Evaluation of Ground Water Quality along the Sides of Vrushabhavathi River, Bangalore, Karnantaka

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Abstract: Tube well and open well samples were collected at different sites along the stream Vrushabhavathi, Bangalore. The Physico-Chemical properties of all the collected 48 samples were evaluated. They were analysed for Temperature, pH, Turbidity, electrical conductivity, Total dissolved solids, Dissolved oxygen, Chloride, Fluoride, Sulphate, Nitrate, Total hardness, Alkalinity, Calcium, Magnesium, Sodium and Potassium. The results obtained were compared with prescribed by WHO and BIS.

Index Terms— Ground water, Water Pollution, Vrushabhavathi river, Physico-chemical properties

1 INTRODUCTION

Water is known to provide essential nutrients to human body. Rain, River, Sea and Ground water are the major components of environmental resources, which are under threat due to, the uncontrolled increase of population, unplanned urbanization, unrestricted exploration policies and dumping of the polluted water at inappropriate places enhancing the infiltration of harmful compounds to the ground water. Consequently, water born diseases have become more. Keeping this in view, the investigators selected the Vrushabhavathi river stream which originates in Bangalore city reaches Mysore road and then move towards the west of the city i.e towards Bidadi and Byrahongala village. The researcher selected 12 grid points, collected four bore well water samples in each grid point in such a way that two samples are near to the stream and two samples away on either side of the stream. All the collected forty eight samples were subjected to physico-chemical characteristic properties thrice for accuracy. The samples were collected in previously cleaned, rinsed with distilled water and finally rinsed thoroughly with sample water. The collected samples were analysed for Temperature,pH, Turbidity, Total dissolved solids, electrical conductivity, Total hardness, Sodium, Potassium, Calcium, Magnesium, Chloride, Sulphate, Nitrate, Fluoride, Chemical oxygen demand, Dissolved oxygen and Alkalinity

2 Methodology

The Temperature, pH, Turbidity, EC, TDS and DO were measured for each sample during collection of samples using water analyser 371 systronics Instrument. The other characteristics properties were analysed at Chemistry lab of Atria I T Bangalore. The Sodium, Potassium, are analysed using micro controlled Flame Photometer FPM-128 Systronics make. The Total hardness, Calcium and Magnesium was analysed using standard EDTA solution. The chloride was analysed using Argento nitrate method. Fluoride by spectro-photometric method using spectrophotometer elico, sulphate was measured using turbidity method using spectro-photometer.

Table – 1a Showing the Physical Properties of first 24 samples of borewell water

Sample	Temp.	pH	Turbidity	EC	TDS
S-1	25.7	6.85	0.08	500	285
S-2	25.7	7.05	0.25	1750	985
S-3	25.2	7.85	0.88	1825	1020
S-4	25.5	7.95	0.45	2860	1670
S-5	25.1	6.25	0.09	2010	1125
S-6	24.8	6.97	0.02	1385	855
S-7	26.0	7.35	0.075	2475	1750
S-8	25.0	7.50	0.29	1325	775
S-9	23.4	7.25	0.39	1150	675
S-10	22.0	7.58	0.51	1210	778
S-11	22.9	7.65	0.52	1212	805
S-12	22.8	7.52	0.29	1625	952
S-13	22.8	7.65	0.6	1250	815
S-14	23.1	8.25	0.45	2085	1254
S-15	25.9	8.35	0.55	1525	857
S-16	26.1	7.95	0.15	2350	1545
S-17	23.8	7.65	7.4	1860	1085
S-18	24.9	9.35	0.32	2075	1252
S-19	25.2	7.05	0.9	2875	1658
S-20	22.8	6.75	0.25	1975	1258
S-21	23.8	6.35	0.23	990	577
S-22	26.1	6.85	0.89	1150	658
S-23	25.5	9.10	0.32	1350	754
S-24	23.8	8.25	0.37	1852	1356

Table – 1b Showing the Physical Properties of Second 24 samples of borewell water

