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ASSESSMENT OF GROUNDWATER CONTAMINATION AND ITS IMPACT IN METTUPALAYAM TALUK -COIMBATORE DISTRICT, TAMILNADU, INDIA

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ABSTRACT

This study aims to analyze the groundwater quality in mettupalayam Taluk. The conditions under which groundwater may become contaminated, and the groundwater vulnerable zones of contamination in the aquifer is analyzed in the Study area. The area selected for study is Mettupalayam Taluk which lies in the 11.3000°N 76.9500°. The vulnerability to contamination ranges between moderate to high due to the shallowness of water table and disposal of waste water. In the central and the eastern part, vulnerability to contamination is low due to depth of water table. GPS is used to select the sample location, 80 samples were taken from both the bore well and tube well for the study. The stations were selected in the Mettupalayam Taluk around four industries namely K.G denim Ltd., united bleachers Ltd., sharadha terry products Ltd., and ITC Ltd. The physio-chemical examinations were carried out for the selected samples. It was observed that the industries had the greater impact on water bodies around it.

Keywords: *Groundwater, Irrigation water quality, Sodium absorption Rat*

I. INTRODUCTION

A massive population explosion, industrialization, scientific advancements and urbanization have resulted in the release of a large quantum of variety of chemicals into the environment every year. There is no doubt that the developments of industries are essential for the growth of a nation but the side effects of industrial growth and urbanization have threatened the mankind in the form of pollution. There is no comprehensive Sewage and waste water disposal system in mettupalayam taluk. Many industries, particularly textile processing units, tanneries, and distillery units, are situated on the banks of Bhavani River. Bhavani river is polluted and the environment is degraded due to flow of untreated sewage / waste water into the river.

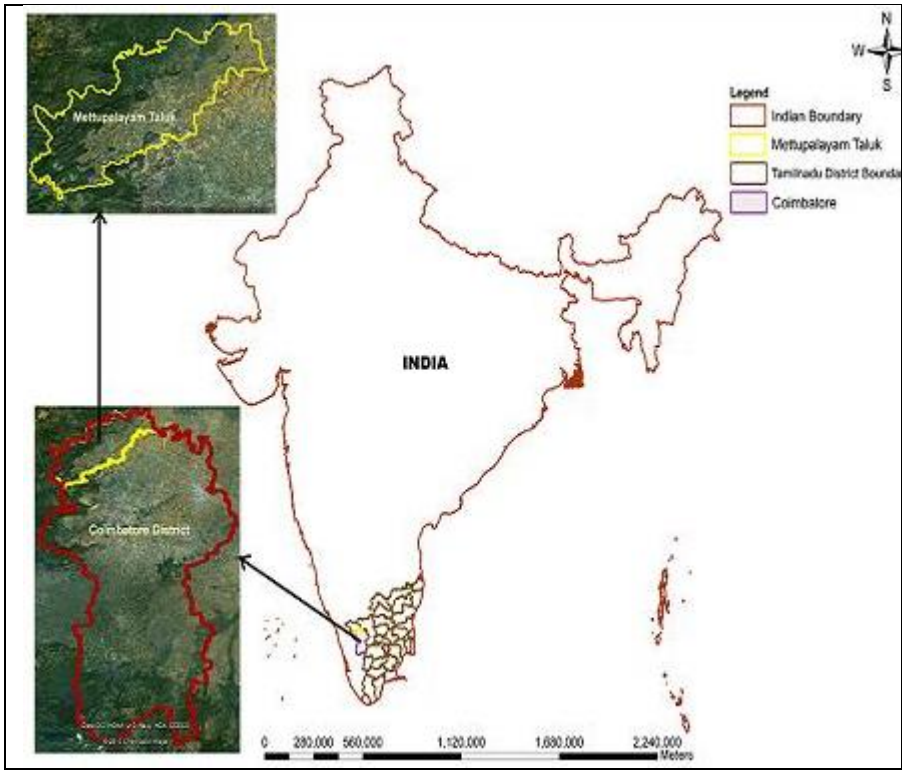
The water resources are vital for the development of ecosystem, agriculture and human settlement. The nation's most important natural resources. Very large Volume of ground water is pumped each day for industrial, agricultural and commercial purpose. The ground water is a drinking water source for about one half of the nation's population. Information on the quality and quantity of ground water is important because of the nations increasing population and dependency of these natural resources. Long term conservation, prudent development and management of these natural recourses are critical for preserving these priceless resources.

