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RESEARCH ARTICLE

GROUNDWATER QUALITY ASSESSMENT IN VAIPPAR RIVER BASIN TAMILNADU (INDIA)

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ABSTRACT

A baseline study involving analyses of surface and bore well water samples from the vaippar river basin was carried out in order to assess their suitability for drinking domestic and agricultural purposes. The data obtained are used to determine important quality parameters and ratio's. High TDS found in groundwater of gneissic and granitic aquifers. Based on the salinity and sodium hazard for irrigation quality, C2S1, C3S1, C3S2 and C4S1 are quality classes found not suitable for even salt tolerant crops in the study area. The quality parameters of the groundwater samples has been matched with ISI standards (1991).

INTRODUCTION

Water is the most important natural resources without life would be nonexistent. Availability of safe and reliable source of water is an essential prerequisite for sustainable development. Desserts are not habitable because of lack of water [1]. Freshwater quality and availability remain one of the most critical environmental and sustainability issues of the twenty – first century [2]. Of all sources of freshwater on the earth, groundwater constitutes over 90% of the world's readily available freshwater resources [3] with remaining 10% in lakes, reservoirs, rivers and wetland. Groundwater is also widely used as a source, for drinking water supply and irrigation in food production [4] However, groundwater is not only a valuable resources for water supply, but also a vital component of the global water cycle and the environment. As such, groundwater provides water to rivers, lakhes, ponds and wetland helping to maintain water levels and sustain the ecosystems. Moreover, some field investigators indicate groundwater [5, 6]. In vaippar river basin has 60 observation wells are considered for this sub basin. The groundwater quality in good for the past two decades. But the total hardness value exceeds the limit in vembur village. This may be due to the influence of the wells of nearby sub basin. During the year of 1993, there is no identification for seawater intuition. But in the latest period of 2000 and 2009 shows the indication for seawater intrusion. During the year of 2000 the area near by Sankaran Kovil and Kovilpatti village have higher vales of TDS, Chloridesand, total hardness. But the quality in moderate for the period of 2009 in this sub basin except pudur, Sattur and Villathikulam town area in these places the values of TDS, TH and CI are above the maximum acceptable limit. The rural nature of the area has made it such that the local people use surface water as their only sources of portable water. Surface of water bodies are very prone to pollution, and this coupled with anticipated future development of the area make it necessary to vary out a baseline water quality evaluation study. This is essential, since the effect water monitoring network requires an accurate characterization of background quality. Although the feasibility of this waste – disposal method has been demonstrated in much area, some groundwater quality problems have occurred. Notable, elevated nitrate –N and Chloride concentrations have been reported in groundwater down gradient from land areas receiving spray-irrigated effluent in carbonate – and crystalline – rock aquifers [8, 9]. Resent groundwater studies have also detected low concentration of chemicals associated with pharmaceuticals and personal care products near waste water disposal areas [10,11].

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MATERIALS AND METHODS

Study Area

The area chosen for the study is hard rock and sedimentary rock aquifer of Vaippar river basin of Tamilnadu (India) (Fig.1). The area has been selected for its under developed nature and also for its varied litho logical conditions geomorphology, hydrological characteristics, consolidated nature of rock etc. The study area spreads over an area 4900 square kilometers. Physiographic ally the area is almost flat and monotones undulating terrain except the pocking relief hills along the fringes of study area is located between Latitudes 9^0 0' 05" and 9^0 30' 54" N and Longitudes 77^0 17'

44” to 78^0 9’ 58” E. It covers an area toposheet No.58 G/5, 6, 7, 8, 10, 11, 12, 15, and 16. 58 K/3, 4, 8.

