19.
Major Ion Chemistry and Quality assessments of Groundwater and Surface Water in and around region of Lonavala during pre and post monsoon season, Pune District, Maharashtra State, India

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Abstract :

Groundwater is found to be globally essential for the support of habitat, human consumption as well as for the maintaining the quality of base flow to rivers, while its quality measurement is very important to ensure sustainable safe use of the resources for agricultural, drinking and industrial purposes. In this paper , Five (05) groundwater samples collected in and around Lonavala region from tanks and bore well to assess water quality and examine hydro chemical nature by analyzing the major cations (K^+, Na^+, Ca^{2+}, Mg^{2+})and anions (HCO^-_3, Cl^-, CO_2^{-3}) besides some physico- chemical parameters (pH, electrical conductivity, TDS and total hardness). The pH ranges from 7.1-7.8 indicating water is slightly acidic to alkaline in nature. TDS ranges from 204 to 1350 and 120 to 320 during pre and post monsoon season. Total Hardness (TH) ranges from 130-450 mg/l and 120-320 mg/l; Chloride ranges from 90-1665 mg/l and 70-1087 mg/l during pre and post season respectively. Bore well sample water (BW1 and BW2) have high concentration of chloride ion in pre and post monsoon season. So these sample may corrode pipes , affect taste and palatability of water .Due to low to medium hardness ,most of the samples are suitable for domestic, drinking and irrigation purposes.

Keywords : Groundwater ; Hydro geochemistry ; Pre and post monsoon region in Lonavala ; TDS ; Total Hardness ; Electrical conductivity ; pH;

Introduction :

Globally , Groundwater is mainly used for the purposes of drinking, domestic, irrigation and industrial requirements .One-third of the world population dependent on groundwater for drinking (1). In India , 30% of urban and 90% of rural population depend on groundwater for domestic and drinking purposes (2). Water scarcity arise in most of the world, especially in fast growing cities and are often located in unfavorable places due to global population growth and drastic change in climate(3). Therefore, at present, water scarcity is broadly recognized as major challenges in India.

Quality of Groundwater is of major concern due to rapid increase in population, industrialization, urbanization ,excessive use of pesticides and fertilizers in agriculture. (4-6)

Geochemistry is useful study for understanding of the suitability of groundwater quality for drinking and irrigation (7-9). Stream and tank water are selected as surface water. The water supplies to these tanks and streams are mainly dependant on rainfall. Literature shows that a good deal of work is carried out on groundwater and surface water quality with in India and around the world with reference to major ion chemistry, trace element chemistry and through multivariate statistical techniques (10-24).

The purpose of this study is to assess the groundwater and surface water quality from parts of Lonavala of Pune district, Maharashtra State for safe drinking and irrigation purposes. A better understanding of water chemistry in the study area is important for evaluating the contamination process more accurately..

Study area :

Lonavala is the most famous hill station in Pune district situated about 64 km to west of Pune City. Generally Lonavala is hot in summer and cool in winter. The temperature gradually rises from the month of February and reaches a maximum in the month of May. It gradually decreases from June to January . May is the hottest month with a temperature range from 30°C to 37°C, and it varies from 6 to 8°C during winter. Rainfall occurs between June and October . The normal annual rainfall of the district is 1733 mm. The monsoon contributes about 85% of the annual rainfall. The highest precipitation occurs during monsoon.

Materials and Methods :

