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A Study of Ground Water Quality of Anna Nagar West Extension

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Abstract: Groundwater is the major source of fresh water, which is getting polluted easily by the man- made activities. Pollution of water alters the quality of water, which restricts its use. In view of this, the present study was focused on the suitability of bore well water for potable application in Anna Nagar West Extension, Chennai. The results on the basis of pH, Total Hardness, Turbidity, Electrical conductance, Dissolved oxygen, some cations like Sodium, Calcium, Magnesium, Potassium, and anions like Chloride, Sulphates, Nitrates revealed that the water is fit for the potable application when subjected to suitable treatments.
Keywords: Groundwater quality, Water parameters, Anna Nagar West Extension.

1. Introduction:

Natural resources are the important wealth of a country; water is one of them. Water is a wonder of the nature. “No life without water” is a common saying depending upon the fact that water is one of the naturally occurring essential requirements of all life supporting activities.(1) Water resources and water quality affect the economic, social and political development of the society.(2) Since it is a dynamic system, containing many living, non-living, organic, inorganic, soluble and insoluble substances, the quality of water changes day by day and from source to source.(3)

The quality of water in any ecosystem provides significant information about the available resource for supporting life in that ecosystem.(4) Any change in the natural quality may disturb the equilibrium of system and would become unfit for designated uses. The availability of water through surface and groundwater resources has become critical day to day.(5) Only 1% part is available on land for drinking, agriculture, domestic power generation, industrial consummation, transportation and waste disposal.(6)

In India, most of the population is dependent on surface water as the only source of drinking water supply. The groundwater is believed to be comparatively much clean and free from pollution than the surface water.(7) But prolonged discharge of industrial effluents, domestic sewage and solid waste dump causes the groundwater to become polluted and creates health problems.(8)

Due to increased human population, industrialization, urbanization, use of fertilizers in agriculture and manmade activities, the natural aquatic biota are getting depleted.(9) Drinking of contaminated water results in variety of water-borne diseases. It is difficult to understand the biological phenomena fully because the chemistry of water reveals much about the metabolism of the ecosystem and explains the general hydrobiological relationship. (10) Hence, there is always a need for the concern over the protection and management of surface water and groundwater quality. (11)

Good quality of water resources depends on a large number of physicochemical parameters. The present study involves the analysis of water quality in terms of physicochemical parameters of Anna Nagar West extension, Chennai, Tamil Nadu, India.

2. Materials and Methods:

2.1. Study Area:

Anna Nagar West, formerly known as Naduvakkarai named after the Tamil Nadu leader C.N. Annadurai, is located under Ambattur taluk of Northwestern Chennai, Tamil Nadu, India. The geographical coordinates are 13°5′31″ North and 80°11′57″ East. The water sources are groundwater and municipal water.

2.2. Collection of Samples:

In order to determine the water quality of Anna Nagar West Extension, three locations [Location 1, L1: Anna 3rd Cross Street, Backiyathammal Nagar; Location 2, L2: 9th Street, Golden Colony; Location 3, L3: Srinivasa Nagar] were chosen for sample collection. The bore well water is collected between 9.00 am and 10.00 am during October 13-September 14 for physicochemical examinations. Different methods of collection and handling were adopted based on the standard procedures.(12)

2.3. Physicochemical Analysis:

Analysis was carried out for various water quality parameters such as pH, Total Hardness (TH), Turbidity, Electrical conductance (EC), Dissolved oxygen (DO), some cations like Sodium, Calcium, Magnesium, Potassium, and anions like Chloride, Sulphates, Nitrates using standard procedures. All the reagents used for the analysis were of Analar grade, and double distilled water was used for the preparation of the solutions.

