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Research Paper

Studies on Changes in Ground Water Quality Status in Pre-Monsoon and Post-Monsoon Season in Shivpuri District of Madhya Pradesh, India

Chemistry

KEYWORDS : Pre and post monsoon variation, physico-chemical properties

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ABSTRACT

The ground water is the chief source of fresh water in this small city of Madhya Pradesh. To assess the physico-chemical properties of underground water in pre and post monsoon underground water samples were collected in the months of May 2011 & November 2011. The physico-chemical properties such as pH, total dissolved solid, electrical conductivity, acidity, alkalinity; chloride, iron, total hardness, calcium and magnesium hardness, and fluoride concentration were studied and analyzed. The results obtained were compared with permissible limits of the drinking water set by Bureau of Indian Standards (BIS). Water quality in post monsoon is better than the pre monsoon season. The physico-chemical characteristics of different water samples showed that pH, EC, alkalinity and iron content were higher in post-monsoon. Results indicate that fluoride content was very low in the samples of Shivpuri town and around and all the water samples were suitable for drinking purpose.

Introduction:

In India, primary sources of drinking water are surface and ground water. About 25% of earth's water is fresh and suitable for human consumption. Approximately 13% of this fraction is ground water used as important source of drinking (Bachmat 1994). Majority of people in India depends upon fresh water supplies from dug wells, ponds, bore wells, springs and the like. In recent years, considerable attention has been focused on the study of ground water to ensure safe drinking water for human consumption. Ground water is renewable natural resource, which is replenished annually by the precipitation. Better water quality was found in Post-monsoon season than Pre-monsoon season (Jinwal and Dixit, 2008).Therefore changes in the physico-chemical properties of ground water were noticed in most of the cases. It is well known that occurrence of ground water and its availability is controlled by the nature of rock formation in which it occurs as well as geological structure etc. The composition of ground water in a region can be changed through the operation of the processes such as evaporation and transpiration, dissociation of minerals, oxidation, reduction and cationic exchange etc.

In recent past, after reports of presence of fluoride in ground water in some places of Shivpuri districts of Madhya Pradesh (Mishra et.al.2011 and GOI survey report 2009) this study was conducted. Fluorine is a naturally occurring element in minerals, geochemical deposits and natural water systems and enters into food chains through drinking water. The area selected for this study was ground water of Shivpuri town and around. It is located at 25.43'N and 77.65'E. The average rainfall of Shivpuri district is about 875 mm most of which is concentrated in monsoon from late June to early October. In the present study the quality of drinking water was assessed in terms of physico chemical parameters in the month of May 2011 and November 2011 from the same source of water.

Material and methods:

The present investigation deals with the quantitative analysis of variations in parameters of groundwater due to monsoon. Thus ground water samples were collected in the month of May 2011 and November 2011 from 14 underground bore wells and hand pumps at various locations of Shivpuri town which is a famous tourist destination of Madhya Pradesh. The location was chosen as study area because recently presence of Fluoride is reported in some of the towns of the district. The samples were collected in sterilized bottles and were stored at 4^0C till further investigations. The physico-chemical parameter such as color, pH, salinity, electrical conductivity, alkalinity, acidity, TDS, total hardness, Ca & Mg hardness, chloride, total iron were analyzed according to standard methods of APHA (2000) and Trivedi and Goel (1986). The results obtained were compared with drinking water quality standards set by the Bureau of Indian Standards (BIS). On the basis of classification, the nature of ground water has been categorized as desirable, permissible and unfit for human consumption.

Results and Discussion:

The values of pre monsoon and post monsoon ground water quality assessment of different samples are given in Table 1 and Table 2 respectively. It was observed that color of all the samples was transparent except the sample collected from Pariksha in Shivpuri was light brown in color.

pH measures the activity of hydrogen ions (H^+) in the water. Slightly acidic water have pH value between 6.5 to7 while slightly alkaline water have pH between7.1-8.4.Results show that pH of all the samples under study varied from 6.96 to 8.04 in post-monsoon (Table 1) and 6.98 to 7.93 in pre monsoon samples(Table 2). Water from Pariksha and Tharra is slightly acidic in nature with pH value 6.96. The pH values of all the water samples are within acceptable limits (pH 8.0) except water form Mansapuran is slightly basic with (8.04pH) (Figure1) hence all the samples are permissible for drinking on the basis of pH.

