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RESEARCH ARTICLE

GROUNDWATER QUALITY STUDIES IN KORAIRAR WATERSHED, COIMBATORE DISTRICT, TAMILNADU-AN GEOINFORMATIC APPROACH

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ABSTRACT

The suitability of groundwater for drinking purpose with respect to BIS: The samples are collected the period from 1981-2011. The suitability of ground water resources available in the country are also not uniformly distributed and the changing land use pattern and population growth and resulting water resources development has resulted in stress in the environment. The result shows the groundwater has partial suitability for drinking purposes and public health because of the concentration of TDS, EC, Mg and Na in groundwater. They have concentration than the recommended limits for drinking. They have partial suitability for domestic use for Human consumption. The parameter such as SAR, Na % is estimated were the one all locatle to assess. These parameter concern suitability of water for irrigation purpose. The EC and sodium concentration are very important in classifying irrigation water. The salt present in the water, besides affecting the growth of the plants directly affect the soil structure, permeability and aeration, which indirectly affect the plant growth. Considering the seriousness of the groundwater contamination and groundwater quality along the study area (Koraiyar sub watershed) has been done.

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INTRODUCTION

Water is considered by many as the 'Elixir of life', and it has been becoming the 'liquid gold' to be 'mined' for the very survival of our human race in as much as the surface and sub-terrain water sources are depleting fast owing to over exploitation by unscrupulous pumping and wasteful flooding for irrigation, domestic water supply, industrial usage, animal feeding and other usage patterns. Water covers 71% of the Earth's surface. On Earth, it is found mostly in oceans and other large water bodies, with 1.6% of water below ground in aquifers and 0.001% in the air as vapor, clouds (formed of solid and liquid water particles suspended in air), and precipitation. Saltwater oceans hold 97% of surface water, glaciers and polar ice caps 2.4%, and other land surface water such as rivers, lakes and ponds 0.6%. A very small amount of the Earth's water is contained within biological biological bodies and manufactured products. Other water is trapped in ice caps, glaciers, aquifers, or in lakes, sometimes providing fresh water for life on land. Groundwater is a key source of fresh drinking water essential to life over the globe. It is found in aquifers, which are rocks that have the capacity of both storing and transmitting groundwater, in significant quantities (Todd, 1980). Water plays an important role in the world economy, as it functions as a solvent for a wide variety of chemical substances and facilitated industrial cooling and transportation. Approximately 70 percent of freshwater is consumed by agriculture. Water in this zone is always on the move getting recharged by rainwater and discharged either through pumping (or) by flow to the lower sections of the valley and contributing to the base flow of rivers. There is however, a larger reservoir of water at depth extending perhaps to 500 m below ground level. Generally, groundwater is found to be more hard compared to surface water. In most regions, ground water in recharge areas percolated down ward under the pull of gravity. Drought and floods are the extreme events of rainfall and vagaries of monsoon and hydro geological framework in the country is highly variable from place to place. The water resources available in the country are also not uniformly distributed and the changing land use pattern and population growth and resulting water resources development

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has resulted in stress in the environment. The extraction of excessive quantities of ground water has resulted in drying up of wells, damaged ecosystems, land subsidence, salt – water intrusion and many other social problems. Agricultural, urban & industrial wastes are increasingly threatening groundwater quality, which is likely to become more serious issue than the quantity in coming years. Considering the seriousness of the groundwater contamination and groundwater quality along the study area (Koraiyar sub watershed) has been done.

Objectives

- To evaluate the groundwater quality in 1981 1nd 2011
- To analyze the parameters of the ground water.
- To concentrate the different ground water quality in thirty years.

Methodology

The array of techniques employed tomeet the objectives the study is as follows. The survey of India (SOI) topographical maps, on 1:50,000 scale, have been used to demarcate the Ground water Quality studies in koraiyar watershed by using the same, the base map has been prepared along with maps of drainages ,settlements with names, administrative boundaries, graticules with values, roads, railway lines and reserved forest boundaries. This ground feather available on topographical maps, facilitates quick ground referencing in order to maintain the base map details for various thematic maps are uniform. Primary and secondary baseline data have been collected and analysed in order to understand the existing conditions of the study area (profile) in some detail and on various physical, economic and social attributes as they reveal the human interaction between man and resources of the basin. A part form the published and unpublished reports / data gathered from different departments.