Sample	Temp.	pH	Turbidity	EC	TDS
S-25	22.8	8.1	1.2	1968	1025
S-26	23.1	7.75	0.98	2015	1125
S-27	22.5	8.25	0.68	2098	1258
S-28	21.5	8.15	2.5	1589	958
S-29	23.9	8.87	1.8	1658	858
S-30	22.5	7.95	0.96	1895	995
S-31	19.8	8.25	5.6	1256	703
S-32	20.9	8.96	6.5	1985	1008
S-33	25.6	8.35	2.98	2030	1098
S-34	22.8	8.25	6.5	2058	1128
S-35	24.8	9.35	1.35	2561	1325
S-36	22.9	7.65	1.85	1235	706
S-37	23.8	8.35	1.98	2564	1657
S-38	25.6	8.25	2.5	2313	1358
S-39	24.8	8.56	3.5	2256	1258
S-40	22.9	8.47	0.68	2587	1601
S-41	23.8	8.25	1.25	1258	698
S-42	21.7	7.95	4.5	1654	985
S-43	24.8	8.1	3.98	1758	1058
S-44	21.8	9.30	2.98	1987	1098
S-45	23.8	6.35	2.65	1569	851
S-46	19.8	6.85	0.87	1465	789
S-47	18.9	6.75	2.58	1993	1124
S-48	19.5	7.05	0.99	1258	715

Table – 2a Showing the Chemical Properties of First 24 Samples of borewell water.

Sample	DO	Cl^-	F^-	SO_4	NO_3
S-1	6.5	35	0.2	25.2	14.8
S-2	6.0	135	0.5	36.2	25.8
S-3	5.9	175	0.09	45.8	26.2
S-4	5.5	200	1.1	65.3	33.5
S-5	6.3	245	0.98	38.4	12.8
S-6	7.1	152	0.8	66.5	126
S-7	6.9	301	0.98	25.6	32.5
S-8	7.2	135	0.85	33.9	28.5
S-9	7.9	166	0.54	55.8	25
S-10	6.9	85	0.45	25.9	45.9
S-11	5.95	156	1.2	36.2	48.7
S-12	6.5	165	0.58	23.8	40.8
S-13	7.25	99	0.85	25.7	55.5
S-14	6.95	305	0.75	126	77.8
S-15	8.25	185	0.95	56.8	52.5
S-16	5.68	277	1.12	124	21.5
S-17	5.95	245	1.25	23.9	11.2
S-18	6.25	333	0.25	19.8	45.8
S-19	6.85	434	0.67	142	25.8
S-20	6.12	113	0.86	126	33.6
S-21	8.25	221	0.22	18.9	35.8
S-22	7.25	158	0.65	36.8	39.8
S-23	8.5	195	0.56	78.8	28.9
S-24	7.25	202	0.58	85.8	45.8

Table –2b Showing the Chemical Properties of Second 24 Samples of borewell water

Sample	DO	Cl^-	F^-	SO_4	NO_3
S-25	6.56	198	1.2	65.8	25.8
S-26	6.85	209	1.05	66.8	26.9
S-27	5.95	235	1.01	25.9	39
S-28	6.89	210	0.9	56.8	44.5
S-29	7.5	198	0.12	45.9	58.9
S-30	5.95	195	0.36	66.8	25.9
S-31	6.36	158	0.98	44.8	19
S-32	5.96	258	0.65	25.8	39.8
S-33	4.99	221	0.78	39.8	59.8
S-34	6.95	235	0.54	65.9	65.9
S-35	6.85	231	0.45	77.8	29.8
S-36	6.95	156	0.02	58.9	58.9
S-37	5.98	198	0.36	65.8	65.9
S-38	7.54	209	0.85	45.8	45.9
S-39	7.98	188	0.52	65.1	58.9
S-40	6.36	201	0.54	33.8	65.8
S-41	6.96	145	0.48	25.8	67.8
S-42	6.36	202	0.68	54.5	59.8
S-43	6.98	185	0.75	55.3	58.9
S-44	5.96	177	0.45	29.9	49
S-45	6.36	178	0.25	32.5	39.9
S-46	8.5	168	0.39	44.9	45.9
S-47	6.85	177	0.75	41.2	78.8
S-48	7.85	185	0.86	45.8	55.9

Table – 3a Showing the Chemical Properties of First 24 Samples of borewell water

Sample	TH	ALK	Ca^{2+}	Mg^{2+}	Na^+	K^+
S-1	191	225	39	35	29	1
S-2	652	285	143	85	110	5
S-3	258	770	109	33	125	13
S-4	954	295	201	59	165	6
S-5	685	98	212	85	125	7
S-6	314	60	109	58	138	2
S-7	858	125	205	98	103	5
S-8	325	122	56	88	72	9
S-9	595	258	131	78	65	5
S-10	350	202	65	33	51	3
S-11	658	365	141	69	94	5
S-12	550	302	128	78	165	7
S-13	158	309	105	22	79	4
S-14	595	435	88	58	178	8
S-15	458	335	103	39	109	9
S-16	900	411	206	105	99	4
S-17	509	378	149	45	165	7
S-18	765	375	195	101	142	15
S-19	777	525	215	116	305	9
S-20	375	385	98	86	175	2
S-21	381	421	93	65	81	3
S-22	429	465	88	56	95	16
S-23	477	362	91	45	113	16
S-24	511	482	111	33	88	28

