Physico-Chemical Characteristics of Groundwater of Hunasagi and Wadgera

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Abstract*—Water is an essential natural resource on our planet, indispensable for almost all human endeavors. The rising demand for water has caused excessive extraction of groundwater, leading to considerable effects on its availability and quality. The World Health Organization (WHO) indicates that around 80% of illnesses are associated with water-related problems. In the Yadgir district of Karnataka, India, the community predominantly depends on groundwater for their drinking water supply. The inhabitants of this region are facing fluorosis and associated health complications as a result of the geochemical irregularity of fluoride present in the groundwater. The region under investigation is characterized by a warm climate and receives a moderate amount of rainfall. Water samples were gathered from 24 villages situated in 2 talukas within the district during both the pre-monsoon and post-monsoon seasons, following established protocols. These samples were analyzed for various parameters, such as pH, total hardness (TH), calcium (Ca), magnesium (Mg), chloride (Cl), total dissolved solids (TDS), fluoride (F), nitrate (NO3), sulfate (SO4), and alkalinity. An analysis is conducted on the physical and chemical characteristics of coal.

***Index Terms*—water quality index (WQI),,Bureau of Indian Standards(BIS), Statistical parameters , fluoride parameter and TDS.**

I. INTRODUCTION

Across the globe, groundwater serves various purposes, including irrigation, domestic use, industrial applications, and water supply. In recent years, the demand for fresh water has surged significantly due to population expansion and heightened industrial activity. The majority of agricultural development activities pose significant risks to human health, particularly due to the excessive use of fertilizers under unsanitary conditions and the rapid pace of urbanization.The assessment of groundwater resources and the quality of that groundwater hold nearly equal significance to its quantity. The physical, chemical, and bacteriological properties of groundwater are critical in determining its suitability for domestic water supply, as well as for commercial, industrial, agricultural, and municipal applications. Samples are collected from 2 talukas which are hunasagi and wadgera with 24 villages.

II. OBJECTIVES

1. To evaluate the physico-chemical properties of groundwater samples in relation to the standards set forth by the Bureau of Indian Standards (BIS).
2. An examination of the physico-chemical properties of groundwater in Yadgir district is being conducted.
3. To determine the water quality index (WQI).

A. Literature Survey

1. Debabrata Mazumder and colleagues (2002) found that in certain rural regions of Howrah, groundwater is being polluted due to the overuse of fertilizers in agriculture. The high solubility of nitrates means that a significant portion of the aquifer can become contaminated quickly. Furthermore, in developed nations, the rising levels of nitrate in groundwater have led to the closure of wells, making aquifers unsuitable for drinking water.
2. Rajmohan N and colleagues (1992) carried out a study on groundwater samples taken from both dug and bore wells in the heavily irrigated region of Kanchepuram Taluk, Tamil Nadu. The samples were analyzed in a laboratory for various parameters including TH, EC, TDS, Ca, Mg, Na, K, Cl, HCO, CO, SO4, NO3, PO4, and SiO2. The findings were utilized for elemental correlation analysis, revealing strong correlations among most elements. A Piper-Trilinear diagram was employed to determine the

hydrochemical types of the groundwater, indicating that the majority fall under the Ca HCO3 category, while the rest are classified as Ca Mg Cl type. The hydrochemical characteristics suggest that the high concentrations of major ions may be attributed to silicate weathering reactions.

B. Methodology

Techniques for Analyzing Water Quality.

1. A pH meter was utilized to measure the pH level of the sample.
2. The total dissolved solids (TDS) in the sample were assessed using the gravimetric method.
3. The hardness of the sample was evaluated through the standard EDTA titrimetric method, employing erichrome black T as the indicator.
4. The concentration of iron in groundwater was measured using the phenanthroline method with a spectrophotometer set to 520 nm.

WATER QUALITY INDEX (WQI):

1. The following steps were taken to compute and formulate the Water Quality Index (WQI):

1) First, each of the 10 factors was assigned a weight (wi) between 1 and 4, based on expert insights from various previous studies. The least important weight was set at 1, while the most important was set at 4.

2) Next, the relative weight (Wi) is determined using this equation:

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

Where Wi represents the relative weight, wi is the assigned weight for each parameter, and n is the total number of parameters.

3) In the third step, a quality rating scale (Qi) is established for all parameters except Dissolved Oxygen (DO). This is done by dividing the concentration of each parameter in the water sample by its corresponding standard, and then multiplying the result by 100.

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

Where Qi is the quality rating, Ci is the mean value of the water quality parameter from laboratory analysis, and Si is the higher value of the parameter according to Indian Standards. This ensures that Qi equals 0 when a pollutant is completely absent from the water sample and Qi equals 100 when the parameter value meets its permissible limit. Therefore, a higher Qi indicates more pollution in the water.

