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CHARACTERIZATION OF GROUND WATER BASED ON WATER QUALITY INDEX IN BHATKAL, UTTARA KANNADA DISTRICT, KARNATAKA

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Abstract - *Ground water is a natural resource for drinking purpose. Like other natural resources, it should be assessed regularly and people should be made aware of quality of drinking water. A simple number given by any WQI model explains the level of water contamination. WQI is commonly used for the detection and evaluation of water pollution and may be defined as a reflection of the composite influence of different quality parameters on the overall quality of water. The present study is aimed at assessing the water quality index for the groundwater of Bhatkal taluk. This has been determined by collecting thirteen groundwater samples. Subjecting samples to a comprehensive physicochemical analysis are made using the standard procedure as per ISI standards. For calculating the WQI, the important parameters such as pH, total hardness, alkalinity, chloride, nitrate, sulphate, chloride, iron, dissolved oxygen have been considered.*

Key Words: **water quality index, Bhatkal taluk, Physicochemical analysis, Groundwater**

1.INTRODUCTION

With the increasing population and water demand for various uses, surface water is becoming inadequate in the recent years. The situation is bound to worse in the years to come. This has shifted usage of water from surface sources to underground resources.

Groundwater is used for domestic and industrial water supply and irrigation all over the world. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization. Rapid urbanization, especially in developing countries like India, has affected the availability and quality of groundwater due to its overexploitation and improper waste disposal, especially in urban areas. According to WHO organization, about 80% of all the diseases in human beings are caused by water. Once the groundwater is contaminated, its quality cannot be restored by stopping the pollutants from the source. It therefore becomes imperative to regularly monitor the quality of groundwater and to device ways and means to protect it. Water quality index is one of the most effective tools to communicate information on the quality of water to the concerned citizens and policy makers. It, thus, becomes an important parameter for the assessment and management of groundwater. WQI is defined as a rating reflecting the composite influence of different water quality parameters. WQI is calculated from the point of view of the suitability of groundwater for human consumption. The objective of the present work is to access the suitability of groundwater for human consumption based on computed water quality index values.

Water is one of the most important commodities which man has exploited than any other resources for sustenance of his life. Most of our demand for water is fulfilled by rain water which gets deposited in surface and sub-surface water sources. The quality of water available is rapidly deteriorating, because of urbanization, industrialization, agriculture, increase in human population, fast growing technologies and needs. As a result of human activities the fresh water bodies are becoming less suitable for drinking, domestic, agricultural, industrial, recreational, wild life and other uses.

There is a difference between “pure water” and “safe drinking water.” Pure water does not contain any minerals or chemicals, and does not exist naturally. Safe drinking water may contain naturally occurring minerals and chemicals such as calcium, potassium, sodium or fluoride which are actually beneficial to human health. In general, good quality drinking water is free from disease-causing organisms, harmful chemical substances and radioactive matter, tastes good, is aesthetically appealing and is free from objectionable colour or odour.

Groundwater occurs almost everywhere beneath the earth surface not in a single widespread aquifer but in thousands of local aquifer systems and compartments that have similar characters. Groundwater quality depends on the quality of recharged water, atmospheric precipitation, inland surface water, and on sub-surface geochemical processes. Temporal changes in the origin and constitution of the recharged water, hydrologic and human factors, may cause periodic changes in groundwater quality.

1.1 Objectives

- ❖ To turn multifaceted water quality data into simple information that is comprehensible and useable by public, by calculating water quality index.

- To find out the quality of water and their chemical contents in stated region.
- To find suitability of water for drinking, irrigation, industries and other purposes.
- To analyze that the groundwater of area needs some degree of treatment before consumption.
- To detection and evaluation of water pollution and the level of water contamination by calculating water quality index.

2. STUDY AREA

Bhatkal Taluk with population of about 1.6 lakh is Uttara Kannada district's the 3rd most populous taluk, located in Uttara Kannada district of the state Karnataka in India with longitude and latitude of 13.9978˚N, 74.5405˚E. There are 59 villages in the sub district, among them Mavalli is the most populous village with population of about 17 thousand and Devastan Megthe is the least populous village with population of 8. Koppa is the biggest village in the sub district with an area of 97 km^2. There are 3 cities in the sub district which comes under the sub district administration, those are Bhatkal Town Municipal Council; Jali and Venkatapura Census Towns.