Collection of sample methods plays a crucial role in maintaining exact accuracy of analytical data and its application to hydro chemical studies. Five (05) groundwater and surface water samples were collected in pre-cleaned 1L polyethylene bottles from bore wells and tanks in and around Lonavala region . Then, the bottles were sealed, labeled , stored properly (at 2-4°C) and brought to laboratory for further analysis . Samples were analyzed using standard procedures (25). The location of these samples is shown in table 1. Pre and post-monsoon samples were studied for various physico-chemical parameters which include pH, TDS(total dissolved solids) , TH (total hardness) ,Electrical conductivity (EC) cations such as K^+ , Na^+, Ca^{2+}, Mg^{2+} and anions $HCO^{"3}$, $Cl^"$ and $CO_2{}^{3-}$ .Titrimetric analysis is used for the detection of cations like Calcium (Ca^{2+}) , magnesium (Mg^{2+}) and the anions like chloride (Cl^-), bicarbonate (HCO_3^-), and carbonate(CO_3^{2-}) . Flame photometry (CL 378) is used for the detection of Sodium (Na) and potassium (K) . TDS portable electrode (Model TDS Testr11+) is used for the measurement of total dissolved solids (TDS) . The pH and electrical conductivity (EC) measured in the field itself by using portable digital meter (Multi-Parameter PCS Tester 35).The analytical data of groundwater and surface water samples are presented in Table

1. **Results and Discussion :**

1) Hydrogen ion concentration (pH):

The pH of the water samples in the study area varies from 7.2-7.8 and 7.1-7.8 with a mean values of 7.44 and 7.4 during pre and post-monsoon seasons respectively (Table 1). The pH is slightly acidic to alkaline in nature. The range of pH in drinking water as per WHO standard is 6.5 - 8.5 (26).

2) Total Dissolved Solids (TDS):

The suitability of groundwater for domestic and irrigation purposes depends upon hydro chemical properties that are categorized with respect to TDS (27).The majority of samples are found suitable for drinking and irrigation . The groundwater of pre-monsoon has high TDS values (from 204 to 1350 versus 183 to 420 mg/l) than in post-monsoon. The average TDS of pre-monsoon samples is 473.6 mg/l, while it is 255.6 mg/l for post-monsoon samples (Table 1).

3) Total hardness (TH) :

Analytical result confirms that all the groundwater samples are within permissible limit. The total hardness as $CaCO_3$ in the present study ranges from 130 to 450 mg/l with an average 206.4 mg/l during the pre-monsoon and from 120 to 320 mg/l with an average of 177.4 mg/l in the post-monsoon period (Table 1).

4) Electrical conductivity (EC) :

The electrical conductivity (EC) of groundwater samples in the study area shows a wide range, i.e., from 343 to 2450 uS/cm with an average 4033 uS/cm during the pre-monsoon and from 246 to 720 mg/l with an average of 381 mg/l in the post-monsoon period (Table 1) .

5)Magnesium (Mg^{2+}) :

The concentration of Mg^{2+} in groundwater ranges from 80.5 to 128 mg/l with an average of 101.7 mg/l during the pre-monsoon and from 90.5 to 134 mg/l with an average of 112.9 mg/l in the post-monsoon period. All the analyzed water samples are suitable for drinking purposes, since the values of Mg2+ are

within the permissible limits (<150 mg/l) as per the standards (28)

6) Calcium (Ca^{2+}):

All the groundwater samples have lower Ca^{2+} than permissible limits of >200 mg/l as per standards (28). The average amount of calcium present in water samples of the pre-monsoon season is 94.8 mg/l and in post-monsoon season, 108.8 mg/l.

7) Chloride (Cl^-):

The chloride content in the groundwater during the pre-monsoon season varies from 90 to 1665 mg/l with a mean of 743.4 mg/l and in the post-monsoon season from 70 to 1087 mg/l with a mean of 507.8 mg/l. All the water samples values are within permissible limit (200 -600 mg/L) set by the WHO standard (28) but sample BW1 and BW2 sample have high concentration of chloride in pre and post monsoon season, may be it is close to industrial area. High concentration of chloride ion sample may affect palatability of water, gives salty taste to water and corrode pipes .

Table 1: Physicochemical parameters of groundwater samples from both pre and post-monsoon.