Table – 3b Showing the Chemical Properties of First 24 Samples of borewell water

Sample	TH	ALK	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}
S-25	658	258	125	92	99	45
S-26	569	198	105	75	89	15
S-27	758	458	201	104	88	12
S-28	857	258	258	125	117	21
S-29	455	355	129	69	105	9
S-30	544	245	154	93	85	5
S-31	658	368	229	101	96	3
S-32	725	458	198	115	126	6
S-33	777	558	203	99	118	7
S-34	656	369	173	81	109	9
S-35	636	325	209	75	108	8
S-36	289	256	75	64	58	25
S-37	569	235	156	89	98	26
S-38	355	298	121	61	85	13
S-39	558	216	229	69	88	15
S-40	695	325	259	121	87	25
S-41	758	315	254	128	45	15
S-42	698	368	256	109	68	5
S-43	701	402	264	125	77	9
S-44	715	325	241	112	55	8
S-45	745	358	205	125	49	7
S-46	621	265	259	98	94	7
S-47	646	396	245	58	56	6
S-48	698	221	221	98	58	9

3 Results and Discussion:

Temperature and pH: Table-1a & 1b and Graph - I shows the physico-chemical analysis of ground water samples. Temperature of collected water samples varied between 18.9^{0}C to 26.1^{0}C. The pH values of water samples were between 6.25 to 9.35 with slightly acidic to basic, 33.33% (16) samples crossed the permissible limits of WHO and 8% (4) samples crossed the excessive limits of WHO (1983). pH has no adverse effect on health (Khadson & Khodu 2003).

Turbidity: The turbidity of collected water samples is as shown in Table-1a & 1b and Graph - I, it ranged between 0.02 NTU to 7.4 NTU, 4 samples of ground water crossed the permissible limits of WHO (1983). All the other samples of water were within the excessive limits of WHO (1983).

Electrical Conductance: The EC depends on TDS. The ground water suitable for irrigation is determined on the basis of EC. The average values of collected ground water are 1784.875 μS and varied between 500 – 2875 μS as shown in Table-1a & 1b.

TDS: The total dissolved solids (TDS) of ground water varied between 285 mg/L to 1750 mg/L, the average TDS is 1044 mg/L. Among the collected samples one sample was below and six samples were above the excessive limits of WHO (1983) as showed in the Table-1a & 1b.

DO: The Dissolved Oxygen values ranged from 4.9 mg/l to 8.5 mg/l and with an average value of 6.766 mg/L oxygen as indicated in Table-2a & 2b and Graph -II. Among the bore well samples collected one sample below the permissible and all other bore well samples were within the permissible limits of WHO (1983).

Chloride: The table – 1 shows the concentration of chloride present in the different samples of water it ranged between 35 mg/L to 434 mg/L, 58% (28) samples of water under investigation were below the permissible limits and 42% (20) samples were within the permissible limits of WHO(1983), as indicated in Table – 2a & 2b and Graph - III.

NO_3^- : The concentration of nitrate in different samples is shown in Table – 1, in the present investigation the concentration varied between 11.2 mg/L to 126 mg/L, , 56% (27) samples of water were below the permissible limits and only one sample crossed the excessive limits of WHO(1983), as indicated in Table – 2a & 2b and Graph - IV. The excess concentration of nitrate may lead to blue baby disease. Nitrate content is very low in natural surface waters, but it is very common in ground water, Fertilizers, industrial wastes and septic tanks are the common sources of Nitrates in ground water. Nitrate itself may be carcinogenic without formation of nitrosamines (Breimer 1982).

SO_4^{2-}: Sulphate presence does not affect the taste of water. The sources of sulphate in rocks are minerals of sulphur. In the present investigation the presence of SO_4^{2-} ranges between 19 mg/L to 142 mg/L which is below the permissible limits of WHO (1983), as indicated in Table – 2a & 2b and Graph - IV

Hardness and Alkalinity: The Hardness of water ranged between 158 mg/l to 954 mg/l, 8% (4) samples of water were less than the permissible limits of BIS and 65% (31) samples of water crossed the excessive limits of BIS as indicated in Table 3a & 3b and Graph - V. Total hardness is an important parameter for determining the suitablility of water for domestic use. Park & Park (1986) observed a correlation between hardness and its role in heart & kidney diseases. Alkalinity is due to the presence of Carbonates, bicarbonates and silicates. The alkalinity is varied from 60 mg/L to 770 mg/L, 93% of tested samples of water were less than the permissible limits of WHO (1983).

