Hydrogeochemistry And Assessment of Groundwater Quality In Mahabubnagar District, Telangana State, India With Special Emphasis on Fluoride Distribution And Its Impact on Health

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Abstract- *Hydrogeochemical studies carried out in south-western part of Mahabubnagar district possessing hard granitic rock terrain of Archaean age and sedimentary rocks of Proterozoic age. The area consisting of basic water, and it is chemically characterized by the intermediate class at most locations. The entire area is devoid of primary-alkalinity and secondary-salinity waters. The Schoeller indices values (Schoeller 1965, 1967) are negative except in some locations showing a cation – anion exchange (chloro-alkaline disequilibrium). Based on the Hydrogeochemical analysis results reveals that the ions like F, Cl, NO_3 are exceeded the permissible limits in certain areas. The analytical data plotted on the US salinity diagram (USDA, 1954) illustrates that 25% of the groundwater samples fall in the field of S1C4, indicating low sodium and very high salinity, 75% of samples fall in the field of S1C3, indicating low sodium and high salinity water in the pre monsoon season. The same diagram states that 8% of samples fall in the field of S1C4 indicating the low sodium and very high salinity water, 2% of samples fall in the field of S2C4 indicating the medium sodium and very high salinity water, 89% of samples fall in the field of S1C3 indicating the low sodium and high salinity, 1% of samples fall in the field of S2C3 indicating the medium sodium and high salinity water, which can be used for irrigation on all types of soil without danger of exchangeable sodium. Which need adequate drainage to overcome salinity problems for irrigational purposes.*

Keywords- Groundwater, Hydrogeochemistry, Water quality, Fluoride, Mahabubnagar, Telangana

I. INTRODUCTION

Water is very vital for nature and can be a limiting resource to the mankind and other living beings. Without a well-functioning water supply, it is difficult to imagine productive human activity be it agriculture or livestock. Water quality is influenced by natural and anthropogenic effects including local climate, geology, and irrigation practices (CGWB, 2007). The quality of water is of uttermost importance in planning water supply programmes. The chemical character of any groundwater determines its quality and utilization. The quality of water is a function of the physical, chemical, and biological parameters and could be subjective, since it depends on a particular intended use.

hundreds of millions of people in urban and rural areas depend on groundwater for domestic supplies, which can be highly vulnerable to pollution. In general, Ground water quality is strongly influenced by bedrock geology and climate, but may also be attributed to the impacts of industrial and agricultural pollution. The present study includes determination of ionic concentrations, chemical classification, chemical relationships, ion-exchange processes, and irrigation suitability by studying groundwater samples collected in parts of Mahbubnagar district, Telangana.

II. STUDY AREA

The area under study is about 578.86 sq km and is bounded approximately by $77^0 35' 0''$ to $77^0 55' 40''$ East and $16^0 6' 56''$ to $16^0 23' 33''$ North (fig 1 & 2). Groundwater forms the main source of drininking water in the majority of the study area.

The study area is in the drainage basin of the Krishna River is ephemeral nature and the basin receive water only during the rainy season. A well-developed, Dendritic drainage system is observed in the study area, which is a characteristic feature of granitic terrain. It indicates the presence of rocks of uniform resistance, which do not have any structural control. The area under investigation is in a semi-arid zone, with a hot and humid climate. Usually this region receives its first rainfall from pre-monsoon conventional showers in the month of June however, its occurrence is erratic.

Geology

The area consists of granites and pegmatites of igneous origin of Archaean age and located in Cuddapah basin. Sedimentary rocks of Cuddapah Basin of Proterozoic age occupy the south-eastern part of the study area.

