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Research Paper

Groundwater Hydrochemistry Evaluation using Graphical Tools

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Abstract: *Aim of the study was to investigate the groundwater resources at Coimbatore district. Contamination of ground water samples is analysed and compared with BIS Majority of the water samples are not suitable for domestic purpose and from drinking water standards however used for irrigation purpose .The study also reveal the groundwater at the area is dominated by parameters like calcium, magnesium and chloride. Continuous monitoring of groundwater is essential to conserve the natural groundwater quality.*

Keywords: groundwater, graphical representation.

Introduction

Ground water is an important source of water supply throughout the world[1]. It's use in irrigation, industries and domestic usage continues to increase where perennial surface are absent. Water is a vital component to the development of an area[2]. Water and its management will continue to be a major issue with defined and profound impact on our lives and that of our planet earth[3].

It is also used for drinking water, food production, agriculture and also for generation of electricity[4]. Ground water constitutes over 90% of world's readily available fresh water resource with remaining 10% in lakes, reservoirs, rivers and wetlands .The geology of particular area has a greater influence on the occurrence and quality of water and its movement. Groundwater carries a higher mineral content than the surface water[5]. Water is one of the precious natural resources of our planet. Change in quality of groundwater with the passage of time has hydrological influences. Activities such as improper landfill, industrialization, use of fertilizer in agriculture activity etc., have great impact on quality and quantity of groundwater. Groundwater, however generally contain larger amounts of dissolved salts, minerals and gases which they pick up during their long journeys through the soil strata[6]. Water pollution is being an issue for the past decades, the recent problems like management of industrial waste and radioactive waste, disposal of sewage, population explosion also increased the magnitude. For optimum utilization of groundwater resources efficient ground water management is essential and necessitates assessment of groundwater[7]. With this background, the study on hydro-chemical characteristics of groundwater and its quality at various locations in the Coimbatore district was carried out. Work conducted in Coimbatore region in the past decades revealed the groundwater is unfit for irrigation and industrial activity[8]. Ventures which emphasis on total sanitation in rural areas such as household toilet, liquid and solid waste disposal system, clean India project etc should be implemented for proper groundwater management system. The intention of this paper is to have qualitative and quantitative analyze of hydrochemical parameters using combination of various statistical analysis tools[9]. In turn this is aided by pictorial representation for easy understanding of the groundwater characteristics.

Study Area

The study area is located between the latitudes 11˚30'N and longitudes 76˚95'E^0. The reason to select the study area is, it is one of important trading hub and industrial area of the state. In the industrial clusters of Coimbatore district 22 groundwater samples were

collected both from the open well and bore well. Land use land cover pattern has significant impact on runoff, so random sampling stations were selected. The Global Positioning System (GPS) surveys are used for locating the sampling points. The depths of the samples are not documented as most of the samples are extracted for bore well. The various ions in the groundwater samples was compared with Bureau of Indian standards[10,11] .

Material and Methods

As per the standard methods [12] all sampling bottles were washed with the filtered sample before filling it and labeled accordingly. pH & conductivity of the water samples were determined with a digital pH meter & digital conductivity meter respectively. sodium and potassium were determined using flame photometer. The samples are analyzed to determine the concentration of sodium (Na^+), calcium (ca^{2+}), total dissolved solids (TDS), Alkanility, sulphate (so_4^{2+}), chloride (cl^-), magnesium (mg^{2+}) and total hardness. The results obtained were compared with the BIS standards. The concentration of the major cations like Ca, Mg, Na, K and anions like CO_3, SO_4, Cl_2 and HCO_3 are determined.

Results and Discussion

Most of the major water consuming & polluting industries located in Thekkampatti & Jadayampalayam villages of Mettupalayam taluk(upstream of the Bhavanisagar reservoir), belong to textile bleaching and dyeing and paper industries Geological history of the area may be revealed from groundwater hydrochemistry[13] Groundwater samples in all station varied in Ph from 7.1 to 8 and acceptable for drinking .The permissible limit of pH value for drinking water is specified as 6.5 to 8.5 as per IS: 10500 std .The analysis of the 10 samples of area at over the rate of value is pH 9.1 in Jadayampalayam . electrical conductivity is used to measure the ability of water to carry an electric current .We knows that pure water is the poor conductor of electricity .Total dissolved solids (TDS) is an important parameter for drinking water and other use and it indicate the general nature of salinity of water[14].Total dissolved solids ranged from 1770 mg/l to 4600mg/l in present study areas. Chloride content ranged from 375-1103mg/l. The permissible limit of Cl is specified as 250mg/l to 1000mg/l as per IS 10500 standards, but Ramampalayam is only over the range of rate value, 1103mg/l of chlorine. Total Hardness of water is characterized by contents of calcium and magnesium salts. For, calcium hardness ranged from 121mg/l to 354mg/l. For magnesium, hardness ranged from 85mg/l to 165mg/l. In this area sulphate content ranged from 208.65mg/l to 452.6mg/l. But the permissible limit of S is specified 200 mg/l to 400mg/l. The concentration of sulphate is higher in (452mg/l) Jadayampalayam.