Ca^{2+} and Mg^{2+}: $Ca^{2+}$is the principal constituent in the Igneous rocks and in fresh water samples. The concentration of Ca^{2+} is varied between 39 mg/l to 264 mg/l as showed in Table – 3a & 3b and Graph - V, the concentration of Ca^{2+} in 6% (3) samples of water were less than the permissible limits and 42% (20) samples of water exceeded the excessive limits of WHO (1983). Mg^{2+} is also an important component in giving hardness to water sample. In this investigation it varied from 22 mg/l to 128 mg/l, 17% (8) samples were below the permissible limits, the remaining samples of water were within the permissible limits of WHO (1983), as indicated in Table – 3a & 3b and Graph – V.

Na^{+} and K^{+}: Sodium is the predominant chemical component of water. The concentration of sodium along with concentration of $Ca2^{+}$ and Mg^{2+} is used to calculate the important factor SAR, which show the distribution of Na^{+} in the study area. In the present investigation the concentration of Na^{+} varied between 28 mg/L to 305 mg/L, among all the samples only one sample crossed the permissible limit of WHO (1983), as indicated in Table – 3a & 3b and Graph – V. Potassium the other alkaline metal was under study, essential nutrient for both plant and animal life. The concentraio of K^{+} ranged between 01 mg/L to 45 mg/L as indicated in Table 3a & 3b and Graph -V.