Mainly the area consisting of pink and grey granite occupies dominant portion, these rocks are composed of quartz, feldspars, and biotite. These are medium to course grained and equigranular in texture. The granites are pink and grey, hard, massive to foliated and well jointed (fig 3). The study area

has a rugged and undulating topography with gentle slopes, and it is characterized by isolated hillocks and narrow valleys at places. The typical grey colour is due to the presence of the plagioclase feldspars and quartz. The potash feldspars that are present in the rock are orthoclase and microcline but in less abundance. Biotite is the most predominant mineral in these rocks. The highest elevation recorded in the study area is 342 m the lowest being 274 m above msl. These rocks possess negligible primary porosity but are rendered porous and permeable due to secondary porosity by fracturing and weathering, and fractured zones locally form potential aquifers. These lineament zones are highly productive for constructing bore wells. The topography is moderately hilly with very sparse vegetation. The hillocks in the area are characteristic of granitic terrain, being small and dome shaped.

Materials and methods

Groundwater samples were collected from the bore wells and analysed for various chemical parameters in department of applied geochemistry as described by the American Public Health Association (APHA 1995) and followed by the ISI, 1983. These parameters include pH, electrical conductivity were measured by the digital meter in the itself. The total dissolved solids, and important cations such as calcium, magnesium, sodium and potassium as well as anions such as carbonates, bicarbonates, chlorides, nitrates, sulphates and fluorides (table 1). Total dissolved solids (TDS) were computed from EC multiplied by 0.64 (Brown and others 1970). Sodium (Na+) and potassium (K+) were determined by flame photometer. Total hardness (TH) as $CaCO_3$, calcium (Ca^{2+}), carbonate (CO_3), bicarbonate (HCO_3) and chloride (Cl) were analysed by volumetric methods. Magnesium (Mg^{2+}) was calculated from TH and Ca2+ contents. Nitrate (NO_3) and fluoride (F^-) were determined using an ion analyzer. Sulphates (SO^-_4) were estimated using the colorimetric technique in the pre monsoon and post monsoon seasons.

III. RESULTS AND DISCUSSION

pH

The pH of water is very important of its quality and provides important piece of information in many types of geochemical equilibrium or solubility calculation. The limit of pH value of drinking water is specified as 6.5 to 8.5 (ISI, 1983).

In most natural waters, the pH value is dependent on the carbon dioxide-carbonate-bicarbonate-equilibrium. As the equilibrium is markedly affected by temperature and pressure, it is obvious that changes in pH may occur when these are alerted. Most of the ground water has a pH range of 6.0-8.5.

The pH of ground water in the study area is ranging from 6.69-7.8 (table 3) during pre monsoon period and from 6.7-7.9 (table 4) during post monsoon season. pH values for all the samples are within the desirable limits. The alkaline pH is more favorable for fluoride dissolution activity (Rao and Rao, 1991). It is observed that most of the ground water is alkaline in nature. Though has no direct effect on the human health, all biochemical reactions are sensitive to variation of the pH.

IV. ELECTRICAL CONDUCTIVITY

The conductivity measurement provides and indication of ionic concentrations. It depends up on temperature, concentration and types of ions present (Hem, 1991; Bhattacharya et al., 2012). The maximum limit of electrical conductivity in drinking water is prescribed as 1500 micro Siemens/cm (WHO, 2004). The electrical conductivity of the ground water is ranging from 820-3689 µSiemens/cm at 25°C with an average 1575 µSiemens/cm (table 3) during pre monsoon period and from 672-3584 µSiemens/cm at 25°C with an average 1637 µSiemens/cm during post monsoon period (table 4). 47% of samples were exceeded the permissible limit remaining samples were fall within the permissible limit in the pre monsoon and post monsoon.

TDS

The total dissolved solids of the ground water in the study area ranges from 524.8 mg/l to 2361mg/l with an average of 1008mg/l (table 3) during pre-monsoon and from 430.08 mg/l to 2293.8 mg/l with an average 1048 mg/l during post-monsoon the highest desirable limit of TDS in drinking water is 500 mg/l (table 4). TDS values of all samples exceed highest desirable limits in the both seasons.

