Geochemical Studies in Edapatty Puthur Village, Salem District, Tamil Nadu, India

P. Palpandian, R. Jayagopal

ABSTRACT- Edapatty is a small village in Attur taluk of Salem District in Tamil Nadu. To understand groundwater quality for pre and post-monsoon period, the pre-monsoon season over exploitation of groundwater leads to water level decreases. Thus the main objective of this study is to give an account of the hydrogeochemistry of the region, to trace the sourced of principal chemical constituents, their concentration and effects on utility. As a result, groundwater becomes very hard. In order to bring out the various physical and chemical characteristics of the groundwater in the study area, twenty four representative groundwater samples were collected from various location of the study area and analysed for various parameters and the result were reported in this project to arrive at a possible solution. After heavy rainfall from NE and SW Monsoon, the total hardness of the water decrease and get diluted due to infiltration. It leaches some chemical constituents, which are derived from fertilizers like Gypsum and Sulphate fertilizers used by farmers for the agriculture. It leads to concentration of Na, K and SO_4 in groundwater. After precipitation, Ca, Mg and Cl concentration decreases. It may be due to dilution of these elements by the percolation of water.

Keywords: Hydro geochemistry, Groundwater, Fertilizer, Precipitation.

I. INTRODUCTION

The over exploitation of groundwater and shortage of rainfall has led to deterioration of its quality. Since water is being widely used for agriculture, drinking and irrigational purposes, the determination of its quality becomes more important. The principles governing the chemical characteristics of groundwater were well documented in many parts of the world (Garrels and Christ, 1965; Stumm and Morgan, 1970; Swaine and Schneider, 1971; frappe et al., 1984; Herczeg, et al., 1991; Som and Bhattacharya, 1992; Pawar, 1993; Wicks and Herman, 1994; Kimblin, 1995; Raju, 1998). It is well documented that environmental pollution depends mainly on human activities (industry, agricultural cultivations, and domestic use) and to a lesser extent, to other natural phenomena, which contribute to this, like volcanoes, earthquakes (Drever, 1997). Groundwater is a key resource in much uses of the world. Irrigation provides the foundation for reliable agricultural production and regional economic security (Hillel, 2000; Tanji, 1990) Human alteration of the landscape has an extensive influence on watershed hydrology (Claessens et al., 2006; Chang, 2007). Water logging and salinity in the case of agricultural use and environmental pollution of various limits as a result of mining, industries and municipal use etc (Choubisa et al, 1995). Transport of nutrients (primarily forms of nitrogen and phosphorus) to lakes and resulting accelerated eutrophication are serious concerns for planners and managers of lakes in urban and developing suburban areas of the country (USGS 2002) The ionic concentrations were found to be higher than the permissible limits of WHO standards, due to leaching and surface run off of chemical fertilizers from agricultural lands. (Divya et al., 2012)

The study area receives meager amount of rainfall even during monsoon season and hence the bore wells drinking water sources becomes insufficient. Similarly the use of unsuitable water may lead to undesirable results in agriculture. Thus the main objective of this study is to give an account on hydrogeochemistry of the region, to trace out the sourced for principal chemical constituents, their concentration and effects on utility

II. STUDY AREA

The Edapatty puthur is situated at 60km from the Salem town. This area is bounded by Kalrayan hills in the East and in the North. It is flanked by Belur in the West and puthiragoundampalyam in the South. The study area in and around puthur is a part of Attur T.K Salem District and it covers 16 sq.km. The entire area often faces dry reason and drought condition. Groundwater is useful and perhaps the only source in this region to mitigate the suffering of local population. The quality and quantity of Groundwater and its mode of occurrence may differ from place to place is due to lithology conditions of the area. Groundwater is useful and perhaps the only source in this region to mitigate the suffering of local population. The study area experience dry climate during February to July and sub tropical climate during November to January. It experiences both NE and SW monsoons with summer showers in the month of March to May. Relative humidity is high from September to December. The temperature ranges from 25ºC to 40ºC in this area. South West monsoon contribute about one third of the annual rainfall. The area depends mainly on the retreating North East monsoon during the month of October and December. There is summer during month of March to May. The study area is beneficiated by the rainfall during South West monsoon (August – October) and North East monsoon (October – December).

