ISSN No:-2456-2165

Hydro Chemical Analysis of Ground Water in Bangalore

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Abstract:- The present study investigates physico-chemical properties of groundwater in the sub-urban part of Bangalore. The quality of the groundwater was determined by taking samples from 58 bore wells within the study area and analyzed for physicochemical parameters. Hydro-chemical analysis was carried out to know the type of water. It is found from the analysis that the water is Magnesium Bi-Carbonate type.

The purposes of this investigation were to provide an overview of present groundwater quality, to present spatial distribution of groundwater quality parameters such as pH, Electrical Conductivity, Cl-, SO4-2 concentrations etc., and to map groundwater quality in the study area by using GIS techniques. Arc GIS10 was used to produce the final groundwater quality map.

Keywords:- *Hydro Chemical Analysis, Chemical Parameters, Ground Water Sampling, Reconnaissance Survey.*

I. INTRODUCTION

Groundwater is subsurface water that fills voids in soils and permeable geological formations. Groundwater is filtered by soil, gravel and sand as it descends into the earth. This means that it is pure in its natural state, and need little if any treatment. Groundwater is also protected from the sun and atmosphere. That means that it is generally cool when drawn up from the ground. It also means that there is no evaporation loss while water is in its 'Natural Reservoir'.

As population grows and usage of water increases, the pressure on our ground water resources also increase. In many areas of the world, ground water is now being over-abstracted, in some places massively so the result is falling water levels and declining well yields, more expensive supplies, land subsidence, the intrusion of salt water into fresh water supplies and ecological damage such as drying out of wetlands.

According to the United States Geological Survey (USGS) figures groundwater provides an estimated:

- 22% of all fresh water withdrawals.
- 37% of agricultural use (mostly irrigation).
- 37% of public water supply withdrawals.
- 51% of drinking water for total population.
- 99% of drinking water for the rural population

II. STUDY AREA

Bangalore district is situated in the heart of the South-Deccan plateau in peninsular India to the South-Eastern corner of Karnataka State between the latitudinal parallels of 12º 39' N & 13º 18' N and longitudinal meridians of 77º 22' E & 77º 52'E at an average elevation of about 900 meters covering an area of about 2,191 sq.kms (Bangalore rural and urban districts).

A. Sequence of investigation

The entire investigation was accomplished in the following sequence

- Reconnaissance survey for identifying the water sampling locations
- Groundwater sampling and analysis
- Hydro-chemical analysis of groundwater samples

B. Ground water Sampling In the Study Area

Careful planning and preparation of a groundwater-sampling trip was made to save time and help reduce the number of difficulties that commonly occur with fieldwork. Correct sampling procedure begins with thorough preparation in the office and laboratory before sample collection. Each sample bottle is to be thoroughly cleaned and protected from any contamination during sample collection, preservation, and shipment to assure a high quality sample. Filtering equipment is to be rinsed thoroughly to remove any mineral deposits in hoses or support container vessels. The sample containers and hoses for organic analyses are to be acid-washed and rinsed several times with deionised water.

Grab sampling has been adopted to collect groundwater samples. 58 groundwater samples were collected in polythene containers of 2 litres capacity for physicochemical and biological analysis after pumping out sufficient quantity of water from the source such that, the sample collected served as a representative sample. For bacterial analysis, samples were collected in sterilized

polythene bottles of 1 litre capacity from the source. The samples thus collected were transported to the laboratory at freezer condition (4°C).

C. Analysis of Groundwater Samples

The groundwater quality was assessed by the analysis of physicochemical and bacteriological parameters such as pH, colour, turbidity, electrical conductivity, total dissolved solids, alkalinity, chlorides, total hardness, calcium hardness, nitrates, sulphates, iron and fluorides The Bureau of Indian Standards (BIS) for drinking water quality for various parameters is presented in the table.

The analytical methods used to measure chemical parameters of groundwater samples collected from all the sampling stations are listed The water samples were analyzed adopting standard methods in the Environmental Laboratory, Dept of Civil Engineering, BMS College of Engineering.

Sl.No	***Physico-chemical Parameter***	***Method***
1	pH	Electrometry (pH meter)
2	Conductivity	Conductivity probe
3	Total Hardness	Complexometry by EDTA titration
4	Alkalinity	Argentometry (Titration)
5	Total Dissolved Solids	TDS Probe
6	Chloride	Argentometry (Titration)
7	Calcium	Argentometry (Titration)
8	Magnesium	Argentometry (Titration)
9	Sodium	Flame photometry
10	Potassium	Flame photometry
11	Nitrate	Spectrophotometry
12	Iron	Atomic absorption Spectrophotometry
13	Fluoride	Spectrophotometery using spadn Reagent

Table 1:- Methods Used for Groundwater analysis (Laboratory analytical methods)

D. Groundwater Quality

To assess the groundwater quality of the study area, the groundwater samples collected were analysed for 14 chemical parameters. The chemical parameters were assessed within 48hrs of sample collection. The water samples were analyzed adopting Standard Methods in the Environmental Laboratory, Dept of Civil Engineering, BMS college of Engineering, Bangalore. The results of all the parameters for different groundwater samples collected from 23 bore wells.

