Monitoring of Pollutants by Physico-Chemical Analysis in Water Bodies and Water Quality Index Assessment

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Abstract:

In the vicinity of Kistapur, 22 samples were obtained from bore wells and examined for pH, acidity, alkalinity, DO, BOD, COD, EC, turbidity, Ca+, mg+, Na+, total hardness, and K+. The test findings are favourable and within acceptable ranges, making it suitable for drinking, residential use, and irrigation. This experiment demonstrated that Ca+ is more abundant than magnesium, sodium, and potassium. Because of the effluents from factories close to the study region, the groundwater is contaminated. The Water Quality Index (WQI) was calculated after a few significant water quality metrics were chosen. So, to assess the quality of groundwater, waters from open wells in and near the industrial region are used. When determining the location of points and the distribution of groundwater, GIS is used, and inverse distance weighting (IDW) is used as an interpolation method. Therefore, it's important to manage the movement of contaminants and ground water pollution in and around the research region.

Keywords: Groundwater, Geochemistry, IDW, WQI, GIS, Study Area.

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Introduction

Water is the most important source for livelihood in nature. As there is rapid growth in urbanisation, irrigation techniques, living standard of life, industrialisation, there is a need of excess quantity of water for various purposes. As water from many sources such as rivers, lakes, ponds etc are being used excessively and are contaminated due to wastes from factories, improper usage of water [1, 2]. Due to inadequate supply, they are depending on groundwater which is the primary source for domestic and irrigation in many parts of India. Knowledge of quality parameters result in knowledge of different characteristics which may affect health conditions of people living in the area [3]. The results which are obtained after testing are compared with the standard results given by the WHO and Water Quality Standards (IS 10500-2012.) [4].

The study area falls in between latitude 17.6295^{o}N and longitude 78.5072^{o}E. It is 3 Km from Medchal located in Telangana. Its study area falls in the Survey of India topo sheet E44M10 and E44M5.

The wettest month of the year is July, and June through September account for 652mm of the average annual rainfall of 833 mm. The region's geomorphology suggests that several geomorphic processes, including erosion, deposition, crustal motions, and climatic changes working on the surface, are responsible for the current landforms.

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The study area consists of mainly pink granites which are highly weathered and fractured. Number of intrusive like dolerite dykes, pegmatite veins and quartz reefs/veins are common in this area [5, 6]. Groundwater Quality studies with reference to drinking and irrigation purposes in different regions were carried out by [7, 8, 9, and 10].Geochemical studies of groundwater [11]. Heavy exploitation of groundwater was found to be reason for the quality deterioration in this district [12].In the most recent studies, researchers found that rock–water interaction and evaporation are the main reasons for the water quality deterioration in this region [13].The concentrations of these ions are more than the permissible limit for drinking purposes [14].

Materials and Methods:

21 samples were collected from underground through borewells, dug wells at different locations in Medchal, Telangana. They were stored in polyethylene bottles and stored at temperature of 15-20^{o} C. The samples were tested for parameters like pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Alkalinity, Acidity, Dissolved Oxygen, BOD, COD, Turbidity, Calcium ($Ca^{+)}$, Magnesium (Mg+), Sodium (Na+), Total Hardness (TH), Potassium (K+). PH, EC, TDS were measured using pH/EC/TDS meter immediately after bringing the samples from the locations in bottles. Ca+, TH were measured using standard EDTA solution using Eriochrome Black T-Indicator. Na+ and K+ were measured using the technique of emission flame photometry. CO_3^{-2}, HCO_3 were measured using titration method using phenolphthalein as indicator. Alkalinities, Acidity were measured by titration method using phenolphthalein, methyl orange indicators using NaOH, H_2SO_4 solutions. DO was measured using titration method by Winkler. Turbidity was measured using Nephelometric turbidimeter. BOD and COD were measured using titration method in which Phosphate buffer, Magnesium sulphate, Calcium chloride, Ferric Chloride were the reagents used and Sodium thiosulphate was the titrant used.

Calculation of Water Quality Index

The Weight arithmetic water quality index meth has been used for calculation of WQI

The overall WQI is determined by using Equation:

$WQI= \Sigma Qi\ Wi / \Sigma Wi$

Unit weight was calculated as following

$Wi = Wi / \Sigma Wi$

Where, Wi is the relative weight, Wi is the weight of each parameter and Σ Wi is the sum of weights of all parameters.

