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Research Article

MEASUREMENT OF PHYSICO-CHEMICAL PARAMETERS IN GROUND WATER SAMPLES AROUND KABINI RIVER BASIN, KARNATAKA, INDIA

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ABSTRACT

Physico-chemical parameters have been measured in the year 2017-18 using chemical analysis methods in 36 ground water samples collected around Kabini river basin, Karnataka State, India. The physico-chemical parameters including sulphate, chloride, alkalinity, total dissolved solids, nitrate, pH, electrical conductivity, calcium hardness. The sulphate values are ranged from 0.05 to 1.28 g.L⁻¹. The concentration of chloride values varied from 35.5 to 482.8 ppm, The estimated values of alkalinity varied from 0.13 to 1.95 g.L⁻¹ total dissolved solids values varied from 0.11 to 1.44 g.L⁻¹. The nitrate values varied from 00 to 113.55mg.L⁻¹, pH value of drinking water samples is varied from 7.1 to 8.5, Electrical conductivity of drinking water is varied from 0.62 to 4.27 m Ω and calcium hardness is ranged from 144 to 948 mg.L⁻¹.

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INTRODUCTION

Water is one of the essential components of ecosystem. We cannot imagine the life in the Earth without water. It covers 71% of the Earth's surface, out of this 1.7% of water occurs as ground water [1]. Rivers, Lakes, dams and bore wells are the main sources of drinking water [2, 3]. These are continuously focused on the state of change with respect to the geological age and geochemical characteristics [4]. Water being used for many purpose such as drinking, domestic, irrigation, industrial, etc., [5]. Quality of water in an aquatic environment is resolute by many physical, chemical and biological factors. Nowadays water is polluted directly or indirectly by various activities. Disposal of wastes to water bodies, industrialization, population explosion, rapid growth of urbanization, over dose of pesticides in agricultural field etc., domestic sewage and solid waste dump causes the pollution of groundwater and created health problems [6-10]. These activities are so extensive such that the water has lost its self purification capacity to a large extent [11]. Thus it requires for concern over the protection of ground water quality. The present study reveals the estimation of physico-chemical parameters in ground water in the study area.

Study area

Kabini is a tributary of river Kaveri, Karnataka State, India. The total length of Kabini river is 240 km. It is originated in Wayanad of Kerala and flows East wards to join the Kaveri river at Tirumakudalu Narasipura in Karnataka. Kabini water is being used for both irrigation and domestic purposes [12, 13]. The types of soils found in this area are red soil, red loam soil, clay soil and, deep black soil. The weather of the study area is the temperature in January and February varies from 17 degree to 32 degree. The place experiences the inset of the monsoon in the month of July to September experiencing hot and humid climate. In an average annual rainfall of 804.2mm.

Experimental method

Preparation of samples

The physicochemical parameters of water such as chloride, fluoride, nitrate, sulphate, alkalinity, pH, electrical conductivity, total dissolved solids (TDS) measured in order to know about the impact of these physicochemical parameters and their health risks to the general public using chemical analysis method [14]. After pumping out the sufficient quantity of water from the source about 1 liter of water samples were collected in polythene containers for physicochemical analysis.

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0.5 liter of water samples used for the determination of physicochemical parameters such as pH, electrical conductivity, total dissolved solids, chlorides, total hardness, calcium hardness, nitrites, sulphates, fluorides. Using standard methods like ion selective electrode method is used to find fluoride. UV spectrophotometric method is used to find Nitrate. EDTA titrimetric method is used for Total hardness, Phenanthroline spectrophotometric method is used for the detection of total iron and water quality kit is used for monitoring pH, conductivity and total dissolved solids (TDS) in groundwater [15].

RESULTS AND DISCUSSION

Physico-chemical parameters include sulphate, alkalinity, chloride, nitrate, pH (potential of hydrogen), total dissolved solids (TDS), electrical conductivity, calcium hardness have been measured. The physico-chemical parameters in drinking water samples are mentioned in the Table 1 and the comparison of the estimated values with standard limits are mentioned in Table 2.

Sulphate

Concentration of sulphate in water collected in the study area was measured by gravimetric method using barium chloride (BaCl_2). The measured values are ranged from 0.05 to 1.28 g.L^{-1} with the geometrical mean value of 0.25 g.L^{-1} . World Health Organization recommended safe limit of sulphate in drinking water as 200 mg.L^{-1} [19]. Many sulphate compounds are readily soluble in water and sulphate ion is the major anion occurring in natural water. Higher concentration of sulphate in drinking water causes the health effects such as gastrointestinal irritation [2, 16, 17].

