ANALYSIS OF GROUNDWATER QUALITY OF USILAMPATTI REGION IN TAMILNADU

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Abstract- *Water is the basis of life and it makes up to 60-95% of the total weight of any functioning living cell. However, in recent years due to increased human population, industrialization, urbanization and poor sanitation the water from various sources is getting polluted. Discharge of waste disposal from agriculture, industries and municipalities are main source of groundwater pollution. The present investigations were carried to analyse the quality of ground water samples in Usilampatti region of Tamilnadu, India. The physico-chemical parameters of water samples such as temperature (T), pH, Specific conductance, Total alkalinity (TA),Total dissolved solids (TDS), Total hardness (TH), Dissolved phosphates, Dissolved oxygen (DO), Chloride (Cl-), Fluoride (F-), Iron (Fe), Calcium (Ca) , BOD and COD have been carried out in Usilampatti region of Madurai District.The results revealed that the values of all the samples (S1,S2,S3,S4 and S5) are below the permissible limits for turbidity, specific conductance, hardness, TDS DO, chloride, fluoride , iron, COD and BOD. Whereas temperature, phosphate, and Calcium showed the values are above the permissible limits by WHO and BIS standards. The result showed that the all ground water samples are unfit for drinking and domestic purposes. Thus it concluded that Rain water harvesting is one of the solutions to minimize the inorganic chemical concentration in ground water. It is suggested that monitoring the ground water quality periodically to prevent further contamination is important.*

Keywords: Usilampatti region, Madurai District, Groundwater, Physico-chemical parameters, WHO and BIS.

1. INTRODUCTION

Water has always been an important and life-sustaining drink to humans and is essential for the survival of all known organisms. However, in recent years due to increased human population, industrialization, urbanization and poor sanitation the water from various sources is getting polluted. It accounts for about 70% of the weight of a human body. About 80% of the earth surface is covered by water out of which only a small fraction is available for consumption. The rest is locked up in oceans as salt water, polar ice caps, glaciers and underground. Groundwater is a significant source of water in many parts of India, especially in semiarid and arid regions. About 50% of the total irrigated area is dependent on groundwater. It is an important source of water for the agricultural and the industrial sectors. Groundwater quality is important as the quantity. Poor quality of water adversely affects the plant growth and human health. Hence, the demarcation of groundwater quality is of vital importance to augment groundwater resources [1].

Groundwater quality is a continuously changing phenomenon, variation occurs with time and space, so there is a need to check and revise the water quality parameters and maps, regularly with time and space. Geographical Information System (GIS) is the only system which handles spatial data as well as non-spatial data, analyses and manipulates the data and performs the most advanced type of planning, management and mapping. Discharge of waste disposal from agriculture, industries and municipalities 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. Contamination of ground water also depends on the geology of the area where extensive cavern systems are below the water table. The changes in quality of groundwater respond to the variation in physical, chemical and biological environments through which it passes [2].

In India, pollution and over extraction are important component of the groundwater problem. Therefore, even countries with vast water resources could suffer from scarcity of water in the near future. Because of the rise in the amount of soil pollution by dumping of municipal wastes, industrial waste and heavy use of fertilizers in agriculture land, properties of ground water have also been simultaneously changing [3]. Hence the present work is to explore the groundwater qualitative analysis of bore well water at different locations in Usilampatti region of Tamil Nadu, India. The physico- chemical parameters of water samples such as temperature (T), pH, Specific conductance, Total alkalinity (TA), Total dissolved solids (TDS), Total hardness (TH), Dissolved phosphates, Dissolved oxygen, Chloride (Cl^-), Fluoride (F^-), Iron (Fe), Calcium (Ca) , BOD and COD have been carried out. The test results were compared with the standard values of WHO and BIS and to suggest a

suitable remedial measure for the treatment of polluted water.