A. Ternary plot

A ternary plot, ternary graph or definite diagram is a barycentre plot on three variables as positions in equilateral triangle. It can be used to create phase diagrams and depicting composition in a two dimensional graph. The ternary plot is shown in figure 1. The ratio of dissolved solids calcium sodium were represented in the ternary plot. TDS in Ramapalayam is higher when compared to other panchayat. It ranges 85% of sodium and calcium is below 20%.Most of the samples are dominant of dissolved solids.

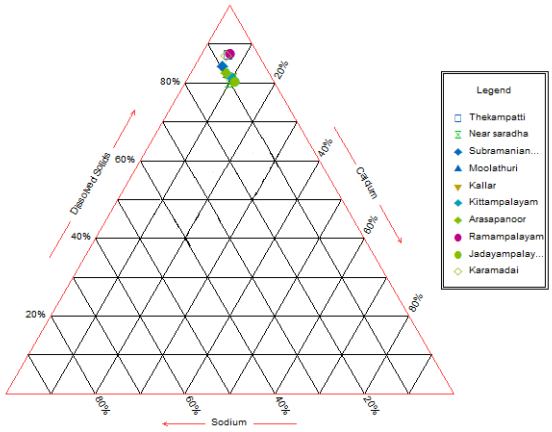

Figure 1: Ternary plot of study areas

Piper diagram:

A piper diagram is a diagrammatical representation of chemistry of a water sample[15]. Piper trilinear diagram is used for delineating hydro chemical characteristics of groundwater [16]. It is a conventional technique of projecting hydro chemical facies, which is suitable for categorising the water quality[17].

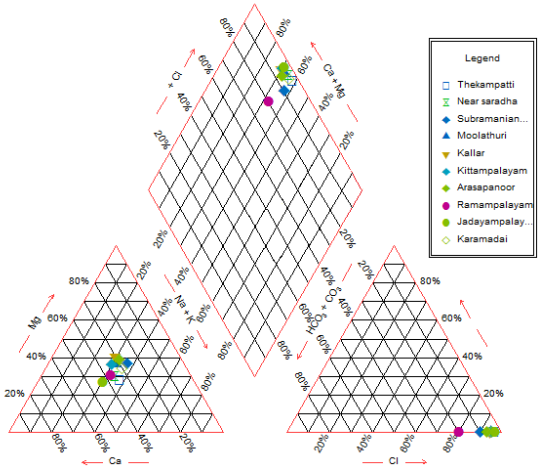

Figure 2: piper diagram of study areas

Piper diagram shown in the figure 2 depicts similarities and dissimilarities among groundwater samples. Piper diagram consist of two triangles, left triangle indicates cation, the right triangle denotes anion in meq/l and diamond shape in the piper diagram signifies the both anion and cation field. The water type is Ca-Mg-Cl type which is predicted from piper diagram. The output form the piper trilinear diagram suggests rock water interface and dissolution of rocks. Elevated value of Calcium hardness is due to groundwater interaction with rocks and does not have hazardous effect. This kind of water type in the study area is due to temporary hardness.

Stiff Diagram

It is used to display the major ion composition of water sample. Stiff patterns are useful in making a rapid visual comparison between water from different sources. The chloride content is high at the sub surface when it act with the atmosphere, It release in the form of bicarbonate. The domination of anion is higher in the stiff diagram.