Sample Collection

The data for this study were based on samples collected from 60 locations in vaippar river basin. 24 for Borehole water and 36 for surface water samples. The collected water samples are analysis specific conductance, pH, TDS, etc., like that geo chemical parameters (Table la, ib). Sample collection and preservation methods for the various chemical constituents are described in the National Field Manual for the Collection of Water – Quality Data [13]. Major ions, Nutrients, Boron, and Dissolved organic carbon were analyzed at the U.S. Geological Survey National Water Quality Laboratory (USGS NWQL) in Denwer, Colorado [11-17] Water samples were analyzed for Nitrite(No.2) Plus nitrate (No3), but concentrations of nitrate in groundwater usually are bellow detection limits [18].

RESULTS AND DISCUSSION

Quality of Borehole Water and Surface Water

High TDS content of 3820 mg/1 tds has been found in Borehole waters of granitic aquifer around the village vaippar (Table 1), the areas adjacent to river course show low TDS. Similarity in vadamalapuram TDS ranges from 332 to 2380 mg/1 (Table 1 & 1a) in surface water is very low ranges from 63 to 984 mg/1. Higher content of TDS can be attributed to the contribution of salts from the thick mantle of soil and the weathered media of the rock and further due to higher residence time of groundwater in contact with the aquifer body.

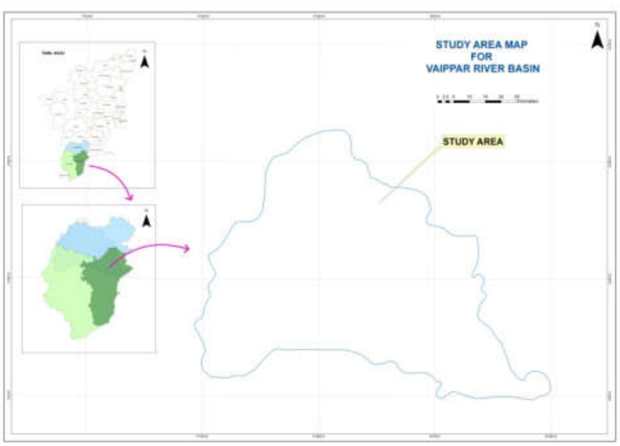

Fig. 1. Location of the vaippar river basin, Tamilnadu, India

As the host rocks belongs to Charnockite and granitic suits, there can be some oxidation and reduction process in groundwater and surface water, thereby also causing enrichment in total dissolved solids. In most part of the study area, the concentration is generally higher than the limits suggested for domestic purposes. The data plot of the analysis results over piper trailer diagram (Fig 3, 3a) has indicted the change of CaHCO3 faces to NaCL as calcium gets replaced by sodium. The enrichment of calcium in mixed type probably indicate dissolution and mixing of calcium present in Charnockite rocks and the chloride enrichment in anion may indicates the transformation of faces from hard calcium bicarbonate type to alkaline mixed bicarbonate type along the flow path [20] as the groundwater moves.

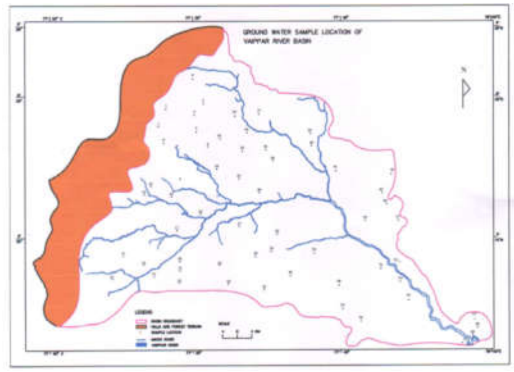

Fig. 2. Sample location map of the study area vaippar river basin, Tamilnadu, India