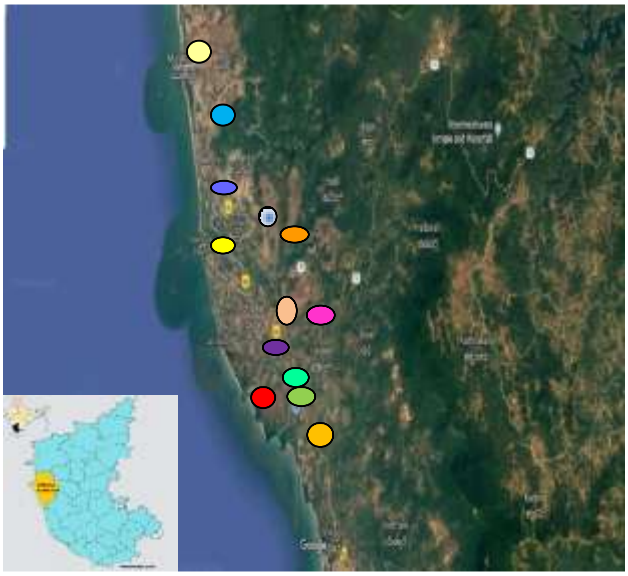

Fig -1: Location of study area

3. METHODOLOGY

Drinking water samples were collected from thirteen wells from Bhatkal taluk. It includes both open wells and borewell. Water samples were collected in pre-claimed plastic polyethylene bottle, and were immediately stored in the coolers with cold packs after collection. Using the Anjuman institute of technology and management, Bhatkal, laboratory facilities Manipal laboratory facilities, the samples were analyzed within one to ten days after the collection. In order to acquire a complete data set of the water quality, the water samples were analyzed for the following parameters: pH, Alkalinity, Chloride, Dissolved oxygen, Total hardness, Flouride, Sulphate, Iron, Nitrite.

After collecting necessary information required to start up our project, reconnaissance survey is made in detail. Water samples are collected from various locations of Bhatkal, fixed during reconnaissance survey. The sampling locations found are based on easy accessibility of water from various sources.

3.1 Water quality index

Water quality indices aim at giving a single value to the water quality of a source on the basis of one or the other system which translates the list of constituents and their concentrations present in a sample into a single value. One can then compare different samples for quality on the basis of the index value of each sample.

A Water Quality Index (WQI) is a means by which water quality data is summarized for reporting to the public in a consistent manner. It is similar to the UV index or an air quality index, and it tells us, in simple terms, what the quality of drinking water is from a drinking water supply.

The WQI measures the scope, frequency, and amplitude of water quality exceedances and then combines the three measures into one score. This calculation produces a score between 0 and 100. The lower the score, the better is the quality of water. The scores are then ranked into one of the five categories described below:

Table 1: Water quality classification based on WQI value

WQI value	Water quality
< 50	Excellent
50 -100	Good water
100 – 200	Poor water
200 – 300	Very poor water
> 300	Water unsuitable for drinking

The WQI is a summary tool and the Department does not intend to use the WQI to replace detailed analysis of drinking water quality data. The Department continues to closely monitor and analyze drinking water quality to protect drinking water safety on a proactive basis.

For computing WQI three steps are followed. In the first step, each of the nine parameters has been assigned a weight (wi) according to its relative importance in the overall quality of water for drinking purposes. The maximum weightage of 5 has been assigned to the parameter nitrate due to its major importance in water quality assessment. Magnesium which is given the minimum weightage of 1 as magnesium by itself may not be harmful. In the second step, the relative weight (W_i) is computed from the following equation:

$$W_i = \frac{W_i}{\sum_{i=1}^{n} W_i}$$

Where, W_i is the relative weight, wi is the weight of each parameter and n is the number of parameters. Calculated relative weight (Wi) values of each parameter are also given in Table 2.