As per the international norms per capita water availability is less than the requirement. Now our country, India is water stressed and is expected to be water inadequate by 2050. Continued research, guidance and regulations by government agencies and pollution abetment programmes are necessary to preserve the nation's groundwater quality and quantity for future generations. Generally the ground quality is affected in two ways. a)contamination caused by the nature of the geological formation. b)contamination caused by human intervention ,like over exploitation of shallow ground water in the coastal area resulting in salt water intrusion and release of untreated domestic sewerage and industrial effluents. The discharge of industrial effluents is also accountable for the deterioration of physical, chemical and biological parameters of groundwater. The environmental impacts on the groundwater contaminants

may seriously affect the socio economic conditions of the country; hence the hydro geochemistry study was conducted in the Mettupalayam Taluk by collecting 15 groundwater samples along the industrial region from the dug well and bore well. The groundwater in the Mettupalayam Taluk is utilized for domestic, agriculture and industrial use.

II. STUDY AREA

Study area Mettupalayam Taluk is located in the foot hills of Nilgris. According to the 2011 census, the taluk of Mettupalayam had a population of 259,633 with 129,299 males and 130,334 females . Mettupalayam is located at 11.3000°N 76.9500°E. It has an average elevation of 314 metres. Mettupalayam Taluk is an important trading hub and transit centre for hill products including potatoes, vegetables, fruits, arecanut, tea and coffee, which are grown in the Nilgiris. Mettupalayam with a total land area of 7.20 sq. km. Mettupalayam Taluk falls in survey of India topo sheet No. 58 A/15/SW, No. 58 A/15/SE & No. 58 A/15/NE.



Climate:
The Taluk receives the rain under the influence of both southwest and northeast monsoons. The northeast monsoon chiefly contributes to the rainfall in the Taluk and summer rains are insignificant. The normal annual rainfall over the Taluk varies from about 550mm to 900mm.

The Taluk enjoys a tropical climate. The weather is pleasing in the period from November to January. On an average the humidity of the region in 78%, In afternoon the humidity is less when compared to Mornings. In the period June to November the afternoon humidity exceeds 66% on an average. In the rest of the year the afternoons are drier, the summer afternoons being the driest. The period from April to June is generally hot and dry. The temperature recorded varies from 11.7°C to 42.6°C.

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Geomorphology:
Mettupalayam Taluk forms part of the upland plateau region of Tamil Nadu with many hill ranges, hillocks and undulating topography with a gentle slope towards east except for the hilly terrain in the west. The rain water is stored in the tanks and used for agriculture which is formed based on the undulating topography.

The prominent geomorphic units identified in the Taluk through interpretation of Satellite imagery are 1) Structural hills, 2) Ridges, 3) Inselbergs, 4) Bazada, 5) Valley fill, 6) Pediment, 7) Shallow Pediments and 8) Deep Pediments.(1)

Soil:
The soils of Coimbatore Taluk can be broadly classified into 6 major soils types viz., Red calcareous Soil, Black Soil, Red non-calcareous, Alluvial and Colluvial Soil, Brown Soil, and Forest Soil. About 60 per cent of the Taluk is covered by red soils, of which red calcareous soil is Predominant. They occupy most parts of Palladam, Coimbatore, Mettupalayam and Udumalpet taluks. The Forest soils are confined to the reserve forest area and have a surface layer of organic matter. (1)

III. MATERIAL AND METHODS

The current study was designed to investigate the conditions of groundwater contamination in the study area. The hydro geochemistry study was undertaken by randomly collected 80 ground samples from dug wells and bore wells covering Mettupalayam Taluk during July 2012. Samples are collected in the pre cleaned plastic polyethylene bottle. All the sampling bottles were washed and rinsed thoroughly with the groundwater before sampling. The Water quality parameters such as pH and electrical conductivity (EC) were analyzed using digital meters immediately.

