EVALUATION OF GROUNDWATER QUALITY FOR DRINKING PURPOSE IN RURAL AREAS OF YADGIR DISTRICT, KARNATAKA (INDIA)

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Abstract

The primary objective of the paper is to evalauate the groundwater quality in rural areas of Yadgir district of Karnataka state. In order to evaluate the quality of groundwater in study area, water samples were collected from twenty nine randomly selected bore wells in post monsoon season during 2012. The collected water samples were analyzed for various physico-chemical parameters as per the standard methods. The concentrations of various parameters recorded in the following range; pH 6.72-8.31, TDS 472.5-10521mg/L, alkalinity 68-1208 mg/L, total hardness 82-3442mg/L, calcium 8.01-561.36mg/l, magnesium 14.88-493.98mg/L, chloride 35.46-3155.67mg/L, sulphate 55.30-2054.40mg/L, nitrate 0.25-7.01 mg/L, phosphate 0.001-0.055mg/L, sodium 17.5-1851mg/L and potassium 0.45-468.8 mg/L. The concentration of physic-chemical parameters were compared with Bureau of Indian Standards for drinking and confirmed that only 50% of the samples were suitable for drinking purpose.

Key words: Groundwater quality, drinking, BIS standards, Shahapur

Introduction

Groundwater is a life sustaining resource that plays an important role in health of human beings. It is a major source for drinking and domestic purposes in both rural and urban areas. The quality of groundwater is equally important over quantity owing to the suitability of water for various purposes (Kumar et al. 2009). The suitability of groundwater for domestic is mainly depends on its groundwater geochemistry such as rock-water interaction, mineral dissolution, soil-water interaction, temperature and anthropogenic activities (Subba Rao et al. 2002).The water used for drinking purpose should be free from any toxic elements, living and nonliving organism and excessive amount of minerals that may be hazardous to health. Hence, water quality monitoring has become an integral part of the water supply

system since the launch of National drinking water mission and provision of safe drinking water to communities. Water quality analysis is the prerequisite for the identification of problematic sources that provides insight for selection of groundwater for human consumption and irrigation. The most of the rural villages of Yadgir district in Karnataka state(India) peoples depend on groundwater source for their domestic use and are facing water quality problem. Adults and children of this area are suffering from health problems due to consumption of contaminated water. Hence, the present the study on evaluation of groundwater quality of rural areas of Yadgir district was carried out to know the suitability of groundwater for drinking purpose

Materials and methods

Study area

The study was carried out in rural villages situated in south eastern part of Shahapur taluk of Yadagiri district of Karnataka state in India. The area lies between latitudes 16°30.04' N to 16°45.709 N and longitudes of 76°52.051 E to 77°12.175 E. The study area experiences a temperature ranging from 12°C to 42°C and average annual rainfall is about 640 mm. The relative humidity varies from 26% in summer to 62% in winter. Out of total population, 19% people lives in urban areas while 81% lives in the rural areas. The geology of the study area is majorly consists of grey/pink granites, gneiss and shale. The area is characterized mixed soil, black and red soil. The main sources of drinking water are bore wells, hand pumps, lakes and river. The depth of underground water level varies between 2.50-7.95 m during post-monsoon season.

Table 1 Sampling location in the study area

Sample ID	Location	Sample ID	Location
1	Hattigaduru	16	Ullesuguru
2	Sahura	17	Gurasunigi
3	Kollur	18	Naikal
4	Markal	19	Karanagai
5	Hayyala B	20	Chatnalli
6	Aikuru	21	Khanapura
7	Anakasuguru	22	Gundalli
8	Konkal	23	Kurakunda
9	Tumakuru	24	Hanchinal
10	Habsihal	25	Hayyala K
11	Shivanura	26	Vadigere T

12	Bilhara	27	Tadibidi
13	Machanur	28	Doranahalli
14	Vadigera H	29	Bevinahalli
15	Halagera		

Groundwater sampling and analysis

A total of 29 samples were collected from bore wells in post-monsoon season during November 2012(Table 1). Groundwater samples were collected in high-density polyethylene (HDPE) bottles and transported to laboratory and analyzed various physicochemical parameters as per the standard methods (APHA, 1998 and BIS, 1991). Further, Groundwater quality index (GWQI) has been calculated using standard methods (Ramakrishnaiah et al. 2009, Sundara Kumar et. al. 2010 and Basavaraja et al., (2018)

Results and discussion

The analytical result of physico-chemical parameters of the groundwater from the study area is presented in Table 2. In the present investigation, pH value ranged between 6.72 and 8.31. All the samples pH value falls within the desirable level. Total dissolved solids varied between 472.5 and 10521 mg/L with an average of 2454.39 mg/L. In the present study 3.49% of the samples below desirable level, 96.54% of the samples found above desirable level (Table 3). Alkalinity values in the range of 68 to 1208 mg/L. According to BIS standards, 6.89% of the samples below desirable level and 93.09% of the samples exceeded the desirable level.

