Hydro Chemical Characteristics and Groundwater Suitability for drinking and irrigation purposes

A Case study in and Around Singanallur, Coimbatore City, Tamil Nadu, India.

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Abstract **- A study of hydrochemical characterization of groundwater and its suitability for drinking and irrigation purposes has been carried out in and around Singanallur, Coimbatore city. sixteen groundwater samples were collected from dug wells and bore wells during Post monsoon season. The collected samples were taken for analysis of various hydro chemical parameters such as pH, Electrical Conductivity, Total Dissolved Solids, Calcium, Magnesium, Sodium, Potassium, Bicarbonate, Carbonate, Sulfate and Chloride. Based on the hydro geochemical results to be carried out into graphical representation such as Piper trilinear diagram, USSL salinity diagram, Wilcox diagram and scatter plot. The hydro geochemical results have to be compare with World Health Organization (WHO), and Indian Standard Institution (ISI) drinking water standards suitable for drinking and irrigation purposes. Multivariate statistical analysis such as correlation matrix and Principal component analysis are used to determined groundwater characters. These analysis have become accepted in identifying variations and source of groundwater pollution.**

Index terms **– dug well, post monsoon, piper trilinear, salinity**

I. INTRODUCTION

Ground water is a vital natural resource. Depending on its usage and consumption it can be a renewable or a non renewable resource. It is estimated that approximately one third of the world's population use groundwater for drinking.Groundwater utilization has increased at an alarming rate over a period of three decades in the study area . The net result is that the groundwater regime of the area has been affected detrimentally, both qualitatively and quantitatively.Geochemical studies of groundwater provide a better understanding of possible changes in quality as development progress.

II. DETAILS ABOUT STUDY AREA

Coimbatore District is a district in the Kongu Nadu region of the state of Tamil Nadu. Coimbatore is the administrative headquarters of the district.It is one of the most industrialized districts and a major textile, industrial, commercial, educational, information technology, healthcare and manufacturing hub of Tamil Nadu.

III. GEOGRAPHIC LOCATION AND DEMOGRAPHY

The Coimbatore city located in between 10^0 10' and 11^0 30' North latitude and 76^0 40' and 77^0 30' East longitude. The town situated 411 meter above the mean sea level. The district covers an extent of 4723 Sq. km., of which, reserve forest comprising of 1052 Sq. km. And the forest cover of the district is about 22 percent of the district geographical area. As per the 2011 Population census Coimbatore district having total population of 34.58 lakh. In this district, both male and female population distributed more or less equally. It is one of the distinctive features of this district. Among the total population, literates were 26.36 lakh, which comprises 76 percent of the total population.The Coimbatore city located in between 10^0 10' and 11^0 30' North latitude and 76^0 40' and 77^0 30' East longitude.

IV. MATERIALS AND METHODS

Sampling methods:

Groundwater samples were collected from 16 representative dug wells and ore wells during Post monsoon season and analyzed to understand the physicochemical variations of water quality parameters using standard methods (APHA 1995).Samples were collected in one liter capacity high density polyethylene (HDPE) bottles. Prior to collection, the bottles were thoroughly washed with dilute HNO_3 acid. Each bottles was rinsed to avoid any possible contamination in bottling and every other precautionary measure was taken.The location of the sampling stations was fixed using Global Positioning System (GPS) and the exact longitudes and latitudes of sampling paints.

Insitu measurements:

The pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS) were measured on site by using HANNA portable water quality meter (HI-9828)

