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Study on physico-chemical characteristics of ground water samples at Ganga region, Allahabad

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Abstract
Water is the most precious and essential part of existence. Its availability in terms of quality and quantity has become the need of the hour. Water being a non-replaceable commodity it is very important to monitor and keep a note of its quality levels. Safe drinking water means that it is free from all kinds of pathogenic micro-organisms poisonous substances, organic matter, color, turbidity, suspended particles, etc. Present research makes an effort to analyze the physico-chemical characteristics of water samples from different sites of Allahabad in the Ganga region where the dependency is mainly on groundwater. The water quality parameters like pH, TDS, EC, DO, BOD, Turbidity, Total hardness, Total alkalinity, and chloride were studied. From the study it was observed that most water samples were within the range of permissible limits as required by BIS specifications but some area of Ganga region water quality is deteriorated.

Keywords: Physicochemical properties, groundwater, Ganga region, water quality

Introduction
Water forms the essence of life. Water was the source which allowed the transformation of the various organic molecules to form the basis of life. All living organisms on the earth need water for their survival and growth. As of now the earth is the only planet having about 70 % of water [1]. The availability of water for drinking both in quantity and quality is necessary for the sustenance of life on Earth. The United Nations Commission on Sustainable Development regards water as one of the main issues facing the world [2, 3]. As water is a universal solvent it is difficult to get pure natural water. The water present below the water table is called groundwater and in Allahabad ground water is one of the major sources of potable water. But due to immense human activities this source of natural water has become contaminated and it thereby increases the necessity to study water quality. Once the bottom (ground) water is contaminated, its quality cannot be renovated back easily, and to device ways to guard it, Water quality index is one among the foremost effective tools to speak data on the standard of water to the involved voters and policy manufacturers. It thus, becomes crucial parameter for the assessment and management of bore well water [4]. Now-a-day, water quality issues have become a significant concern due to the growth of population, urban expansion and technological development [5]. The most important aspect of water quality monitoring is the problem arising due to the complex nature of analysis and the large number of variables or parameters. The data collected contains large information on the quality of water in and around those regions. The classification and interpretation of data are important aspects of quality assessment. The application of different statistical techniques also helps in finding out the different components which are responsible for bringing about the most variance in a data set. Environ-metric methods have been used for the assessment of surface water, groundwater and other environmental research by various workers. These methods extract the hidden information in the single sample and whole data and also the impacts of the environmental factors on the water quality and assist the environmental managers in terms of aiding the decision making process [6, 7]. The groundwater quality is an important factor in protection of water and its quality. In India, problem of water availability is considered more important and water quality takes a backseat but it has to be understood that problem of water quality is a serious problem too and needs to be assessed. Today the increased demand of water for different purposes such as drinking, industrial use, and agricultural sectors pressurized the extensive extraction of groundwater resources resulting in the lowering of the ground water

level. These results in increased pollutants load of the sewage and solid waste which seepage into the groundwater and alter the water quality for drinking purposes [8]. In this study an attempt has been made to understand the water quality of groundwater in the Ganga belt of Allahabad city. The main purpose of this study is to evaluate some of the parameters and know about the distribution of solute in ground water and its suitability for drinking purposes. Even though ground water contains lesser quantity of bacteria or biological pathogens yet a study of dissolved oxygen and biological oxygen demand has also been considered as there are regions of sewage disposal and dumping grounds around the selected stations. The time period of the sampling and analysis is restricted to summer season in the year 2015.

2. Materials and Methods

The study area of Ganga region is located at coordinates 25.4358˚N and 81.8463˚ E. The area is located at near the Ganga belt region namely Muirabad, Mumfordganj, Salori, Rajapoor and Phaphamau. The mix population resides near the selected region but Rajapoor and Salori site has more populated and dense locality.

Fig 1: Sampling site and marked area of sampling location at Ganga region, Allahabad

2.1 Sampling Site and Frequency

Groundwater samples were collected from tube wells and hand pumps at selected sampling site situated in Ganga region. Location of the sampling sites is shown in Figure 1 and Table 1. The water samples were collected from five different sites namely Muirabad (G1), Mumfordganj (G2), Salori (G3), Phaphamau (G4), Rajapur (G5). The sample was collected during the months of March, April, May, and June and collection frequency was monthly at selected sites.

