



Hydrogeology and Geochemical Aspects of Groundwater in Tirupati, Chittoor District, Andhrapradesh

KEYWORDS

physico-chemical parameters, electrical conductivity, total hardness, Hydrogeological

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ABSTRACT *This paper is an attempt to assess the effect of drinking water quality and lithological characteristics of different rocks present in the Tirupati Corporation. Ground water is a natural and indispensable resource. The available surface water sources cannot fulfill the needs of an entire city owing to growing population and rapid urbanization. Nineteen samples were collected from different locations of Tirupati rural and urban areas and analyzed for physico-chemical parameters such as pH, turbidity, Chloride, Electrical conductivity, total hardness, calcium, and Iron. The values of physico-chemical parameters were compared with the world health organization (WHO) water quality standards. The geochemical characteristics of ground water samples are correlated with geological, pedological and topological conditions which has a direct bearing upon the accumulation of salts in the study area and degree of treatment before consumption and prevention steps to be taken from contamination.*

INTRODUCTION

Water is a natural and indispensable natural resource. The quality of drinking water is vital concern for mankind since it is directly linked with human health. The available surface water resources cannot fulfill the needs of an entire city and rural areas. It is important to monitor ground water quality in Tirupati Municipal Corporation.

The Tirupati city is located in the survey of India Toposheet number 57 O/6 on a scale of 1:50,000 and lies in between the North latitude 13°38', East longitude 79°27'(Fig.1). Tirupati was constituted into municipality on 1st April 1886 and as corporation on 3rd march 2007. The present population of the city is 2, 87,035. The floating population of Tirupati Corporation is nearly 60,000 per day.

The climate of area is hot and semi-arid for most part of the year especially in the month of April- May with a mean maximum temperature of 42° C, a mean minimum of 16° C and a mean of 29° C, while December being the coldest month. The area receives an average rainfall of 485 mm. The wind direction is from west to east during greater duration of the year. The relative humidity generally varies from 86% to 33%.

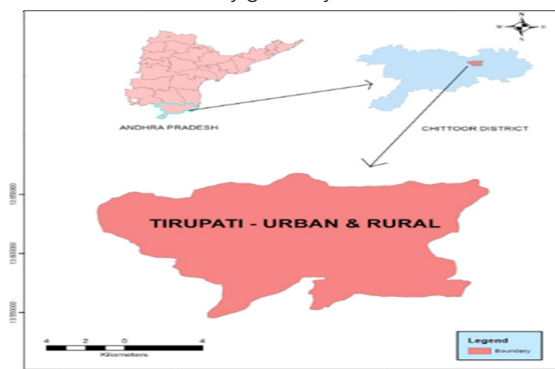


Fig: 1. Location map of Tirupati- Urban & Rural

The people of Tirupati city being fed with the surface water at the rate of 150LPCD from the Kalyani dam as well as Sri Sai Ganga canal under Telugu ganga project in addition to 340 power bore wells and 502 hand bore wells. The total requirement of water for Tirupati area is 69.03MLD. There is a lot of scarcity for water and have done chemical analysis

to check the quality of present water supply and used the remote sensing and GIS to improve the supply system and have suggested some measures to reduce the water scarcity at Tirupati.

GEOLOGY

The district is underlain by rocks of Archaean, Proterozoic, Jurassic-cretaceous and tertiary-quaternary ages. The oldest rocks in the area belong to migmatite complex, represented by migmatized quartzo-felspathic gneiss and are exposed in northeastern part of the area. Older metamorphic comprises amphibolites/hornblend, talc-mica-schists, fuchsite, quartzite, calc-silicate rock, marble and banded ferruginous quartzite. These older metamorphic rocks occur as enclaves within peninsular gneissic complex (PGC).

The PGC comprises a complex assemblage of gneissic variants and granitic rocks, which occupy almost major parts of the Tirupati.PGC in the area is represented mostly by Biotite hornblende Gneiss, Biotite, Granite and Migmatite(Fig.2).



Fig 2 Different Types of Rocks in Tirupati region

METHODOLOGY

Sampling of groundwater has been carried out as per the established norms. The mode of collection of 19 water samples from different locations in rural and urban areas are analyzed systematically as given by Rainwater and Thatcher (1960). Brown et. al. (1970) and Hem(1970) S,Siddiraju et. al. (1994), S.V Dorairaju et. al.(2012), K.Raju and T.Damodaram(2012).. The constituents analyzed and the parameters computed include PH , Turbidity, Chloride ,Electrical Conductivity, Total

hardness ,Calcium and Iron.

RESULTS AND DISCUSSION

The results of the physicochemical analysis of the water samples and some of the relevant parameters are computed Table.1& ,2.