Total hardness

The Total hardness of the study area ranges from 60 to 634 mg/l with an average of 256.1 mg/l during pre-monsoon (table 3) and from 70 mg/l to 640 mg/l with an average 286.4 mg/l during post-monsoon period (table 4). All samples exceed the highest desirable limits. Water hardness is primarily due to the result of interaction between water and the geological formations (Piper, 1944; Tatawat et al., 2008). The limit of total hardness for drinking water is specified as 300 mg/l (ISI, 1983).

SODIUM

The sodium concentration of the ground water in the study area is ranging from 24 mg/l to 80 mg/l with an average of 45.3 mg/l during pre monsoon period (table 3) and from 73 mg/l to 200 mg/l with an average of 144 mg/l during post monsoon period (table 4). The prescribed limit of sodium in potable water is 200 mg/ l (Edwin, 1994; WHO, 2004). Excessive amount of sodium in drinking water would normally affect the potability of water, and water containing up to 1000 mg/l may generally be physiologically tolerable (Ramesh and Anbu 1996). Almost all samples exceeded the desirable limits.

Potassium

The Potassium concentration of the groundwater in the investigation area is ranging from 8 mg/l to 36 mg/l with an average 13.7 mg/l during pre-monsoon (table 3) and from 2 mg/l to 200 mg/l with an average 33 mg/l during post-monsoon season (table 4). Potassium being more soluble than sodium salts are last to crystallize during evaporation (Karanth, 1989; Saleh et al., 1999; Yadav et al., 2013). The acceptable limit of potassium in drinking water is 10-15 mg/L. Almost all samples exceed the desirable limits.

Calcium

The calcium concentration of the ground water in the study area is ranging from 2 mg/l to 187 mg/l with an average of 50 mg/l during pre-monsoon period (table 3) and from 4 mg/l to 192 mg/l with an average 87 mg/l during post monsoon period (table 4). The limit of calcium concentration for drinking water is specified as 75 mg/l (ISI, 1983).

Magnesium

The Mg concentration of the ground water in the study area is ranging from 0.8 mg/l to 75 mg/l with an average of 24.6 mg/l during pre monsoon period (table 3) and from 1 mg/l to 80 mg/l with an average 25.45 mg/l during pre-monsoon period (table 4). It is observed that nearly all the samples exceeded the desirable limit both during pre and post-monsoon periods.

Carbonate

The carbonate concentration of the ground water in the study area is ranging from 0 mg/l to 144 mg/l with an average of 26.9 mg/l during pre monsoon period (table 3) and from 0 mg/l to 142 mg/l with an average 22.2 mg/l during pre-monsoon period (table 4).

Bicarbonate

The bicarbonate concentration of the ground water in the study area is ranging from 201 mg/l to 587 mg/l with an average of 363.4 mg/l during pre monsoon period and from 3 mg/l to 677 mg/l with an average 367.9 mg/l during pre-monsoon period (table 3). The permissible limit of bicarbonate (HCO_3) for drinking water is 500 mg/l (Jagdap et al., 2002; Singh, 2003; Dhirendra et al., 2009). Bicarbonate concentrations in all samples are within the desirable limit for drinking water.

Sulphate

The sulphate concentration of the ground water in the study area is ranging from 27 mg/l to 122 mg/l with an average 52.72 mg/l during pre-monsoon period (table 3) and from 22 mg/l to 117 mg/l with an average 48.4 mg/l during post-monsoon period (table 4). The upper limit of sulphate concentration for drinking water is specified as 150 mg/l (ISI, 1983).

Chloride

The chloride concentration of the ground water in the study area is ranging from 85 mg/l to 986 mg/l with an average 268.5 mg/l during pre-monsoon period (table 3) and from 61 mg/l to 905 mg/l with an average 312 mg/l during post-monsoon period (table 4). The upper limit of chloride concentration for drinking water is specified as 250 mg/l (ISI, 1983).

Nitrate

The Nitrate concentration of the ground water in the study area is ranging from 2 mg/l to 120 mg/l with an average 40 mg/l during pre-monsoon period (table 3) and from 2 mg/l to 105 mg/l with an average 43 mg/l during post-monsoon period (table 4). The upper limit of nitrate concentration for drinking water is specifies as 45 mg/l (ISI, 1983).