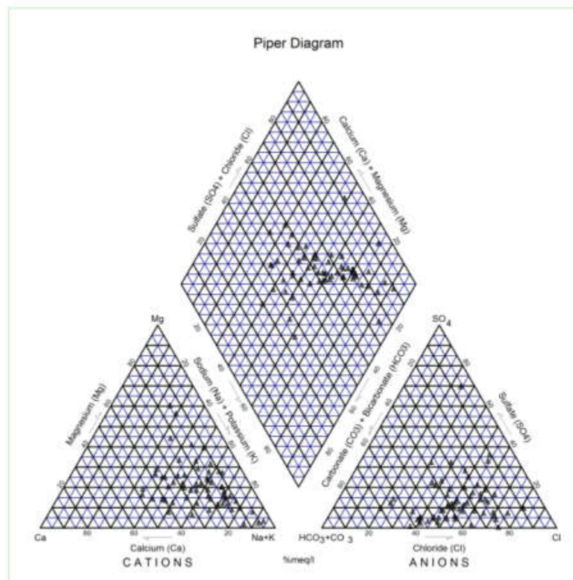

Figure :3 Piper Trilinear Diagram of Borehole Water of the study area

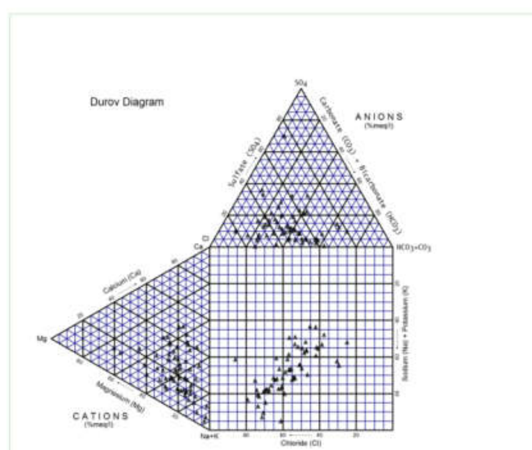

Figure :4 Piper Trilinear Diagram of Surface Water of the study area

Table 1: Chemical analysis Result of Borehole water in the Vaippar river Basin

Name	Ec	PH	Ca	Mg	Na	K	HCO3	Cl	SO4	NO3	F	TDS	TDS
Chokkampatti	0.59	7.89	75	59	78	0.12	125	106	65	0.02	3.16	378	0.3776
Kunnur	0.46	7.59	74	52	75	0.16	113	108	45	0.03	2.89	294	0.2944
Sundrapandian	0.52	7.54	82	56	72	0.13	120	89	49	0.02	2.75	333	0.3328
Vathirairuppur	0.75	7.54	86	58	86	0.15	136	75	62	0.02	2.56	480	0.48
Srivilliputhur	0.82	7.62	89	62	85	0.09	142	96	60	0.032	3.06	525	0.5248
Rajapalam	0.89	7.26	89	56	113	0.09	142	110	56	0.05	2.85	570	0.5696
Chathirampatti	0.75	7.16	96	51	120	0.12	136	112	51	0.05	3.1	480	0.48
Alakkulam	0.59	7.42	83	58	105	0.11	120	132	62	0.04	3.25	378	0.3776
Kandiyapuram	0.49	7.54	84	54	96	0.08	123	116	65	0.04	3.06	314	0.3136
Sevalpatti	0.52	7.34	82	59	105	0.13	130	125	63	0.05	2.75	333	0.3328
Sankarankovil	0.56	7.89	75	56	70	0.12	89	75	69	0.02	2.56	358	0.3584
Puliyankudi	79	7.64	86	51	62	0.15	95	76	62	0.06	2.36	506	50.56
Chinthamani	52	7.56	82	52	68	0.06	93	73	67	0.05	2.48	333	33.28
Vasudevanallur	1.06	7.42	116	56	120	0.08	112	125	63	0.03	2.61	678	0.6784
Mullikulam	1.1	7.5	124	54	125	0.06	124	130	60	0.02	2.85	704	0.704
Vadamalapuram	1.06	8.02	129	89	135	0.16	142	116	85	0.05	3.2	678	0.6784
Ramalingapuram	1.12	7.96	125	78	125	0.13	136	120	86	0.05	3.16	717	0.7168
Panaiyur	1.06	8.02	129	89	135	0.16	142	116	85	0.06	3.2	678	0.6784
Meenatchipuram	1.22	8.06	132	85	124	0.12	132	115	84	0.04	3	781	0.7808
Sivagiri	1.08	7.68	125	75	132	0.1	130	113	89	0.02	3.18	691	0.6912
Devipattinam	1.09	7.54	136	76	132	0.13	140	114	87	0.05	3.2	698	0.6976
Chokkonathnpudur	68	8.1	89	48	98	0.08	112	89	69	0.02	2.81	435	43.52
Mettupatti	0.89	7.96	84	46	93	0.09	102	85	85	0.04	2.65	570	0.5696
Nallamangalam	0.78	8.19	78	40	92	0.15	109	84	72	0.03	2.89	499	0.4992
Chettiarpatti	0.82	7.59	83	47	87	0.13	123	95	81	0.03	2.65	524	0.5248
Cholapuram	0.91	7.85	82	42	86	0.12	108	86	68	0.02	2.78	582	0.5824
Manalur	1.25	7.85	116	84	118	0.12	128	112	80	0.02	3.16	800	0.8