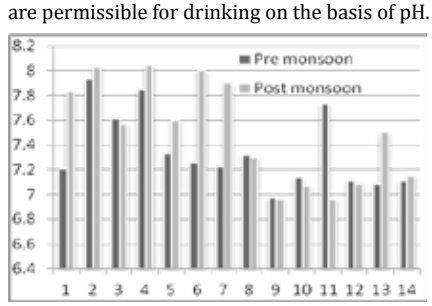

Figure 1: pH of water samples

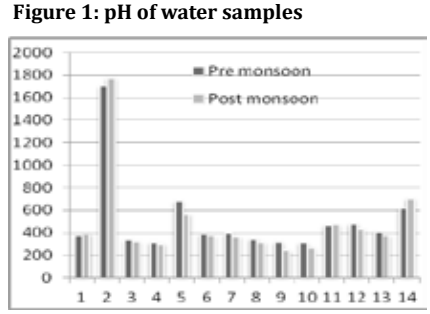

Figure 2: TDS in water samples.

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Total dissolved solid (TDS) consists of inorganic and organic substances. Inorganic substances which include clay, silt, minerals, metals, etc. mainly in the form of carbonates, bicarbonates, chlorides, sulphates, phosphates, nitrates, calcium, magnesium and sodium can create taste, odor, hardness, corrosion & scaling problem. It was observed that TDS values were high in all the samples in pre monsoon samples. TDS of the different water samples ranged from 246 to 1769 mg/l in post-monsoon and 312 to1771mg/l in pre monsoon water samples. One sample i.e. sample No.2 showed high percentage of total dissolved solids, but it is in the permissible limit.

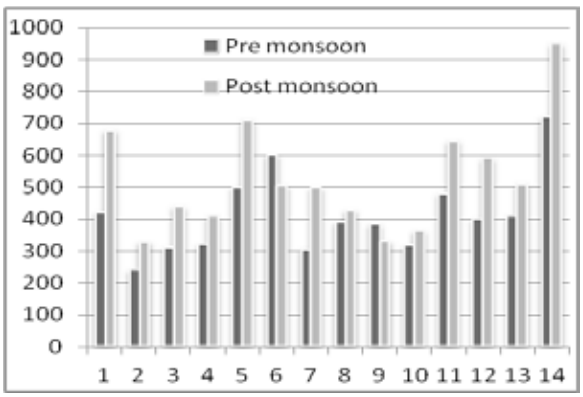

Figure 7: Electrical Conductivity µs/cm

Electrical conductivity is directly linked to the concentration of the ionic impurities in the water. Conductivity measurements are influenced by pH levels and the temperature. Conductance of all the samples were ranged 240 to 718µs/cm in pre monsoon and between 328µs/cm to 949µs/cm in post-monsoon. Results indicated that increased electrical conductivity reported in post- monsoon samples. This showed that ionic impurities increased in water in post monsoon samples, which may be due to increased mineral content.

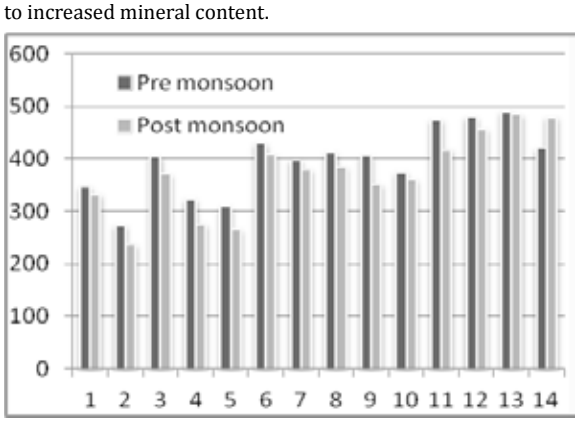

Figure3. Total hardness in water.

Hardness is expressed in terms of equivalent quantity of CaCO3. Total hardness of water is caused by the presence of multivalent metallic cations and is largely due to calcium and magnesium ions. Water quality association has provided a general scale of hardness demarcating the limits for soft and hard waters. It is not caused by single substance but by a variety of dissolved polyvalent metallic ions, predominantly calcium and magnesium cations. Hardness of all the water samples is found in the range of 274.5 mg/l to 491.5 mg/l in pre- monsoon and between 238mg/l to 485.6 mg/l in post-monsoon. Results indicated that hardness decreased in post monsoon water. BIS has prescribed desirable limit of total hardness is300 mg/lit and permissible limit in the absence of alternate source is 600 mg/lit (De, 2002). Although all the samples fall in the category of hard and very hard but in permissible limit.