Table.1 : Water analysis results of urban area

SL. NO	Name of the Area	pH mg/l	Turbidity NTU	Cloride mg/l	E.C. us/cm	Total Hardness mg/l	Calcium mg/l	Ironmg/l
1	Alipiri	8	1	259	611	116	29	0
2	Bhavani nagar	8.5	1	152	103	157.2	41.7	0
3	Kapilatheertham	7.1	1	125	495	404	22	0.2
4	M.R.Palli	8	1	103	700	171	6.5	0
5	SVIMS	7.1	1	112	684	232	24	0
6	S.V.Zoo Park	7.5	1	76	659	209	74	0.2
7	S.V.Museum	7.2	1.5	306	502	98	46	0
8	S.V.University	7.1	1	106	451	119	48	0
9	Thiruchanoor	7.8	1.2	264	150	477	60	0.3
10	LIC office	7.7	1	129.9	652	159.8	44.6	0

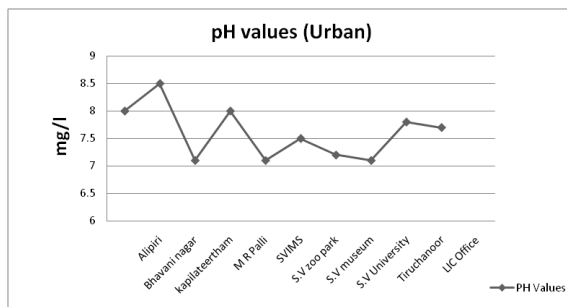
Table.2 : Water analysis results of rural areas

SL. NO	Name of the Area	pH mg/l	Turbidity NTU	Cloridemg/l	E.C.	Total Hardness mg/l	Calcium mg/l	Ironmg/l
1	Perumalapalle	6.35	5.02	210	10	30	20.5	2.7
2	Mallavaram	6.30	6.89	365	58	22	31.0	2.9
3	Paidipalle	6.50	4.39	147	34	14	15.3	1.8
4	Pathakalava	6.50	4.69	210	1	11	19.3	1.8
5	Peruru	6.30	4.28	153	1	10	22.4	2.5
6	Durga Samudhram	6.25	2.20	35	9	14	15.5	2.1
7	Tanapalli	6.40	2.98	94	160	11	13.8	2.5
8	Vemuru	6.50	2.93	70	56	09	23.5	1.7
9	Mundlapudi	6.60	3.50	95	4	09	18.2	2.1

pH:

The pH is considered as an important ecological factor and provides an important factor of information in many types of geochemical equilibrium or solubility calculation. pH is an important parameter in water body since most of the aquatic organisms are adapted to an average pH and do not withstand abrupt changes. The pH values of the samples in fluctuated between 7.5-8.5. The limit of pH values for drinking water is specified as 6.5-8.5. The pH values shows almost safe except some places like, Bavaninagar and Peruru village of Tirupati.

Exposure to extreme pH values results in irritation to the eyes, skin, and mucous membranes. Eye irritation and exacerbation of skin disorders have been associated with pH values greater than 11. In addition, solutions of pH values in between range from 10–12.5 have been reported to cause hair fibers to swell.



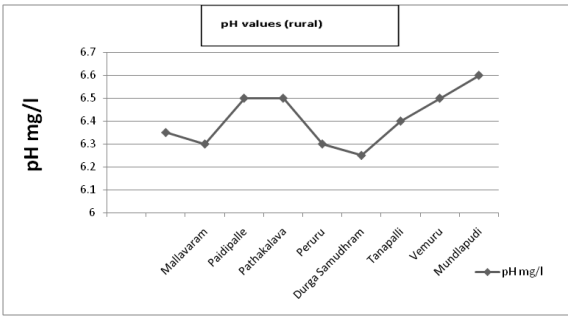


Fig 3. pH values of urban and rural areas of Tirupati city

Turbidity:

Governments have set standards on the allowable turbidity in drinking water. The turbidity of the water collected from the Tirupati rural has exceeded the standard values and at S.V. museum and Thiruchanoor in urban area have exceeded the limits.

Turbidity cannot be higher than 1.0 nephelometric turbidity units (NTU) for all samples for turbidity must be less than or equal to 0.3 NTU for at least 95 percent of the samples in any month. Systems that use filtration other than the conventional or direct filtration must follow state limits, which must include turbidity at no time exceeding 5 NTU. Many drinking water utilities strive to achieve levels as low as 0.1 NTU.

