

Experimental Study of Groundwater Quality around Bidar City

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Abstract- The water and environment has become an emotive issue with the people and policy makers. The chief causes for the pollution of water and environment are anthropogenic activities of human beings. The primary objective is to study the groundwater quality parameters around Bidar city. The project work is aimed at assessing the water quality index (WQI) for the ground water of Bidar city. The groundwater samples from 6 places were collected and subjected for a chemical analysis. For calculating the WQI, the following 3 parameters have been considered viz., pH, total hardness and alkalinity. The results analyzed (by WQI method) have been used to suggest models for predicting water quality. The analysis reveals that the groundwater quality status of the study area is good and the concentration of major constituents are well within the permissible limits of IS (10500-1994). Hence a study has been carried out for the quality of the available groundwater around the Bidar city.

continually through the water cycle of evaporation, transpiration (evapo - transpiration), condensation, precipitation, and runoff, usually reaching the sea. Water covers 71% of the Earth's surface, mostly in seas and oceans. Small portions of water occur as groundwater (1.7%), in the glaciers and the ice caps of Antarctica and Greenland (1.7%) and in the air as vapour, clouds (formed of ice and liquid water suspended in air) and precipitation (0.001%). "The water on the surface of Earth is found mainly in its oceans (97.25 percent) and polar ice caps and glaciers (2.05 percent), with the balance in freshwater lakes, rivers, and groundwater. As Earth's population grows and the demand for fresh water increases, water purification and recycling become increasingly important. Interestingly, the purity requirements of water for industrial use often exceed those for human consumption. For example, the water used in high-pressure boilers must be at least 99.999998 percent pure. Because seawater contains large quantities of dissolved salts, it must be desalinated for most uses, including human consumption.

I. INTRODUCTION

Water is a polar inorganic compound and it is a transparent, tasteless, odourless, and nearly colourless with a hint of blue chemical substance, which is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. Water is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H₂O, meaning that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is the name of the liquid state of H₂O at standard ambient temperature and pressure. It is the only common substance to exist as a solid, liquid, and gas in normal trees. It forms precipitation in the form of rain and aerosols in the form of fog. Clouds are formed from suspended droplets of water and ice, its solid state. When finely divided, crystalline ice may precipitate in the form of snow. The gaseous state of water is steam or water vapour. Water moves

1.1 Groundwater

Groundwater is the water present beneath Earth's surface in soil pore spaces and in the fractures of rock formations. A unit of rock or an unconsolidated deposit is called an aquifer when it can yield a usable quantity of water. The depth at which soil pore spaces or fractures and voids in rock become completely saturated with water is called the water table. Groundwater is recharged from and eventually flows to the surface naturally. Natural discharge often occurs at springs and seeps, and can form oases or wetlands. Groundwater is also often withdrawn for agricultural, municipal, and industrial use by constructing and operating extraction wells. The study of the distribution and movement of groundwater is hydrogeology, also called groundwater hydrology.

Groundwater represents about 30% of world’s fresh water. From the other 70%, nearly 69% is captured in the ice caps and mountain snow/glaciers and merely 1% is found in river and lakes. Groundwater counts in average for one third of the fresh water consumed by humans, but at some parts of the world, this percentage can reach up to 100%. In the illustration bellow an overview is given of Earth’s water distribution.

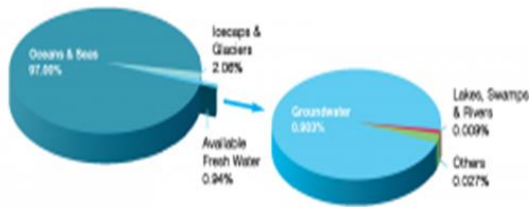


Fig.1– Ground Water Distribution

1.2 Objectives of the Study

- To study water quality parameters like PH, acidity, alkalinity etc.
- To study water quality index of the respective location
- To study experimental results of sample water from respective location around Bidar city

II. METHODOLOGY AND MATERIALS

1. Methodology

The Department of Environment & Scientific Technologies was set up on April 13, 2007 with objectives to improve the effectiveness of environmental management, protect vulnerable ecosystems and enhance sustainability of development. This department monitors groundwater quality and surface water quality. There are total 1494 ground water stations located in Karnataka and out of these 42 stations are located in study area. Water quality indices are calculated for these stations Correlation coefficients are analyzed and linear regression is done to find the relation between water quality parameters which have correlation coefficient greater than 0.5 . Water quality indices are calculated at all stations using Weighted Arithmetic Index Method (Ansari & Hemke, 2013).Water quality index is given by following formula

$$WQI_i = \sum (WQR)_i \times (W)_i / \sum W$$

Where WQI_i =Water quality index of ith parameter, WQR_i = water quality rating of ith parameters, W_i = Relative Weight age of ith parameter, $RW_i = 1/S_i$, S_i =Standard permissible value of ith parameter

Water quality index is calculated in 3 steps as explained below.