Total hardness (TH) as CaCo3 and calcium (Ca) were analyzed titrimetrically, using standard EDTA. Total dissolved solids (TDS) were computed by digital method. Magnesium (Mg) was calculated by taking the different value between total hardness (TH) and Calcium (Ca) concentration. Chloride (Cl) was determined by titration method. The content of sodium (Na) and potassium (K) in the groundwater was estimated flame photo metrically, employing Flame Photometer.

All parameters are expressed in mg/l (milligrams per litre) except pH (units) and electrical conductivity (EC) is expressed in micro mhos/cm (µS/cm) at 25^0C

Table No 1.Study Location

Sample no.	Identification	latitude	longitude
1	Thodathasanur	11°15''39"	76°58'28"
2	Thekampaaatti	11°15'34"	76°53'10"
3	Periyapallam	11°15'47"	76°53'14"
4	Near CCC indusrtry	11°17'43"	76°53'43"
5	Bathirakaliamman koil mandapam	11°17'50"	76°53'50"
6	Amman nagar	11°17'57"	76°53'57"
7	Road side near saradha	11°17'34"	76°54'33"
8	UBL near house	11°17'3"	76°58'16"
9	Ramanpalayam siruvani textiless opposite	11°17'39"	76°58'16"
10	Jadayampalayam behind kg	11°18'21"	76°58'46"
11	Thoddabavi	11°18'27"	76°59'22"
12	Alangombu near alagiri suresh school	11°20'39"	77°59'37"
13	Sirumugai	11°21'18"	77°59'38"
14	Motheypalayam	11°21'36"	77°59'32"
15	Chittepalayam	11°19'31"	77°59'30"

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pH:
Alkaline or acidic conditions of water or sewage are frequently expressed by their pH which is a symbol for hydrogen ion concentration. A pH test determines the strength of the acid or alkali in water, while the chemical tests for acidity or alkalinity determine the amount of acid or alkali present. An ion is an atom or group of atoms that carries an electric charge. Certain compounds in solution, ionize i.e., split up into the electrically charged ions. Acidity is caused by the positively charged hydrogen or H+ ions, and alkalinity by negatively charged hydroxyl or OH- ions. It is observed that for neutral or pure water H+ and OH- ions are equal. In the mettupalayam taluk the pH varies between 7.2 to 9.7(table1). In most of the samples the groundwater is alkaline (table 1)

Specific conductivity of water:
This parameter also comes under the measurement of physical characteristic of water. The specific conductivity of water is analysed by means of a portable ionic water test equipment and is expressed in micro-mhos per centimeter at a temperature of 25°. The total amount of dissolve salts present in water can be approximately estimated by measuring the specific conductivity of water.

If the specific conductivity of water in micro-mhos per cm at 25°c is multiplied by a coefficient so as to directly obtain the dissolved salt contain in the water in milligram per litre of ppm. The specific conductivity of the water is between 0.8 mille equivalents per litre to 7.11 mille equivalents per litre. In most of the samples are above the permissible limits.

Hardness:
Hardness in water is due to carbonates, bicarbonates, chlorides and sulphates of calcium and magnesium dissolved in it. Hardness is measured by means of the versenate method. In this method the total hardness is estimated by titrating against diethelene diamine tetra acidic acid salt solution using Erio chrome black T as indicator at pH 8.5 to 11. The color changes from wine red to blue. Water with hardness of 50 ppm are caked sift. For domestic use hardness upto 150 ppm is not objectionable. Too Soft water loses its taste. From health view point hardness even upto 600 ppm is not of any concern but beyond that it may cause a laxative effect. For certain industries it requires water of zero hardness. The minimum value of hardness in the study area is 310 mg/l; it extends up to 920 mg/l.