III. METHODOLOGY

Twenty four groundwater samples were collected in and around Edapatty puthur village, and they were analysed for various chemical parameters. These parameters include pH, electrical conductivity, total hardness, total dissolved solids, and important cations such as calcium, magnesium, sodium and potassium as well as

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P. Palpandian, Department of Geology, Periyar University, Salem-11, Tamilnadu, India

R. Jayagopal, Principal, L.R.G. Govt. Arts and Science College for Women - Tirupur.

anions such as carbonates, bicarbonates, chlorides, and Sulphate. Three of each in four directions around Edapatty puthur village to get overall picture of groundwater of the area. The water samples were determined by chemical analyses using standard procedure in Government soils and water testing laboratory in Silanayakkanpatti Salem. The results of chemical analyses of Groundwater are given in the Table 1a, 1b, 2a and 2b. The collected values of TH, NCH, %NA, Residual Carbonate, Collin's Ratio, Kelly's Ratio and TDS are shown in Table 3a and 3b.

IV. RESULTS

Any substance that comes in contact with the Groundwater can affect water quality. 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 physical observations of the samples are colourless and odorless in natures which are given. From these data, the following observations were made for different parameter.

A. Physical Properties

Regarding physical properties, the groundwater samples are colorless, free from odour and tasteless.

B. Chemical Analysis

The analyzed chemical constituents of the water samples of the area are furnished in the Table 1and 2 along with the values of Premonsoon and Postmonsoon respectively. Table 3 represents calculated chemical parameters. The results are compared with the standards of drinking water of National Academy of Science and Engineering USA (1972) and Indian Standard Values (1983). The chemical characteristics are discussed below.

C. Bicarbonate (HCO_3)

In general, the HCO_3 values do not exceed the limit of 500 mg/l, as groundwater usually contain less than within limit. In Premonsoon HCO_3 ranges from 482mg/l to 683 mg/l. Increase in HCO_3 in post monsoon samples is seen in samples 1,3,4,5,6,11 and decrease is seen in samples 2,7,8,9 and 12.

D. Chloride (Cl)

By and large, Cl concentration is within the maximum permissible limits. Concentrations exceeding 100 mg/l may cause physiological damage and the water is unfit for using in textile, paper, rubber and food processing industries. It ranges from 53mg/l - 339mg/l in pre monsoon. Except in sample no. 9 and 12, the values of Cl shows decrease in post monsoon samples. In post monsoon it varies from 43mg/l - 359mg/l.

E. Sulphate (SO_4^-)

Most of the values are more than 300 mg/l in the study area. If the SO_4 content exceeds the highest desirable range of 150 mg/l, it may cause gastrointestinal irritation in combination with mg and Na. Both pre and post monsoon samples are fall within desirable limit. Except in sample 3 and 7, all other samples shows increase sulphates in post monsoon analyses.

F. Sodium (Na^+)

More than 50 mg/l of Na may cause corrosion in boilers and pose problems in ice manufacture. High concentrations are noticed in the groundwater of the area showing increase of sodium. In post monsoon samples all of them increase in percentage.

G. Potassium

Only in two water samples, potassium content exceeds the desirable limit of 10 mg/l, while in the rest of the samples; it averages 5.41 mg/l. The potassium content in post monsoon samples show decrease in their percentage.

H. Calcium

Calcium often causes encrustation along pipelines and prevents the flow of water. In post monsoon analyses all the samples show decrease in their values.

I. Magnesium

The concentration of magnesium in groundwater samples varies from 51 mg/l to 106 mg/l in Premonsoon. In post monsoon it varies from 36 mg/l to 72 mg/l. Majority of post monsoon samples shows decrease in their values. Both monsoon samples are fall within maximum permissible limit.

J. Sodium Percentage

Sodium ions have a tendency to be absorbed as soil colloids. As the proportion of sodium to other cations in irrigation water increases, Sodium replaces the soil calcium and magnesium. In Premonsoon, sodium percentage ranges from 20% to 49% and in post monsoon it ranges from 42% to 75%. The premonsoon samples mostly fall in permissible limit while in post monsoon samples, the value of sodium percentages increased.

K. Total Hardness

The total hardness values of the samples ranges from 375 to 610 in pre monsoon. In post monsoon it ranges from 223 to 300. The total hardness values decreases in post monsoon samples.

L. Total dissolved solids

TDS increases in the post monsoon samples. In Premonsoon TDS ranges from 640 mg/l to 1216 mg/l. Except 3,6,7,9 and 10, all others are fall under fresh water. Remaining samples falls under brackish water (Samples 1,2,4,5,8,11 and 12) (after Carroll's).in post monsoon TDS ranges from 576 mg/l to 1216mg/l.

M. Residual carbonate

In Premonsoon, Residual carbonate values ranges from -4.7 to 1.1 while in post monsoon the values increases and it ranges from1.10 to 6.54.