Fluoride

Fluoride concentration of the ground water in the study area ranging from 0.42 mg/l to 4 mg/l with an average of 1.4 mg/l during pre-monsoon period (table 3) and from 0.13 mg/l to 2.7 mg/l with an average 0.65 mg/l during post-monsoon period (table 4). The permissible limit of fluoride in drinking water is 1.5 mg/l (ISI, 1983). It is observed that nearly 90% of the groundwater of the area exceeds the desirable limits during pre-monsoon and post-monsoon periods. In the study area pegmatites, granite, gneisses commonly contain fluorine-bearing minerals. High weather rates and enhanced circulation of water in the weathered rocks and due to intensive irrigation practices are responsible for the leaching of fluoride from their parent minerals.

Chemical classification and relationships

Determining the chemical relationships in groundwater in more definite terms than is possible with other plotting methods (Walton, 1970; Jha et al., 2000; Sunitha et al., 2005;). Piper's trilinear diagram method is used to classify the groundwater, based on the basic geochemical character of the constituent ionic concentrations. The analytical values obtained from the groundwater samples, and plotted on a Piper's diagram (fig 4 & 5), reveal that the major cations are sodium, calcium, and magnesium, and the anions are chlorides, potassium, and sulphates were found to be minor chemical constituents of cations and anions respectively during the pre monsoon and post monsoon.

Alkalinity hazards

Sodium replacing adsorbed calcium and magnesium is a hazard as it causes damage to the soil structure and becomes compact and impervious (Brown et al., 1974; Raju, 2006; Garg et al., 2008; Ramesh et al 2015). The analytical data plotted on the US salinity diagram (fig 6 & 7) (Kelley, 1951; Wilcox, 1962; Laluraj et al., 2005) illustrates that 25% of the groundwater samples fall in the field of S1C4, indicating low sodium and very high salinity, 75% of samples fall in the field of S1C3, indicating low sodium and high salinity water in the pre monsoon season. The same diagram states that 8% of samples fall in the field of S1C4 indicating the low sodium and very high salinity water, 2% of samples fall in the field of S2C4 indicating the medium sodium and very high salinity water, 89% of samples fall in the field of S1C3 indicating the low sodium and high salinity, 1% of samples fall in the field of S2C3 indicating the medium sodium and high salinity water, which can be used for irrigation on all types of soil without danger of exchangeable sodium.

V. CONCLUSIONS

The south-eastern part of the Mahaboob nagar district is a hard-rock terrain consisting of granites and forms a part of the Peninsular Shield of India. The groundwater samples of the study area when plotted in the Piper trilinear diagram (Piper 1953) shows that, in general, the area has basic water, and it is chemically characterized by the intermediate class at most locations. The entire area is devoid of primary-alkalinity and secondary-salinity waters. Based on the Hydrogeochemical analysis results reveals that the ions like F, Cl, NO_3 are exceeded the permissible limits in certain areas. The analytical data plotted on the US salinity diagram (fig 5&6) (USDA, 1954) illustrates that 25% of the groundwater samples fall in the field of S1C4, indicating low sodium and very high salinity, 75% of samples fall in the field of S1C3, indicating low sodium and high salinity water in the pre monsoon season. The same diagram states that 8% of samples fall in the field of S1C4 indicating the low sodium and very high salinity water, 2% of samples fall in the field of S2C4 indicating the medium sodium and very high salinity water, 89% of samples fall in the field of S1C3 indicating the low sodium and high salinity, 1% of samples fall in the field of S2C3 indicating the medium sodium and high salinity water, which can be used for irrigation on all types of soil without danger of exchangeable sodium which need adequate drainage to overcome salinity problems for irrigational purposes.