Total Hardness exhibited in the range of 82-3442 mg/L with an average value of 806.28mg/L. According to drinking water standards, 31.03% of the samples found within the desirable, 68.96% of the samples found above desirable level. Sawyer and McCarty (1967) classified groundwater based on total hardness as soft, moderate, hard, and very hard category. According to this classification, 3.44% of the samples belong to medium hardness, 27.58% belongs to hard category and 68.96% of the samples belong to very hard category (Table 3). Calcium concentration varies with 8.01 to 561.36 mg/L. As per BIS standards, 48.27% of the samples were fall in desirable range and 21.71% of the samples found beyond desirable range. The magnesium content was in the range of 14.88-493.98mg/L. It is observed

that 20.68% of the samples found to be within desirable range and 79.3% of the samples exceeded the desirable range.

The concentration of chloride in groundwater of the study area ranges from 35.46 to 3155.67mg/L with an average value of 597mg/L. As per the drinking standards, 68.96% of the samples found below desirable range and 31.03% of the samples found the above desirable range. The presence of sulphate in drinking-water can cause a noticeable taste, and laxative effect in consumers (WHO, 2008). Its values fluctuated from 55.30 to 2054.4mg/L. It is observed that 37.93% of the samples within the desirable and 62.06% of the samples above permissible level.

Nitrate content present in the range of 0.25 - 7.01mg/L and found within the desirable level. High nitrate in drinking water is considered as hazardous for infants causing methemoglobinaemia syndrome (Sajal and Athar,2016) disease. Phosphate level is present in very low concentration and its level in between 0.001 and 0.055mg/L. The concentration of sodium ranged from 17.5 to 1851mg/L. According to WHO (2011), the suggested limit for sodium in drinking water is 200 mg/L. Generally, the concentration of potassium is less than 10 mg/L in the drinking water. The concentration of potassium varied from 0.45 to 468.8mg/L. Groundwater quality index(GWQI) is a mathematical framework used to convert large water quality data into a single number which represent the overall water quality level and categorize into excellent, good, poor, very poor, and unsuitable(Mohamad, 2019). Table 3 shows that, 48.27% of the samples belong to good, 20.68% and 3.44% belongs to poor and very poor and 27.58% belong to unsuitable for drinking category.

Conclusion

The chemical composition of groundwater of the study area is strongly influenced by the composition of rocks, weathering and leaching action .The most of the physicochemical parameters concentration was exceeded desirable level of BIS drinking water standards. The degree of hardness confirmed that 68.96% of the samples belong to very hard category. And also the groundwater quality index calculated for post monsoon season exhibit poor quality in greater percentage. Hence, the results reveals that some precautionary measures are required before using groundwater for drinking purpose in the study area in order to prevent the adverse health effects on human beings.

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Table 2. Physico-chemical parameters of ground water in rural areas of Yadgir district

Parameter	Range	Average	Stdev	Bureau of Indian Standards(BIS)	
				Desirable	Permissible
pH	6.72-8.31	7.28	0.38	6.5-9.2	-
TDS	472.5-10521	2454.39	2836.58	500	1000
Alkalinity	68-1208	523.52	238.18	200	600
Hardness	82-3442	806.28	828.53	300	600
Calcium	8.01-561.36	155.85	165.99	75	200
Magnesium	14.88-493.98	97.01	108.39	30	100
Chloride	35.46-3155.67	597.00	8.7.48	250	1000
Sulphate	55.30-2054.40	480.94	488.35	200	400
Nitrate	0.25-7.01	2.80	2.35	45	45
Phosphate	0.001-0.055	0.005	0.010	-	-
Sodium	17.5-1851	321.38	384.57	-	-
Potassium	0.45-468.8	73.97	130.43	-	-

Note: All parameters are expressed in terms mg/L except pH

Table 3. Classification of groundwater for drinking purpose based on indices

Parameter	Category	Water Classification	Number of samples	% of samples
TDS (mg/L)	<500	Desirable for drinking	01	3.44
	500-1000	Permissible for drinking	15	51.72
	1000-3000	Useful for irrigation	06	20.68
	>3000	Unfit fro drinking and irrigation	07	24.13
Degree of Hardness (mg/L)	0-75	Soft	-	-
	75-150	Medium	01	3.44
	150-300	Hard	08	27.58
	>300	Very Hard	20	68.96
GWQI	<25	Excellent water	-	-
	26-50	Good water	14	48.27
	51-7 5	Poor water	06	20.68
	76-100	Very poor water	01	3.44
	>100	Water unsuitable for drinking	08	27.58