N. pH values

The concentration of Hydrogen ions (pH) ranges from 6.8 to 7.5. By and large in both Premonsoon and post monsoon, the pH remains uniform.

O. Durov's Diagram

In Durov's Diagram, Premonsoon (Fig-9a) samples No. 4, 7, and 10 fall in no contamination zone and the remaining in moderate contamination zone (Sample No 1, 2,3,6,8 and 12). In post monsoon (Fig-9b) samples plot except the sample no 12; all of them fall in no contamination zone. This may be due to dilution of groundwater after monsoon. The pH values show slight changes from neutral to alkalinity.

P. Piper's Diagram

In piper's diagram, all the post monsoon (Fig-10b) samples fall in zone 1 where alkaline earth is greater than alkali's. Sample No. 3, 4, 5,6,7,10,11 and 12 fall in strong acid zone and the remaining samples 1, 2, 8 and 9 falls in weak acid zone. Secondary Alkalinity is found in samples 1, 2,3,5,8 and 12.

From the above studies, it is clear that the percentage of potassium, calcium, magnesium and total hardness decreases in the post monsoon samples. It may due to dilution of these elements in groundwater after heavy rainfall.

The increase in the percentage of Na, SO_4 and TDS may be due to excessive use of Gypsum, sulphates fertilizers and pyrite that are present abundance in the Charnockite rocks of the study area.

The pyrite, by reacting with water would liberate sulphates which increased its percentage in groundwater. The sodium might have been derived from the albite feldspars present in the Charnockite of the study area as the area is composed of acid Charnockite which has high percentage of Albite mineral. The high percentage sulphates in post monsoon samples might have come from Gypsum and Sulphate fertilizers.

Q. Schoeller's Semi Logarithmic Diagram

Here the principle ionic concentrations, expressed in milliequivalents per litre, are plotted on six equally space logarithmic scales in the arrangement. Straight lines join the points thus plotted. This type of graph shows not only absolute values of each ion but also the concentration differences among various ground water analyses. The Collin's ratio of Pre-monsoon and post monsoon groundwater samples do not show remarkable changes and Collin's ratio is less than 1.15 which indicates that the water can be used for drinking purpose.

V. CONCLUSION

In Pre-Monsoon period, the over exploitation of groundwater leads to water level decreases. As a result, water becomes very hard. After heavy rainfall from NE and SW Monsoon, the total hardness of the water decrease and get diluted due to infiltration. It leaches some chemical constituents, which are derived from fertilizers like Gypsum and Sulphate fertilizers used by farmers for the agriculture. It leads to concentration of Na, Mg and HCO_3 in Groundwater. After precipitation, Ca, Mg, and Cl concentration decreases. It may be due to dilution of these elements by the percolation of water.

From the above study, it is found that the groundwater samples can be used for domestic and irrigation purposes. The excessive and indiscriminate use of Gypsum and Sulphates fertilizers are responsible for the high percentage of sulphates in the groundwater. The rock of study area has a lot of pyrite minerals which upon decomposition may liberate sulphates. So, the farmers should limit the use of gypsum and sulphates fertilizers to the optimum level to prevent the gastrointestinal diseases in the study area.

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Table-1a Pre-monsoon (epm) in meq/l										
WELL NO.	Ph	Ec	Ca	Na	Mg	K	HCO3	CO3	SO4	Cl
1	6.8	1000	3.3	2.65	4.2	0.13	8.6	0	0.2	1.5
2	7.1	1200	3.6	2.39	6.1	0.08	9.1	0	0.6	2.5
3	7.3	1800	3.3	8.19	5.8	0.31	10.0	0	1.2	7.0
4	7	1500	3.3	3.48	8.3	0.21	9.5	0	0.6	5.25
5	7.1	1400	3.2	3.7	7.4	0.21	9.4	0	0.8	4.25
6	7.1	1800	3.9	5.43	8.7	0.15	7.9	0	1.2	9.0
7	7	1800	4.8	5.65	7.6	0.51	8.4	0	1.8	9.55
8	7.1	1300	4.1	3.91	5.0	0.18	9.5	0	0.6	3.0
9	7.1	1900	4.2	9.78	4.9	0.23	11.2	0	0.6	7.75
10	7.4	1800	3.5	7.17	7.33	0.62	8.6	0	0.4	9.75
11	7.7	1500	2.6	7.17	5.2	0.28	8.8	0	0.8	5.75
12	7.5	1400	2.4	6.09	5.6	0.18	10.0	0	0.4	4.0