2. MATERIALS AND METHODS

2.1. Collection of water samples

Total five ground water samples (Aundipatti, Nakkalapatti, Varusanadu,Vaigaidam and Usilampatti) were collected from bore wells of study area in Table 1, using pre cleaned sterilized poly - propylene plastic bottle with cap. The sampling has been carried out in the month of Feb 2018. The samples in the canes were kept in the refrigerator. The water quality analysis was done as per the standard procedure of APHA [4]. Standards have been laid down by various agencies such as WHO and BIS for determining water quality for various uses.

3. RESULTS AND DISCUSSION

The water samples were collected from various areas of Usilampatti regions, and were analyzed for their physico-chemical characteristics. The estimated physicochemical parameters are reported in the Table 2. The discussions of various parameters in ground water samples of Usilampatti regions are given as follows:

3.1. Colour

Colour of water may be due to the presence of fine particles in suspension or due to certain mineral matter in solution. The entire collected samples S1,S2,S3,S4 and S5 had colourless which indicate that there may be the absence of colloidal substances, suspended and decomposed vegetation [5].

3.2 Odour and Taste

Organic and inorganic chemicals originating from domestic wastes and by decomposition of vegetables matter contributes taste and odour to the water. The entire collected samples S1, S2, S3, S4 and S5 had odourless, salty and normal.

3.3. Turbidity

Turbidity in natural water is caused by clay, organic matter and phytoplankton etc. All the samples show below the prescribed limit (WHO and BSI).

3.4. Temperature

The temperature of the water is important for its effect on the chemical and biological reactions of the organisms in water. Temperature is an essential factor in the determination of other parameters like conductivity and pH etc. The temperature of the samples ranged from 29-32°C.Temperature is basically important for the chemical and biological reactions of organisms in water. BIS and WHO permissible limit is 28-30°C.

3.5. Ph

The water samples ranged from 7.0-8.2. Almost all the sites show that pH is slightly alkaline which is within the permissible limit for all the sample stations S1,S2,S3,S4 and S5. If pH values are higher than the permissible limit, this will affect adversely alkalinity of soils, microbial life, mucous membrane of cells and corrosion rate [6].

3.6. Electrical conductivity

The values were found to vary from 990 to 1474 µmhos/cm, which are quite higher than the limits of the prescribed standards (1500µmhos/cm) as recommended by WHO except samples S1,S2,S3,S4 and S5. Several factors like temperature, ionic mobility and ionic valences also influence the conductivity [5].

3.7. Total Alkalinity

Total alkalinity of water samples were lies in the range from 222 to 266 mg/L. Sample S1 had high concentration of alkalinity and exceeds the permissible limit proposed by BIS and WHO in Table 3. High alkalinity in water bodies leads to sour taste and salinity. Alkalinity in water is due to the presence of carbonates, bicarbonates and hydroxides. In general, excessive alkalinity may cause stomach upset and encrustation of utensils, pipes and water heaters. High levels can also give a flat taste to the water and cause itchy skin when bathing [7].

3.8. Total hardness

The samples ranged from 312 to 350mg/L. On the basis of total hardness, water samples analysed can be classified as soft (0-70mg/L), moderately hard (75-150mg/L), and hard (150-300mg/L) and very hard (above 300mg/L). The standard value of hardness ranges for a good quality water range is 300-600mg/L. In general, total hardness is very high due to the high content of calcium and magnesium salts.

Table-1 Different samples around Usilampatti region

Sample. No	Sampling stations	Source	Depth in feet
S1	Aundipatti	Borewell	350
S2	Nakkalapatti	Borewell	350
S3	Varusanaddu	Borewell	300
S4	Vaigaidam	Borewell	250
S5	Usilampatti	Borewell	400

Table 2: Results of physico-chemical parametres of ground water samples at different locations of Usilampatti region.