Total dissolved solids:
The total dissolved solids (TDS) are the concentrations of all dissolved minerals in water indicate the general nature of salinity of water. The higher value of total dissolved solid is attributed to application of agriculture fertilizer contributing the higher concentration of ions into the groundwater. The total dissolved solids ranges from 620 mg/l to 6890 mg/l. Eight samples out of fifteen samples exceed the permissible limits.

Calcium (Ca):
Calcium is naturally present in water. Calcium is determinant of water hardness, because it can be found in water as CA ion. The calcium content of groundwater samples varies from96.42 mg/l to 182.38 mg/l. All the samples were within the permissible limits as per BIS classification.

Magnesium (Mg):
A large number of minerals contain magnesium; Magnesium is washed from rocks and subsequently may ends up in water. Magnesium has many different applications and as a result may end up in water in different ways. Chemical industries add magnesium to plastics and other materials as a fire protection measure or as filler. Most of the sample in the study area crossed the permissible limit as per the standard.

Sodium (Na):
Sodium is the sixth most abundant in the earth crust and sodium stems from rocks and soils. Concentration however are much lesser, depending on the geological condition and waste water contamination sodium compounds serve many industrial purpose, and many also ends up in water from industries. The range of sodium varies from 60.62 mg/l to 450.62 mg/l. Three samples exceed the permissible limit.

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Potassium (K):
Potassium is the important element for humans, plants and animals and derived in food chain chiefly from vegetation and soil. The chief sources of potassium in the groundwater consist of rain water, weathering of potash silicate minerals, use of potash fertilizers and use of surface water for irrigation. The European Economic Community (EEC) has prescribed the guideline level of potassium at 10 mg/l in Drinking water. Even though the potassium is extensively found in some of igneous and sedimentary rocks, its concentration in natural water is usually quite low. This is due to the fact that potassium minerals offer resistance to weathering and dissolution. Most of the samples exceed the permissible limit.

Irrigation Water Quality:
The Main source of irrigation is groundwater in entire study area. Quality of water is assuming great importance with the rising on industries and agriculture and increase in standard of living. The adequate amount of water is very important for proper growth of plants but the quality of water used for irrigation purpose should also be well within the permissible limit otherwise it could adversely affect the plant growth. Questions have been raised as to the social and environmental sustainability of this intensive mode of crop production. The continuous use of poor quality water without drainage and soil management may lead to saline and sodic soil, predominantly in clayey soils. The water used for irrigation is a vital factor in production of crop, its yield and quality of irrigated crops. The irrigation water Quality depends mainly on the presence of dissolved salts and their concentrations. Water quality for irrigation is determined by Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC).

Sodium Absorption Ratio (SAR):
The sodium adsorption ration (SAR) indicates the effect of relative cation concentration on sodium accumulation in the soil; thus, sodium adsorption ration (SAR) is a more reliable method for determining this effect than sodium percentage. Sodium adsorption ration (SAR) is calculated using the following formula:

$$SAR=[Na^{+}] / \{([Ca^{2+}] + [Mg^{2+}]) / 2\}^{1/2}$$

If the SAR value is greater than 26, the water is unsuitable for irrigation purpose. Out of 15 samples 3 samples is not fit for irrigation.

Kelly's Ratio (KR):
Sodium Measured against C_a^{2+} and M_g^{2+} is used to calculate Kelley's Ratio .The Formula Used in the estimation of Kelley's ratio is expressed as, Kelley's Ratio is expressed as, Kelley's ratio (KR) = $N_a^{+}/C_a^{2+}+Mg^{2+}$

A Kelley's ratio (KR) of more than one represents an excess level of sodium in waters. Hence, waters with a Kelley's Ratio less than one are best suited for irrigation, while those with a ratio more than one are unsuitable for irrigation. If the Kelly's ratio is greater than 1 it is not suitable for irrigation, 3 Samples is not fit for irrigation.

Soluble sodium Percent (SSP): The Soluble Sodium Percent (SSP) for ground water was calculated by the formula

$$SSP = \frac{Na \times 100}{C_a^{2+} + M_g^{2+} + Na^{+}}$$

Where the concentrations of Ca^{2+}, Mg^{2+} and Na^{+} are expressed in mill equivalents per litre (ppm). The soluble Sodium Percent (SSP) values less than 50 or equal to 50 signify good quality water and if it is more than 50 it indicate the unsuitable water quality for irrigation.