Table-2b Post-monsoon (epm) meq/l										
WELL NO.	Ph	Ec	Ca	Na	Mg	K	HCO3	CO3	SO4	Cl
1	7.1	1600	1.20	9.18	3.3	0.03	10.3	0	1.5	1.2
2	6.7	1100	1.50	4.31	4.5	0.03	7.70	0	0.6	2.1
3	7	1300	1.50	13.83	3.0	0.15	10.60	0	1.1	6.5
4	6.7	1200	1.00	10.83	3.5	0.03	11.00	0	0.7	3.5
5	7.4	1000	2.20	9.18	3.3	0.03	9.00	0	0.6	5.0
6	7.2	1400	1.00	11.30	4.9	0.13	8.00	0	0.7	8.5
7	7.6	1900	1.00	9.00	3.5	0.03	8.00	0	1.2	4.0
8	7.9	1300	1.50	7.66	3.5	0.17	9.00	0	0.8	3.0
9	7.1	1600	1.50	10.18	3.9	0.23	10.00	0	0.9	5.0
10	7.4	1900	2.00	11.79	3.5	0.31	8.30	0	1.4	7.5
11	7	1900	1.50	14.57	3.5	0.03	9.00	0	0.5	10.1
12	7.1	900	1.50	9.53	5.9	0.50	8.50	0	0.6	8.5