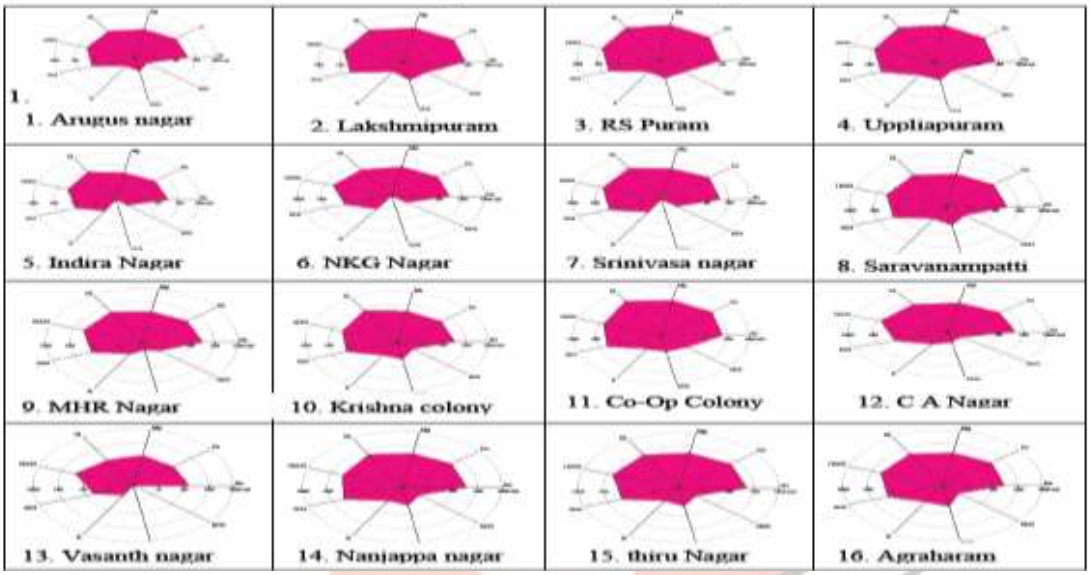
Analytical Methods:

The groundwater water samples were analyzed for physical and chemical parameters by using standard water quality methods (APHA 1995). For the chemical analysis, calcium (Ca^{2+}) and magnesium (Mg^{2+}) concentrations were determined by EDTA

(Ethylene-di-amine-tera-acetate) titration. The concentrations of sodium (Na^+) and potassium (K^+) were estimated using Digital flame photometer (DEEP VISION, Model-381). Chloride (Cl^-) was determined by $AgNO_3$ (0.01N) titration method using 1mL of potassium chromate (5%) as an indicator. The bicarbonate (HCO_3^-) content was determined by sulfuric acid titration (0.01N) using phenolphthalein and methyl-orange as indicators. Sulfate (SO_4^{2-}) estimation was done using UV/ Visible spectrophotometer. The analyzed groundwater samples show that the value of computed ionic balance error is within the acceptable limit of ±10%. All concentrations were expressed in milligrams per liter (mg/l) except pH and EC. The results were evaluated in accordance with the drinking water quality standards given by the World Health Organization (WHO 2004). The groundwater suitability for irrigation was determined by certain indices such as sodium adsorption ratio (SAR), Sodium percentage (Na %), permeability index (PI), magnesium hazard (MH). US salinity diagram and Wilcox plots was carried out to recognize the various hydro-geochemical types in the groundwater and its suitability for irrigation purposes. Major hydrochemical facies were identified through Piper trilinear diagram (Piper 1944) using Aquachem Scientific v4.0 software. Multivariate statistical analysis such as Pearson correlation matrix, factor analysis and cluster analysis was performed using IBM SPSS 19 software.

