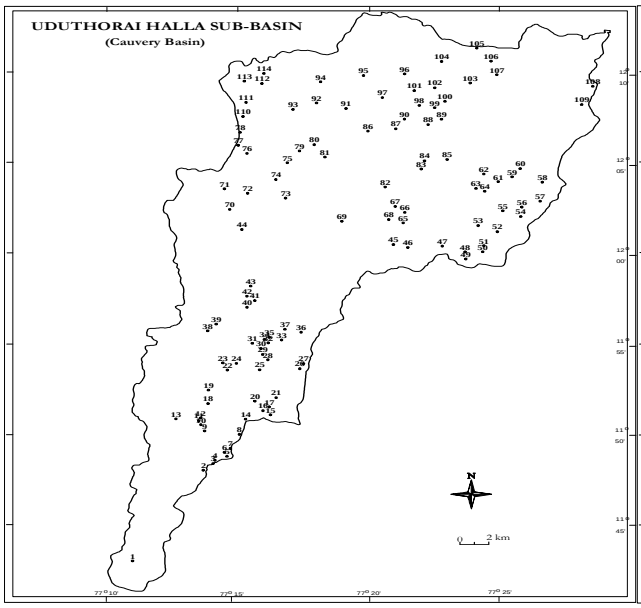
$$Qi = \frac{Ci}{Si} * 100$$

Water Quality Index (*WQI*)

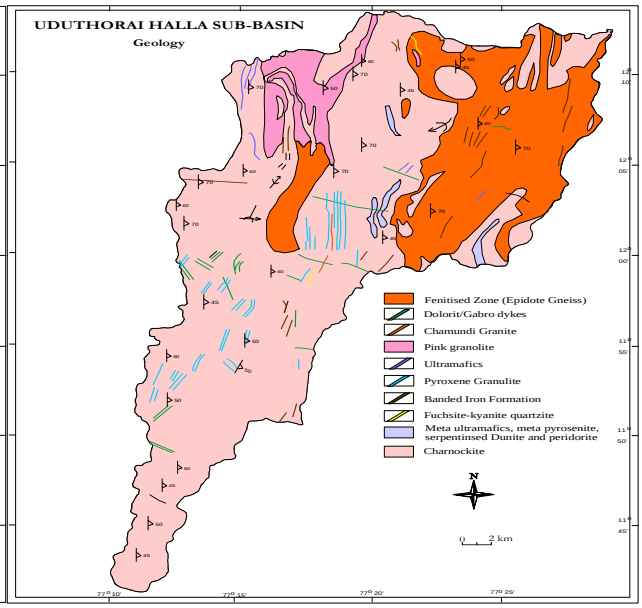
Computation of *WQI* needs primarily calculation of Si which is the sub index of i^{th} parameter and can be obtained from the product of relative weight and the quality rating scale. The summation of the same is then used for the determination of water quality index. It can be computed by;

$$Si = Wi * Qi$$

$$WQI = \sum Si$$



Map 2: Sample Locations Map



Map 3: Geology of the Study Area

Classification of *WQI*

The *WQI* classification could be used in the assessment of groundwater contamination[5]. In the study area the computed WQI value ranges from 28.7 to 257.47 with an average of 76.78. The different WQI values in the study area can be categorized into four different classes Viz., Excellent, Good, Poor and Very poor. Most of the samples fall under the category of Good. The water quality classification based on WQI is given in Table 2.

Table 2: Water Quality Classification Based on WQI

WQI	Water Quality	% of Samples
< 50	Excellent	7.89
50 - 100	Good water	76.31
100 - 200	Poor water	14.91
> 200	Very Poor water	0.87

Co- relation matrix for the water quality parameters has been generated to bring about the degree of linear association of two water quality parameters which is given in Table 3. The correlation matrix shows that most of the water quality parameters have positive correlation with each other.