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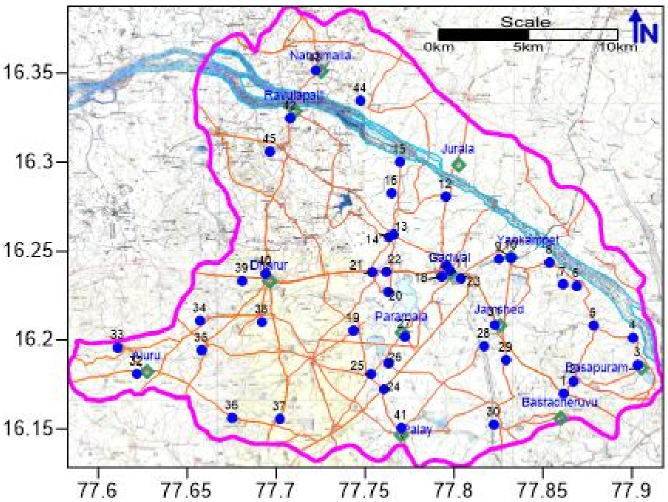

Fig 1 location and road net work of the study area.

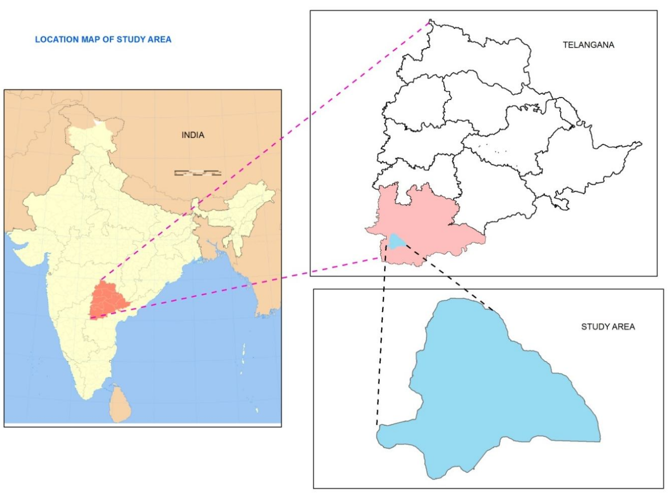

Fig 2 location map of the study area

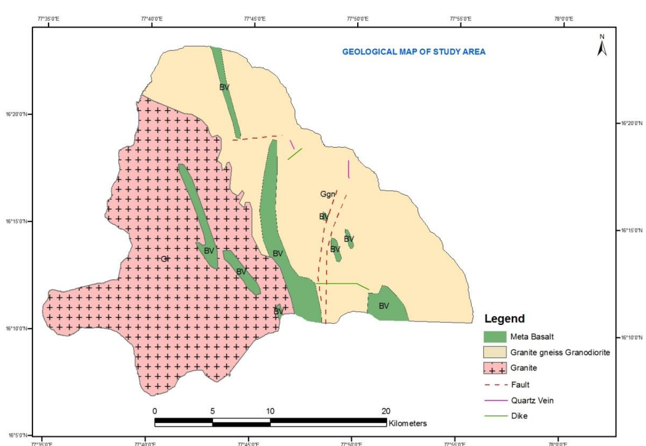

Fig 3 Geological map of study area

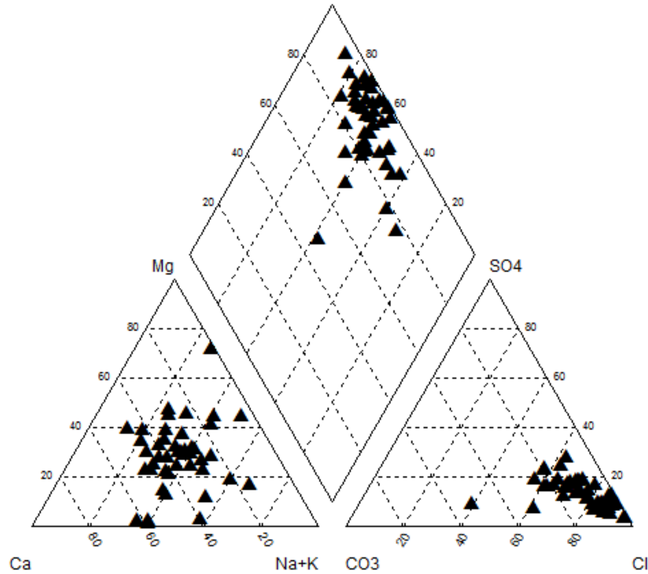