One of the purposes of the study is to understand the quality of groundwater in the Sub-Urban areas of Bangalore and pictorially represent it using Geographic Information System (GIS). spatially and retrieved for the spatial analysis and integration to produce the desirable output.

III. RESULTS AND DISCUSSION

➢ *Ph*:

pH is one of the most important parameters in water chemistry, defined as –log [H+], and measured as intensity of acidity or alkalinity on a logarithmic scale ranging from 0-14. In the study area, assessment of groundwater quality status indicates that all the values of pH are within the permissible limits of BIS for drinking water. The pH values in the study site were found to be in the range of 6.36-7.4.

➢ *Total Hardness:*

As per BIS, the desirable limit for total hardness is 300mgL-1 and can be accepted up to 600 mgL-1 in the absence of potable water. Total hardness in the study area were found to be in the range of 48-666 mgL-1 and out of 58 groundwater samples, 5 samples have total hardness value above the maximum acceptable limit of 600Mg/L

➢ *Electrical Conductivity*

Electrical conductivity (specific conductance) is the numerical expression of the ability of water to conduct electric current and is measured in terms of micro-Siemens per cm. It depends on the total concentration, mobility, valence and temperature of the ions in a solution. The conductance of the samples gives practical estimate of the variation in dissolved mineral content of the water sample. Generally conductance is defined as the reciprocal of the resistance involved and expressed as mho or Siemens (s).

➢ *TDS:*

The permissible level of TDS for drinking water is 500mgL-1 and in the absence of potable water source the permissible limit is up to 2000 mgL-1. From the analysis of the groundwater samples it is found that TDS value of all the samples were in the range of 117-1149 mgL-1 and within the permissible limit of 2000 mgL-1

➢ *CHLORIDES:*

Chlorides are leached from various rocks into soil and water by weathering. The chloride ion is highly mobile and is transported to closed basins or oceans. High Chloride content can corrode metals and affect the taste of food products. Therefore, water that is used in industry or processed for any use has recommended maximum chloride level. The maximum permissible limit of chloride as per BIS is 250 mgL-1 in drinking water. Chloride content of

groundwater samples in the study area were in the range of 6.98-266.5mgL

➢ *BICARBONATES:*

The major natural sources of bicarbonates are limestone and dolomite in the earth crust. It is generally present in quantity less than 500mgL-1. In the present study, the groundwater samples have Bicarbonates concentration varying from 24-604 mgL-1

➢ *FLUORIDE:*

The fluoride in drinking water should be within a range that slightly varies above and below 1 mg/L. In temperate regions, where water intake is low, fluoride level up to 1.5 mg/L is acceptable. The Ministry of Health, Government of India, has prescribed 1.0 and 2.0 mg/L as permissive and excessive limits for fluoride in drinking water, respectively. In the present study, the groundwater samples have fluoride concentration varying from 0.76-1.2 mgL-1 and 6 samples have fluoride value above the maximum permissible limit of 1.0 mgL-1.