3. Results and Discussion:

The results obtained for the water samples were compared with the standard referred by the WHO, EPA, CPCB (Tables 1-4).(13)

Table 1: Physicochemical parameters for sample water at L1

	Oct 13	Nov 13	Dec 13	Jan 14	Feb 14	Mar 14	Apr 14	May 14	Jun 14	Jul 14	Aug 14	Sep 14
PH	6.65	6.60	6.57	6.59	6.64	6.66	6.70	6.80	6.95	6.65	6.64	6.66
TH (ppm)	800	809	815	818	824	828	830	834	837	840	848	850
Turbidity(NTU)	539	520	518	520	530	535	539	545	555	534	530	538
EC(mho)	1.24	1.18	1.14	1.18	1.22	1.24	1.28	1.35	1.45	1.24	1.23	1.23
DO(ppm)	4.1	6.0	5.7	6.0	6.8	7.0	7.8	8.8	9.5	4.2	4.0	4.3
Sodium(ppm)	121.02	118.00	118.00	120.00	122.00	123.00	124.00	129.00	135.00	120.50	120.00	121.00
Calcium(ppm)	46.82	45.32	45.20	45.30	45.80	46.00	46.08	46.28	46.38	48.14	48.00	48.29
Magnesium(ppm)	16.32	16.52	16.50	16.70	16.90	17.10	17.40	17.80	18.20	17.53	17.50	17.58
Potassium(ppm)	6.00	5.89	5.88	6.00	6.05	6.07	6.12	6.30	6.45	5.93	5.89	6.00
Chlorides(ppm)	0.195	0.187	0.185	0.188	0.195	0.198	0.205	0.215	0.225	0.194	0.192	0.194
Sulphates(ppm)	56.90	56.50	56.620	56.70	56.90	57.30	57.60	58.00	60.00	57.20	57.20	57.40
Nitrates(ppm)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.15	BDL	BDL	BDL

Table 2: Physicochemical parameters for sample water at L2

	Oct 13	Nov 13	Dec 13	Jan 14	Feb 14	Mar 14	Apr 14	May 14	Jun 14	Jul 14	Aug 14	Sep 14
pH	6.82	6.80	6.76	6.78	6.84	6.92	7.00	7.10	6.84	6.83	6.81	6.83
TH (ppm)	700	702	706	710	714	717	720	722	738	730	740	750
Turbidity(NTU)	469	465	460	462	466	480	490	494	485	482	470	480
EC(mho)	1.09	1.07	1.00	1.02	1.05	1.12	1.16	1.20	1.14	1.12	1.09	1.11

DO(ppm)	5.15	5.12	5.12	5.13	5.15	5.30	5.40	5.42	5.35	5.30	5.00	5.24
Sodium(ppm)	114.00	113.92	113.90	113.92	113.95	115.27	117.30	117.50	116.80	116.50	110.00	116.00
Calcium(ppm)	45.09	45.00	44.96	44.99	45.00	45.00	45.42	45.92	45.94	45.70	45.50	44.70
Magnesium(ppm)	16.28	16.23	16.21	16.22	16.25	16.50	16.92	16.95	16.77	16.70	16.00	16.58
Potassium(ppm)	4.98	4.97	4.95	4.95	4.98	5.21	5.56	5.56	5.42	5.30	4.80	5.00
Chlorides(ppm)	0.162	0.162	0.161	0.161	0.161	0.164	0.166	0.166	0.165	0.165	0.162	0.165
Sulphates(ppm)	55.97	55.98	55.95	55.95	55.98	56.29	57.70	58.00	57.20	56.70	55.60	56.10
Nitrates(ppm)	BDL	BDL	BDL	BDL	BDL	BDL	0.11	0.12	BDL	BDL	BDL	BDL