Study Area Description

The Koraiyar watershed is in the southwestern part of Coimbatore district. It is located between 10^{o} 36'N and 10^{o} 57'N and 76^{o}48' E and 77^{o} 09' E (Figure 2.1) with an area of about 659.06 sq.km. It's originated from south western part of Coimbatore near cheetipalayam at the elevation of 420 meter above sea level. Its covers four taluk and five block. The climate of the study area is hot and humid climate. Rainfall receives from south west and north east monsoon seasons. The basin is surrounded to the north by the Noyyal river basin and Palar river basin in the south on the Valayar reserved forest in the Western Ghats in the west, and parambikulam canal in the east.

RESULTS AND DISCUSSION

Geochemistry

Ground water is one of the renewable natural resources available of man. The use of water for domestic, agricultural, and irrigational purpose has increased enormously for the past few years. It is calculated that in the fourth evoking year 21 centuary water will be one of the available of water is one of the strategic resource while the availability of water is one of the problem the other is due to the deforming quality of existing water. Resource in the other side. The quality of water is more important than the quantity of water since it is live with human health. The chemistry of ground water is altered by the material though which then pass. During precipitation the rainwater directly extents reach the soil zone, due to the solvent power of water minerals present in soil, gets dissolved and move in solution when water moves of aquifer. As the water flow of the aquifer the quality of the water is affected by various geochemical processes. The certain and anion contraction, depends upon the rock formation and residence, of the counter rock and the amount dissolved in water. Water gets polluted due to anthropogenic contaminants like urban, agricultural and industrial activities one important aspect of ground water pollution is due to industries releasing effluence mixes with ground water where the quality of the groundwater changes. The main aim of this work is to characterize the hydro geochemical processes that have produced a series of water types, with reference to phenomena which have the potential to modify the natural chemistry of the water. The study area has a marked human influence and a complex recent geological history. The physio-chemical characteristics of the groundwater of the Temara aquifer were studied by means of piezo metric mapping and determination of the ionic composition of the groundwater. In general, the agricultural activity is intense in the area, with water being pumped from numerous wells. Two aquifer formations can be distinguished which, over a wide area, are separated by layers of low permeability. The increased salinity at some points of the coastal zone is probably linked to the combined action of the washing out of Miocene marls, dissolution of carbonate rocks, agricultural pollution and seawater intrusion.