V. RESULTS

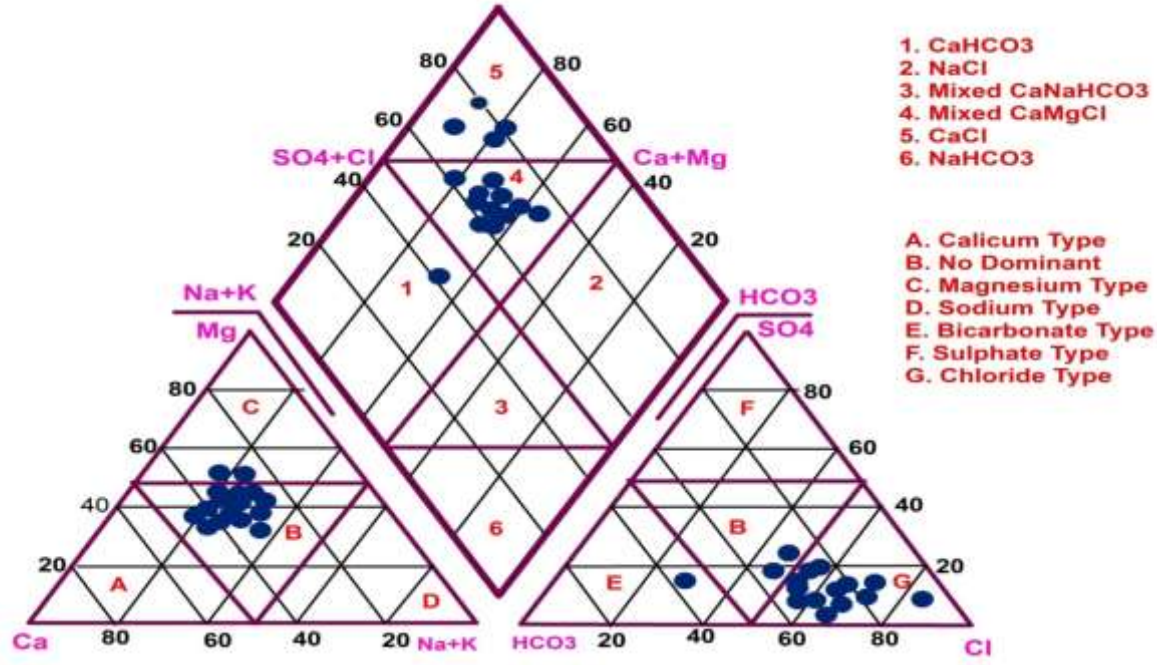
Ionic distribution of all groundwater samples



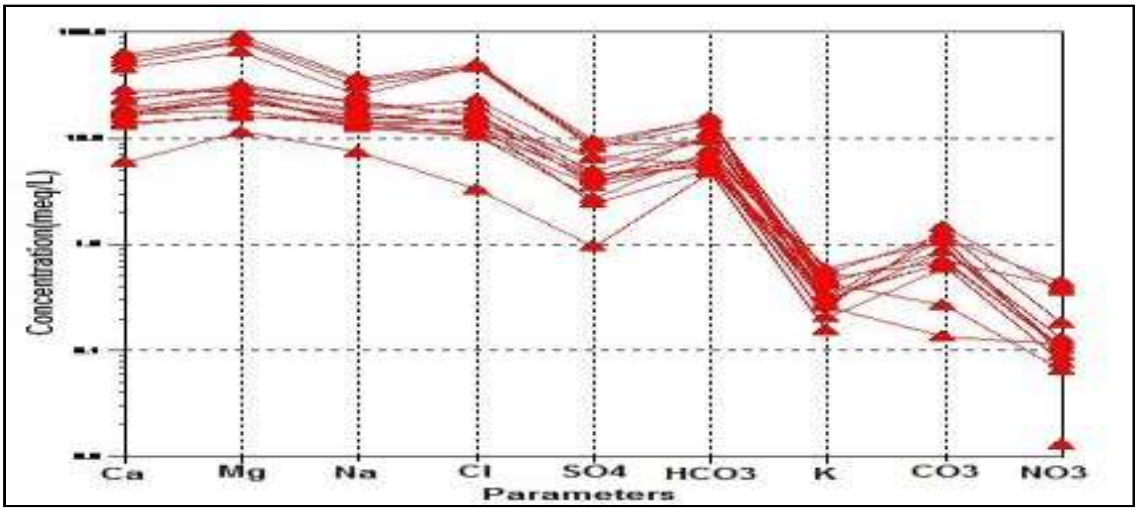
Analytical results And irrigation water quality parameters of groundwater in the study area