Quality rating Qi was calculated as below:

$Qi = (Vi / Si)\ X100$

RESULTS AND DISCUSSION

The minimumium, maximum, mean median and standard deviation values generated from the analysis of the samples are presented in table The pH indicates the acidity or alkalinity material present in the water. The pH values of the groundwater vary from 8-10 with a mean pH of 8.6 which is alkaline in nature and it tastes bitter. The permissible limit for drinking water should be in the range of 6.5-8.5. The groundwater shall be treated before consuming as its value is above the permissible limit. Acidity of water is the capacity to neutralize bases. The Acidity of the Groundwater samples varies from 20-150 mg/l with a mean value of 71.42 mg/l. The limit for drinking water should be Alkalinity of water is the capacity to neutralize acids. The Alkalinity of the Groundwater samples vary from 20-128 mg/l and mean value was 68.85 mg/l. The permissible limit of drinking water should be less than 250 mg/l and the samples are safe for drinking purposes. The TDS is a sum of cations and anions in the water. It consists of Inorganic salts and some organic salts. The Groundwater samples have a TDS value varying from Conductivity is the capacity of water to carry an electrical current. The Groundwater samples have an EC values varying from 0.89-13 µS/m with a mean value of 2.6 mS. the permissible value of EC is 1500mS/cm[15]. The Groundwater Samples are safe for drinking purposes. Amount of Dissolved Calcium and magnesium in water represents the TH of water. The Groundwater samples have a TH varying from 72.56-915.82 mg/l with a mean value of 465 mg/l. The permissible limit of TH in drinking water is 600 mg/l. hence the groundwater samples can be used for drinking purposes. Calcium concentrations vary from 80.2-150 mg/l with a mean value of 125.5 mg/l. The permissible value of calcium is 200 mg/l and the samples are found to be safe for drinking purposes. Magnesium concentrations vary from 36-108 mg/l with a mean value of 70.7 mg/l and the permissible value for magnesium is 30 mg/l [16]. Which are not safe for drinking purposes? Due to relative abundance in rocks the values of calcium exceed the magnesium values. Sodium and magnesium concentrations are due to mineralogical origin of soils and Soluble Na^+ and K^+ are results from weathering of feldspar. Na^+ values vary from 15-51 mg/l with mean value of 34.28 mg/l. The permissible value of Sodium in water is 45 mg/l. K^+ values vary from 2-26 mg/l with mean value of 5.21 mg/l. The permissible value of potassium in water is 10mg/l. Both sodium and potassium are in the range and Groundwater samples can be utilised for drinking purposes. Carbonates of water samples vary from 24-66 mg/l with mean value of 36.48 mg/l and Bicarbonates values vary from 79.31-292.84 mg/l with mean value of 167.28 mg/l.BOD is the most widely used test to establish the concentration of organic matter in waste water samples[17,18]. It is based on the principle that if sufficient oxygen is available, aerobic biological decomposition by microorganisms will continue until all waste is consumed. The Groundwater samples have a BOD value varying from 50.6-487.6 mg/l with a mean value of 210 mg/l. COD is the alternative test to BOD for establishing the concentration of organic matter in wastewater samples. The PH exhibits positive correlation with BOD (R2= 0.5) in fig.1.COD test can be completed within few hours compared to BOD. The Groundwater samples have COD values varying from 50.72-260 mg/l with a mean value of 80 mg/l. It is observed that the PH positive correlation BOD (R2=0.23), COD (r2=0.02) in fig.1 -3.The water can be safely discharged into streams and this water samples cannot be utilised for drinking as organic matter is very high. The amount of oxygen present in the water in dissolved state is DO. The Groundwater samples have DO values varying from 6-25 mg/l with mean value of 15.5 mg/l. Therefore, the water contains sufficient amount of DO for growth of aquatic life. This water samples can be used for drinking. The presence of dissolved solids in water may affect taste. Water with extremely low concentrations of TDS may also be unacceptable due to its flat, insipid taste. The Groundwater samples collected from locations have a TDS value varying from 637-8450 mg/l with a mean value of 1691.90 mg/l. Though some values have TDS values which are permissible for drinking purposes the samples S-14 & S-15 have a high

TDS value of 8450 mg/l which are unacceptable for drinking purposes. The amount of suspended particles in the liquid. The Groundwater samples have a value of 2-18 NTU with a mean value of 5.2 NTU. The WQI of the groundwater ranged between87.2 to 396.5 that indicates the pollution level is very high [19, 20].