Calcium is one of the most common constituent presents in natural water ranging from zero to several hundred milligrams per liter. It is a major constituent of various types of rock. Calcium ranged from 190.4mg/L to 438.9mg/L in post monsoon and 206.8mg/l to 443.7mg/l in pre-monsoon. It shows all the

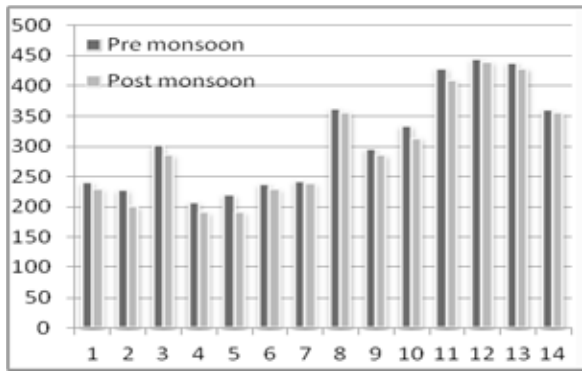

Figure6: Calcium contents in water samples

Samples have high concentration of calcium. Excessive calcium may contribute to many health problems.

Magnesium concentrations vary widely and can be from 1 to over 50 mg/l depending upon the rock types within the catchment.

Magnesium is often associated with calcium in all kinds of water but its concentration remains generally lower than the calcium

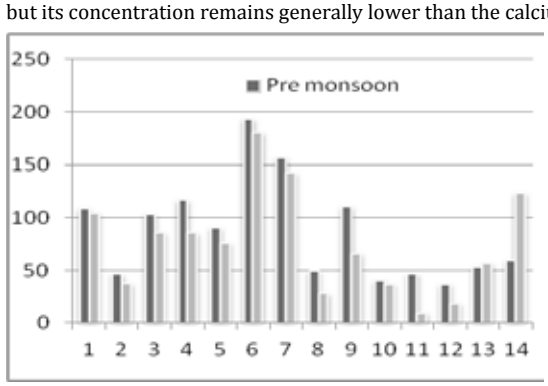

Figure 5: Mg contents in water samples

Magnesium content in the samples under study ranged from 37.1 mg/l to 194.2 mg/l in pre monsoon and between in 9.5 mg/l to 179.9 mg/l post-monsoon. It was above the acceptable limit in sample number 6,7and 14.Concentrations of magnesium and calcium was lower in post monsoon water samples.

Alkalinity is the content level of carbonate (CO_3^{2-}), bicarbonate (HCO_3^-) and hydroxide (OH^-) in water. Alkalinity was found in the ranged of 180 mg/l to 900 mg/l in pre monsoon and between in 217 mg/l to 1240 mg/l in post-monsoon samples. Alkalinity of sample number 5 is found to be very high than permissible range of 30-500 mg/L prescribed by BIS.

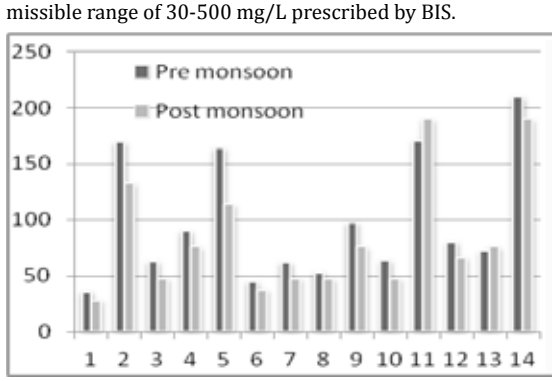

Figure5: Chloride contents in water samples

Fluoride was found in below the range of 1.0 mg/L (according to BIS it is in permissible range). Its concentration was found from 0.48 mg/l to 0.79 mg/l in pre monsoon and 0.38 mg/l to 0.68 mg/l in post monsoon months. This shows that drinking water in and around Shivpuri is safe for drinking.

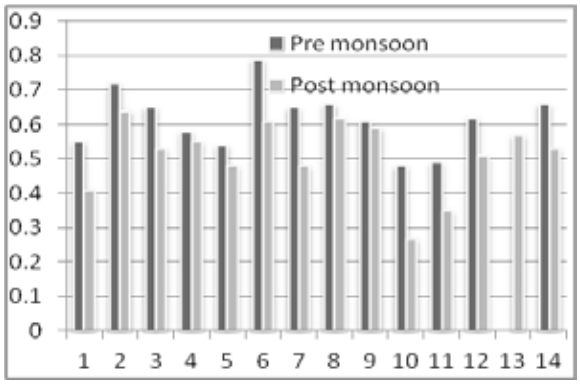

Figure 8: Fluoride contents in water samples in mg/ L

Chloride is highly soluble in water. It is present in all natural water mostly at low concentrations. There is no known evidence that chlorides constitute any human health hazard. Chlorides are generally limited to 250mg/l to1000mg/l (according to BIS). Chloride ion concentration of all the samples varied from 36.1 to 210.5 mg/l in pre monsoon and 28.5 to 190.2mg/l in post-monsoon samples.