Chloride

Chloride concentration was measured by titrating a known volume of water sample with standardized silver nitrate solution using potassium chromate solution in water, where glycerol was used as an indicator. The concentration of chloride in drinking water around the study area varied from 35.5 to 482.8 ppm with geometrical mean value of 142.4 ppm. Water with high chloride content usually has an unpleasant taste, eye and nose irritation, besides stomach discomfort. It increases corrosive nature of water [18]. The present study shows about 16% of samples have higher concentration of chloride than the maximum permissible limit of 250 ppm as prescribed by World Health Organization [19].

Alkalinity

Alkalinity of drinking water was determined by dilute HCl titration in presence of phenolphthalein and methyl orange indicator. The estimated values of alkalinity in the study area varied from 0.13 to 1.95 g.L^{-1} with the geometrical mean value of 0.91 g.L^{-1} . Alkalinity helps the water to remain stable in pH. The drinking water of pH is 7 means that it is neutral. As per World Health Organization, amount of alkalinity in drinking water is 20–200 mg.L^{-1} [19]. Alkalinity to water is primarily due to carbonate, bicarbonate and hydroxide contents [20].

Total Dissolved Solids (TDS)

Total dissolved solids content was analysed by using precipitate method. TDS in the study area varied from 0.11 to

1.44 g.L^{-1} with geometrical mean value 0.46 g.L^{-1} . TDS indicates the nature of water quality for salinity. The desirable concentration of TDS in natural water is usually less than 500 mg.L^{-1} for drinking purpose. TDS value measured in the study area is within the maximum permissible limit recommended by Bureau of Indian standards is which is 2000 mg.L^{-1} [21].

Nitrate

Nitrate content in drinking water collected from the study area was measured using UV Visible Spectrophotometer and values are varying 0 to 113.55 mg.L^{-1} with the geometrical mean concentration of 1.43 mg.L^{-1} . Nitrate is the most highly oxidized form of nitrogen commonly present in natural waters. It is produced by aerobic decomposition of organic nitrogenous matter. The nitrate content of all water samples analysed in the study area are within the maximum permissible limit of 100 g.L^{-1} as recommended by Bureau of Indian standards excluding Hunuganahalli [21]. Higher concentration of nitrate present in drinking water leads to health effect on infants includes shortness of breath and blue-baby syndrome [16].

pH (Potential of Hydrogen)

pH value of drinking water samples is varied from 7.1 to 8.5 with geometrical mean value of 7.7 and are within the maximum permissible limit of 7.5 to 8.5 as recommended by World Health Organization [22]. Environmental Protection Agency [23] set a secondary maximum contaminant level for pH in drinking water as 6.5 to 8.5. The higher value of pH in drinking water leads to health effects like mucous membrane, bitter taste [24].

Electrical conductivity (m Ω)

Electrical conductivity (EC) in drinking water samples has been measured by using Electrometric method. Occurrence of electrical conductivity (EC) reflects the mineral salt content of water. The measured values of electrical conductivity present in drinking water are varied from 0.62 to 4.27 $\text{m}\Omega$ with a geometrical mean value of 1.73 $\text{m}\Omega$. The maximum permissible limit recommended by World Health Organization is 600 $\text{m}\Omega$ [19]. Bureau of Indian standards recommended that the acceptable level of Electrical conductivity should be 400 $\text{m}\Omega$ and maximum permissible limit is 1000 $\text{m}\Omega$ [21]. High conductivity increases corrosive nature of water [2, 16, 18].

Calcium hardness

Calcium hardness in water was measured by titration method with standard solution of EDTA (ethy lene diamine tetraacetic acid) using buffer solution and EBT (Eriochrome black T) indicator. In the present study, the calcium hardness is ranged from 144 to 948 mg.L^{-1} with the geometrical mean value of 388.7 mg.L^{-1} . As per the World Health Organization, permissible limit for calcium content in water is 100 mg.L^{-1} [19]. Bureau of Indian standards recommended acceptable limit of calcium is 300 mg.L^{-1} . In present study, about 19.4% of water samples showed higher concentration of calcium hardness than the maximum permissible limit of 600 mg.L^{-1} according to Bureau of Indian standards [21].

