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Study of Physicochemical Parameters of Groundwater Quality of Kopargaon Area, Maharastra State, India during Pre-monsoon and Post-monsoon Seasons

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Abstract: The physicochemical parameters were studied for water samples collected from different locations in Kopargaon area; It is one of the important taluka of Ahmednagar district, Maharastra state, India. The main purpose of the study was to ascertain the quality of water for drinking from selected locations. Assessment of water quality was done by comparing the parameters with standard values prescribed by different agencies. Most of the parameters were found within permissible limits of above standards. Correlation co-efficient 'r' was calculated for these parameters.

Keywords: Kopargaon, Physicochemical parameters, Pre-monsoon, Post-monsoon, Correlation coefficient

Introduction

Groundwater is the major source of drinking water in both urban and rural areas. The importance of groundwater for the existence of human society cannot be overemphasized[1]. The modern civilization, industrialization, urbanization and increase in population have laid to the fast degradation of our groundwater quality[2]. Groundwater is about 20% of the world resource of fresh water and widely used for various purposes. Only about 1% of all of fresh water is available from rivers, ponds, lakes *etc*[3]. The quality of water depends upon various chemical constituents and their concentration generated by fertilizers, industrial waste, garbage or domestic waste.

The groundwater analysis for physical and chemical properties is very important for public health studies. These studies are also main part of pollution studies in the environment[4].

Literature survey shows that there has been no published report in ground water quality studies in rural parts of Kopargaon. This has created the focus to select the present work over five sampling stations in and around kopargaon city. Kopargaon is a taluka place in Ahmednagar district and is well developed in industrial, educational and agricultural fields. Its location is longitude 74028'60E and latitude 19052'60N. The climate of this area is hot and humid and the average rainfall[5] is about 58.7 cm. The range of temperature is between 39 ^{0}C and 11.7 ^{0}C.

Experimental

Water samples from the selected sites were collected from April-2009 to March-2010. Samples were taken in 2 liter capacity pre-cleaned polythene bottles[6-7]. Collection and analysis of samples was done monthly for the measurement of temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, total hardness (TH), chloride contents, total alkalinity and salinity. Data analysis was further done for pre-monsoon and post-monsoon seasons. Out of five samples one was municipal sample (from Kopargaon town), one was tap drinking water (from College of Engineering, Sahajanandnagar) and remaining three were dug well samples (from Ravande, Kolpewadi and Kanhegaon). All samples were properly labeled as S_1, S_2, S_3, S_4 and S_5 and record was prepared as indicated in Table 1.

Table 1. Area, Source and distance from central place

Sampling Station No.	Area	Source	Approximate distance(km) (From first station as a central place)
S_1	Sahajanandnagar	Tap	00
S_2	Kopargaon Town	Municipality Supply	03
S_3	Ravande	Dug Well	15
S_4	Kolpewadi	Dug Well	18
S_5	Kanhegaon	Dug Well	22

A multi-parameter water testing kit "PCS Tester 35" (Eutech make) was used for the measurement of temperature, pH, EC, TDS and salinity. A Labtronics make nephelometer (Model No. 34) having range 0-200 NTU was used for the measurement of turbidity. TH was measured by EDTA (Ethylenediaminetetraacetic acid) method[8] in which EBT (Erichrome black-T) is used as an indicator. Chloride contents were measured by a titrative Mohr's method. Total alkalinity was also measured by a titration method using methyl orange and phenolphthalein as indicator. All the chemicals used for the analysis were of AR grade. To find out the correlation between any two measured parameters a correlation analysis has been carried out with the help of correlation co-efficient 'r'.

Results and Discussion

The standard values of different water quality physicochemical parameters[9-10] and units employed are listed in Table 2. In present study the physicochemical parameters were studied for five different water samples and were divided into pre-monsoon and post-monsoon groups as listed in Table 3.

Temperature

Cool water is generally more potable than warm water. High water temperature enhances the growth of microorganisms and may increase taste, odour, color and corrosion problems (WHO). The temperature was found to be in the range between 25.5 and 31.4 ^{0}C. The higher values of temperature are noticed especially for pre-monsoon measurements.

Table 2. The physicochemical parameters of various samples for pre-monsoon and post-monsoon seasons (parenthesis indicates units / desirable limits)

Parameter		Temperature, ^{0}C	pH (6.5-8.5)	EC (7.1×10^2 µS)
Pre-monsoon	S_1	26.9	8.73	1069
	S_2	26.7	8.73	1047
	S_3	31.4	7.84	1400
	S_4	30	8.45	503
	S_5	28	8.62	917
Post-monsoon	S_1	25.5	8.88	1081
	S_2	26	8.2	410
	S_3	26.2	8.17	808
	S_4	26	8.72	545
	S_5	26.3	8.81	1096

Parameter		TDS, 500 mg/L	Turbidity (5 NTU)	TH, 300 mg/L
Pre-monsoon	S_1	756	1.8	357
	S_2	743	1.6	314
	S_3	993	1.8	1215
	S_4	356	0.2	329
	S_5	837	1.6	375
Post-monsoon	S_1	767	6.6	629
	S_2	292	0.2	257
	S_3	572	7.2	671
	S_4	385	8.5	486
	S_5	778	7.7	557

Parameter		Chloride content, 250 mg/L	Tot. Alkalinity 200 mg/L	Salinity mg/L
Pre-monsoon	S_1	249	230	527
	S_2	606	130	514
	S_3	1355	100	700
	S_4	444	80	254
	S_5	326	76	348
Post-monsoon	S_1	182	120	535
	S_2	151	60	199
	S_3	151	80	396
	S_4	93	90	263
	S_5	245	90	544

pH

The pH serves as an index to denote the extent of pollution by acidic or basic waste. The pH values were found between 7.84 and 8.88. The pH shows slightly alkaline nature of all samples.