Table 1: Sampling sites and source of water supply in Ganga region

Station Sites	Site Code	Source of Water Supply
Muirabad	G1	Handpump
Mumfordganj	G2	Tubewell
Salori	G3	Handpump
Phaphamau	G4	Handpump
Rajapur	G5	Tubewell

2.2 Sampling methods and procedure: All samples were collected in plastic containers (PVC) previously washed with detergents and nitric acid and thereafter rinsed thoroughly with sampled water several times before collection. The collected samples directly transported to the laboratory of Department of Chemistry, SHUATS, Allahabad for further analysis of collected water samples. The Dissolved oxygen was fixed at a sampling site. The obtained data reported in Table 3 of water quality parameters compared with appended Table 2 of water quality standards laid by Indian Standard specification (1S:10500:1991) for drinking purpose. The water samples were analyzed for different physical, chemical parameters as per standard protocol of APHA/AWWA (1998).

Table 2: Water quality standards with parameters

S. No	Parameters	Indian Standard (BIS) (IS-10500:1991)	
		Desirable Limit	Maximum Permissible Limit
1	pH	6.5	8.5
2	EC	-	-
3	TDS (mg/l)	500 mg/l	2000 mg/l
4	Turbidity (NTU)	5 NTU	10 NTU
5	Total Hardness (mg/l)	300 mg/l	600 mg/l
6	Alkalinity (mg/l)	200 mg/l	600 mg/l
7	Chloride (mg/l)	250 mg/l	1000 mg/l
8	Dissolved Oxygen	6 mg/l	-
9	Biochemical oxygen demand (mg/l)	2.0 mg/l	-

Table 3: Physico-chemical parameters of groundwater of the Ganga region of Allahabad city

DATE	Sampling Site	pH	Turbidity	EC	DO	BOD	TDS	T Hard	T Alk	Chloride
11/03/2015	G1	7.2	2.25	1.3	6.3	1.43	182.4	307	261	105.2
11/03/2015	G2	7.5	3	2.18	6.35	2.15	191.39	327	404	126.8
11/03/2015	G3	7.75	5.25	2.37	6.625	3.1	243.95	333	421	228.9
11/03/2015	G4	7.95	5.5	2.62	4.223	3.48	226.95	345	395	249
11/03/2015	G5	8.1	5.5	2.22	2.95	3.33	233.74	345	476	250
13/04/2015	G1	7.18	2.25	1.2475	6.2	1.45	180.45	314	276.6	105.68
13/04/2015	G2	7.75	3	2.0725	6.55	1.8	191.2	338	345	124.25
13/04/2015	G3	7.98	4.5	2.22	6	2.43	192	348	254	219.75
13/04/2015	G4	7.53	5.75	2.6325	3.88	3.25	219.95	340	405	249.5
13/04/2015	G5	7.9	5	2.4	4.38	3.41	247.13	341	415.3	248.75
20/05/2015	G1	7.35	2.75	1.3	5.1	1.35	180.5	329	266	108
20/05/2015	G2	7.9	2.25	2.31	4.97	1.55	188.2	359.3	333	134
20/05/2015	G3	8.3	4.25	2.36	5.15	2.05	191.9	374.5	333	215
20/05/2015	G4	7.78	4.75	2.93	3.85	2.85	215.8	367.5	363	271
20/05/2015	G5	8.05	6	2.65	4.27	3.3	248	371.8	393	275
15/06/2015	G1	7.53	2	1.35	5	1.48	180	337	234	110.18
15/06/2015	G2	8.22	3	2.358	4.85	1.58	188	360.3	304.5	138.05
15/06/2015	G3	8.5	3	2.5	5.2	2	124	378.3	306.5	217.68
15/06/2015	G4	8.16	5	3.258	3.9	2.68	229	363	345.3	256
15/06/2015	G5	8.3	6	2.878	4.28	2.75	253	371.8	352.3	278.75