First step: a relative weightage of each parameter is calculated by taking reciprocal of standard permissible value for that parameter. The relative weightage of iron is highest among all the parameters. Relative weightage of all the selected parameters are given in table below

Table 1: Relative Weightage of Water Quality Parameters

S.No	Parameter	Standard permissible value	Relative Weightage (Wi)
1	PH	7	0.1429
2	Total Hardness	300	0.0033
3	Alkalinity	200	0.0050
$\sum W_i = 0.1512$			

Second step: water quality ratings are calculated for each parameter at each station. Water quality rating is given by the following formula:

$$WQR_i = \{(C_i - V_i) / (S_i - V_i)\} \times 100$$

Where is WQR_i = water quality rating of ith parameter, C_i = value of the water quality parameter obtained from the laboratory analysis, S_i = value of the water quality parameter obtained from recommended Indian Standard Parameter, V_i = the ideal value which is considered as 7.0 for pH and zero for all other parameters

Third step: In last step water quality sub-indices are calculated for each parameter by multiplying relative weightage and water quality rating and divided by sum of relative weights.

$$SI_i = (WQR)_i \times (W)_i / \sum W$$

SI_i = Sub index for ith parameter,
 WQR_i = Water quality rating of ith parameters
 W_i = Relative Weightage of ith parameter,

2. Materials

Water samples collected from six sampling stations selected for the analysis were given below: S1- Papnash, S2- Ashtoor , S3- Bidar Fort .Samples for analysis are to be collected in sterilized bottles using the standard procedure for grab (or) catch samples in accordance with standard methods of APHA (1995). The analysis of various Physico – Chemical parameters namely PH, Temperature, Total hardness, Alkalinity, Calcium hardness, Magnesium hardness, are to be carried out – as per the methods described in APHA (1992). All the chemicals and reagents are to be used of analytical grade. D.D water was used for the preparation of solutions.

III. RESULTS AND DISCUSSION

- Location No 1 :-S1- Papnash

Table No: - 2. Results of Papnash

Parameter	Standard values	Week 1	Results Week 2	Week 3
Acidity	<60mg/Litre	55.8mg/Litre	56mg/Litre	56.9mg/Litre
Alkalinity	<120mg/Litre	71.6mg/Litre	72.1mg/Litre	72mg/Litre
Total hardness	<200mg/Litre	120.9mg/Litre	122mg/Litre	121.3mg/Litre
% of chlorine in bleaching powder	33%	7.93%	8.15%	8.09%
Dissolved oxygen	>6mg/Litre	6.25mg/Litre	6.31mg/Litre	6.43mg/Litre
pH	6.5-8.5	6.95	7.18	7.18

Table No: - 3 Water quality index

Sl No	Chemical Parameters	Indian Standards	Weightage (wi)	Relative Weight (Wi)	Quality Rating (qi)	Sub Index (Sii)
1	pH	7	4	0.4	83.56	33.424
2	Total Hardness	<200	3	0.3	60.7	18.21
3	Alkalinity	<120	3	0.3	59.51	17.97
			$\Sigma(wi)=10$	$\Sigma(Wi)=1.0$	$\Sigma(qi)=204.17$	$\Sigma(Sii)=69.607$

Water Quality Index (WQI) = $\Sigma(Sii) = 69.607$

- LOCATION NO 2 : S2- Ashtoor

Table No: - 4. Results of Ashtoor

Parameter	Standard values	Week 1	Results Week 2	Week 3
Acidity	>60mg/Litre	38.8mg/Litre	38mg/Litre	37.5 mg/Litre
Alkalinity	<120mg/Litre	54.6mg/Litre	56.6mg/Litre	56.5 mg/Litre
Total hardness	<200mg/Litre	125 mg/Litre	127 mg/Litre	127.5 mg/Litre
% of chlorine in bleaching powder	33%	7.9 mg/Litre	7.9 mg/Litre	7.9 mg/Litre
Dissolved oxygen	>6mg/Litre	6.5mg/litre	6.3mg/litre	6.25Mg/litre
pH	6.5-8.5	7.3	7.3	7.2

Table No: - 5 Water quality index

Sl No	Chemical Parameters	Indian Standards	Weightage (wi)	Relative Weight (Wi)	Quality Rating (qi)	Sub Index (Sii)
1	pH	7	4	0.4	85.49	34.196

2	Total Hardness	<200	3	0.3	63.756	18.97
3	Alkalinity	<120	3	0.3	46.30	13.98
			$\Sigma(w_i)=10$	$\Sigma(W_i)=1.0$	$\Sigma(q_i)=195.84$	$\Sigma(SI_i)=67.146$

Water Quality Index (WQI) = $\Sigma(SI_i) = 67.146$

- LOCATION NO 3 :S3- Bidar Fort

Table No: - 6. Results of Bidar Fort

Parameter	Standard values	Week 1	Results Week 2	Week 3
Acidity	<60mg/Litre	58.5mg/Litre	58.2mg/Litre	58.7mg/Litre
Alkalinity	<120mg/Litre	84.6mg/Litre	85.3mg/Litre	86.8mg/Litre
Total hardness	<200mg/Litre	189.7mg/Litre	189mg/Litre	190.3mg/Litre
% of chlorine in bleaching powder	33%	8.93%	9.21%	9.3%
Dissolved oxygen	>6mg/Litre	6.92mg/Litre	7.16mg/Litre	7.2mg/Litre
pH	6.5-8.5	7.32	7.4	7.48

Table No: - 7 Water quality index

S	Chemical Parameters	Indian Standard	Weight (wi)	Relative Weight (Wi)	Quality Rating (qi)	Sub Index (SIi)
1	pH	7	4	0.4	87.05	34.82
2	Total	<200	3	0.3	94.83	28.449

	Hardness					
3	Alkalinity	<120	3	0.3	71.305	21.391
			$\Sigma(w_i)=10$	$\Sigma(W_i)=1.0$	$\Sigma(q_i)=253.185$	$\Sigma(SI_i)=84.66$

Water Quality Index (WQI) = $\Sigma(SI_i) = 84.66$

IV. CONCLUSION

The analysis of the water quality parameters of ground water from six different locations around the Bidar city shows that the groundwater is crystal clear, odourless, and potable. Most of the bore wells yield potable water with moderate mineral or dissolved salts. Water is soft in almost all the sampling points. The water quality index (WQI) falls in the Good quality range and hence the ground water of Bidar city is as considered as Good. The parameters like pH, alkalinity, acidity etc. were within permissible limit. Slightly exceeded value of alkalinity and total hardness were reported at fort water of study area.

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