Ground Water Quality in Korairar Watershed Year – 1981

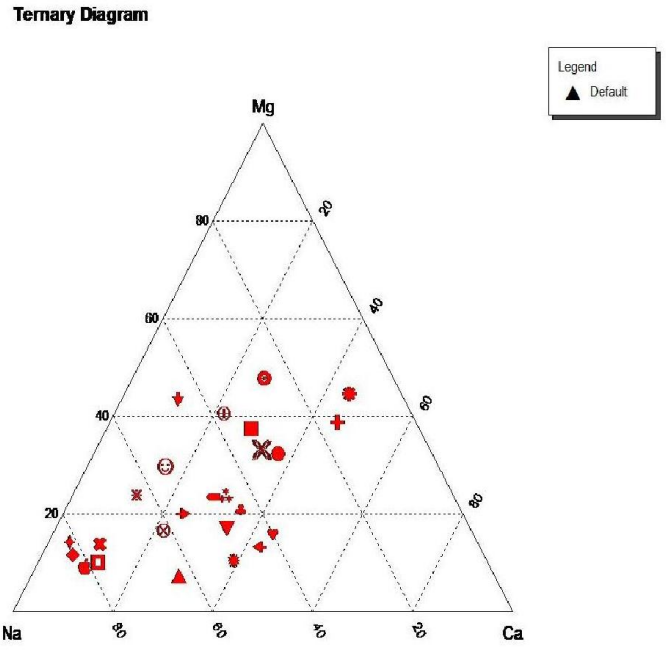

Figure 1. Electrical Conductivity

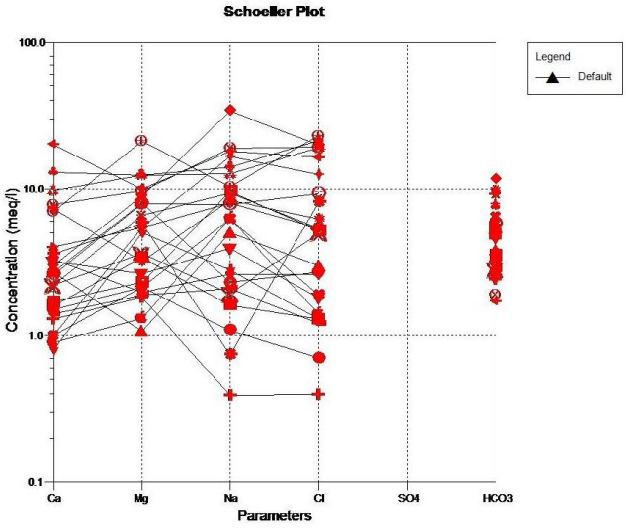

Figure 2. Power of Hydrogen

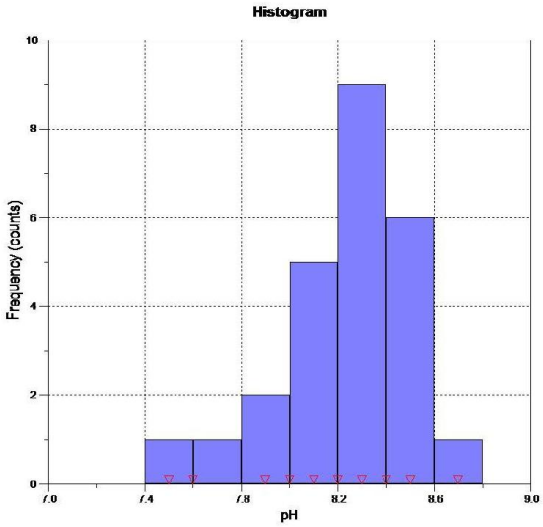

Figure 5. Sodium

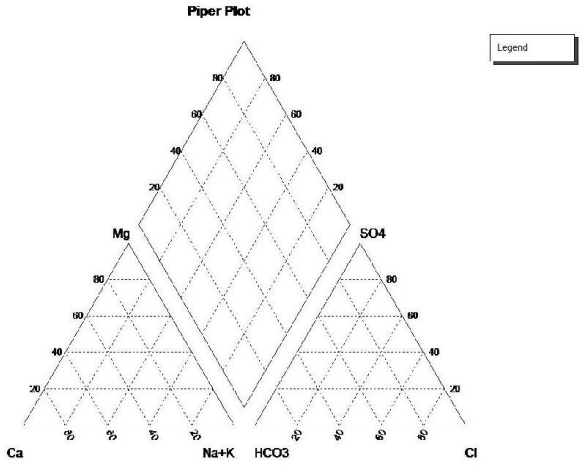

Figure 3. Calcium

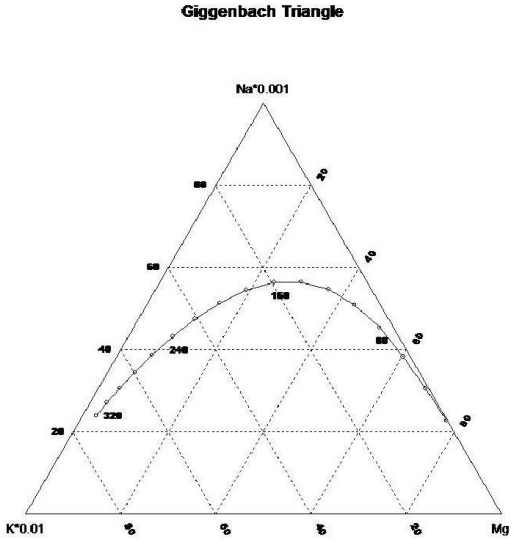

Figure 6. Bicorbonate

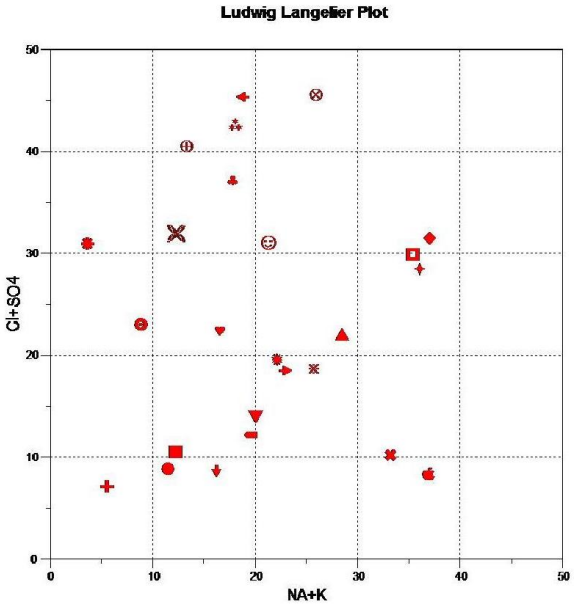

Figure 4. Magnesium

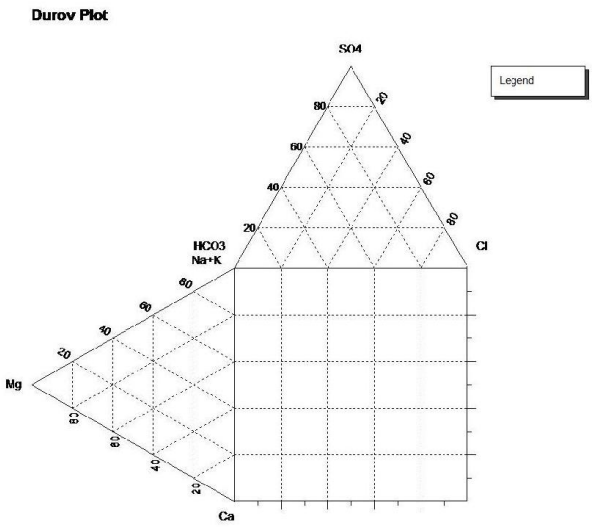

Figure 7. Chloride

Ground Water Quality in Korairar Watershed Year – 2011

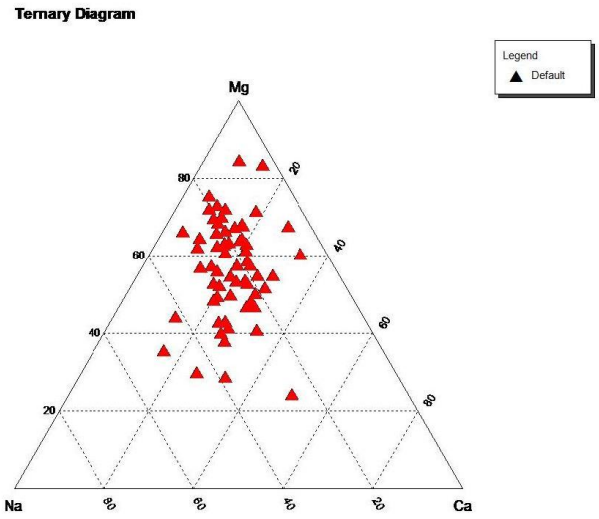

Figure 8. Total Dissolved Solids

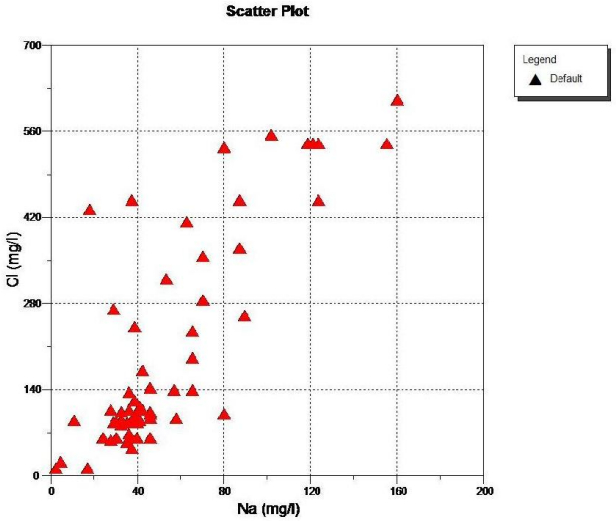

Figure 9. Sodium Absorption Ratio

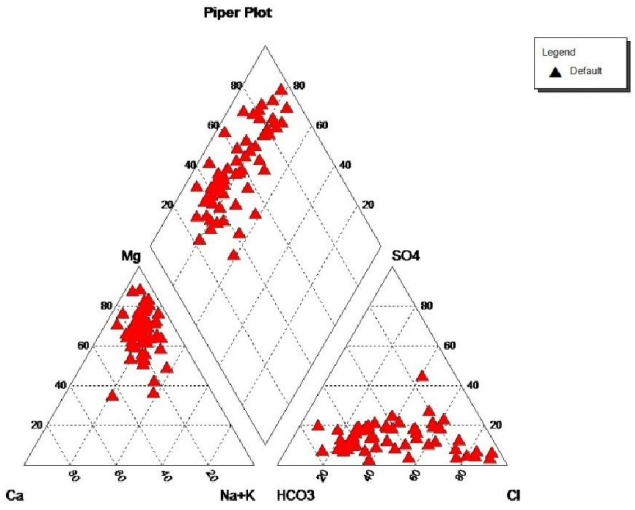

Figure 10. Sodium Percentage

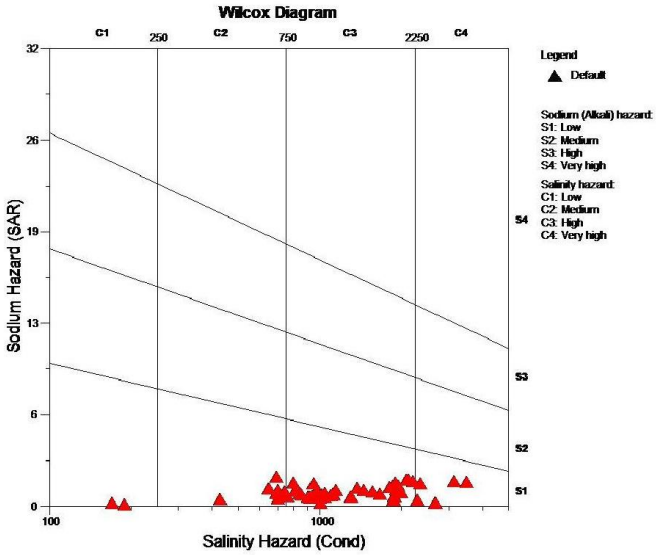

Figure 11. Sodium

Electrical Conductivity

EC was measured in micro semen's per centimeter (ms cm). The instruments were first Calibrated and set for 0.01 m kcl standard (1287 ms cm at 25C). An Electrical Conductivity should be seen from the Figure 4.1. The year of 1981 Electrical Conductivity was found in the minimum value on Kinathukadavu and the maximum value of 4800 Poosarippatti. In 2011 Electrical Conductivity was found in the minimum value 