In the third step, a quality rating scale (qi) for each parameter is assigned by dividing its concentration in each water sample by its respective standard according to the guidelines laid down in the BIS and the result multiplied by 100:

$$qi = \left(\frac{Ci}{Si}\right) \times 100$$

Where qi is the quality rating. Ci is the concentration of each chemical parameter in each water sample in mg/L, and Si is the Indian drinking water standard for each chemical parameter in mg/L according to the guidelines of the BIS 10500, 1991.

For computing the WQI, the SI is first determined for each chemical parameter, which is then used to determine the WQI as per the following equation.

$$Sli = Wi.qi$$
$$WQI = \sum Sli$$

Sli is the subindex of ith parameter, qi is the rating based on concentration of ith parameter and n is the number of parameters. The computed WQI values are classified into five types, “excellent water” to “water, unsuitable for drinking”.

4. RESULT AND DISCUSSION

Table- 2:- trail 1 (22/11/2018)

Sample	***pH***	***Chloride*** (mg/l)	***TH*** (mg/l)	***Alkalinity*** (mg/l)	***DO*** (mg/l)	***WQI***
standard values	6.5-8.5	250	300	200	4	
S1	7.43	64.02	155	34	4.3	14.95
S2	5.55	88.83	20	34	5.15	12.05
S3	5.34	0	21	46	1.05	7.74
S4	6.03	48.63	40	30.5	3.63	10.84
S5	5.79	49.63	40	42	5.06	11.4
S6	5.88	79.41	67	66	5.25	13.78
S7	6.63	117.12	190	127.5	3.2	19.06
S8	6.82	120.6	262	124	4.35	20.72
S9	6.62	64.02	201	59	4.9	15.72
S10	7.45	63.03	288	62.5	5.15	18.07
S11	6.55	71.46	119	72	5	15.1
S12	6.71	30.5	58	28	4.45	11.36
S13	6.84	72.95	254	68.5	5.15	17.45

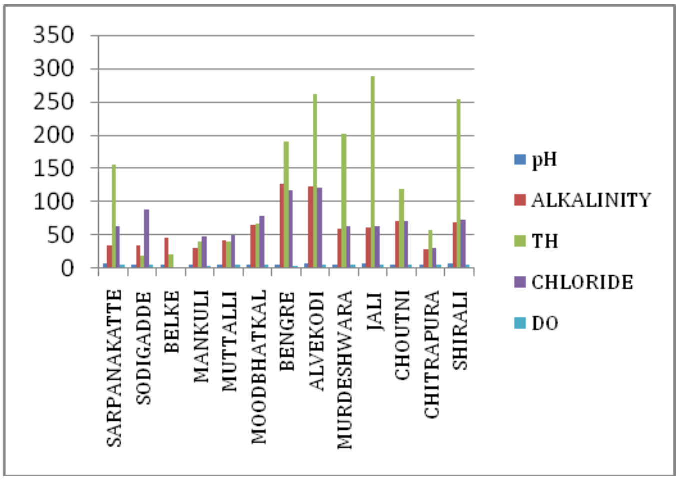

Chart- 1: Trial 1 Results

Table -2: trail 2 (12/01/2019)

Sample	***pH***	***Chloride*** (mg/l)	***TH*** (mg/l)	***Alkalinity*** (mg/l)	***DO*** (mg/l)
standard values	6.5-8.5	250	300	200	4
S1	7.5	66.5	185	0	5.1
S2	5.87	43	37	35.5	6
S3	6	29.5	19	32	7.1
S4	5.99	28.5	43	51.5	4.2
S5	6.2	35.5	82	102	5
S6	6.2	32.5	76	105	6.3
S7	6.73	100.5	196	129.5	4.1
S8	6.1	115.5	270	120	5.2
S9	5.9	19	176	72.5	4.4
S10	7.2	60.5	300	65.7	6.3
S11	6.9	75.5	155	230	4.55
S12	6.5	43.5	87	23.5	5.23
S13	7.2	63.5	288	71.5	5.75

