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Study of Groundwater Quality in Anjana Sub Basin, Aurangabad Dist., India

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Abstract

An attempt has made to do the assessment of the groundwater quality in Anjana subbasin, in Aurangabad district, Maharashtra, India. A total number of twenty one groundwater samples were taken from the Dug well. All the groundwater samples are subjected to investigation of physico-chemical parameters such as pH, electrical conductivity, total dissolved solids, total alkalinity, chloride, sodium, potassium, calcium, magnesium, nitrate, sulphate, and fluoride. The obtained results are comparing with WHO and BIS standard values. The results show that parameters such as fluoride, and nitrate were in high concentration at some of the groundwater sampling stations. The study of physico-chemical characteristics of these groundwater samples suggest that to meet the constantly increasing need of potable groundwater, the best way is to power the groundwater by protecting it from pollution and augment the groundwater resources by recharging it all the way through rainwater harvesting.

Keywords: Groundwater, physico-chemical, water quality, Anjana subbasin, Aurangabad.

Introduction

The contest for groundwater resources has put on importance in recent years. Groundwater is the uncontaminated forms of groundwater sourced from natural resources and congregate the by and large require of rural and semi-urban community. But the development of human societies and industry result in bioenvironmental problems; pollution puts the water, air and soil resources at risk[1,2]. Groundwater quality depends on the quality of recharged water, atmospheric precipitation, inland surface water and subsurface geochemical processes. The chemical composition of groundwater is very important criteria that determine the quality of water. Water quality is very important and often degraded due to agricultural, industrial and human activities. Even though the natural environmental route provide by means of removing pollutants from groundwater, there are definite limits. It is up to the people to provide safety to protect and keep quality of water[3]. Drinking water with good quality is very important to improve the life of people and to prevent diseases[4,5]. Groundwater resources play a major role in ensuring livelihood security across the world, especially in economies that depend on agriculture. The socio-economic dependency on groundwater is explained over a range of factors[6,7,8]. Water resources have played a critical and vital role throughout history in the growth and development of human civilization. In modern times, water resources continue to be a factor of critical importance in the economic growth of all contemporary societies[9]. The major part of Maharashtra State is occupied by hard rock terrain especially Basalt where ground water resources availability is limited and ground water availability during the lean period is susceptible. Thus augmentation and management of ground water resources is indispensible measure to maintain the sustainability of the ground water[10]. Pollution of groundwater comes from many sources. Discharge of waste disposal from agriculture and etc. are main source of groundwater pollution. Sometimes surface run-off also brings mud, leaves, and human and animal wastes into surface water bodies. These pollutants may enter directly into the groundwater and contaminate it. The objective of this study was to determine the physico-chemical characteristics of groundwater in Anjana sub basin.

Study area: Anjana subbasin is a part of Purna basin and lies in Aurangabad district at the latitude 20°13’9’’ north to 20°20’34’’ and longitude of 75°10’00’’ to75°33’88’’ east covering an area of approximately 350.5 sq. km. this area sits in a strategic position on the Deccan Plateau. The climate of the area is characterized by a hot summer and a general dryness throughput the year except during the south west monsoon season, which is from June to September while October and November constitute the post monsoon season. The temperature varies between 24 and 40°C during the hottest months (April/May) and from 13 to 28°C during winter months (December/January). Annual average rainfall is about 660 mm.

Geology and Hydrogeology: Geologically the present area is underlain by basaltic rocks grouped under fissured formations. The formations are acting as aquifer, are vesicular basalt and fractured and jointed massive basalt. Alluvium also acting as a aquifer which covers 10% of the area. The thickness depends upon the intensity and duration of weathering. The depth of water level in subbasin varies from 6 to 8m during postmonsoon season and from 12 to 14m during premonsoon season. The soil

is mostly formed from igneous rocks and are black, medium black, shallow and calcareous types.

Material and Methods

In order to assess the physico-chemical parameters, a total of 21 ground water samples from different dugweell were collected in good quality polyethylene bottles of one-litre capacity. Prior to sampling all the sampling containers were washed as well as rinsed with the groundwater. The physical parameters such as pH and electrical conductivity were determined in the field at the time of sample collection. The chemical characteristics were determined immediately in the lab as per the standard methods for examination of water and wastewater[11] and Trivedi and Goel[12]. The entire results are compared with standard limit recommended by the Bureau of Indian Standards[13] (BIS), and WHO[14].