	POSITION		CATIONS									ANIONS				
SL. no	Latitude	Longitude	pH	TDS	EC	TH	Ca^{2+}	Mg^{2+}	Na+	K+	Fe	HCO3	Cl	F	NO3+	S
1	12°59'32.01"	77°37'12.34"	8.2	330	290	578	109.09	65.124	9	5.5	0.11	67	58.89	0.86	AB	15
2	13°02'22.42"	77°37'14.29"	8.0	276	243	420	94.59	54.43	11	3.5	0.52	44	31.94	0.95	AB	33
3	13°01'28.10"	77°35'18.61"	8.1	117	590	298	25.3	12.5	7.5	0.25	0.74	68	36.93	0.98	AB	1.2
4	13°00'35.28"	77°34'21.53"	7.6	343	360	420	75.6	32.9	5.6	7.5	0.82	86	61.89	0.93	AB	16
5	12°57'40.30"	77°35'15.61"	8.6	344	600	293	14.5	7.5	9.6	7.4	0.64	52	120	1.0	AB	21
6	12°56'49.32"	77°37'12.06"	7.7	216	270	265	11.3	6.2	8.64	1.7	0.35	580	79	0.86	AB	23
7	12°57'35.26"	77°39'12.06"	7.5	270	290	464	64.2	32.11	14.11	2.7	1.01	496	6.98	0.92	AB	26
8	12°59'33.69"	77°39'59.38"	8.1	339	250	383	54.89	22.89	15.6	6.2	1.6	504	13.97	0.9	AB	20.2
9	13°01'28.32"	77°39'09.15"	8.3	878	1240	512	79.4	35.6	3.2	1.3	0.82	420	62.89	0.8	AB	14
10	13°04'55.39"	77°37'15.89"	7.6	625	1120	352	61.38	30.1	6.23	2.3	0.72	492	137.7	0.6	AB	12
11	13°03'26.74"	77°41'05.82"	7.9	677	470	664	120.56	54.6	15.2	1.1	0.7	470	9.98	0.51	AB	7
12	12°59'36.53"	77°42'49.55"	7.4	606	1010	480	76.25	32.6	9.5	1.1	0.76	385	39.93	0.16	AB	17
13	12°55'41.05"	77°41'06.08"	8.1	916	480	428	69.15	33.49	4.56	1.9	1.07	378	10.98	1.6	AB	13
14	12°54'08.59"	77°37'09.22"	8.3	716	920	571	79.68	36.25	9.8	1.2	0.86	445	200.6	0.96	AB	15
15	12°55'37.00"	77°33'21.43"	8.0	668	270	515	73.45	36.49	9.68	0.98	0.8	325	62.32	1.2	AB	18
16	13°59'34.51"	77°31'42.38"	8.5	661	390	639	131.05	64.28	10.23	1.8	0.8	345	60.93	1.1	AB	16
17	13°03'24.31"	77°33'25.18"	7.6	692	440	661	135.10	69.56	21.5	1.21	0.8	420	147.3	1	AB	22
18	13°07'45.55"	77°37'16.18"	8.2	707	1060	601	125.48	55.4	13.68	1.5	0.68	486	175.6	0.99	AB	27
19	13°51'19.28"	77°43'02.18"	8.3	766	450	525	101.5	49.2	16.68	0.25	0.94	370	227	0.86	AB	13
20	12°59'35.55"	77°45'31.75"	7.9	674	1740	615	116.2	49.65	24.10	0.9	.082	428	146	0.76	AB	21
21	12°53'44.81"	77°43'03.18"	7.4	762	1900	750	145.86	75.62	20.25	2.4	0.98	376	185	1.1	AB	25
22	12°51'22.32"	77°37'06.17"	7.8	1149	1970	458	75.36	35.62	6.5	3.5	0.8	440	238	0.96	AB	24
23	12°53'46.77"	77°31'22.31"	7.2	952	1480	268	15.42	7.2	3.4	1.5	0.95	604	330	1.0	AB	12

Table 2:- Chemical Analysis Of Groundwater

➢ *Iron:*

Iron is seldom found at concentrations greater than 10 milligrams per litre (mgL-1) and rarely may go up to 50mgL-1. In drinking water, iron shouldn't exceed 0.3mgL-1 and can be permissible up to 1 mgL-1, though for some industrial use it may have to be as little as 0.1mgL-1 (generally obtained by fully aeration). In the present study, all the groundwater samples have iron concentration within the permissible limit varying from 0.11-1.6 mgL-1.

Above 500mgL-1 imparts an unpleasant taste to water and renders it unfit for drinking. As per IS 10500: (2003), the desirable limit of magnesium is 30 mgL-1 and permissible limit in the absence of alternate source is 100 mgL-1. In the present study, the groundwater samples have magnesium concentration varying from 6.8-84.564 mgL-1.

➢ *Potassium*

Potassium is released into groundwater on weathering of rocks followed by leaching by rain water. Very high concentration of potassium over 200 mgL-1, may be harmful to nervous and digestive systems. No recommended limit is however reported . The range of potassium levels in the study area is 0.25-7.5 mgL-1.

Potassium is an essential element in humans and is seldom, if ever, found in drinking- water at levels that could be a concern for healthy humans. It occurs widely in the environment, including all natural waters. It can also occur in drinking-water as a consequence of the use of potassium permanganate as an oxidant in water treatment

IV. CONCLUSION

Groundwater in the study area has been contaminated, especially NO3-N pollution. Most physiochemical parameters have high variations in concentration. the samples with exceeding contents of nitrate are accounted for over 50% of all samples that have excess of sulphate, fluoride, Total dissolved solids, Total hardness has also exceeded by 40%.

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