Table 1 Physico-chemical parameters around Kabini river basin, Karnataka, India

Sl.No	Location name	pH	Alkalinity (g.L-1)	TDS L-1	Sulphate (g.L-1)	Chloride (PPM)	Nitrate (PPM)	Electrical Conductivity (mo)	Calcium Hardness
1	N Beguru	7.4	0.6	1.40	0.45	213.0	0.01	1.41	332
2	Magge	7.2	0.6	1.44	0.31	255.6	00	1.54	296
3	Bidarahalli	7.8	0.6	0.51	0.08	142.1	1.79	1.07	360
4	Nerale	7.6	1.2	0.13	0.05	149.1	0.16	2.05	636
5	Sagare	8.0	1.2	0.32	0.12	85.2	1.94	1.28	288
6	Beechanahalli	8.1	0.7	0.67	0.07	49.7	0.10	0.72	224
7	Agatturu	8.3	0.8	0.17	0.08	56.8	2.29	0.64	176
8	Niluvagilu	8.2	0.6	0.33	0.09	35.5	1.59	0.62	144
9	Tumsoge	8.1	0.6	1.23	0.24	63.9	0.10	0.94	148
10	Jakkahalli	7.1	1.5	1.42	0.32	284.0	1.37	3.34	936
11	Hyrige	7.6	1.2	0.99	0.26	213.0	1.47	3.34	848
12	Saraguru	8.0	1.2	0.31	0.12	198.8	2.77	2.35	380
13	Itna	7.3	0.6	1.24	0.35	177.5	0.04	1.46	388
14	K Beltur	8.2	1.2	0.23	0.23	71.2	0.12	1.65	208
15	Chakkuru	7.9	0.9	0.32	0.17	177.5	1.59	1.67	536
16	Manuganahalli	7.8	1.5	0.53	0.32	234.3	1.54	3.00	364
17	Hunuganahalli	7.6	1.2	0.27	0.22	99.4	113.55	1.74	564
18	Kullya	7.8	1.3	0.57	0.23	85.2	1.43	1.60	164
19	Madapura	7.9	1.1	0.63	0.09	113.6	101.43	1.36	380
20	Maleyuru	7.3	1.9	1.13	0.52	447.3	0.23	4.2	536
21	Haradanahalli	7.5	0.1	0.24	0.17	56.8	0.34	2.45	508
22	Homaraganahalli	7.1	1.1	0.73	0.65	234.3	1.25	2.36	450
23	Gaddige	7.4	0.8	0.17	1.28	106.5	0.10	0.81	423
24	Kanchanahalli	8.3	1.2	0.13	0.21	255.6	0.12	2.50	640
25	Hullahalli	8.5	1.2	0.47	0.25	156.2	4.63	1.93	380
26	Kadakola	8.1	1.4	0.24	0.28	269.8	2.53	3.55	936
27	Thandavapura	7.4	1.2	0.33	0.24	95.3	0.36	1.23	265
28	Basavanapura	7.5	0.6	0.37	0.53	165.8	0.12	1.23	446
29	Nanjadevanapura	7.4	0.6	1.40	0.45	213.0	0.01	1.41	332
30	Nanjangudu	7.9	0.7	0.63	0.21	177.5	10.89	2.03	444
31	Hejige	8.1	0.8	0.57	0.22	163.3	3.54	1.67	308
32	Immavu	7.2	1.3	0.83	0.73	220.1	1.57	2.52	600
33	Bakkhalli	7.4	0.6	1.08	0.78	92.3	0.03	2.34	439
34	suthuru	7.2	1.9	0.11	0.43	482.8	6.89	4.27	948
35	Kappagala	7.9	1.2	0.13	0.26	156.2	4.50	2.39	340
36	T Narasipura	8.2	1.0	0.37	0.59	85.2	0	1.29	344
	Maximum	8.5	1.9	1.44	1.28	482.8	113.55	4.27	948
	Minimum	7.1	0.1	0.11	0.05	35.5	0	0.62	144
	Median	7.8	1.1	0.49	0.29	159.8	1.4	1.67	380
	Geomean	7.7	0.9	0.46	0.25	142.4	1.43	1.73	388.7

Table 2 Mean and standard limits of physicochemical parameters around Kabini River basin, Karnataka, India.

Sl.No.	Constituent	Observed range	Mean	Standard Limits (BIS-)		WHO Standard
				Acceptable limit	Maximum Permissible limit	
1	Chloride (PPM)	35.5-482.8	142.4	250	1000	200
2	Sulphate (g.L-1)	0.05-1.28	0.25	200	400	200
3	Nitrate (PPM)	00-113.55	1.43	45	100	45
4	TDS (TDS.L-1)	0.11-1.44	0.46	500	2000	500
5	Alkalinity (g.L-1)	0.13-1.95	0.91	-	-	0.02-21
6	pH	7.12-8.57	7.72	6.5-8.5	No relaxation	7.5-8.5
7	Electrical conductivity (mu)	0.62-4.27	1.73	400	1000	600
8	Calcium Hardness (g.L-1)	144-948	388.7	300	600	100

CONCLUSION

The present study shows that sulphate, Alkalinity, Total Dissolved Solids (TDS), pH (Potential of Hydrogen), Electrical conductivity all the parameters are within the safe limit as recommended by World Health Organization and Bureau of Indian standards. In 16% of samples of the study area have higher concentration of chloride than that of maximum permissible limit set by WHO.

The nitrate content of all water samples analysed in the study area is within the maximum permissible limit excluding Hunuganahalli and 19.4% of water samples showed higher concentration of calcium hardness than the maximum permissible limit according to Bureau of Indian standards (BIS, 1991) [21] standard. In this study area 80.6% of water is safer for drinking and the remaining 19.4% water is unfit for drinking due to physico-chemical parameters.

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