Kuruvigulam	1.06	7.82	118	82	123	0.15	156	116	78	0.03	3.06	678	0.6784
Kalugmalai	1.04	7.68	108	89	120	0.09	136	120	83	0.04	3.18	666	0.6656
Pazhankokkai	1.02	7.59	120	76	124	0.12	125	108	81	0.04	3.16	653	0.6528
Gururajakulam	1.03	7.62	95	80	123	0.07	130	123	83	0.03	3.08	659	0.6592
Kovilpatti	89	7.58	86	62	110	0.13	114	125	85	0.05	3.15	570	56.96
Kadalai	82	7.26	115	68	115	0.09	119	123	83	0.02	3.05	525	52.48
Ettaiyapuram	1.25	7.4	118	58	106	0.14	123	135	69	0.04	3.42	800	0.8
Nalathiputhur	1.2	7.56	96	64	108	0.12	128	125	64	0.02	3.26	768	0.768
Eliyarasanendal	1.09	7.34	106	67	106	0.09	132	116	63	0.03	3.42	698	0.6976
Chidhambarananthapuram	1.08	7.89	89	56	104	0.12	108	96	62	0.04	3.08	691	0.6912
Mulliseval	1.25	7.63	82	51	93	0.13	123	85	63	0.02	2.48	800	0.8
Ealairumpannai	1.12	7.76	84	53	102	0.16	106	92	64	0.04	2.56	717	0.7168
O.Mettupatti	1.18	7.84	79	54	115	0.15	115	97	67	0.04	2.42	755	0.7552
Sathur	1.15	7.69	75	52	106	0.1	110	91	53	0.02	2.65	736	0.736
Sulakkarai	0.84	8.06	84	56	83	0.13	85	110	68	0.05	3.56	537	0.5376
Virudunagar	0.87	8.15	83	46	89	0.14	106	105	62	0.04	3.15	556	0.5568
Vellur	0.72	8.06	84	50	81	0.09	82	102	61	0.05	3.26	460	0.4608
Pandalkudi	0.92	7.59	86	53	83	0.1	83	106	64	0.04	3.15	588	0.5888
Melapatti	0.69	7.82	84	59	82	0.08	87	103	63	0.05	3.05	441	0.4416
Vembur	0.86	7.89	85	49	89	0.11	124	105	69	0.05	2.89	550	0.5504
Mettlepatti	0.82	7.92	83	46	96	0.13	120	103	67	0.02	2.57	525	0.5248
Puthur	0.93	7.89	96	48	97	0.12	116	108	63	0.02	2.68	595	0.5952
Nagalapuram	0.87	7.58	84	43	95	0.14	108	106	65	0.02	2.85	557	0.5568
Karisulkulam	0.93	7.82	82	42	86	0.1	112	110	66	0.02	2.49	595	0.5952
Vilathikulam	0.69	7.56	88	49	96	0.11	105	99	85	0.02	0.11	442	0.4416
Vadamalaisamuthiram	0.85	7.52	89	45	91	0.1	112	102	83	0.02	0.1	544	0.544
Kulathur	0.74	7.46	86	40	93	0.16	106	114	84	0.02	0.09	474	0.4736
Uppathur	0.83	7.22	84	47	97	0.12	110	110	89	0.03	0.13	531	0.5312
Sarivaikundapuram	0.82	7.61	82	43	95	0.13	104	112	87	0.02	0.12	525	0.5248
Kilavaippar	0.89	8.09	87	65	125	0.09	109	124	68	0.05	2.82	570	0.5696
Vaippar	0.74	8.12	92	63	123	0.08	110	119	65	0.03	2.65	474	0.4736
Melmanthai	0.82	8.05	93	67	102	0.13	113	121	64	0.03	2.45	525	0.5248
Gunarasaganapuram	0.8	7.95	94	74	113	0.15	121	125	68	0.03	2.61	512	0.512