S. No	Loc. Name	X	Y	pH	EC	TDS	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	SAR	PI	Na%	MH	RSBC	TH
1	Arugus nagar	77.01546	11.02385	7.2	10016	6410	1250	1106	837	13	34	954	1753	405	34	5.877	21.22	19.31	59.29	-46.85	3840.81
2	Lakshmipuram	77.0206	11.01788	7.4	9780	6259	1130	1005	796	10	43	928	1646	452	28	5.870	22.13	20.04	59.41	-41.28	3482.75
3	RS Puram	77.0256	11.01436	8.05	3766	2410	389	326	405	8	18	346	467	190	6	5.180	31.20	27.81	57.97	-13.78	1157.82
4	Uppiliyapuram	77.0198	11.01235	7.6	9067	5803	1036	969	705	21	38	827	1651	390	14	5.348	21.11	19.18	60.62	-38.24	3291.04
5	Indira Nagar	77.01102	11.01244	7.9	4792	3067	570	334	426	16	0	608	814	305	8	4.954	28.95	25.28	49.09	-18.53	1400.72
6	NKG Nagar	77.03153	11.00938	8.15	3108	1989	335	324	290	18	0	470	369	130	7	3.829	27.25	23.15	61.42	-9.04	1086.14
7	Srinivasa Nagar	77.02173	11.00389	8.26	2791	1786	270	196	308	12	0	305	477	116	5	4.923	36.08	31.63	54.44	-8.50	741.30
8	Saravanampatti	77.01475	11.00303	8.07	3498	2239	346	284	330	11	26	412	514	213	10	4.502	30.66	26.47	57.46	-10.54	1017.55
9	MHR Nagar	77.00894	11.00459	7.4	7923	5071	915	786	586	19	21	574	1710	404	31	4.852	20.94	19.05	58.57	-36.33	2762.90
10	Krishna colony	77.01009	11.00311	8.04	3667	2347	314	291	340	17	26	336	705	220	8	4.698	31.23	27.75	60.40	-10.19	991.93
11	Co-Op. colony	77.01153	10.99819	8.36	2878	1842	278	197	326	10	4	380	374	167	9	5.169	37.44	32.41	53.84	-7.67	753.37
12	Celamman nagar	77.02266	11.00034	7.8	4759	3046	461	386	490	17	8	690	598	170	5	5.758	32.24	28.41	57.95	-11.74	1371.42
13	Vasanth nagar	77.02603	10.99666	7.95	4925	3152	475	363	516	12	21	605	570	236	8	6.131	33.52	29.79	55.71	-13.83	1341.58
14	Nanjappa nagar	77.01703	10.99611	8.12	3917	2507	368	267	378	13	20	346	490	314	8	5.176	32.94	29.36	54.42	-12.73	1010.07
15	Thiru nagar	77.0123	10.99415	7.26	1258	805	118	140	170	6	0	289	116	46	1	3.544	38.34	30.23	66.13	-1.16	435.85
16	Agraharam	77.03483	10.99919	7.92	3108	1989	338	226	296	23	32	405	407	204	7	4.322	31.56	27.50	52.39	-10.26	888.13