Graph - I

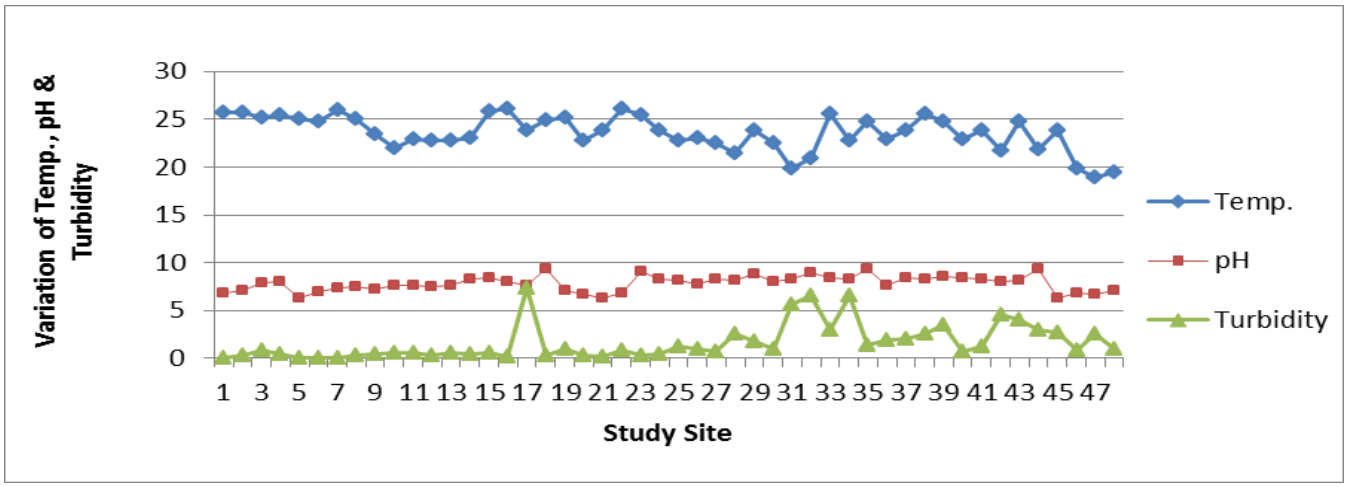

Fig. 1 - Variation of Temp., pH & Turbidity study sites

Graph – II

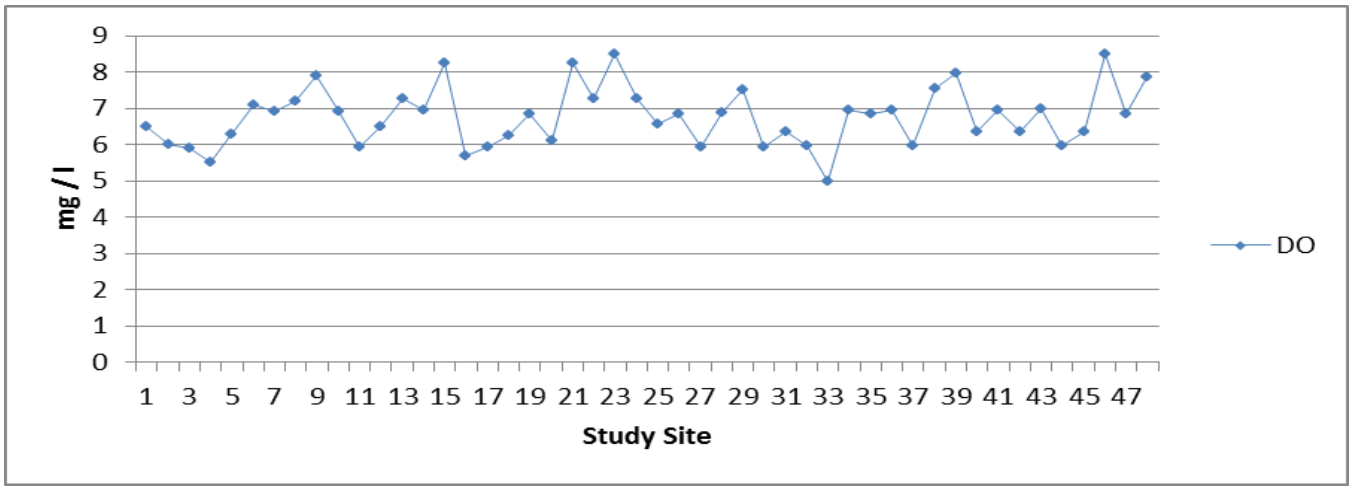

Fig. 2 - Variation of Dissolved oxygen at different study sites

Graph - III

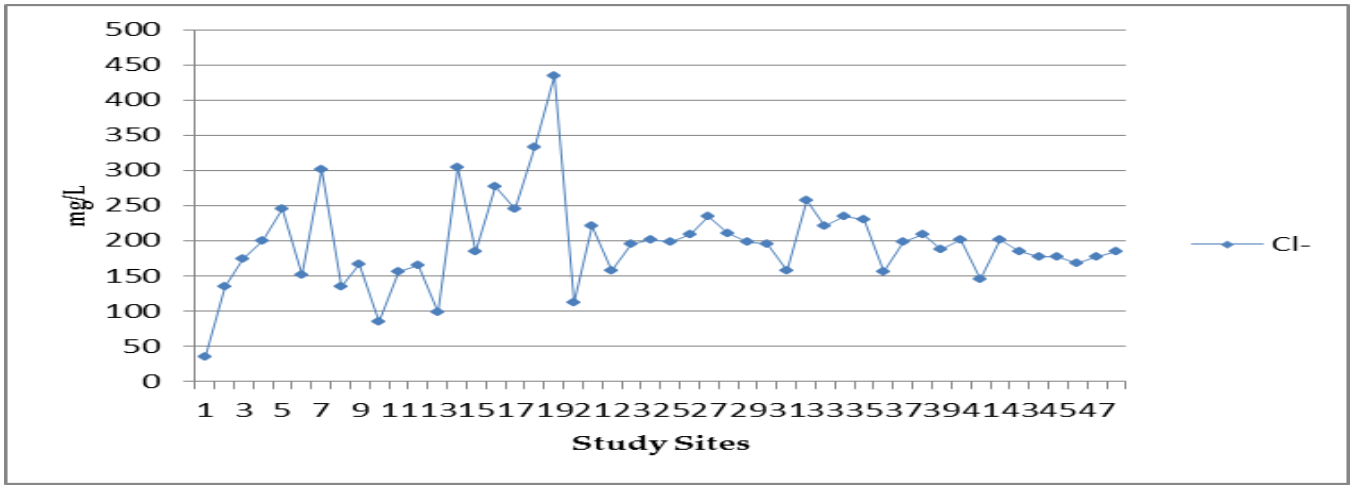

Fig. 3 - Variation of Chloride at different study sites

Graph – IV

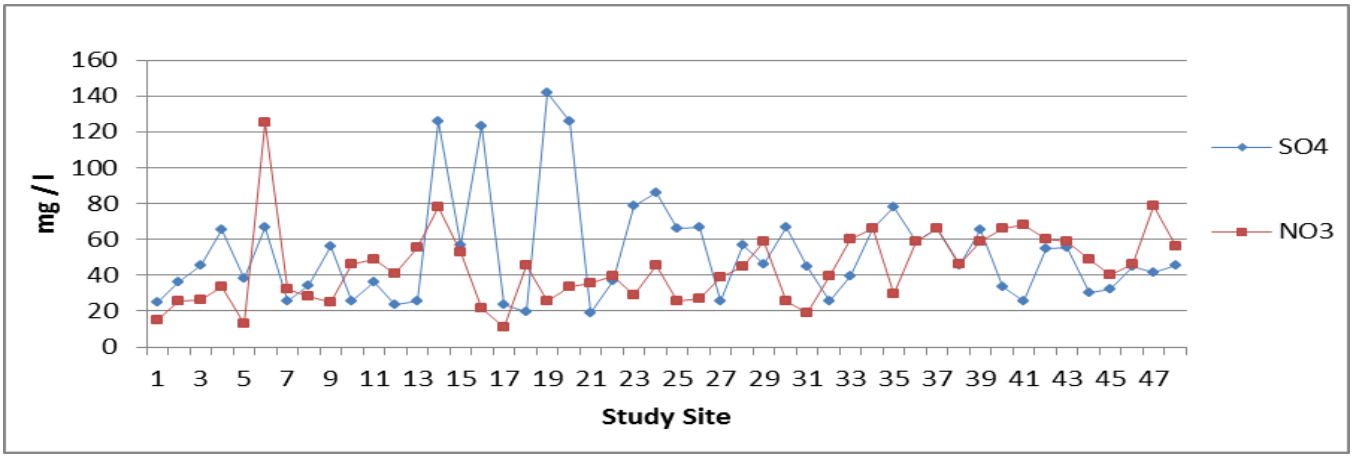

Fig. 4 - Variation of Nitrate and Sulphate at different study sites

Graph – V

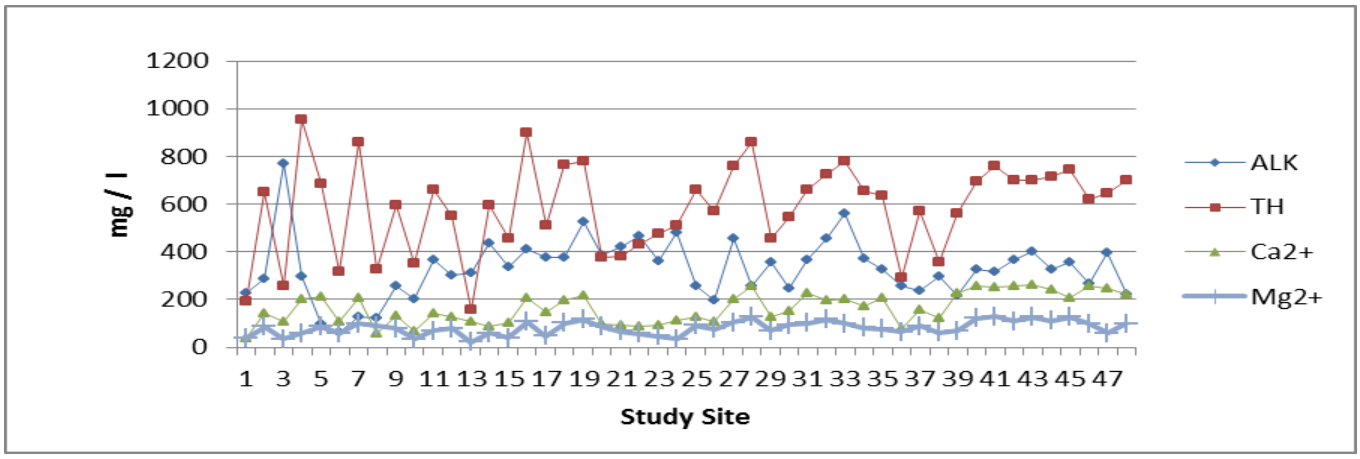

Fig. 5 - Variation of Alkalinity, Total hardness, Calcium and Magnesium at different study sites

4 Results and Discussion

Conclusion: The data revealed that the most of the samples of ground water along the Vrushabhavathi river stream are alkaline in nature. 65% of sample of water under investigation are not suitable for drinking as there hardness crossed the excessive limits of WHO (1983). The present investigation indicates that there is a chance for these parameters to rise in concentration after some years. Hence, it is suggested that the water for drinking is pretreated before utilization.

4 References

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