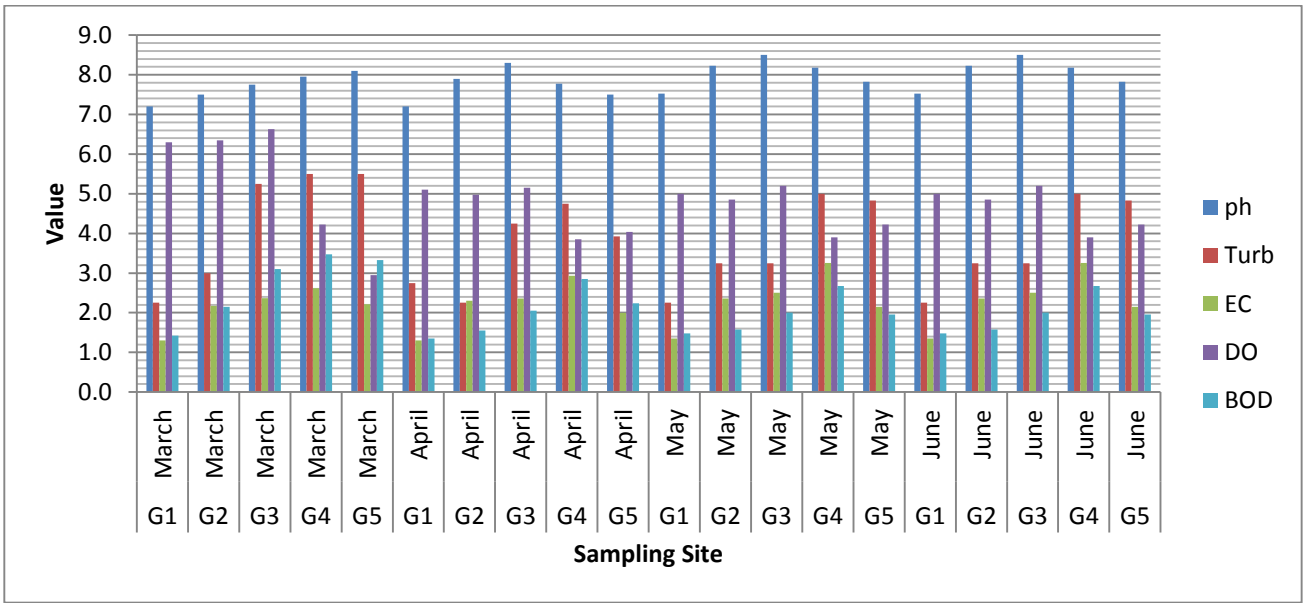

Fig 1: Variation of water quality parameter (mg/l) except pH, turbidity and EC at different sites of Ganga Region

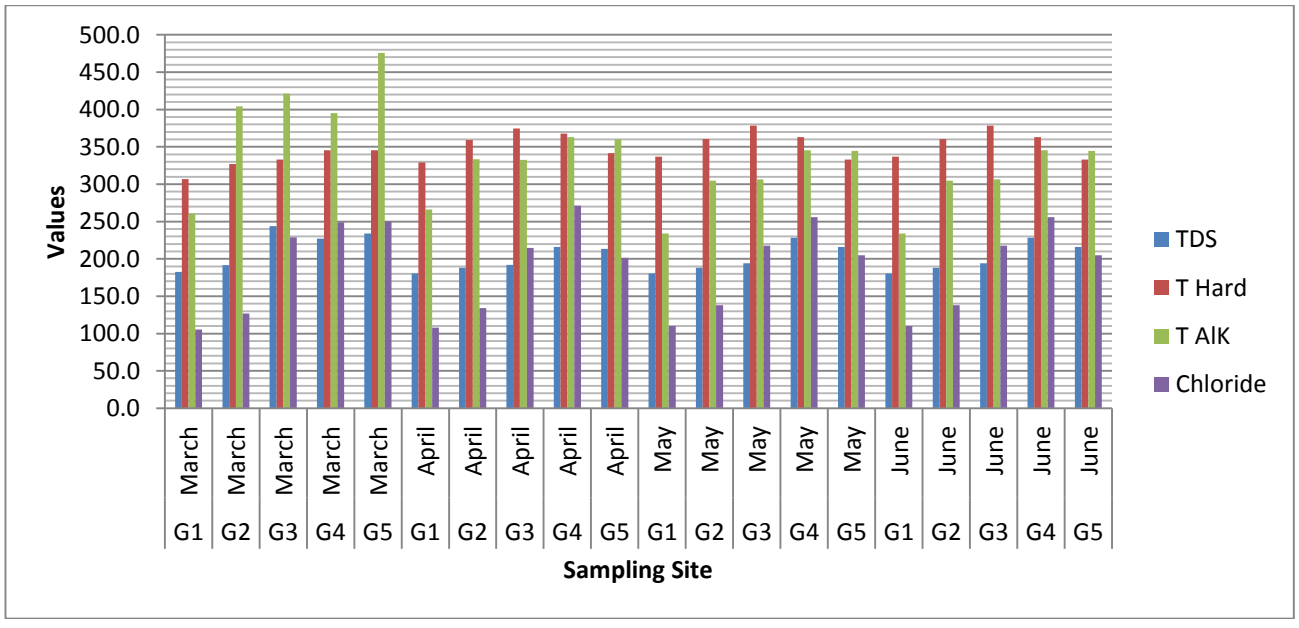

Fig 2: Variation of water quality parameter (mg/l) at different sites of Ganga region