Table 3: Physicochemical parameters for sample water at L3

	Oct 13	**Nov 13**	**Dec 13**	**Jan 14**	**Feb 14**	**Mar 14**	**Apr 14**	**May 14**	**Jun 14**	**Jul 14**	**Aug 14**	**Sep 14**
pH	5.55	5.50	5.48	5.48	5.49	5.49	5.6	5.62	5.60	5.59	5.58	5.58
TH (ppm)	7898	7905	7912	7919	7924	7933	7936	7939	7942	7946	7947	7950
Turbidity(NTU)	408	403	402	405	409	413	415	420	418	417	414	411
EC(mho)	11.78	11.76	11.75	11.85	11.88	11.95	12.00	12.05	12.03	11.98	11.92	11.81
DO(ppm)	3.76	3.73	3.72	3.69	3.70	3.72	3.74	3.75	3.76	3.76	3.77	3.84
Sodium(ppm)	135.00	134.50	134.20	134.60	134.90	135.30	136.70	137.00	137.60	138.00	138.30	139.00
Calcium(ppm)	51.50	51.10	51.00	51.20	51.20	51.30	51.40	51.50	51.70	51.80	51.90	52.00
Magnesium(ppm)	20.00	19.87	19.85	19.93	19.98	20.00	20.04	20.04	20.03	20.02	20.02	20.03
Potassium(ppm)	6.40	6.20	6.00	6.10	6.20	6.30	6.40	6.50	6.50	6.60	6.70	6.80
Chlorides(ppm)	2.248	2.240	2.238	2.258	2.259	2.260	2.263	2.265	2.261	2.258	2.256	2.254
Sulphates(ppm)	58.90	58.40	58.20	58.40	58.60	58.60	58.90	59.40	59.30	59.40	59.30	59.30
Nitrates(ppm)	0.10	BDL	BDL	BDL	0.11	0.11	0.12	0.13	0.12	0.12	0.12	0.12

Table 4: Average of physicochemical parameters for sample water at L1, L2 and L3

	L1	**L2**	**L3**	**Permissible limit**
pH	6.66	6.86	5.54	6.5-8.5
TH (ppm)	827.75	720.75	7929.25	300-600
Turbidity(NTU)	533.58	475.25	411.25	10-25
EC(mho)	1.24	1.10	11.89	200
DO(ppm)	6.187	5.222	3.740	2-6
Sodium(ppm)	122.62	106.58	126.25	200
Calcium(ppm)	46.46	45.31	51.46	75-200
Magnesium(ppm)	16.33	16.46	19.98	30-100
Potassium(ppm)	6.04	5.14	6.39	-
Chlorides(ppm)	1.977	1.636	2.255	250-1000
Sulphates(ppm)	57.36	56.45	58.89	150-400
Nitrates(ppm)	0.012(BDL)	0.019(BDL)	0.097	45

3.1. pH:

pH is a term used universally to express the intensity of the acid or alkaline condition of a solution. The pH values of the sample water at L1 varied between 6.57 and 6.95, at L2 between 6.76 and 7.10, and at L3 between 5.48 and 5.62. L3 had lower pH than L1, L2 and the permissible limit.

3.2. Total Hardness (TH):

Hardness is the property of water which prevents the lather formation with soap and increases the boiling points of water. Hardness of water mainly depends upon the amount of calcium or magnesium or both.(14) The total hardness of sample water at L1 was in the range of 800–850, at L2 in the range of 700–750 and at L3 in the range of 7898–7950 ppm. The values were slightly greater than the prescribed limit.

3.3. Turbidity:

The turbidity in sample water may be due to colloidal and extremely fine dispersions. The turbidity of the sample water at the locations L1, L2 and L3 were ranging between 518 and 555, 460 and 494, 402 and 420 NTU, respectively.

3.4. Electrical Conductance (EC):

Electrical conductivity of water is the capability to conduct electrical current, which is due to the presence of ions. (15) The electrical conductance of the sample water at L1 was found as 1.14-1.45, L2 was found as 1.00-1.20 and at L3 as 11.75-12.05 mho. The values were within the limits of the WHO.