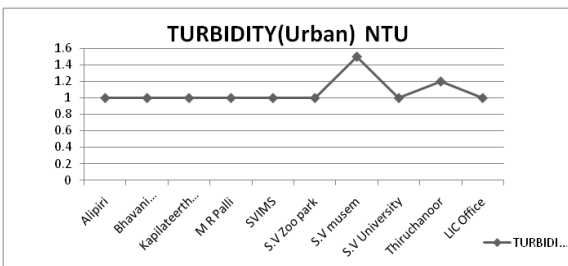
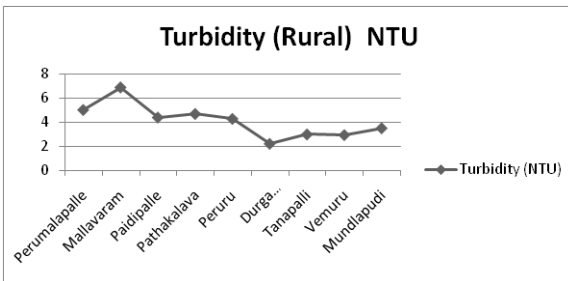


Fig.4: Turbidity in rural and urban areas of Tirupati city

Chloride:

Chlorides are important in detecting the contamination of ground water by waste water. The permissible limit of chloride in drinking water is 250 mg/l. The values of chloride observed in Alipiri, S.V.museum, Thiruchanoor and Mallavaram are well above the standard desirable limits prescribed by WHO (1984). Chlorine is present in most disinfected drinking-water at concentrations of 0.2–1 mg/litre. Intake of a small quantity of bleach generally results in irritation of the esophagus, a burning sensation in the mouth and throat, and spontaneous vomiting.

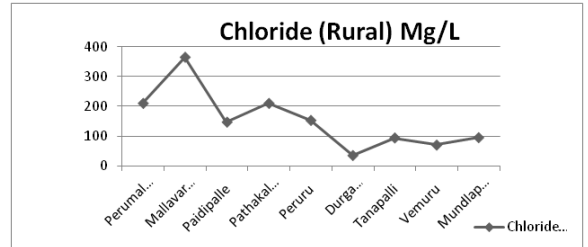
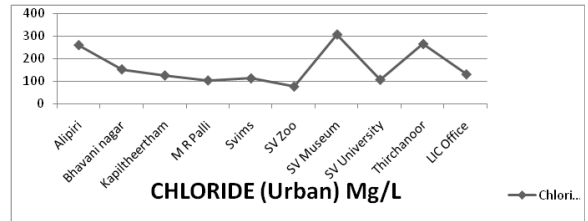


Fig.5: Chlorides in urban and rural areas of Tirupati city

Electrical Conductivity:

In many cases, conductivity is linked directly to the total dissolved solids (TDS). High quality demonized water has a conductivity of about 5.5 µS/m, typical drinking water in the range of 5-50 µS/m, while sea water about 5 S/m(i.e., sea water's conductivity is one million times higher than demonized water).

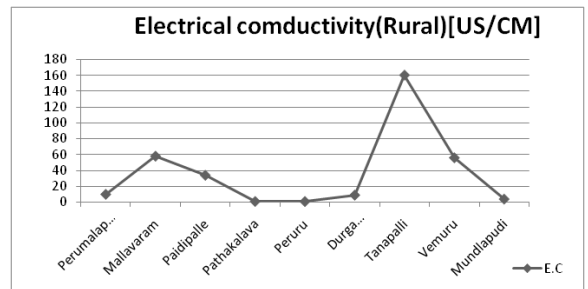
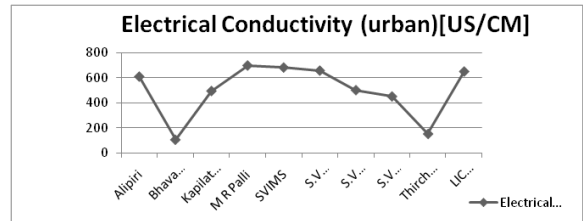


Fig.6 : Electrical Conductivity in urban and rural areas of Tirupati city

Total Hardness:

Water hardness is the traditional measure of the capacity of water to react with soap, hard water requiring considerably more soap to produce lather. Hard water often produces a noticeable deposit of precipitate (e.g. insoluble metals, soaps or salts) in containers. ISI has specified the total hardness to be within 300 mg/l of CaCO₃.

The rural areas values are low and some of the urban area which has exceeded the values is like kapilatheertham and Thiruchanoor Exposure to hard water has been suggested to be a risk factor that could exacerbate eczema. The environment plays an important part in the etiology of atopic eczema, but specific causes are unknown. Numerous factors have been associated with eczema flare-up, including dust, nylon, shampoo, sweating, swimming and wool.