Fluoride (mg/l)	***Sulphate*** (mg/l)	***Nitrite*** (mg/l)	***Iron*** (mg/l)	***WQI***
1	200	45	0.3-3	
0.55	41.57	NIL	0.8	60.78
0.52	NIL	0.8	0.2	54.7
0.42	NIL	NIL	0.4	45.93
0.58	NIL	2	0.2	59.38

0.52	NIL	NIL	0.2	57.15
0.56	34.98	2	0.2	60.83
0.6	59.27	4.6	0.2	69.34
0.58	34.98	4.6	0.4	68.66
0.53	NIL	0.4	0.2	57.42
0.6	NIL	0.32	0.2	68.4
0.5	20.58	2	0.2	62.65
0.45	45.97	0.8	1	49.81
0.5	75.32	2	0.2	60.22

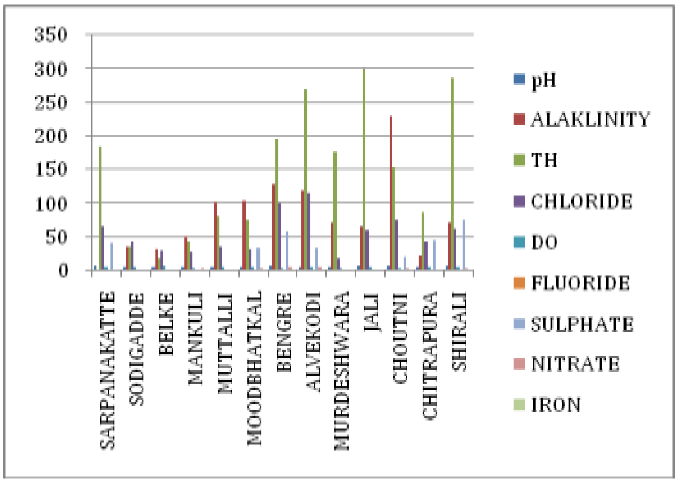

Chart- 2: Trail 2 Results

Table -4: trail 3 (01/04/2019)

Sample	*pH*	*Chloride* (mg/l)	*TH* (mg/l)	*Alkalinity* (mg/l)	*DO* (mg/l)	*WQI*
standard values	6.5-8.5	250	300	200	4	
S1	6.6	33	32	73.5	7.15	13.13
S2	5.6	48.5	32	27.5	5.95	10.87
S3	6.2	34.5	49	52.5	6.85	12.29
S4	6.2	32.5	43	59.5	6.3	12.17
S5	5.5	55.5	35	30	4.8	10.79
S6	6.1	45	94	86.5	5	13.71
S7	6.4	152.5	194	212.5	3.75	22.9
S8	6.5	125	209	587	4.75	24.79
S9	6.6	31	51	83.5	5.95	13.29
S10	5.1	50	375	13	5.45	14.99
S11	6.2	105.5	414	220	5.6	25.1

S12	6.4	75.5	198	30.3	5.9	15.29
S13	5.6	35.5	48	22	6.85	10.74

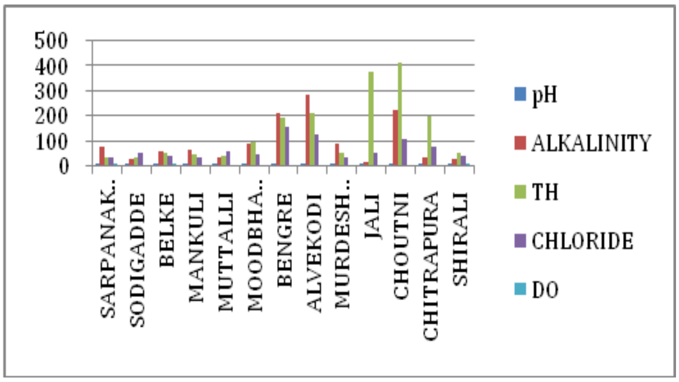

Chart- 3: Trial 3 Results

Table -5: trial 4 (24/04/2019)