3.5. Dissolved Oxygen (DO):

Dissolved oxygen analysis measures the amount of gaseous oxygen (O_2) dissolved in an aqueous solution. Oxygen gets into water by diffusion from the surrounding air, by aeration (rapid movement) and as a waste product of photosynthesis. (16) Environmental impact of total dissolved solids gas concentration in water should not exceed 110% (above 13-14 mg/l). Concentration above this level can be harmful to aquatic life. Adequate dissolved oxygen is necessary for good water quality. Dissolved Oxygen of L1 lies between 4.00 and 9.50, L2 lies between 5.00 and 5.42, and L3 lies between 3.69 and 3.84 ppm. The values were in the preferable limit.

3.6. Sodium:

In humans, sodium is an essential nutrient that regulates blood volume, blood pressure, osmotic equilibrium and pH; the minimum physiological requirement for sodium is 500 milligrams per day. Sodium is also important in neuron function and osmoregulation between cells and the extracellular fluid. (17) The sodium content of water sample at L1 ranged as 118.00-135.00, at L2 as 110.00-117.50 and at L3 as 134.20-139.00 ppm, and the values were of considerable amount within the limit

3.7. Potassium:

Together with nitrogen and phosphorous, potassium is one of the essential macrominerals for plant survival. Its presence is of great importance for soil health, plant growth and animal nutrition. (18) Its primary function in the plant is the maintenance of osmotic pressure and cell size, thereby influencing photosynthesis and energy production as well as stomatal opening and carbon dioxide supply, plant turgor and translocation of nutrients.(19)

It is also used in the treatment of hypokalemia and water softening. The potassium content of water sample at L1 was in the range of 5.88-6.45, at L2 in the range of 4.80-5.56, and at L3 in the range of 6.00-6.80 ppm

3.8. Calcium:

Calcium is related to the hardness of water and may negatively influence toxicity of other compounds. The calcium concentration of the sample was in the range of 45.20-48.29, 44.70-45.94, and 51.00-52.00 ppm at L1, L2 and L3, respectively. The values were in the limit prescribed for the parameters.

3.9. Magnesium:

Magnesium is very chemically active; it takes the place of hydrogen in boiling water, and a great number of metals can be produced by thermic reduction of its salts and oxidized forms with magnesium. (20)

Magnesium is also related to the hardness of water. The magnesium content of our water samples at L1, L2 and L3 were in the range of 16.32-18.20, 16.00-16.95 and 19.85-20.04, respectively. The summary shows that the values were within the limit.

3.10. Chloride:

Chlorides are the inorganic compounds resulting from the combination of the chlorine gas with metal. (21)

The chloride content serves as an indicator of pollution by sewage. People subjected to higher chloride in water are subjected to laxative effects. The chloride content of L1 was in the range of 0.185-0.225, L2 in the range of 0.161-0.166 and L3 in the range of 2.238-2.265 ppm which was found to be within the WHO limit.

3.11. Sulphates:

Sulphates occur naturally in the water as a result of leaching of gypsum and other common minerals. Discharge of industrial waste and domestic sewage will increase the sulphate content of water. (22) The investigation reports show that the sulphates at L1 lie in the range of 56.50-60.00, at L2 in the range of 55.60-58.00, at L3 in the range of 58.20-59.40 ppm. The values of the samples were within the prescribed limit.

3.12. Nitrates:

Nitrates are the naturally occurring ions that are part of nitrogen cycle. High level of nitrates in drinking water results in serious issues. (23) The nitrates content of the sample water at L1, L2 was Below Detection Limit (BDL) and at L3 in the range of 0.11-0.13 ppm, and the values were found to be within the limits of water quality parameters given by EPA.

4. Conclusion:

Deviations were observed in the water samples of Anna Nagar West Extension. The total hardness of the samples were beyond the limits, and the rest of the parameters, except chloride content of L3, were within the limits. Thus, the present investigation suggests that the groundwater of Anna Nagar West Extension is preferred for the potable application after following suitable water treatments to minimize the water-borne problems.

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