170 on Appanaickenpatty and the maximum value of 3510 were in Vadachithur. Maximum zones are found in this figure are depicts in the direction of Northeast and the minimum zones are found in this figure depicts in the direction of North and central part of the study area.

Power of Hydrogen

PH and EC of water samples were measured by pH conductivity meter model CONSORT C 425. The pH electrode is active and stable only after wetting for this purpose it must be immersed for at least ten hours in 0.1 m HCL or in a buffer of pH4 to 7. During short interruptions the electrode should be immersed in KCL solution, diluted HCl or a buffer of pH 4 to 7. Before using the references part of the electrode with distilled water, it was immersed in a buffer solution of pH 6.87 (25C). After the instrument is calibrated, pH of each water sample was determined. Three readings of each sample were recorded to get accurate result. The samples were stirred during measurement to promote homogeneity. Power of Hydrogen can be seen from the Figure 4.2. pH concentration in1981 was found in the minimum of 7.5 the area name is Pichanur. The maximum value of the study area is 8.7 in Kovundampalaiyam. In 2011the minimum of 7.80 at Paramadaiyur, and the maximum value 8.70 at Angalakurichi.

Calcium

Calcium is the chemical element with symbol Ca and atomic number 20. Calcium is a soft gray alkaline earth metal, and is the fifth-most-abundant element by mass in the Earth's crust.

Calcium is also the fifth-most-abundant dissolved ion in seawater by both morality and mass, after sodium, chloride, magnesium, and sulfate. Calcium was analyses by trimetric. 20ml of sample was nitrated against 0.02m EDTA, after adding ammonium chloride-ammonia buffer and 14-48 mg of ferrochrome black-t and indicator. The endpoint was indicated by appearance of steel blue color.

The amount of EDTA consumed for determining total calcium magnesium is obtained (B) (Ramesh and Anbu 1996) the amount of calcium is obtained titrating 20 ml of sample after adding 2 ml of 1 in sodium hydroxide, and 16-107 mg of murex indicator against 0.02m EDTA solutions. The end point is denoted by the appearance of blue violet color. The amount of EDTA consumed is (A)

$$Ca(mg/I) = \frac{0.004\ xml}{Vol.ofSamplex\ 106}$$

Calcium should be seen from the Figure 4.3. Calcium concentration in 1981 was distribute in the minimum value of 16P.N Palaiyam and the maximum value is 400 in Poosaripatti. Calcium concentration in 2011 wasminimum value of 10 in Appanaickenpatti, and the maximum value is 172 in Paramadaiyur.