Table 3: Correlation Matrix of Water Quality Parameters

	Ca	Mg	Na	K	So4	Cl	NO3	HCO3	EC	pH	F
Ca	1										
Mg	0.21	1									
Na	0.13	0.25	1								
K	0.05	0.19	0.14	1							
SO4	0.27	0.29	0.65	0.04	1						
Cl	0.41	0.45	0.67	0.20	0.54	1					
NO3	-0.04	-0.20	0.28	-0.17	0.49	0.20	1				
HCO3	0.18	0.40	0.40	0.08	0.32	0.36	-0.11	1			
EC	0.54	0.66	0.68	0.17	0.63	0.75	0.08	0.47	1		
pH	-0.33	-0.19	0.05	0.05	-0.06	-0.18	-0.09	0.03	-0.25	1	
F	0.15	0.13	0.36	-0.08	0.21	0.30	0.08	0.02	0.32	-0.25	1

pH in study area vary from 6.65 to 8.4 with an average of 7.68. EC of the groundwater varies from 380 to 5080 microsiemens/cm at 25^{o}C with an average of 1262. The Calcium ranges from 8 mg/l to 314 mg/l with an average of 81 mg/l. The Magnesium value ranges from 32 mg/l to 260 mg/l with an average of 106.88 mg/l. The average Sodium content for the study area is 93.72 mg/l, ranging from 13 mg/l to 651 mg/l. Potassium concentration is found varying from traces to 121 mg/l, with an average of 10.61 mg/l in groundwater. The Sulphate concentration varies from 0 to 276 mg/l. with an average of 46.99 mg/l. Chloride concentration ranges from 14 mg/l to 1071mg/l with an average of 133 mg/l. Nitrate concentration varies from 0 to 173 mg/l with an average of 34.71 mg/l. Fluoride concentration ranges from 0 to 2.2 mg/l. with an average of 0.23 mg/l. Statistical parameter of the analytical results of groundwater is given in Table 4.

Table 4: Statistical Analysis of Groundwater Quality Parameters

Constituents (mg/l.)	Maximum	Minimum	Mean	S.D	Coefficient of Variation
Ca	260	32	106.8	56.85	53.23
Mg	253	9	63.61	45.40	71.37
Na	651	13	93.72	77.73	82.93
K	121	0.05	10.61	17.94	169.08
Cl	1071	14	133.02	150.46	113.11
SO_4	276	0	46.99	42.16	89.72
NO_3	173	0	23.10	34.71	150.25
F	2	0	0.23	0.24	104.34
HCO_3	725	109	418	118	28.22
EC (ms/cm)	5080	380	1262	684.54	54.24
pH	8.94	6.65	7.68	0.42	5.46

CONCLUSIONS

In the study area the computed WQI value ranges from 28.7 to 257.47 with an average of 76.78. Analysed and WQI is calculated for total 114 samples in the study area. Out of which about 9 samples (7.89%) are excellent, 87 samples (76.31%) are good, 17 samples (14.91%) are poor and only one sample (0.87%) is in Very poor category. The WQI in poor category is mainly due to high nitrate, chloride, bicarbonate in the groundwater. The results obtained from the study indicate that groundwater is suitable for both drinking and domestic purpose.

REFERENCES

1. **BIS (2003).** Drinking water - specification, Bureau of Indian Standards: New Delhi IS; 10500.
2. **Brown R.M., Mc Cleil, Deininger R.A. and O'Conner M.F., (1972).** A water quality index crashing the psychological barrier, Edi. Bys. H. Jenkis, proc. Int. Conf. on water poll., Res. Jerusalem. 6,787-797.
3. **Davis S.N., Dewiest R.J.M., (1966)**. Hydrogeology, John Wiley & Sons Inc., New York.
4. **Holden W.S., (1970).** Water treatment and examination, Churchill Publishers: London.
5. **Horten R.K., (1965).** An Index number for rating water quality, J. Water Poll. Cont. Fed. 37 (3): 300-306.
6. **Mishra P.C and Patel R.K., (2011).** Study of the pollution load in the drinking water of Rairangpur, a small tribal dominated town of North Orissa, Indian J. Environ. Ecoplan. 5(2), 293 - 298.