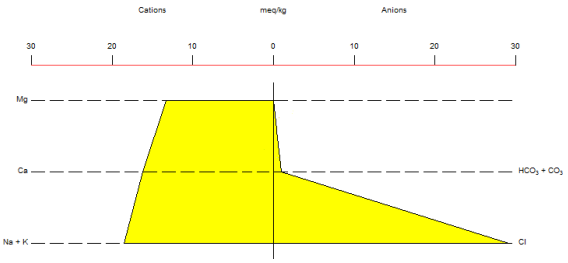

Figure 3 : Stiff diagram for ground water samples

Ion Balance Diagram

An ion balance diagram shows that cationic and anionic composition of a sample, in terms of electrical equivalents. By above given ion balance diagram we can easily identify the content of ion present in the water samples. Anions domination is higher than the cationic domination in the study area.

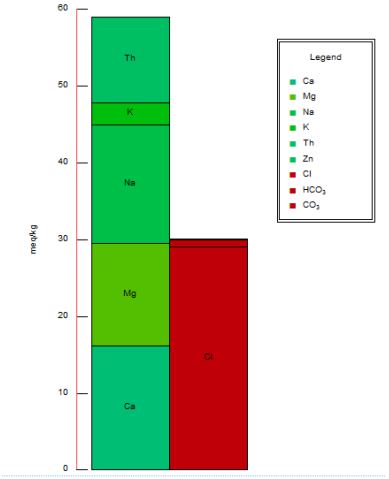

Figure 4: Ion balance diagram

Durov Diagram

Durov diagrams represent the major ion composition, pH and TDS content of any number of samples. In the durov diagram the pH and TDS values are given separate which is easy to identify (Figure 5).

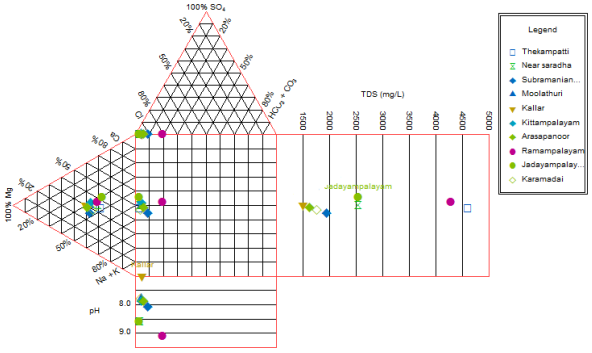

Figure 5: durov diagram

Cross Plot Diagram

In the cross plot diagram the content of a dissolved solid and the pH is represented. The pH is plotted in the plotted in the x-axis and the dissolved solids are plotted on the y-axis. The cross plot diagram shows that in Ramapalayam the pH ranges above 9 and TDS ranges above 4500mg/l (Figure 6).

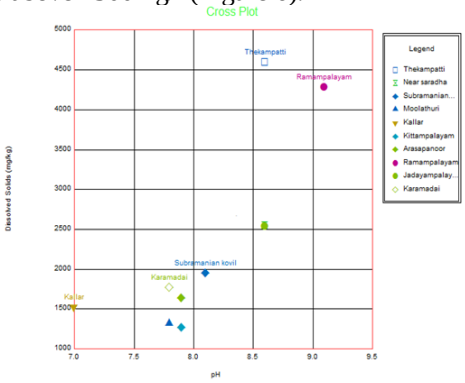

Figure 6: Cross plot of study areas

Pie Chart

The pie chart is same as the ion balance diagram. The values of high range can be noted using the diagram where the chloride content is high and the potassium level is at minimum level for the study area (Figure 7).

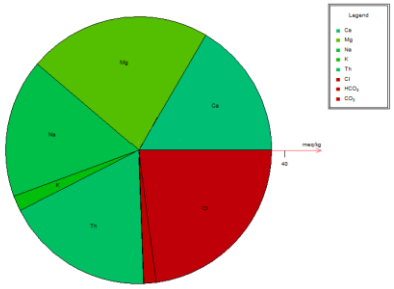

Figure 7: pie chart for ground water samples

Conclusion

The groundwater samples in the Coimbatore region have been carried out to ascertain the suitability for drinking and irrigation purposes. The water samples were collected in the areas of Thekkampatti, Jadayampalayam, Thottapavi and Ramampalayam. In these areas the samples are thoroughly taken and the results are given below. In Jadayampalayam and Ramampalalayam the pH Level is 9.1, hence it is not used for drinking purpose and it may be suitable for some crops. Since the soil salinity may increases. In Thekkampatti region the ground water is used only for cultivation purpose. Most of the samples fall under the category of unsuitable for drinking purpose compared with BIS standards. Conventional graphical method of representing water quality parameters is useful for delineating groundwater system. The output from the study will be a base for implementation of water quality management programme.

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