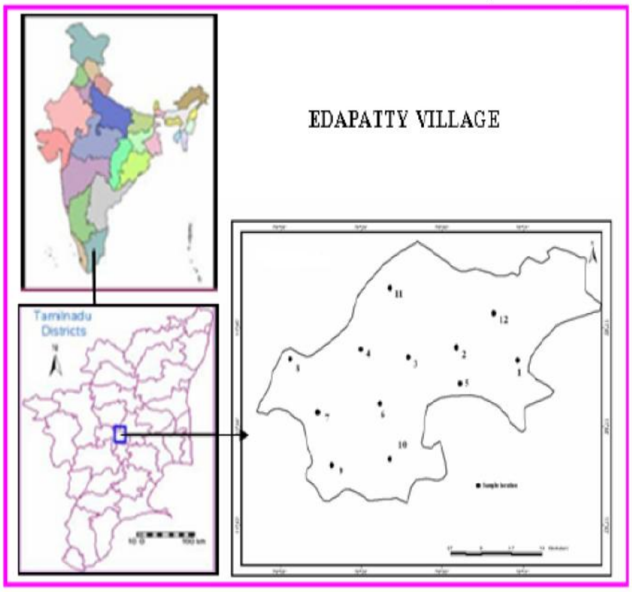

Figure 1 Base Map of the study area with well locations

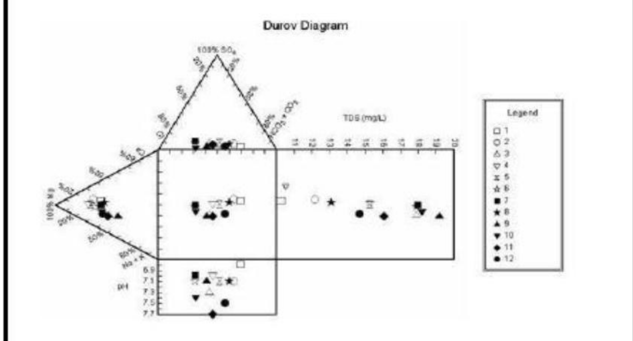

Figure 2a Durov's Classification for premonsoon

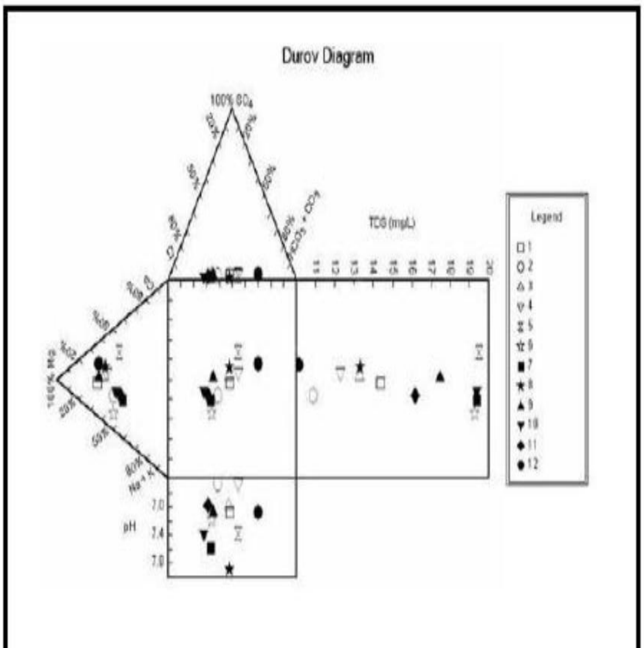

Figure 2b Durov's Classification for post monsoon

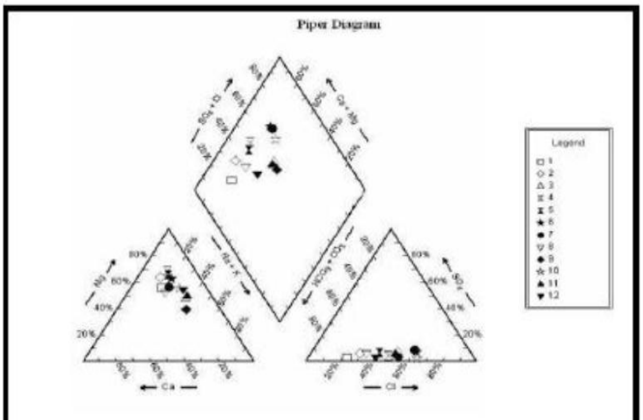

Figure 3a Piper's trilinear diagram for premonsoon

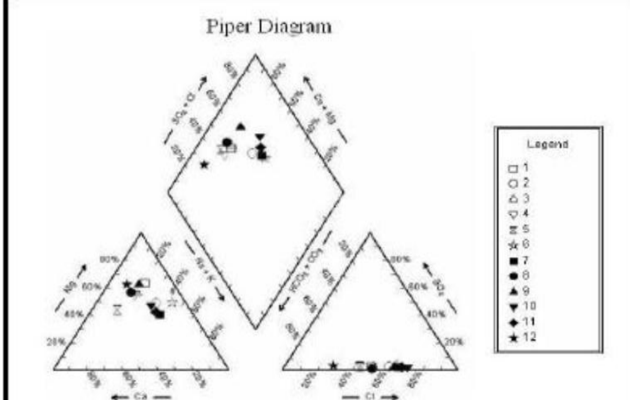

Figure 3b Piper's trilinear diagram for post monsoon

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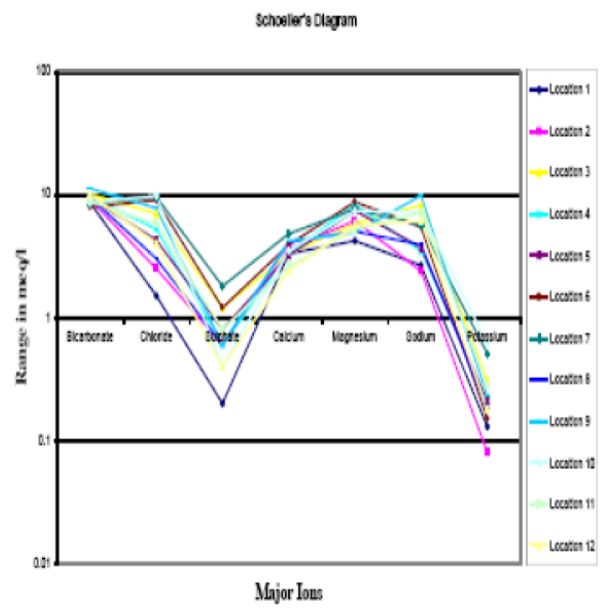

Figure-4a Schoeller's diagram for Pre-monsoon

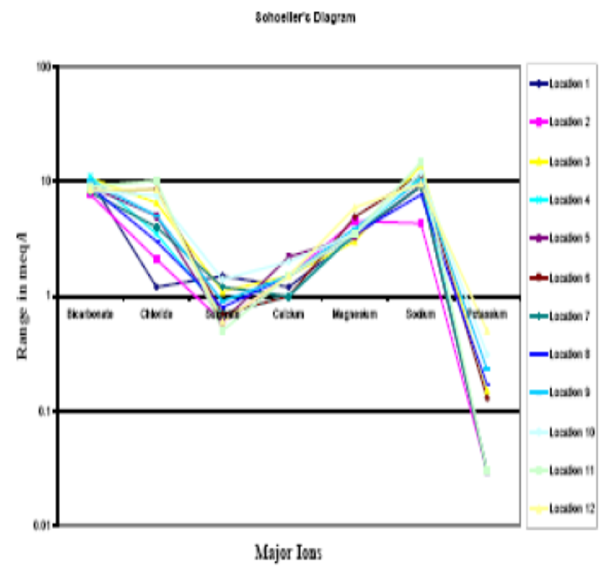

Figure-4b Schoeller's diagram for Post-monsoon

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