Sr.No.	Sample Name	Name of the village	Pre Monsoon				Post Monsoon			
			pH	EC uS/cm	TDS mg/l	TH mg/l	pH	EC uS/cm	TDS mg/l	TH mg/l
1	SW 1	Kamshet	***7.3***	***2450***	***1350***	***450***	***7.2***	***246***	***420***	***320***
2	SW 2	Malvali	***7.5***	***398***	***256***	***130***	***7.5***	***285***	***183***	***120***
3	BW1	Tungi	***7.4***	***316***	***204***	***132***	***7.4***	***332***	***214***	***154***
4	BW2	Tungarli	***7.8***	***526***	***336***	***172***	***7.8***	***720***	***250***	***163***
5	SW3	Pangoli	***7.2***	***343***	***222***	***148***	***7.1***	***322***	***208***	***130***

NOTE: SW=Surface Water ; BW=Bore Well

Sr. No.	Sample Name	Name of the village	Monsoon	Cations				Anions		
				K^+ mg/l	Na^+ mg/l	Ca^{2+} mg/l	Mg^{2+} mg/l	HCO^{-3} mg/l	Cl^- mg/l	CO_2^{3-} mg/l
1	SW 1	Kamshet	Pre	**10**	**150**	**97**	**95**	**130**	**160**	**08**
			Post	**12**	**165**	**110**	**105**	**150**	**150**	**10**
2	SW 2	Malvali	Pre	**12**	**140**	**90**	**80.5**	**145**	**170**	**07**
			Post	**15**	**164**	**105**	**90.5**	**165**	**165**	**11**
3	BW1	Tungi	Pre	**14**	**184**	**105**	**120**	**170**	**1665**	**15**
			Post	**16**	**204**	**110**	**130**	**195**	**1087**	**20**
4	BW2	Tungarli	Pre	**15**	**194**	**98**	**128**	**165**	**1632**	**16**
			Post	**22**	**215**	**115**	**134**	**185**	**1067**	**18**
5	SW3	Pangoli	Pre	**12**	**155**	**84**	**85**	**142**	**90**	**12**
			Post	**14**	**175**	**104**	**105**	**152**	**70**	**14**

Table 2 : Comparison of groundwater quality data with WHO (World Health Organization) (28)

Sr. No	Parameters	WHO standards(28)		
		Desirable permissible limit	Number of samples falling above desirable limit	Undesirable effects
1	pH	6.5–8.5	0	Taste, affects mucous membrane
2	TDS	500–1500	1	Gastrointestinal irritation
3	TH	100–500	1	Scale formation, encrustation in water supply, urolithiasis and adverse effects on domestic use
4	Ca	75–200	0	Scale formation
5	EC	1500	1	
6	Na	200–600	0	Vomiting, elimination of salts from body, convolutions, etc.
7	Cl	200-600	0	Salty taste, corrode pipes
8	K	30	0	Bitter in taste
9	Mg	50-150	0	Encrustation in water supply encephalitis and adverse effects on domestic use

Conclusion :

Pre and post monsoon groundwater samples were collected in and around Lonavala region and studied their various physico-chemical parameters. The results of above samples clearly indicate that groundwater quality is good and all the samples are within permissible limits of the World Health Organization. The pH above tested samples is in between 7 to 8 reveals that the water is slightly acidic to alkaline in nature and are useful for drinking purposes. The EC result of tested samples are within permissible limits and are fit for irrigation as well as for drinking purpose. However, TDS result of the pre and post monsoon sample indicate that most of the samples are useful for drinking as well as irrigation purpose because their TDS values are less 500 mg/L .Only SW1 pre monsoon sample is unfit for drinking but useful for irrigation because of its 1000–3000 TDS range. Total hardness (TH) of the groundwater results indicates

that majority of samples fall in hard water class (150–300 mg/L) and they are suitable for domestic purposes due to low to medium hardness; however SW1 samples in the pre and post-monsoon contain >300 mg/l TH due to presence of alkaline earth elements in sample. The major cations (Ca2+, Mg2+) and anions (Cl^-) from the groundwater samples shown considerable variation from the pre to post-monsoon periods and their values falls within permissible limits. High concentration of chloride ion sample BW1 and BW2 may affect palatability of water, gives salty taste to water and corrode pipes.

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