IV. CONCLUSION

The analytical results revealed the higher concentration of total hardness and total dissolved solids. Out of 15 Groundwater samples collected in Mettupalayam Taluk. Eight samples exceed the permissible limit. It indicates the significant deterioration as per the WHO and BIS standards.

The electric conductivity of the study area reaches the maximum value of 7.11 mille equivalents per litre. If the electric conductivity is higher than 1.5 mille equivalents per litre proper drainage should be ensured. In the study

area most of the land is used for agriculture purpose where the application of fertilizer is heavy contributing to the extraordinary values of conductivity and chlorides. As per the classification of groundwater on the basis of Sodium Absorption Ratio, 3 samples are not fit for irrigation and drinking purpose. The data revealed the application of fertilizer and discharge of industrial effluent for farming has polluted the groundwater to the greater extent contributing higher concentration of ions in the Mettupalayam Taluk.

V. RECOMMENDATION

In the study area the regular monitoring of the groundwater quality is needed for taking appropriate managerial measures to minimize the pollution of groundwater

The remedial measures include:

- Recharge wells should be built, to reduce the pollution intensity of groundwater
- Usage of Bio fertilizers is encouraged to avoid contamination of groundwater.
- Awareness among the farmers and industrialist may be created for the sustainable use of groundwater
- Long term and short term management plans may be implemented.

Table 2: Physico- chemical parameters of bore well and open well in mettupalyam taluk

S NO	pH	EC	Cl mg/l	TDS mg/l	Sul mg/l	TH mg/l	Ca mg/l	Mg mg/l	na mg/l	k mg/l	SAR mg/l	KR mg/l	SSP mg/l
1	7.76	0.8	192	780	140.31	440	131.6	96.43	91.21	42.31	8.5	0.40	28.57
2	8.13	1.69	375	3640	108.48	680	141.7	111.41	140.62	70.67	12.5	0.56	35.72
3	9.7	2.51	2270	5540	72.43	920	173.2	137.61	160.36	101.3	12.9	0.52	34.04
4	7.5	1.78	754	2060	121.32	730	168.4	114.31	180.32	80.91	15.2	0.64	38.95
5	7.66	2.75	3410	3620	110.41	640	131.4	118.37	180.93	67.58	16.2	0.72	42.01
6	7.4	4.72	1650	6890	140.32	830	156.5	101.32	450.62	89.56	39.7	1.75	63.61
7	7.45	1.44	1190	1680	50.62	310	96.42	87.67	158.32	35.51	16.5	0.86	46.24
8	7.76	1.81	422	3140	130.62	720	182.4	119.32	360.28	48.59	29.3	1.19	54.42
9	7.56	2.13	3230	4980	140.38	740	163.2	111.72	360.46	50.61	30.7	1.31	56.73
10	9.25	7.11	143.5	940	52.68	410	113.6	121.43	80.69	30.98	7.4	0.34	25.56
11	7.15	2.42	2762	2540	121.38	720	151.7	138.61	140.19	38.61	11.6	0.48	32.57
12	7.4	0.98	450	1621	67.32	360	106.4	101.32	60.61	19.81	5.9	0.29	22.59
13	8.11	1.13	485	620	49.38	350	96.47	91.42	91.62	18.68	9.5	0.49	32.78
14	8	5.1	1385	1210	54.98	490	105.7	97.63	71.42	24.32	7.1	0.35	26.00
15	8.15	4.12	1325	1240	98.68	680	167.4	112.31	120.38	36.51	10.2	0.43	30.09
mean	7.9	2.7	1336.2	2700	97.3	601.3	139.1	110.7	176.5	50.4	15.6	0.7	38.0
min	7.2	0.8	143.5	620.0	49.4	310.0	96.4	87.7	60.6	18.7	5.95	0.29	22.59
max	9.7	7.11	3410	6890	140.38	920	182.4	138.61	450.62	101.3	39.69	1.75	63.61

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