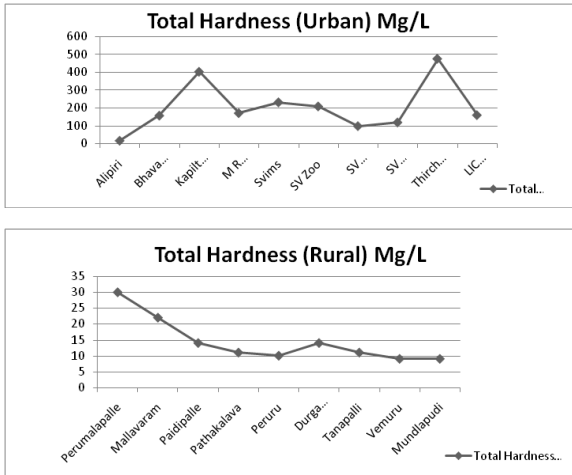


Fig.7: Total Hardness in urban and rural areas of Tirupati city

Calcium:

Calcium concentrations were found to vary from 6.5-74mg/l. The upper limit of calcium concentration for drinking water is specified as 75mg/l. All the areas have the calcium concentration with the permissible limits.

Inadequate intakes of calcium have been associated with increased risks of osteoporosis, nephrolithiasis (kidney stones), colorectal cancer, hypertension and stroke, coronary artery disease, insulin resistance and obesity. Most of these disorders have treatments, but not cures. Owing to a lack of compelling evidence for the role of calcium as a contributory element in relation to these diseases, estimates of calcium requirement have been made on the basis of bone health outcomes, with the goal of optimizing bone mineral density.

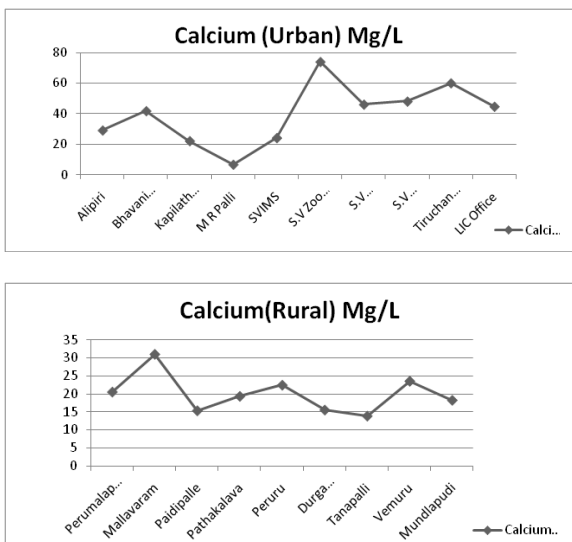


Fig. 8 : Calcium in the water of urban and rural areas of Tirupati city

Iron:

Aeration of iron-containing layers in the soil can affect the quality of both groundwater and surface water if the groundwater table is lowered or nitrate leaching takes place. Dissolution of iron can occur as a result of oxidation and decrease in pH.

The median iron concentration in rivers has been reported to be 0.7 mg/litre. In anaerobic groundwater where iron is in the form of iron (II), concentrations will usually be 0.5–1 mg/litre, but concentrations up to 50 mg/litre can sometimes be found (6). Concentrations of iron in drinking-water are normally less than 0.3 mg/litre but may be higher in countries.

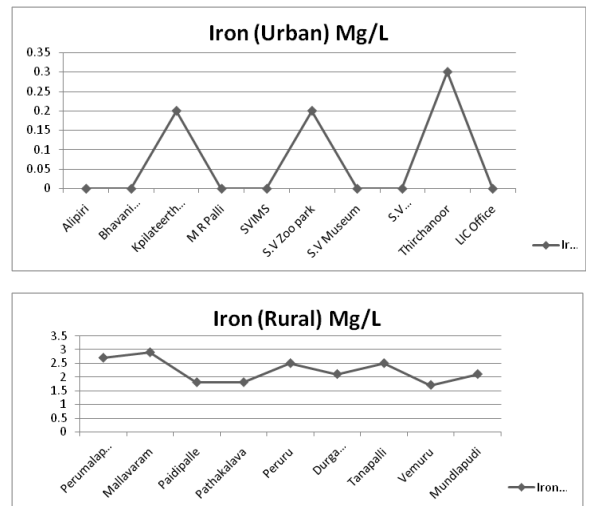


Fig.9 : Iron in the water of urban and rural areas of Tirupati city

CONCLUSION:

From the analyses of the water samples of the study area, nineteen samples analyzed for physico-chemical parameters such as pH, Chloride, Iron, Electrical conductivity, total hardness, calcium, and turbidity. The found values of physico-chemical parameters were compared with the world health organization's water quality standards. Based on the analysis a few samples were exceeding the permissible limits. The geochemical characteristics of ground water samples are correlated with geological, pedological and topological conditions which has a direct bearing upon the accumulation of salts in the study area. The drinking water of the area needs some degree of treatment before consumption and prevention steps to be taken from contamination.

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