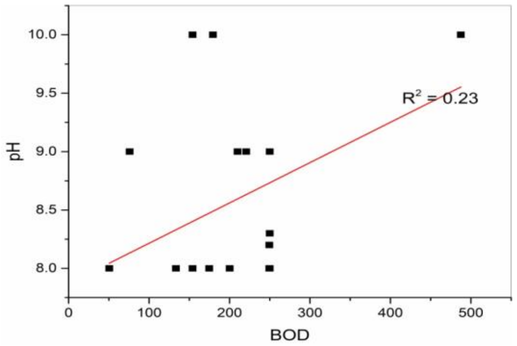

Fig 1.Scatter diagram of P^H Vs BOD

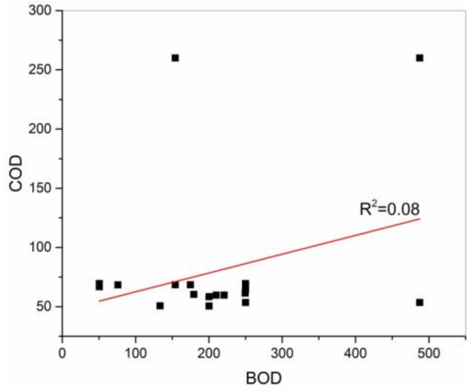

Fig 2. Scatter diagram of COD Vs BOD

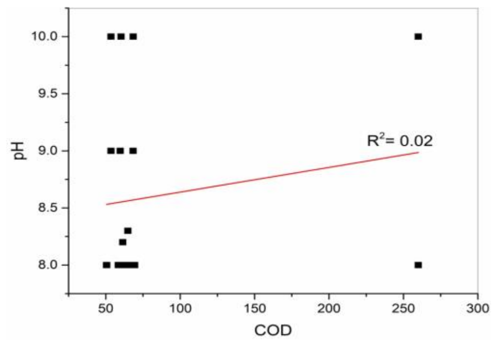

Fig 3.Scatter diagram of P^H Vs COD

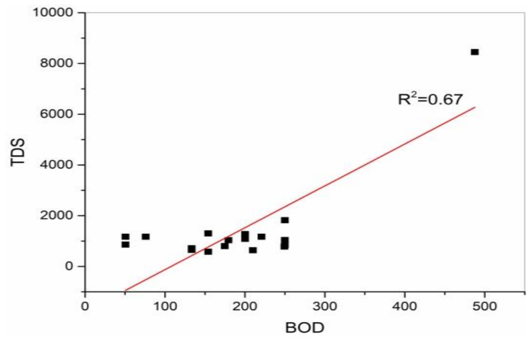

Fig.4. Scatter diagram of COD Vs BOD

Table 1 .Descriptive Statistics of Physico- Chemical Quality of Ground water

Sl. No.	Water Quality Parameter	W.H.O. standards in ppm		I.S.I. standards in ppm		Analysis of the area investigated	
		Min.	Max.	Min.	Max.	Min.	Max.
1	pH	6.5	8.5	6.5-8.5	6.5-9.2	8	10
2	EC	500	2000	500	1500	0.89	13
3	Ca	75	200	75	200	80.2	195
4	Mg	50	150	30	100	36	108
5	Na	-	200	-	200	15	53
6	K	-	12	-	12	2	26
7	HCO_3	500		-	-	79.37	292.84
8	TDS	-	500			637	8450
9	TH	-	200		300	120.7	915.8
10	Alkalinity	20	128			20	128
11	acidity	20	150			20	150
12	BOD	30				50.6	457.6
13	COD	250				50.3	260

14	DO					6	15.4
15	Turbidity		5		5	2	18

Conclusion

The study area's groundwater sample level is within acceptable drinking water quality criteria. The main source of the chloride is the weathering of minerals found in the rocks of the research area. The increase in TDS content was caused by a combination of natural sources, domestic sewage, and industrial effluents. The BOD/COD ratio was consistently lower than 0.50, which indicates that the waste is not biodegradable and needs further care both throughout the treatment processes and before final disposal. The WQI scores for 88% of the locations are higher above the maximum drinking water standard of 100. The results show that every area's groundwater's WQI was found to be unsafe for drinking.

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