Fig 4 Piper trilinear diagram of pre monsoon season of the study area

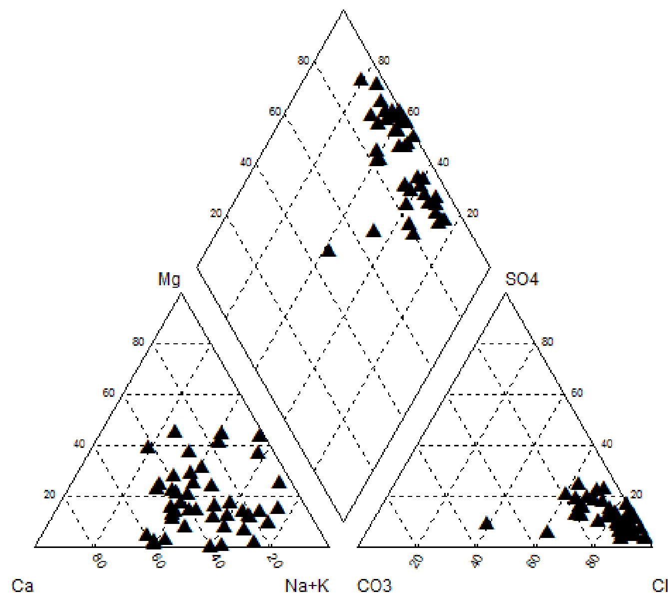

Fig 5 Piper trilinear diagram of post monsoon season of the study area

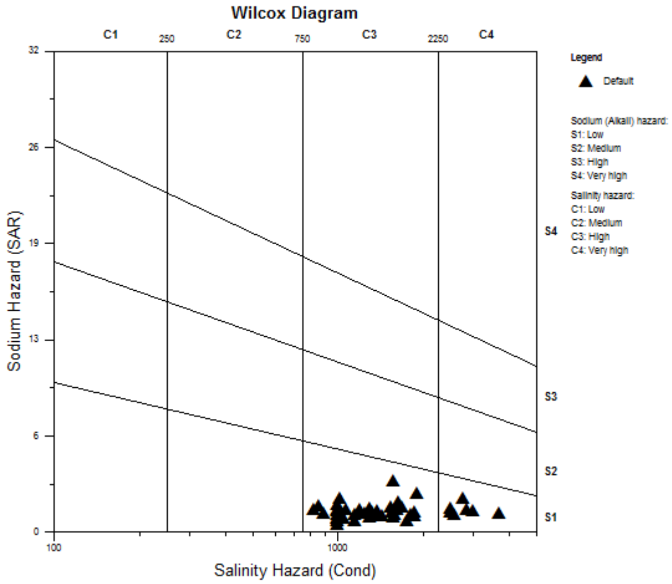

Fig 6 Groundwater samples in relation to Salinity and Sodium Hazard in the pre monsoon season.

