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Research Article

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A comparative assessment on ground water quality of rural and city locations of Salem district, Tamil Nadu, India

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ABSTRACT

Ground water quality was evaluated using the physico-chemical parameters in the city and rural locations of Salem district, Tamil Nadu, India after North-East monsoon. Water samples were collected from ten city and seven rural locations of Salem district. In this study, different parameters like pH, temperature, TDS, alkalinity, hardness, Fe, dissolve oxygen, chloride, sulphate, BOD were analysed. The conducted study suggested that water quality management practices must be carried out regularly to conserve the water resources.

Keywords: Ground water, physico-chemical analysis, water quality, BOD, Salem

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INTRODUCTION

Water plays vital role for human life**.** Ground water has an essential role in human life. The consequences of urbanization and industrialization lead to ruin the water for agricultural purposes. Ground water is explored in rural especially in those areas where other sources of water like dam and river or a canal is not considerable [1]. During last decade, this is observed that ground water get polluted drastically because of increased human activities. Consequently number of cases of water borne diseases has been seen which a cause of health hazards [2]. An understanding of water chemistry is the bases of the knowledge of the multidimensional aspect of aquatic environmental chemistry which involves the source, composition, reactions and transportation of water [3,4,5]. The quality of water is of vital concern for the mankind since it is directly linked with human welfare. It is a matter of history that facial pollution of drinking water caused water-borne diseases which wiped out entire population of the studied. Water quality assessment is essential for pollution control and protection of surface and ground waters.

The objective of the present work is an attempt to measure the groundwater water quality and to know the suitability of ground water as a potable water at ten city locations such as New bus stand, Ammapet, Kannakurichi, Old bus stand, Ponnamapet, Hasthampatty, Ramakrishna road, Four road, Gorimedu and Korangusavadi and at seven rural locations such as Puthu road, Poosaripatty, Nalikalpatty, Theivettipatty, Pottaneri, Muthunaikanpatti and Panchukalipatty of Salem district, Tamil Nadu, India.

Study area: Salem District in Tamil Nadu is geographically situated between the North latitudes 11°14´ to 12°53´ and East longitudes 77 °44´ to 78° 50´ covering an area about 7905.38 square kilometers. The present study area is shown in the Fig 1. The study area experiences arid and semi-arid climate with an average annual minimum and maximum temperature 18.9°C and 37.9°C respectively. The geographical formation of study area comprises hard rock types of granites, gneiss, charnockite, dunite, pyroxinite, mica and quartzite. The minerals found in this locations are magnesite, bauxite, quartz, feldspar, limestone, soapstone, dunite, roughstone, granites [6].