Para meters	S1	S2	S3	S4	S5	BIS (2012) (IS10500)	WHO [8] (2011)	Significance / Health effects
Colour	Colour less	Colour less	Colour less	Colour less	Colour less	–	–	Consumer acceptance decreases
Odour	Odour Less	Odour less	Odour Less	Odour Less	Odour less	–	–	Consumer acceptance decreases
Taste	Normal	Normal	Salty	Normal	Normal	–	–	Consumer acceptance decreases
Turbidity	1NTU	1NTU	2NTU	1NTU	1NTU	5 NTU	5NTU	Consumer acceptance decreases
Temperature	31	30	32	29	31	28-30	28-30	Consumer acceptance decreases
pH	7.0	7.9	8.2	8.0	7.1	7.0-8.5	7.0-8.5	Mucous membranes affected, corrosion and skin irritation.
Specific Conductance	1110	1474	990	1332	1080	1500	1500	Laxative effect
Alkalinity	266	245	222	250	231	250	250	Flat taste to the water and cause itchy skin when bathing.
Total Hardness	320	316	350	312	334	300-600	300-600	Forms scum and curd; causes yellowing of fabrics; toughens vegetables cooked in the water; excessive scale deposits in pipes, heaters, and boilers.
Dissolved Oxygen	5.9	5.7	6.5	6.3	5.7	8-10	8-10	Undesirable taste, Gastro-intestinal irritation and corrosion.
Phosphates	0.40	0.24	0.19	0.33	0.43	0.1	0.1	Algal growth
Total Dissolved Solids	721	958	687	858	802	1500	1500	This causes fish and other forms of oxygen consuming aquatic life to death.
Chloride	134	277	245	226	281	250	250	Taste affected corrosive.
Fluoride	<0.1	<0.1	0.13	0.11	<0.1	1.0	1-1.15	Dental and skeletal fluorosis.
Iron	0.11	0.13	<0.1	0.13	<0.1	0.3	0.32	Stinging of materials.

Calcium	123	80	92	115	79	75	75	Poor lather with soap and deterioration of cloths scale formation.
BOD	<2.0	<2.0	2.5	2.5	2.1	5	5	Maximum biological activity at elevated temperature.
COD	4.0	4.0	4.5	4.3	4.1	10	10	It causes toxic effects on aquatic life.

3.9. Dissolved oxygen (DO)

The DO values in the groundwater samples have observed from 5.7 to 6.5 mg/L. The S3 highest value (6.5mg/L) of DO is recorded and at station S2 and S5 had the lowest value (5.7 mg/L). This lowest value may be slightly affecting the fish life in aquatic system. The concentration of dissolved oxygen in clean water is 8- 10 mg/L. In this investigation, the DO is very low in all the groundwater samples. It indicates that the deoxygenating is due to biological decomposition of organic matter. The dissolved oxygen is a regulator of metabolic activities of organisms. Oxygen is generally reduced in the water due to respiration of biota, decomposition of organic matter, rise in temperature, oxygen demanding wastes and inorganic reluctant [9].

3.10. Phosphates

The value of phosphate in the groundwater samples lies between 0.19 to 0.43 mg/L. Highest value (0.43 mg/L) is recorded at station S5 and minimum value (0.19 mg/L) is recorded at station S3. In the study, the phosphate values are found within the permissible limit (0.1 mg/L) of WHO and BIS. Normally groundwater contains only a minimum phosphorus level because of the low solubility of native phosphate minerals and the ability of soils to retain phosphate. The major cause for phosphate concentration in ground water may due to the agricultural runoff from the irrigated lands containing phosphate fertilizers.

3.11. Total dissolved solids

Total dissolved solids were observed in the range of 687 to 958mg/L and these values within the limit as prescribed by WHO and BIS. The samples which have high values of TDS are unsuitable for drinking and irrigation. The maximum allowable limit of total dissolved solids in groundwater for domestic purpose is 1500 mg/L (WHO and BIS). The maximum value (958mg/L) is recorded at station S2 and minimum value (687 mg/l) is recorded at station S3. It is essential to classify the ground waters depending upon their hydro chemical properties based on TDS values for ascertaining the suitability of groundwater for any purpose.