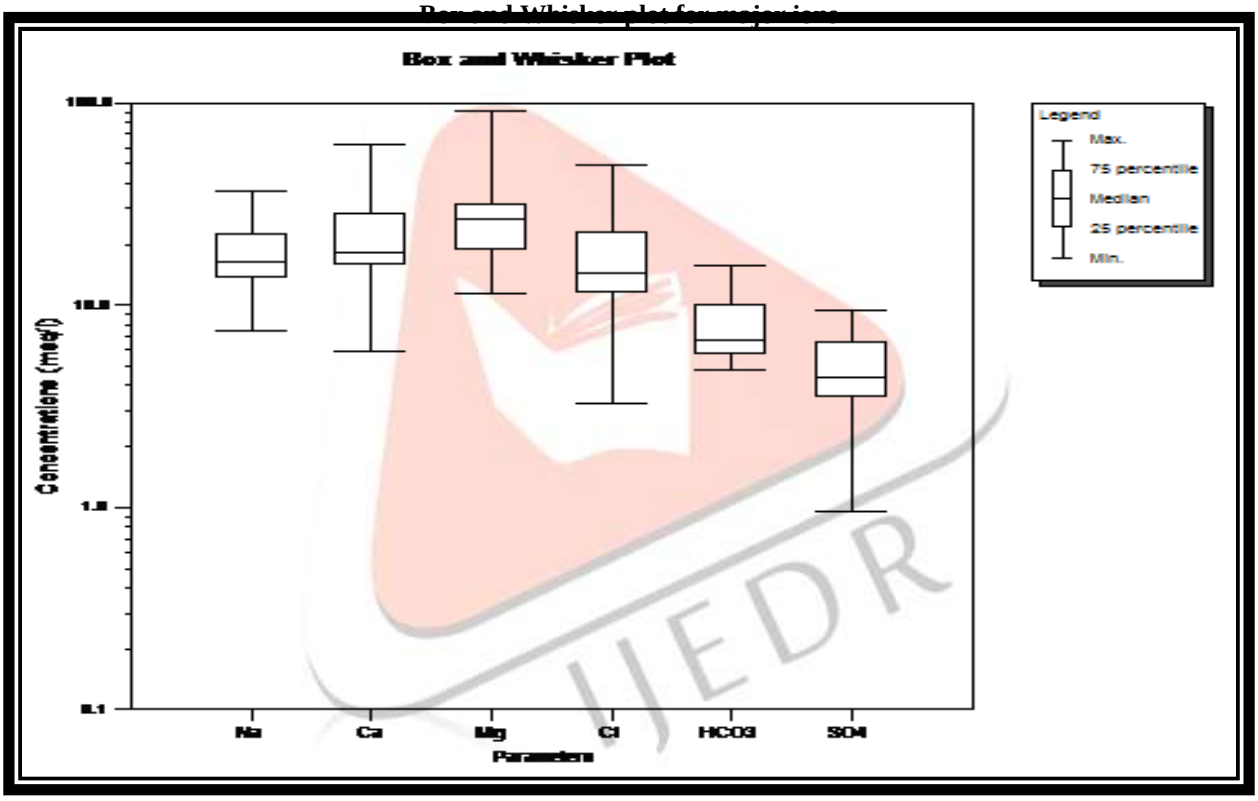
Piper Trilinear diagram for hydrogeochemical facies of study area groundwater



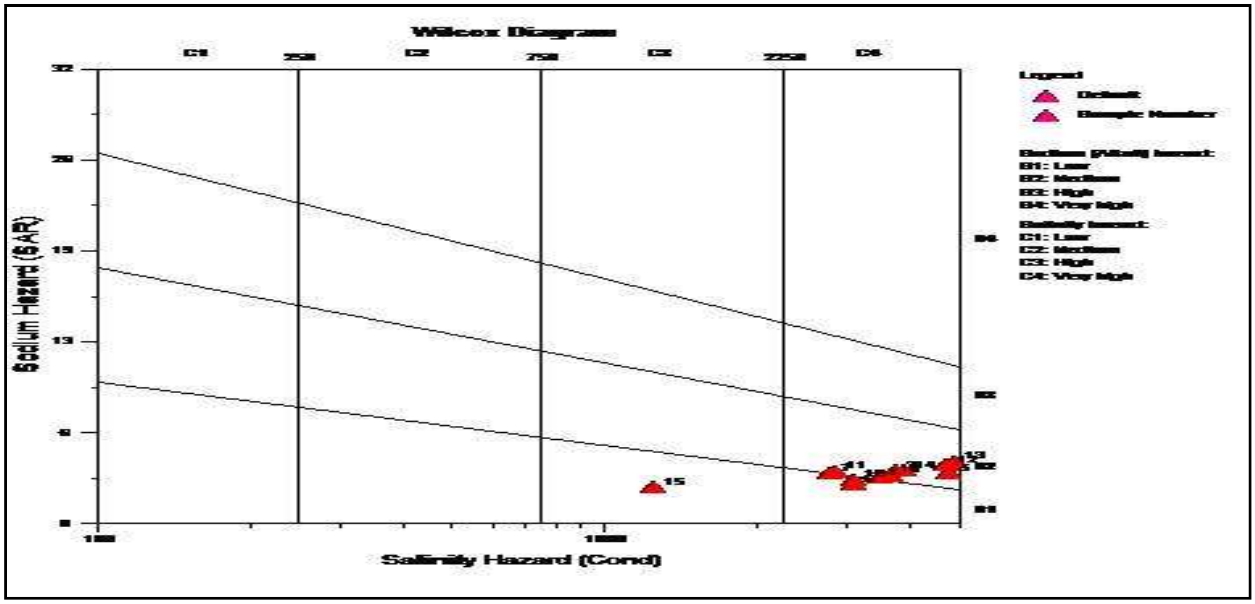
Schoeller plot showing ionic variation in the study area