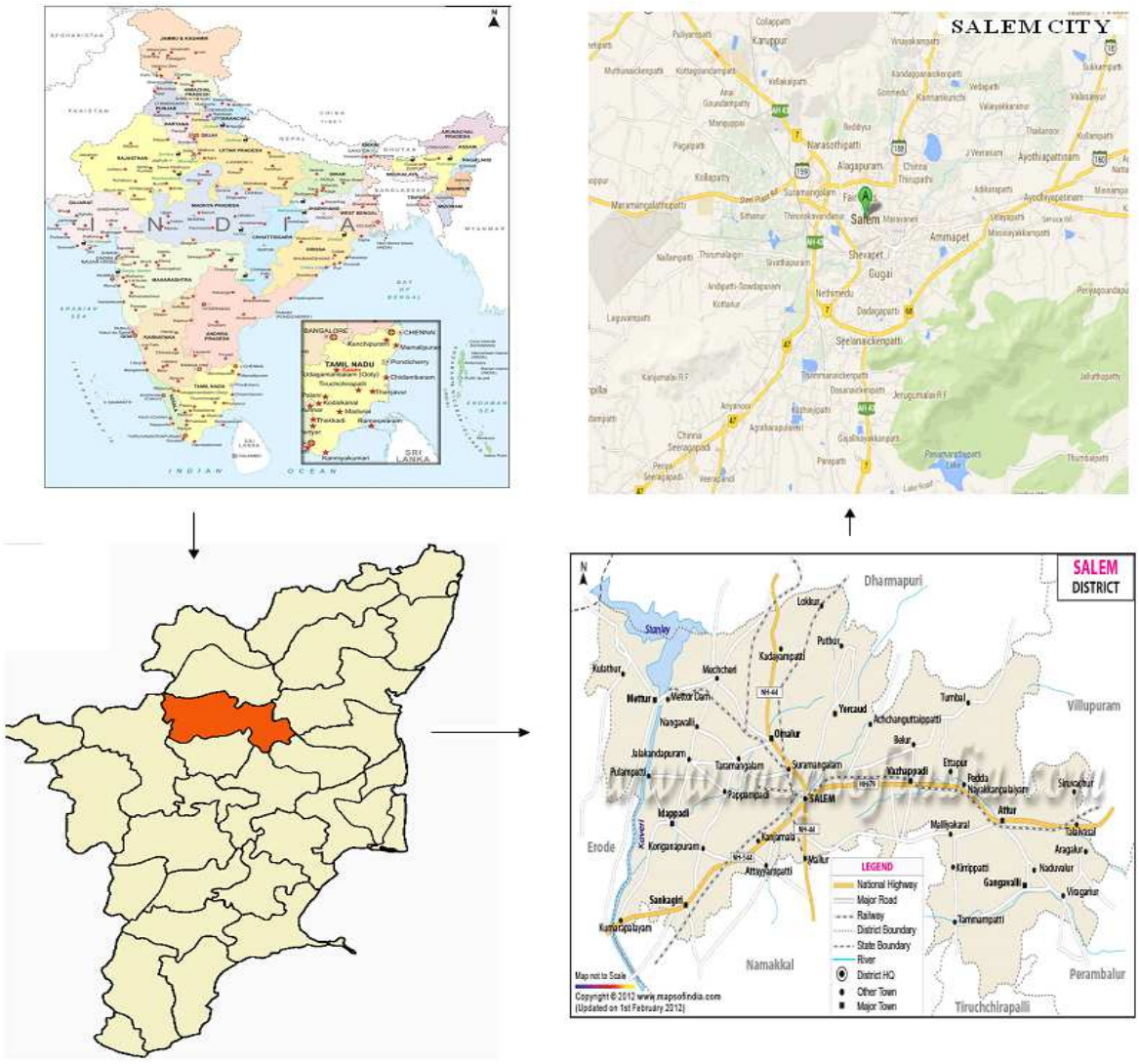

Fig.1. Study area for analysis

EXPERIMENTAL SECTION

Water samples were collected in polyethylene bottles of two litres with necessary precaution from all locations. They were then carefully sealed, labelled and taken for analysis of physico-chemical parameters such pH, temperature, TDS, alkalinity, hardness, Fe, dissolved oxygen, chloride, sulphate, BOD. The reagents used for this study were analytical grade. The groundwater samples were subjected to physico-chemical analysis using standard procedure by APHA [7].

RESULTS AND DISCUSSION

The groundwater samples were collected in and around Salem district. The obtained results are given in Table 1 and Table 2 for city locations and rural locations respectively. The experimental results are compared with the limits recommended by ISI and discussed. Groundwater comes into intimate contact with various mineral, which are soluble in water in varying degrees. The dissolved minerals determine the property of the water for various purposes. The water from the study area of has no colour, odour. Taste of the water of the water sample in most of the locations pleasant in taste.

pH: The pH is used to determine whether a solution is acidic or alkaline. The pH values of city locations groundwater samples are found to be in the range of 6.95 - 7.70 (Table 1). The highest value of 7.70 is observed at Ammapet area whereas the lowest value of 6.95 is observed at Gorimedu area. The pH values of rural locations groundwater samples are found to be in the range of 6.82 - 7.60 (Table 2). The highest value of 7.60 is observed at

Muthunaikanpatti area whereas the lowest value of 6.82 is observed at Nalikalpatty area. The permissible limit of pH for drinking water is 6.5 - 8.5 (ISI standards). The groundwater samples in both city and rural locations are found to be within the acceptable limit of ISI standards. There is no abnormal change of pH in the groundwater samples. If the pH is found beyond the permissible limit, it affects the mucous membrane of cells [8].

Temperature: The temperature values of city areas groundwater samples are found to be in the range of 26.9 ^{0}C – 30.0 ^{0}C (Table 1). The highest value of 30.0 ^{0}C is observed at Ramakrishna road area whereas the lowest value of 26.9 ^{0}C is observed at Hasthampatty and Gorimedu areas. The temperature values of rural locations groundwater samples are found to be in the range of 26.0 ^{0}C – 29.80 ^{0}C (Table 2). The highest value of 29.8 ^{0}C is observed at Theivettiipatti area whereas the lowest value of 26.0 ^{0}C is observed at Panchukalipatty area. The permissible limit of temperature for drinking water should not exceed 5 ^{0}C above the receiving water temperature (ISI standards). The groundwater sample is found to be within the acceptable limit of ISI standards. Water temperature regulates the metabolism of the aquatic ecosystem. High water temperature stress aquatic ecosystem by reducing the ability of water to hold essential dissolved gases like oxygen.