Results and Discussion

From the Fig. 1, it is evident that the pH of water samples range from 7.1 to 8.9 in all the stations of Ganga region There is a slight increase in the pH value in stations G2 and G4. pH indicates the acidic or basic level of water with respect to potential hydrogen. Since the human body maintains its levels naturally the pH of drinking water does not affect the body to a large extent, pH provides an important piece of information in many type of geochemical equilibrium or solubility calculation and is considered as an important ecological factor [10]. Turbidity is an expression of light scattering and light absorbing property of water and is caused by the presence of suspended particles such as clay, silt and colloidal organic particles. Higher turbidity is known to affect the primary productivity by restricting the light penetration and photosynthesis [11]. Turbidity of the water samples range from value of 1.7 -7 NTU. The turbidity values indicate that the region has a higher turbidity level in comparison to the desirable limits but is well within the permissible limit of BIS standard for drinking purposes, the turbidity values at stations G4 and G5 is higher which may be due to the percolation of silt or sediment. Electrical conductivity is an algorithm to measure both salinity and TDS. It is used to understand the ions present in water which can conduct current. Higher value of EC indicates higher salinity and thus can decrease the presence of oxygen dissolved in water. The EC values in the stations studied is ranging from 1.11 – 3.52 indicating that it is below the desirable limits and hence the water is safe for human consumption. Fig. 2. Indicated that level of Dissolved oxygen present in water samples, the dissolved oxygen varies between 2.5-7.6 mg/l it reflect that water carrying a good quantity of oxygen in water samples, biological oxygen demand ranges from 1.14-3.8 are also within the prescribed range except for stations G4 and G5. BOD levels are slightly high which may be due to the sewage and garbage dumping ground near the point of collection. The observed value of total dissolved solids (TDS) between 180.17 -286.9 mg/l presented in fig 2, which is found to be within the BIS prescribed limit of 500 mg/l. TDS is an indication of the dissolved matter such as small amounts of inorganic salts or even some organic matter. Total dissolved solids are a measure of total inorganic substances dissolved in water. TDS indicates the general nature of water quality or salinity. The TDS concentration above the permissible limit may be due to the leaching of various pollutants into the ground water which can decrease the potability and may cause gastrointestinal irritation in human and may also have laxative effect particularly upon transits [12]. The present study indicates that this region is safe in terms of TDS concentration. High TDS causes certain disorders in the kidneys disease. The values for total hardness range from 300-397 in the various sites. The water is above the desirable limit of 200mg/l as prescribed by BIS but within the permissible limit of 600 mg/l without alternate source. Total hardness is an indication of the mineral content and is irreversible on boiling. The concentration of total hardness indicate that there is a slightly higher degree of mineral content in Allahabad Ganga region. The levels of total alkalinity in the region are higher than the desirable limits. The mean values range from 189 to 496 mg/l which is above the desirable limits but within the permissible limit of 600mg/l. The chloride content is found to range from 102.5 to 298 mg/l, which is within the prescribed limits of BIS in stations G1, G2 and G3 but sampling sites G4 and G5 observed values in higher ranges which shows that there is seepage of sewage and untreated water into the lower layers of the soil.

Conclusion

From the results of the study, the following conclusions can be drawn turbidity, total hardness and total alkalinity are on the higher scale and thus these factors are instrumental in decreasing the levels of portability of water in these regions. Thus it may be concluded that the results that have been obtained point to the fact that the quality of ground water in these regions of Allahabad especially site Salori (G3), phaphamau (G4), and Rajapur (G5) are above as compared to the standard desirable limit of the corresponding parameter prescribed by the Indian standards of BIS but sampling site Muirabad (G1) and Mumfordganj (G2) are well falls within the desirable limits of Indian standard (BIS). Obtained results showed that the physico chemical charactertics of water quality is slightly changes and may be due to percolation of waste water and dumping of waste at selected locations. From the study, it can be recommended that people should contribute to the access of safe drinking water and it is necessary for the public to understand about the quality of water they have access to. It is not only the responsibility of the authorities to keep the public informed about the quality of water they use but also to use different steps to see that the quality is maintained as per the standards followed.

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