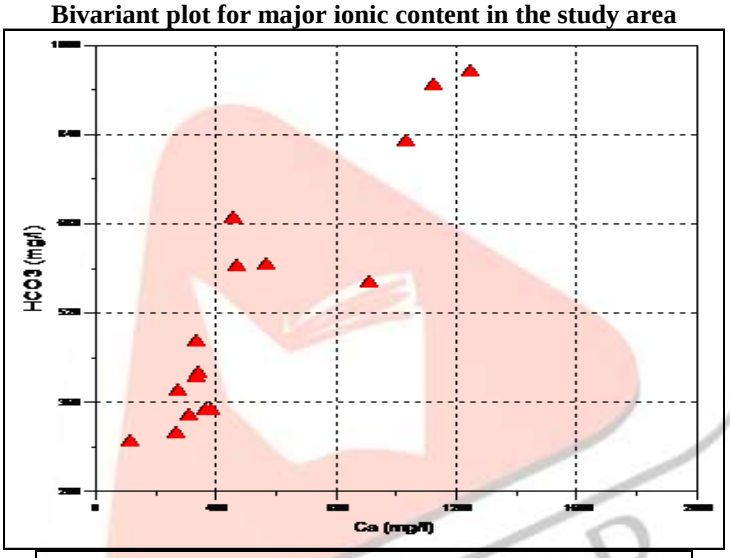
Box and Whisker plot for major ions

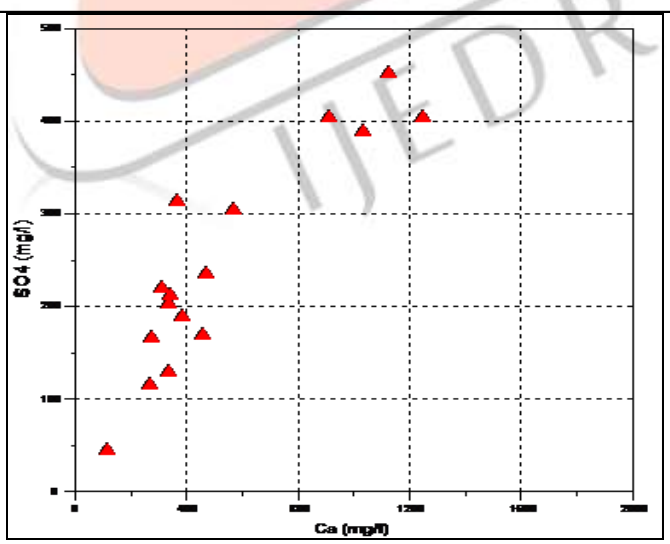


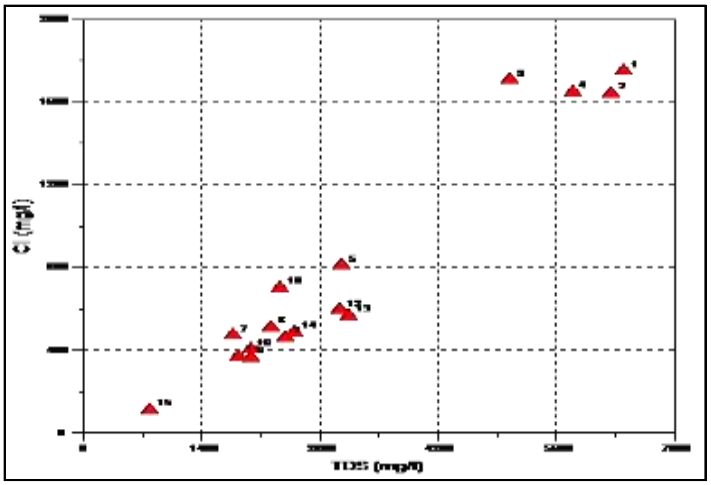
USSL Salinity diagram for the classification of irrigation waters (Wilcox 1955)



Bivariant plot for major ionic content in the study area







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