Total dissolved solids (TDS): The total dissolved solids in water are due to the presence of sodium, potassium, calcium, magnesium, manganese, carbonates, bicarbonates, chlorides, phosphate, organic matter, and other particles. The values of the total dissolved solids for the city locations groundwater samples vary between 268 and 1742 mg/l (Table 1). The maximum value (1742 mg/l) is recorded at New bus stand and minimum value (268 mg/l) is recorded at Ammapet area. The values of the total dissolved solids for the rural locations groundwater samples vary between 536 and 2546 mg/l (Table 2). The maximum value (2546 mg/l) is recorded at Muthunayakanpatti and minimum value (536 mg/l) is recorded at Pottaneri area. The maximum allowable limit of total dissolved solids in drinking water is 500 mg/l (ISI standards). Away from this permissible level, palatability decreases and may cause gastro intentional irritation [8].

Hardness: Hardness of the water is due to presence of Ca and Mg salts. The hardness values of city locations groundwater samples were recorded between 115 and 970 mg/l (Table 1). The maximum value (970 mg/l) is observed at New bus stand area and minimum value (115 mg/l) recorded at Ammapet area. The hardness values of rural areas groundwater samples were recorded between 330 and 780 mg/l (Table 2). The maximum value (780 mg/l) is observed at Poosaripatty area and minimum value (330 mg/l) recorded at Pottaneri area. The permissible level of hardness is 300 mg/l (ISI standards). The most of the ground water samples have crossed this permissible level. Encrustation in water supply structure and adverse effects on domestic use occur beyond this permissible level.

Alkalinity: Alkalinity of the water is due to presence of carbonates, bicarbonates and hydroxide salts. The alkalinity values of city locations groundwater samples were recorded between 15 and 75.0 mg/l (Table 1). The maximum value (75 mg/l) is observed at New bus stand area and minimum value (15 mg/l) recorded at Ammapet area. The alkalinity values of rural locations groundwater samples were recorded between 48.5 and 120 mg/l (Table 2). The maximum value (120 mg/l) is observed at Muthunayakanpatti area and minimum value (48.5 mg/l) recorded at Pottaneri area.The permissible level of alkalinity is 200 mg/l (ISI standards). All the ground water samples are found to be with in the permissible level. High amount of alkalinity in water is harmful for irrigation which leads to soil damage and reduce crop yields [9].

Chloride (Cl): The value of chloride for city locations groundwater samples is ranged from 4.4 – 41.6 mg/l (Table 1). The highest value of 41.6 mg/l is observed at New bus stand area whereas the lowest value of 4.4 mg/l is observed at Ammapet area. Rural locations groundwater samples show chloride values within the acceptable limit (250 mg/l) of ISI standards. The highest value of 79.7 mg/l is observed at Muthunayakanpatti area whereas the lowest value of 7.9 mg/l is observed at Pottaneri area (Table 2). Both the city and rural locations groundwater samples show chloride values within the acceptable limit (250 mg/l) of ISI standards. Excessive chloride in potable water is particularly not harmful but the criteria set for chloride value is based on its potentially high corrosiveness. Soil porosity and permeability also play an important role in building up the chloride value. Increase of chlorine level in water is injurious to people suffering due to heart and kidney diseases [10].

Sulphate (SO_4): The sulphate values for the city locations groundwater samples are exhibited between 225 and 31 mg/l (Table 1). The maximum value (225 mg/l) is noted at New bus stand and minimum value of sulphate (31 mg/l) is noted at Ammapet area. The sulphate values for all the groundwater samples are well within the permissible limit except New bus stand area (200 mg/l) of ISI standards. The sulphate values for the rural areas groundwater samples are exhibited between 83 and 297 mg/l (Table 2). The maximum value (297 mg/l) is noted at Muthunayakanpatti area and minimum value of sulphate (83 mg/l) is noted at Pottaneri area. The sulphate values for all the groundwater samples are well within the permissible limit except Muthunayakanpatti area (200 mg/l) of ISI standards. High

concentration of sulphate may cause gastro – intestinal irritation particularly when magnesium and sodium ions are also present in drinking water resources [11].

Iron (Fe): The Fe values for the city locations groundwater samples are exhibited between 1.1 and 1.5 mg/l (Table 1) . Highest value (1.5 mg/l) is noted at Old bus stand and minimum value of Fe (1.1 mg/l) is noted at Gorimedu area. The Fe values for the rural locations groundwater samples are exhibited between 0.55 and 0.80 mg/l (Table 2). The maximum value (0.80 mg/l) is noted at Muthunayakanpatti area and minimum value of Fe (0.55 mg/l) is noted at Theivettipatti area. All the city and rural locations groundwater samples have crossed the permissible limit (0.3 mg/l) of ISI standards. Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures, and promotes iron bacteria.