Table 3. Correlation matrix for water quality parameters (Pre-monsoon)

Parameter	Temperature	pH	EC	TDS	Turbidity	TH	Chloride	Alkalinity	Salinity
Temperature	1.00	-0.9268	0.10108	0.04152	-0.3142	0.7638	0.7279	-0.5633	0.1659
pH		1.00	-0.4641	-0.3773	-0.04156	-0.9485	-0.9096	0.4015	-0.346
EC			1.00	0.9353*	0.8835	0.7191	0.6552	0.2895	0.9609*
TDS				1.00	0.9225*	0.6315	0.5223	0.1319	0.8013*
Turbidity					1.00	0.351	0.2444	0.4487	0.7639
TH						1.00	0.9354*	-0.2003	0.7422
Chloride							1.00	-0.3125	0.7177
Alkalinity								1.00	0.3679
Salinity									1.00

**Highly significant correlation between EC & TDS, EC & Salinity, TDS & Turbidity, TDS & Salinity, TH & Chloride*

Table 4. Correlation matrix for various water quality parameters (Post-monsoon)

Parameter	Temperature	pH	EC	TDS	Turbidity	TH	Chloride	Alkalinity	Salinity
Temperature	1.00	-0.3848	-0.1313	-0.1661	0.1093	-0.0656	0.186	-0.636	-0.1305
pH		1.00	0.6117	0.6113	0.575	0.3323	0.3207	0.8143	0.6107
EC			1.00	.9999*	0.5586	0.763	0.7605	0.7426	0.9999*
TDS				1.00	0.5545	0.7599	0.7634	0.7412	0.9999*
Turbidity					1.00	0.8036	0.0415	0.6231	0.5505
TH						1.00	0.2444	0.6823	0.7562
Chloride							1.00	0.2215	0.7672
Alkalinity								1.00	0.7387
Salinity									1.00

**Highly significant correlation between EC & TDS, EC & Salinity, TDS & Salinity*

EC

Electrical conductivity is a measure of water's capacity to convey an electric current. This property is related to the total concentration of ionized substances in water. The more dissolved salts in water, the stronger is current flow and higher the EC. In short, EC of water increases with salts. In present study EC values were found within the range of 503 µSiemens to 1400 µSiemens and 292 µSiemens to 1096 µSiemens for pre-monsoon and post-monsoon seasons respectively.

TDS

TDS indicates the salinity behavior of groundwater[11]. TDS of ground water is mainly due to vegetable decay, evaporation, disposal of effluent and chemical weathering of rocks. In the present investigation the TDS was found up to 993 mg/L and 778 mg/L for pre- and post-monsoon season respectively.

Turbidity

Turbidity in water is the reduction of transparency due to the presence of particulate matter such as clay or slit, finely divided organic matter *etc*. These can cause light to be scattered or absorbed rather than transmitted in straight lines through the sample. In present study turbidity was found between 0.2 and 1.8 NTU for pre-monsoon and 0.2 to 8.5 NTU for post-monsoon measurements. Turbidity of S1, S3, S4 and S5 was found with high values than that prescribed by IS:10500.

TH

Hardness of water is the capacity of water to react with soap, hard water requiring considerably more soap to produce lather. Hardness is one of the important properties of groundwater from utility point of view for different purposes[12]. For potable water the TH should be limited up to 300 mg/L and maximum permissible value is 600 mg/L (Table 2). The TH values were found within permissible range except for S3.

Chloride contents

The maximum permissible value of chloride content is 1000 mg/L (Table 2). Except S3, all samples were found to be having concentration of chloride within limit.

Total alkalinity

The desirable limit of alkalinity is 200 mg/L and maximum permissible limit is 600 mg/L (Table 2). The alkalinity values were found within permissible range for all samples.

Salinity

The salt content of water is termed as salinity. TDS and EC are proportional to salinity. In present investigation, salinity was found between 254 and 700 mg/L.

Statistical analysis

Interrelationship studies between different values are very helpful tools in promoting research and opening new frontiers of knowledge. The study of correlation reduces the range of uncertainty associated with decision making[1,11]. The correlation co-efficient 'r' was calculated using the equation

$$r = \frac{\sum xy}{\sqrt{\sum_x 2x \sum_y 2}}$$

Where x =X- $\bar{X}$ and y =Y-$\bar{Y}$, X and Y represent two different parameters $\bar{X}$ = Mean value of X; $\bar{Y}$ = Mean value of Y. The values of correlation co-efficient 'r' for different parameters for pre-monsoon and post-monsoon seasons are as shown in Table 3 and Table 4 respectively.

Conclusion

Water quality parameters were found deviating for different samples. All water samples were found with alkaline trend and with slightly higher values of TDS than desirable value. The water sample S3 was found unfit for drinking due to high values of EC (WHO standards[11]), TH and chloride contents. It is recommended that the water of S3 should be used after proper treatment.

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