Magnesium

Magnesium is a chemical element with the symbol Mg and atomic number 12. Its common oxidation number is +2. It is an alkaline earth metal and the eighth-most-abundant element in the Earth's crust [Agerwal *et al*., 1982] and ninth in the known universe as a whole. Magnesium is the fourth-most-common element in the Earth as a whole (behind iron, oxygen and silicon), making up 13% of the planet's mass and a large fraction of the planet's mantle. The year of 1981 Magnesium concentration was found in this Figure 4.4. It should be seen the minium value of 13 in Ambarapaiyam. The maximum value of 257 at Sirumugai. In 2011 the minimum value of 18 found in Appanaickenpatti, and the maximum value of 506 in Bogampatti.

Sodium

Sodium is a chemical element with the symbol Na and atomic number 11. It is a soft, silver-white, highly reactive metal and is a member of the alkali metals; its only stable isotope is Na. Sodium is the sixth most abundant element in the Earth's crust, and exists in numerous minerals such as feldspars, sodalite and rock salt (NaCl). Many salts of sodium are highly water-soluble, and their sodium has been leached by the action of water so that sodium and chlorine (Cl) are the most common dissolved elements by weight in the Earth's bodies of oceanic water. The Sodium should be seen from the Figure 4.5. The concentration of sodium 1981 was found in the minimum of 9 in Kinathukadavu. The maximum value of sodium concentration was found in 782 at Dayanur. The concentration of sodium 2011 was found in the minimum of 2.43 in Ganapahypalaiyam. The maximum value of sodium concentration was found in 160.38 at Vadachithur.

Bicarbonate

Inorganic chemistry, bicarbonate (IUPAC-recommended nomenclature: hydrogen carbonate) is an intermediate form in the deprotonation of carbonic acid. It is an anion with the chemical formula HCO_3^-. Bicarbonate serves a crucial biochemical role in the physiological pHbuffering system. A bicarbonate salt forms when a positively charged ion attaches to the negatively charged oxygen atoms of the ion, forming an ionic compound. Many bicarbonates are soluble in water at standard temperature and pressure, in particular sodium bicarbonate contributes to total dissolved solids, a common parameter for assessing water quality. Bicarbonate should be seen from this Figure 4.6. Bicarbonate is in 1981 found in the minimum of 104 Poosaripatti and the maximum value of 714 in Dayanur. Bicarbonate in 2011 found in the minimum of 36.60 in Kamachipuram and the maximum value of 573.40 in Bogampatti.

Chloride

Chloride is in the form of chloride ion (cl) is one of the major inorganic anion in water. The chloride ion is the anion (negatively charged ion) Cl. It is formed when the elementchlorine (a halogen) gains an electron or when a compound such as hydrogen chloride is dissolved in water or other polar solvents. Chlorides salts such as sodium chloride are often very soluble in water. Chloride shown in the Figure 4.7. In 1981 the Chloride concentration was found in the minimum value of the study area is 14 at Kinathukadavu. The maximum range of the study area is 815 in Sirumugai. In 2011 the Chloride concentration was found in the minimum value of the study area is 11 in Ganapahypalaiyam. The maximum range of the study area is 610 at Vadachithur.

Total Dissolved Solids

It is also referred to as parts per million (ppm). TDS is directly related to the purity of water and the quality of water purification systems and affects everything that consumes, lives in, or uses water, whether organic or inorganic, whether for better or for worse. Total Dissolved SolidsShows in Figure 4.8. In 1980 the maximum concentration is 2010 in Dayanur. The minimum concentration is 144 in Kinathukadavu. In 2011 the maximum concentration is 2258 in Unjavelampatti. The minimum concentration is 100 in Kottampatti.

Sodium Adsorption Ratio

USSLS (1954) defined the Sodium adsorption ratio (SAR) of water as:

$$S.A.R = \frac{Na^+}{\sqrt{\frac{1}{2}(Ca^{2+} + Mg^{2+})}}$$

According to SAR value (<10) the groundwater from the study area is of excellent quality because of low sodium hazard. Sodium Adsorption Ratio should be formed from the Figure 4.9. In 1981 SAR concentration was found in the minimum value of the study area is 0.31 in Kinathukadavu.