Hydrogeochemistry: Understanding the quality of groundwater is important as its quality for the reason that it is the main factor determining its suitability for household, consumption, agricultural and industrial use. The results of the physicochemical analysis are presented in table 1 and table 2 shows the critical parameters exceeding the BIS permissible limits along with the permissible limits for these parameters.

pH: The pH values of groundwater ranged from 6.49 to 8.47 with an average value 7.49. This shows that the groundwater of the study area is mainly alkaline in nature and all samples were within the permissible limit prescribed by BIS[13] (table-1 and table-2).

Electrical Conductivity (EC): The value of EC varied from 360µmhos/cm to 1320 µmhos/cm with mean value of 929 µmhos/cm. The maximum limit of EC in drinking water is prescribed as 1500 µmhos /cm as per WHO[14] standard. All samples are within the permissible limit (table-1 and table-2).

Total Dissolves solids (TDS): The TDS value ranged from 234 to 858 with a mean of 604mg/L. The BIS specifies a desirable total dissolved solids limit of 500mg/l and a maximum permissible limit of 2,000mg/L and study area shows 13 (62%) samples were exceeding desirable limit but within the maximum permissible limit as prescribed by BIS[13](table-1 and table-2).

Calcium (Ca^{++}): Calcium (Ca^{++}) values vary from 24 to 157 mg/L with an average value of 80 mg/L. The desirable limit of Calcium (Ca^{++}) for drinking water is specified by BIS[13] as 75 mg/L and a maximum permissible limit of 200 mg/L. It is observed that 10 (48%) samples were exceeding desirable limit but within the maximum permissible limit (table-1 and table-2).

Magnesium (Mg^{++}): Magnesium (Mg^{++}) concentration ranges' from 10 mg/L to 68 mg/L with mean values of 32 mg/L. According to BIS[13] the desirable values of Mg^{++} is 30 mg/L and a maximum permissible limit of 100 mg/L where 7 (33%) samples were exceeding desirable limit but are within the maximum permissible limit (table-1 and table-2).

Total Hardness: A total hardness value varies from 112 to 496 mg/L with a mean values 331 mg/L. The desirable limit of total hardness (TH) for drinking water is specified by BIS[13] as 300 mg/L and a maximum permissible limit of 600 mg/L. It is observed that 12 (57 %) of samples were exceeding desirable limit but are within maximum permissible limit (table-1 and table-2).

Chloride (Cl^-): The Chloride (Cl^-) ion concentration varied between 50 to 244 mg/L with a mean values 128 mg/L. All samples were within maximum permissible limit prescribed by BIS[13] (table-1 and table-2).

Total Alkalinity (TA): Alkalinity is the measure of the capacity of the water to neutralize a strong acid. The Alkalinity in the water is generally imparted by the salts of carbonates, silicates, etc. together with the hydroxyl ions in free state[12,15]. The bicarbonate alkalinity varies from 44 to 404mg/L with an average value of 227 mg/L (table-1).

Sodium (Na^+) and Potassium (K^+): Sodium and Potassium are present in a number of minerals. The increasing pollution of groundwater has resulted in a substantial increase in the sodium content of drinking water. Sodium (Na) and Potassium (K) values ranged from 26.5 to 101mg/L and 0.1 to 1.9mg/L with an average value of 55 to 0.51mg/L respectively (table-1).

Sulphate (SO^-_4): Sulphate content in groundwater is made possible through oxidation, precipitation, solution and concentration, as the water traverses throughout rocks[16]. The Sulphate (SO^-_4) values of groundwater ranged from 14 to 64mg/L with an average value 35 mg/L this show that the all the sample were within the maximum permissible limit prescribed by BIS[13] (table-1).

Fluoride (F^-): The Fluoride content of the samples groundwater ranged from 0.39 to 1.91 mg/L with an average value 1.22mg/L (Table-1). It is observed that 4 (19 %) of samples were exceeding maximum permissible limit prescribed by BIS[13] (Table-2). The fluoride infectivity in the groundwater point out the existence of fluoride-bearing minerals[17,18]. Consumption of fluoride-contaminated groundwater (>1.50 mg/l) origin dental fluorosis[19,20].