4) Lastly, to calculate the WQI, sub-indices (SI) for each parameter were first computed, which were then used to derive the WQI through the following equations:

$$SIi = Wi \times Qi$$

$$WQI = \sum_{i=1}^{n} SI_i$$

4. The classification of water quality based on the WQI values is detailed in Table No: 1.0

Water Quality Indexlevel	Water quality status	Grade
<50	Excellent water quality	A
50-100	Good water quality	B
100-200	Poor water quality	C
200-300	Very poor water quality	D
>300	Unsuitable for drinking purpose	E

Table No:1

C. Figures

Fig No. 1 Map of Hunasagi

Sl No.	Village Name	Sl No.	Village Name
1	Hunasagi town	7	Sonapur
2	Marnal	8	Channur
3	Bassapur	9	Rampur
4	Kuppi	10	Siddapur

5	Ram nagar	11	Kodekal
6	Kamalpur	12	Yadiyapur

Table No: 2. Villages of Hunasagi Taluka

Fig No. 2: Map of Wadgera

Sl No.	Village Name	Sl No.	Village Name
1	Wadgera town	7	Bablad
2	Hanchinal	8	Anwar
3	Bilwad	9	Bammanhalli
4	Konhalli	10	Tumkur
5	Bilhar	11	Kodal
6	Birnal	12	Sangam

D. Tables And Result

Parameters → / Villages ↓	pH	TH in mg/L	Ca in mg/L	Mg in mg/L	Cl in mg/L	TDS in mg/L	F in mg/L	NO_3 in mg/L	T alk in mg/L	SO_4 in mg/L
Hunasagi town	7.27	664.61	589.40	102.84	777.05	1295.24	1.47	41.51	532.46	245.13
Marnal	7.33	690.75	630.82	65.59	603.84	1322.61	1.42	55.15	587.11	187.78
Bassapur	7.56	696.61	628.37	63.67	947.25	1438.01	1.55	49.23	572.80	219.61
Kuppi	7.23	724.67	654.13	86.96	941.17	1677.28	1.59	52.63	589.77	238.29
Ram nagar	7.52	685.93	625.80	71.40	747.70	1589.11	1.08	44.33	575.46	308.24
Kamalpur	7.31	682.12	627.93	84.07	516.58	1336.30	1.69	48.87	581.56	213.68
Sonapur	7.24	732.28	628.41	88.49	966.28	1484.07	1.35	51.03	565.12	268.68
Channur	7.27	745.89	666.44	78.64	966.56	1393.34	1.41	44.60	578.55	239.38
Rampur	7.27	707.66	621.49	78.59	892.33	1516.43	1.46	44.80	620.40	234.89
Siddapur	7.24	702.02	640.54	93.73	914.14	1477.52	1.23	45.88	567.88	264.77
Kodekal	7.38	738.13	627.24	90.79	932.44	1509.81	1.54	53.63	637.36	244.46
Yediyapur	7.34	720.16	642.01	67.92	741.87	1369.11	1.66	41.45	629.95	295.95
MEAN	7.33	707.57	631.88	81.06	828.93	1450.73	1.45	47.76	586.53	246.74
MAX	7.56	745.89	666.44	102.84	966.56	1677.28	1.69	55.15	637.36	308.24
MIN	7.23	664.61	589.40	63.67	516.58	1295.24	1.08	41.45	532.46	187.78
SD	0.11	24.97	18.78	12.24	151.21	114.38	0.17	4.67	29.78	33.83

Table No: 4 Physico-Chemical Characteristics of Groundwater of Hunasagi Taluka

Parameters → / Villages ↓	pH	TH in mg/L	Ca in mg/L	Mg in mg/L	Cl in mg/L	TDS in mg/L	F in mg/L	NO_3 in mg/L	T alk in mg/L	SO_4 in mg/L
Wadgea town	7.29	712.91	619.11	93.80	1100.71	1395.01	1.55	49.30	531.54	263.30
Hanchinal	7.34	737.10	651.42	85.68	655.36	1488.02	1.38	57.03	602.01	246.75
Bilwad	7.18	709.68	649.14	60.55	1229.97	1355.51	1.59	53.84	556.09	212.68

Konhalli	7.29	701.22	596.36	104.86	1207.90	1594.86	1.50	51.31	571.29	257.49
Bihar	7.21	696.97	631.76	65.21	823.60	1649.07	1.52	47.41	619.36	275.08
Birnal	7.46	707.49	625.23	82.26	870.57	1359.07	1.67	47.86	570.40	218.75
Bablad	7.47	735.34	633.68	101.66	1022.88	1506.73	1.20	51.44	568.35	253.94
Anwar	7.37	702.08	593.10	108.98	934.89	1581.45	1.00	49.18	597.30	220.92
Bammanhalli	7.46	762.48	671.44	91.04	776.92	1639.04	1.41	49.24	606.31	237.34
Tumkur	7.38	771.50	633.03	138.47	791.16	1335.38	1.31	49.31	541.55	279.74
Kodal	7.55	722.38	638.73	83.65	998.87	1311.40	1.31	54.49	624.34	257.07
Sangam	7.29	671.22	607.56	63.67	910.65	1499.89	1.62	40.40	585.13	259.04
MEAN	7.35	719.19	629.21	89.98	943.62	1476.28	1.42	50.07	581.14	248.51
MAX	7.55	771.50	671.44	138.47	1229.97	1649.07	1.67	57.03	624.34	279.74
MIN	7.18	671.22	593.10	60.55	655.36	1311.40	1.00	40.40	531.54	212.68
SD	0.11	28.41	22.91	22.11	176.04	122.50	0.19	4.20	29.70	21.85

Table No: 5 Physico-Chemical Characteristics of Groundwater of WadgeraTaluka

CONCLUSION

pH of water is alkaline, water is hard and chloride concentration is towards heigher ragnge. It requires certain treatmentAs per the water quality index water is good quality The quality of water is mainly controlled by the high loading parameters i.e TH, Ca.The fluoride concentration is more then permissible range at certain points and it requires treatment before consumption.

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