3.12. Chlorides

The value of chloride for all the groundwater samples is ranged from 134-281mg/L. Most of the groundwater samples show chloride values within the acceptable limit (250 mg/L) of WHO and BIS. The groundwater sample at station S2 and S5 has slightly excess chloride (277 and 281 mg/L). Excess chloride (>250 mg/L) imparts a salty taste to water. Increase of chlorine level in water is injurious to people suffering due to heart and kidney diseases.

3.13. Fluorides

The value of fluorides for the groundwater samples is recorded between <0.1and 0.13 mg/L. The maximum allowed limit of fluoride according to WHO is 1.0 mg/L. The fluoride values for all the groundwater samples are within the permissible limit. High concentration of fluoride in groundwater may be due to breakdown of rocks and soils or infiltration of chemical fertilizers from agricultural land. Skeletal fluorosis is an important disease due to presence of high fluoride content in groundwater [10].

3.14. Iron

Iron content of water ranges from <0.1 mg/L to 0.13 mg/L. Low range was found at all bore wells. Iron usually exists in ferrous and ferric forms. Dependence on these boreholes as a source of iron can result in anaemia. Iron is an essential element in human nutrition. The minimum daily requirement of iron is ranged from about 10 to 50 mg/day. BIS permissible limit is 0.3 mg/L. It is vital in oxygen transport in the blood of all vertebrate and some invertebrate animals.

3.15. Calcium

Calcium ranged from 79 to 123mg/L and these values are above the desirable limit of 75mg/L in all the samples (S1,S2,S3,S4 and S5). Calcium may dissolve readily from carbonate rocks and lime stones or be leached from soils. But calcium is an essential nutritional element for human being and aids in the maintaining the structure of plant cells and soils.

3.16. Biochemical oxygen demand (BOD)

Biochemical oxygen demand is used as an experimental measure of the amount of biochemically degradable organic matter present in a water sample. It is the amount of oxygen required for microbial metabolism of organic compounds in water. Its demand occurs some variable period of time depending on temperature, nutrient concentration and the enzyme available to indigenous microbial population. In the study, BOD value of the groundwater samples are recorded in the range of <2.0 to 2.5 mg/L. All the ground water samples are within the permissible limit (5 mg/L) of WHO and BIS. Generally, high value may be attributed to the maximum biological activity at elevated temperature whereas the lowest BOD may indicate lower biological activity [11].

3.17. Chemical oxygen demand (COD)

COD is a measure of the oxygen required for the chemical oxidation of organic matter. The values of COD in the groundwater samples are found to be in the range of 4.0 - 4.5 mg/L. The maximum value (4.5 mg/L) is recorded at station S3 and minimum value (4.0 mg/L) is recorded at station S1 and S2. The COD values at all sampling stations are within the permissible limit (10 mg/L) according to WHO and BIS. High COD may cause oxygen depletion on account of decomposition of microbes to a level detrimental to aquatic life.

4. CONCLUSION

Assessment of Groundwater quality in Usilampatti region of Tamilnadu has been carried out. The results revealed that the values of all the samples (S1,S2,S3,S4 and S5) are below the permissible limits for turbidity, specific conductance, hardness, TDS DO, chloride, fluoride, iron, COD and BOD. Whereas temperature, phosphate and Calcium showed the values are above the permissible limits by WHO and BIS standards. The result showed that the all ground water samples are unfit for drinking and domestic purposes.

4.1 Recommendations

1. Rain water harvesting is one of the solutions to minimize the inorganic chemical concentration in ground water.
2. From the observed results it is suggested that monitor the ground water quality periodically to prevent further contamination is important. Groundwater is extremely important to the future economy and growth of the country. This is of great importance, because the problem concerns securing a safe drinking water supply for the present and future generation. The ground water quality assessment guides in a better way to get the information about the sources of pollution and to identify the main parameters of knowing the relevant information. It is obviously clear from the obtained results that the ground water source is polluted. To avoid the effect of the pollution, various precautionary and remedial measures must be done immediately.

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