Dissolved oxygen (DO): The DO values in the city locations groundwater samples were observed from 1.36 to 2.76 mg/l (Table 1). The highest value (2.76 mg/l) of DO is recorded at Ponnamapet area whereas the lowest value (1.36 mg/l) is recorded at Kurangusavadi area. The DO values in the rural locations groundwater samples were observed from 1.16 to 2.92 mg/l (Table 2). The highest value (2.92 mg/l) of DO is recorded at Theivettipatti whereas the lowest value (1.16 mg/l) is recorded at Poosaripatti area. 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 deoxygenation 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 [12].

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. The BOD value of the city locations groundwater samples are recorded in the range of 3.45 to 6.72 mg/l (Table 1). Most of the groundwater samples are exceeded the permissible limit (5 mg/l) of ISI standards. The BOD value of the groundwater samples are recorded in the range of 0.84 to 6.72 mg/l (Table 2). Muthunayakanpatti and Theivettipati groundwater samples have exceeded the permissible limit (5 mg/l) of ISI standards. This indicates that the groundwater has suffered degradation due to continuous discharge of domestic, industrial and municipal sewage. The high value of BOD at all sampling stations indicates the pollution by biochemically degradable organic wastes from various sources.

Table 1. Physico-chemical parameters for ground water samples from city locations

S.No	Location	pH	Temperature (^{0}C)	TDS (ppm)	Hardness (ppm)	Alkalinity (ppm)	Cl (ppm)	SO_4 (ppm)	Fe (ppm)	DO (ppm)	BOD (ppm)
1	New bus stand	7.5	28	1742	970	75	41.6	225	1.2	1.6	6.72
2	Ammapet	7.7	28.5	268	115	15	4.4	31	1	2.6	6.5
3	Kannakurichi	7.3	28.8	1345	692	58	35	170	1.4	2.7	6.4
4	Old bus stand	7	29.7	1471	422	60	28.1	178	1.5	1.9	4.2
5	Ponnamapet	7.6	29	1197	446	56	17.2	153	1.4	2.76	6.4
6	Hasthampatty	7.5	26.9	1065	618	61	16.1	138	1.3	6.7	3.6
7	Ramakrishna road	7.2	30	1405	772	63	35.3	168	1.3	2.8	4.9
8	Four road	7.3	27.1	1062	191	64	17	140	1.2	2.4	5.2
9	Gorimedu	6.95	26.9	1005	176	52	14.2	132	1.1	1.65	3.45
10	Kurangusavady	7.4	27	1012	182	66	16.1	134	1.2	1.36	6.5

Table 2. Physico-chemical parameters for ground water samples from rural locations

S. No	Location	pH	Temperature (^{0}C)	TDS (ppm)	Hardness (ppm)	Alkalinity (ppm)	Cl (ppm)	SO_4 (ppm)	Fe (ppm)	DO (ppm)	BOD (ppm)
1	Pudu road	7.17	29.1	1171	352	75	42	155	0.76	1.6	2.94
2	Poosaripatty	6.9	29	1002	780	56	35	132	0.73	1.16	0.84
3	Nalikkalpatti	6.82	28.8	575	502	52	13	87	0.59	1.75	2.61
4	Theivettipatti	7.05	29.8	1213	624	63	48	143	0.55	2.92	6.34
5	Pottaneri	6.88	28.7	536	330	48.5	7.9	83	0.74	1.83	4.21
6	Muthunaickenpatty	7.6	27	2546	505	120	79.7	297	0.8	2.68	6.72

CONCLUSION

Groundwater samples were collected from ten city and seven rural locations of Salem district and analyzed for pH, temperature, TDS, alkalinity, hardness, Fe, DO, chloride, sulphate, BOD using standard procedures. The values of both city and rural locations groundwater samples are compared with the standard permissible values. TDS, BOD and Fe content are exceeding the permissible limit in most of the groundwater samples. The maximum parameters

for city location ground water sample from Ammapet area are at permissible level as per ISI standards and which is more suitable for drinking purpose as compared to other city location water samples and water sample collected from New bus stand location is highly polluted as compared other water samples. Similarly, it has been found that rural location ground water sample from Muthunayakanpatty area is highly contaminated as compared to other areas water samples. The maximum parameters for ground water sample from Pottaneri area are at permissible level as per ISI standards and which is suitable for drinking purpose. Most of the water samples from both city and rural locations are having more TDS, hardness, BOD and the areas like New bus stand (city) and Muthunaickenpatty (rural) are highly polluted. From the obtained results, it is suggested to monitor the groundwater quality and assess periodically in this study area to prevent the further contamination.

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