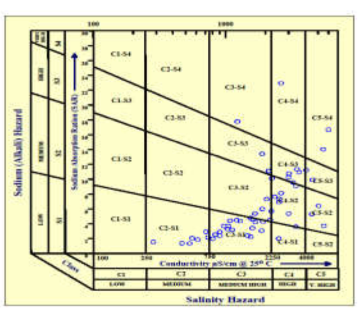

Figure :3 USSL classification of Borehole Water

The integrated effect of SAR and EC values of groundwater and Surface water of the study area were plotted in the graphical diagram of U.S.S.I. classification (USDA, 1955) (Fig.4, 4a).

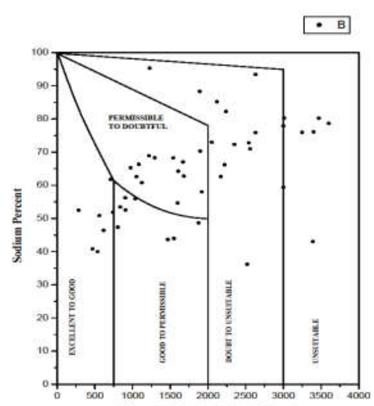

Fig: 4. USSL classification Surface of Water of the study area

They fall in the category of the good (C2-S1) quality with low alkali hazard and moderate salinity hazards in Groundwater. But most of the samples are C3-S1, C3-S2, C4-S1 classes which are seen in the villages of are found not for suitable even for salt tolerant crops. In surface water C2-S1, C3-S1, classes it shows medium to high salinity hazards. The quality parameters of the groundwater samples has been compared with ISI standards (1991) (Table 2,3).

Table: 2. The Water Quality Standard for Drinking Purposes

Parameters	Permissible Limit
Calcium	30ppm
Chloride	250ppm
Electrical Conductivity (EC)	1000 micro mhos/cm at 25^{0}C
Floride	1.7ppm
Iron	0.3ppm
Magnesium	125ppm
Nitrate	45ppm
pH	8.5ppm
Sulphate	250ppm
Total Dissolved Solids (TDS)	500ppm

Table: 3. The Water Quality Standard for Irrigation Purposes I. Salinity Hazard

S.No	Electrical Conductivity (EC) in Micromhos/cm at 25^{0}C	Salinity Hazard and type of water
1	Less than 1000ppm	Good to Excellent
2	Less than – 3000ppm	Injurious to Good
3	More than 3000ppm	Injurious to Unsatisfactory

II. Sodium Hazard

S.No	Sodium Absorption Ration (SAR) SAR = $Na^+/\sqrt{(Ca^2+Mg^{2+}/2}$	Type of Water
1	0-10 Low Sodium Water	Suitable for almost all Soils
2	10-18 Medium Sodium Water	Suitable only for almost all soils
3	18-26 High Sodium Water	Harmful
4	More than 26 very high Sodium Water	Unsatisfactory

Conclusion

The bore well water is partially suitable for drinking purpose and public health because of the bore well water sometimes exceeds the permissible limit of 500mg/1. The Borehole and surface water is also good for irrigation with low alkali hazard and moderate to high salinity hazard. However, it is not suitable for industrial purposes because of high total hardness and TDS.

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