Nitrate (NO^-_3): The Nitrate content of the samples groundwater ranged from 12 to 79 mg/L with an average value 49mg/L (table-1). It is observed that 6 (29 %) of samples were exceeding maximum permissible limit prescribed by BIS[13] (table-2). Nitrate is sensible in occurrence of the groundwater samples of the study area. Household ravage and buried organic stuff have pitch in nitrate to groundwater[21].

Table-1
Physico-chemical analysis report of Anjana subbasin

Sr. No	pH	E.C.	TDS	Total Hardness	Ca	Mg	Na.	K.	Total Alkalinity	Cl	SO_4	F	NO_3
		µmhos /cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1	6.59	550	358	180	40	19	35.6	0.4	128	68	32	1.91	27
2	7.08	673	437	288	98	11	42	0.1	164	122	22	1.34	40
3	7.11	360	234	112	24	13	42.8	0.1	44	70	56	1.05	12
4	7.26	1080	702	432	157	10	55	0.1	272	176	42	1.25	45
5	7.72	945	614	344	115	14	49	0.1	168	150	54	0.77	45
6	7.19	1130	735	404	101	37	60.5	0.5	324	114	46	1.29	50
7	7.71	1290	839	496	93	64	75.9	1.5	404	142	31	1.32	79
8	7.32	936	608	372	82	41	51	1.4	356	82	14	1.4	51
9	7.15	710	462	280	67	27	33	0.7	236	62	16	1.39	42
10	7.01	750	488	220	50	23	26.5	0.5	184	50	25	1.03	29
11	7.15	690	449	252	54	28	30.5	0.4	204	58	26	1.16	43
12	7.51	840	546	212	62	14	32.6	1.9	188	62	18	1.57	28
13	8.32	1320	858	272	66	26	101	0.1	108	194	58.82	1.4	49
14	8.47	955	621	324	58	44	42.5	0.1	240	78	42.17	0.39	37
15	8.43	1222	794	476	126	39	79	0.1	268	222	54	1.03	44
16	7.71	1101	716	396	139	12	79	0.1	288	162	64	1.01	41
17	7.71	1020	663	388	50	64	62	0.6	244	182	32	1.14	37
18	7.85	620	403	248	67	19	45	0.1	160	112	23	1.53	40
19	7.07	1280	832	492	85	68	88	0.1	312	244	31	1.04	57
20	7.52	940	611	368	99	29	61	0.1	220	168	25	0.94	47
21	7.35	1090	709	392	58	60	60	1.8	248	162	29	1.58	54
Min.	6.59	360	234	112	24	10	26.5	0.1	44	50	14	0.39	12
Max.	8.47	1320	858	496	157	68	101	1.9	404	244	64	1.91	79
Average	7.49	929	604	331	80	32	55	0.51	227	128	35	1.22	43

Conclusion

The groundwater samples from the various places of Anjana subbasin area of Aurangabad district were analyzed and the analysis reports shows that the water quality parameters like F^- (19%), NO^-_3 (29%), exceeded maximum permissible limit prescribed by Bureau of Indian Standards (BIS) and World health organization (WHO), Guidelines for drinking water. The findings clearly indicate that the groundwater quality is getting deteriorate at some places due to excess use of fertilizer and domestic wastes. To meet the ever increasing need of potable groundwater, the best way is to control the groundwater by protecting it from contamination and increase the groundwater resources by recharging it through rainwater harvesting.

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Table-2
Comparison of the quality parameters of groundwater for drinking purpose

Sr.no	BIS,1991 and WHO,1993		Minimum	Maximum	Mean
	Highest Desirable	Maximum Permissible			
pH	6.5 to 8.5	No relaxation	6.59	8.47	7.49
EC		1500	360	1320	929
TDS	500	2000	234	858	604
TH	300	600	112	496	331
Ca^{2+}	75	200	24	157	80
Mg^{2+}	30	100	10	68	32
Na^{+}	-	200	26.5	101	55
Total Alkalinity	200	600	44	404	227
Cl^{-}	250	1000	50	244	128
SO_4^{2-}	200	400	14	64	35
NO_3^{-}	45	No relaxation	12	79	43
F^{-}	1	1.5	0.39	1.91	1.22

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