Iron is common constituent in ground water. It is present in water either as soluble ferrous iron or insoluble ferric iron. Taste of iron is not usually noticeable at iron concentrations below 0.3mg/L. Although iron has got little concern as a health hazard but is still considered as a nuisance in excessive quantities. Long time consumption of drinking water with a high concentration of iron can lead to liver diseases (Hemosiderosis). High concentration of iron in water is not suitable for processing of food, beverages, ice, dyeing, bleaching and many other items. The permissible iron concentration in ground water is less than 1.0mg/L as BIS standard. Total iron content in the samples lie between 0.1mg/l to 1mg/l, hence fall in permissible range except the sample no. 9 which has high iron content more than the permissible limit..

Table1. Pre monsoon ground water quality assessment of Shivpuri district of Madhya Pradesh.

Sample No.	pH	TDS mg/L	Electrical Conductivity µs/cm	Fluoride Mg/L	Total Hardness mg/L	Ca mg/L	Mg mg/L	Alkalinity mg/L	Cl mg/L	Fe mg/L
1	7.21	397	418	0.55	348.5	239.3	109.2	410.0	36.1	0.1
2	7.93	1771	240	0.72	274.5	227.1	47.4	180.0	170.3	0.2
3	7.61	340	310	0. 65	405	301.5	103.5	270.0	63.4	0.1
4	7.85	316	320	0.58	323.9	206.8	117.1	380.0	90.2	0.2
5	7.33	593	500	0.54	309.8	219.3	90.5	900.0	164.7	0.2
6	7.26	389	600	0.79	431.3	237.1	194.2	410.0	45.1	0.1
7	7.23	395	305	0.65	398.6	241.3	157.3	400.0	62.5	0.1
8	7.32	349	390	0.66	412.8	362.5	50.3	280.0	53.7	0.1
9	6.98	318	384	0.61	406.7	296.2	110.5	320.0	98.2	1.2
10	7.14	312	316	0.48	374.7	334.0	40.7	240.0	64.2	0.1
11	7.73	477	480	0.49	475.6	428.3	47.3	210.0	171.6	0.1
12	7.11	481	400	0.62	480.8	443.7	37.1	300.0	80.5	0.1
13	7.09	413	410	0. 61	491.5	437.4	54.1	260.0	72.6	0.1
14	7.11	715	718	0.66	421.5	361.4	154.1	390.0	210.5	0.1
Post monsoon ground water quality assessment of Shivpuri district of Madhya Pradesh.										
1	7.83	394	678	0.45	333.3	228.5	104.7	470.0	28.5	0.1
2	8.03	1769	328	0.64	238.0	200.0	38.0	217.0	133.1	0.4
3	7.57	325	439	0.56	371.4	285.7	85.7	400.0	47.5	0.1
4	8.04	303	409	0.55	276.1	190.4	85.7	300.0	76.1	0.2
5	7.60	568	711	0.48	266.6	190.4	76.1	1240.0	114.1	0.1
6	8.00	376	505	0.67	409.4	228.5	179.9	400.0	38.0	0.1
7	7.90	368	498	0.56	380.9	238.0	142.8	440.0	47.5	0.1
8	7.30	315	426	0.62	385.7	357.1	28.5	430.0	47.5	0.1
9	6.96	246	330	0.68	352.3	285.7	66.6	120.0	76.1	0.8
10	7.07	269	362	0.38	361.7	314.2	37.4	280.0	47.5	0.1
11	6.96	474	645	0.46	419.0	409.5	9.5	310.0	190.2	0.1
12	7.09	436	590	0.56	458.0	438.9	19.0	260.0	66.5	0.1
13	7.50	379	510	0.67	485.6	428.5	57.1	340.0	76.1	0.1
14	7.15	703	949	0.62	480.6	356.8	123.8	460.0	190.2	0.1

1. Sakhya Sagar Lake 2. Bilava village 3. Jasrajpur village 4. Mansapuran 5. Chhatries

6. Sirsod village 7. Ramkhedi village 8. Sighniwas 9. Pariksha village 10. Khurd village

11. Tharra village 12. Balaji Dham 13.Old Shivpuri 14. Bus Stand

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