Sample	***pH***	***Chloride*** (mg/l)	***TH*** (mg/l)	***Alkalinity*** (mg/l)	***DO*** (mg/l)	***WQI***
standard values	6.5-8.5	250	300	200	4	
S1	8.06	47.2	190.8	90.5	6.7	17.99
S2	5.2	50.2	65.8	40.5	5.3	11.21
S3	5.1	35.5	67.3	73.2	6.3	11.89
S4	6.3	40.9	74.6	64.1	5.5	12.96
S5	7	67.2	40.5	44.2	4.9	13.36
S6	5.5	71.5	145.6	98.2	5.1	15.2
S7	5.3	185.6	305.2	286.5	6.7	27.75
S8	6.2	153.2	300.7	378.2	5.8	29.97
S9	7.1	100.5	73.5	100.7	4.9	16.89
S10	5.7	89.2	398.6	27.6	6.6	18.21
S11	6.3	90.7	355.2	360.8	4.7	27.77
S12	5	70.2	160.2	50.7	5.5	13.52
S13	5.5	45.7	45.7	30	7.1	11.29

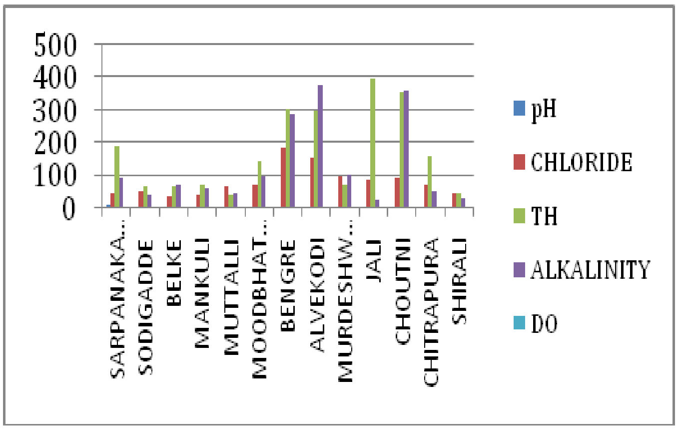

Chart -4: Trial 4 Results

Table -6: Water quality index

AREA	WQI			
	Trail 1	Trail 2	Trail 3	Trail 4
Sarpanakatte	14.95	60.78	13.13	17.99
Sodigadde	12.05	54.7	10.87	11.21
Belke	7.74	45.93	12.29	11.89
Mankuli	10.84	59.38	12.17	12.96
Muttalli	11.4	57.15	10.79	13.36
Moodbhatkal	13.78	60.83	13.71	15.2
Bengre	19.06	69.34	22.9	27.75
Alvekodi	20.72	68.66	24.79	29.97
Murdeshwara	15.72	57.42	13.29	16.89
Jali	18.07	68.4	14.99	18.21
Choutni	15.1	62.65	25.1	27.77
Chitrapura	11.36	49.81	15.29	13.52
Shirali	17.45	60.22	10.74	11.29

5. CONCLUSIONS

pH of the water samples collected varies from 5.1 to 8.06 which on average are in permissible limit as per BIS values. When water has a low pH, it is often referred it as “soft water”. Total hardness of S7, S8, S10, S11 varies above the standard values it may due to intrusion of sea water. Water quality is decreasing from trial 1 to trail 3. Total hardness varies from 19 to 414 mg/L. The hardness values for the study area are found to be low for almost all within the standard values. The chloride content was found to be well within the permissible levels. The chloride content ranges from 19 to 152.5 mg/L. in trail 1 S3 sample shown no result with light pink color it may due to presence of bacteria, so further analysis made to find bacterial presence (>2400). Sulphate, nitrate, fluoride, iron are in very few amount so they are neglected during finding out WQI

WQI of thirteen water sample varies from 7.74 to 69.34. Almost 100 percent of the samples are within the limit and water quality varies from excellent to good. The high value of WQI at these locations has been found to be mainly from the higher values of, total hardness, and chloride in the groundwater. Chloride content values indicate that the hardness of the water is permanent in nature. The groundwater quality decreasing from trial 1 to trail 3, this may due to contamination or intrusion of sea water as areas are very near to ocean. The analysis reveals that the water from various sources like, well bore well and tap of the area are potable and fit for consumption, but it also needs to be protected from the perils of contamination.

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