International Standard (2004) have evolved a set of specification for water to be used for drinking purpose and these are presented in Table and compared with the analyzes samples

Table 1. Limits of general acceptability - WHO International Standard (2004)

Constituents	Limits of general acceptability	Allowable Limit	Analyzed samples Range
Dissolved solid (mg/L)	500	1500	474-896
pH	7-8	0.5-9.2	7.08-8.7
Chloride (mg/L)	200	600	96-154
Magnesium (mg/L)	50	150	54-96
Calcium (mg/L)	75	200	106-152
Total Hardness (mg/L)	300	600	346-896

Table 2. Classification of ground water based on TDS (Carroll, 1962)

Water class	TDS (mg/L)
Fresh water	0 to 1000
Brakish water	1000 to 10,000
Saline water	10,000 to 1,00,000
Brine	>1,00,000

Table 3. Who and Indian standards for drinking water

Water Quality parameters in ppm	Who international standards		Bureau of indian standards		Concentration in study area	
	Highest desirable	Maximum desirable	Highest desirable	Maximum desirable	Minimum	Maximum
Ph	6.5	8.5	6.5	8.5	7.5	8.7
Tds	500	1000	500	2000	100	2010
Calcium	100	200	75	200	10	172
Magnesium	30	50	30	100	18	506
Pottasium	10	12	-	-	-	-
Sodium	20	175	-	-	9	160.38
Bicarbonate	-	-	300	600	104	714
Chloride	25	600	250	1000	11	610
Sulphate	25	250	200	400	-	-

The maximum range of the study area is 9.26 in Pollachi. In 2011 SAR concentration was found in the minimum value of the study area is0.79 in Vadakkipalaiyam. The maximum range of the study area is 13.05 in Bogampatti.

Sodium Percentage

The Na% in groundwater ranges from 11.6 to 33.61%. According to the quality classification of irrigation water based on the Na% (Wilcox, 1967), groundwater in the study area is of permissible to doubtful quality. Sodium percentage should be formed from this Figure 4.10. In 1981 Na% concentration was found in the minimum value of the study area is 11.18 in Kinathukadavu. The maximum range of the study area is 74 in Poovalapai. In 2011 Na% concentration was found in the minimum value of the study area is 18.16 in Vadakkipalaiyam. The maximum range of the study area is 76.76 in Bogampatti.

Carbonate

The Corbonate shown in Figure 4.11. In 1981 CO_3 concentration was found in the minimum value of the study area is 18 in Andipalaiyam. The maximum range of the study area is 48 in Pollachi. In 2011 CO_3 concentration was found in the minimum value of the study area is 0.51 in Appanaickanpatti. The maximum range of the study area is 24 in Athipalaiyam.

HAR

The HAR shown in Figure 4.12. In 1981HAR concentration was found in the minimum value of the study area is 110 in Pooavalaparuthiyur. The maximum range of the study area is 1500 in Poosaripatti. In 2011 HAR concentration was found in the minimum value of the study area is 45 in Appanaickanpatti. The maximum range of the study area is 800 in Vadachithur.

WHO

Sutability of grondwater for drinking and domestic uses

The result shows the groundwater has partial suitability for drinking purposes and public health because of the concentration of TDS, EC, Mg and Na in groundwater. They have concentration than the recommended limits for drinking. They have partial suitability for domestic use for Human consumption.

Sutability of grounwater for irrigation uses

The parameter such as SAR, Na % is estimated were the one all locateto assess. These parameter concern suitability of water for irrigation purpose. The EC and sodium concentration are very important in classifying irrigation water. The salt

present in the water, besides affecting the growth of the plants directly affect the soil structure, permeability and aeration, which indirectly affect the plant growth.

Conclusion

The Quality of groundwater is inferred standard graphical representations as concentration of different ions in water samples. The Quality parameters are compared with WHO & BIS standards. The data obtained by chemical analyses were evaluated in terms of its suitability for and general domestic use, irrigation and industrial use. Range values of chemical parameter in study area and WHO and Indian Standards for drinking water table is given below. The hydrochemical parameters of the study area compared with the prescribed specification of WHO (1993) and Indian Standard for drinking water ISO-10900 (1991).

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