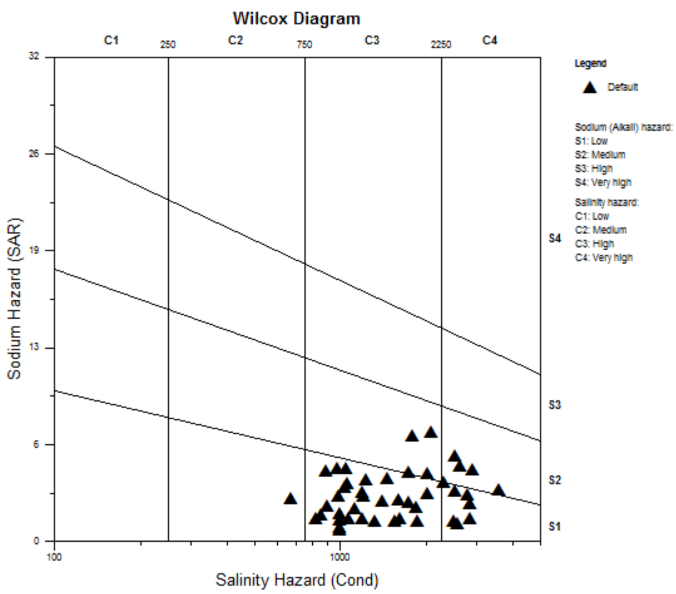

Fig 7 Groundwater samples in relation to Salinity and Sodium Hazard in the post monsoon season.

List of Tables:

Table1: Statistics of the different chemical constituents of ground water of the study area during pre- monsoon period (in mg/l).

Parameter	Min	Max	Mean	Std. dev	Permissible limits (ISI, 1983)
pH	6.69	7.8	7.14	0.98	6.5-8.5
EC	820	3689	1575	0.35	1500
TDS	524.8	2361	1008	0.35	500
TH	60	634	256.1	0.35	200
Na^+	24	80	45.3	0.59	200
K^+	8	36	13.7	0.53	12
Ca^{2+}	2	187	50	0.62	75
Mg^{2+}	0.8	75	24.6	7	30
HCO_3^-	201	587	363.38	0.64	500
CO_3^{2-}	0	144	26.89	10.5	-
SO_4^{2-}	27	122	52.72	2.10	250
Cl^-	85	986	268.5	0.31	250
F^-	0.42	4	1.41	1.01	1.5
NO_3^-	2	120	40	33.20	45

Table2: Statistics of the different chemical constituents of ground water for the post- monsoon season (in mg/l).

Parameter	Minimum	Maximum	Mean	Std. dev	Permissible limits (ISI, 1983)
pH	6.7	7. 9	7.2	1.0	6.5-8.5
EC	672	3584	1637	0.32	1500 (WHO, 2011)
TDS	430.08	2293.8	1048	0.32	500
TH	70	640	286.4	0.35	200
Na^+	73	200	144	0.14	200
K^+	2	200	33	0.9	12
Ca^{2+}	4	192	87	0.3	75
Mg^{2+}	1	80	25.45	367.94	30
HCO_3^-	3	677	367.94	0.54	500
CO_3^{2-}	0	142	22.191	0	-
SO_4^{2-}	22	117	48.4	1.88	250
Cl^-	61	905	312	0.19	250
F^-	0.13	2.7	0.65	0.92	1.5 (WHO, 2011)
NO_3^-	2	105	43	1.43	45

Table 3. Analytical data of the groundwater of the study area for Pre-monsoon season (mg/l)

S.NO	pH	EC	TDS	TH	Na	K	Ca	Mg	HCO3	CO3	SO4	Cl	F	NO3
1	6.69	1000	640	170	29	8	46	14	293	21	61	171	0.9	14
2	6.83	1630	1043.2	170	60	11	34	21	403	30	71	199	2	102
3	7.09	1440	921.6	195	35	21	40	24	384	63	80	174	1	50
4	6.94	1860	1190.4	265	42	12	73	21	384	27	61	220	1	20
5	6.86	1750	1120	315	33	10	71	34	421	42	76	238	2	10
6	7.18	1050	672	210	32	10	46	24	220	36	73	132	1	24
7	7.23	1150	736	190	24	9	46	19	201	15	76	125	0.9	4
8	7.1	1300	832	195	34	11	6	32	268	18	58	164	2	37
9	7.38	1240	793.6	150	37	10	36	15	366	18	58	164	1	24
10	7.8	1180	755.2	160	36	10	34	19	329	12	37	139		23
11	7.41	1680	1075.2	160	48	36	28	22	378	18	71	199	2	4
12	7.68	820	524.8	60	28	11	18	4	225	18	58	107	0.8	2
13	7.46	1070	684.8	145	41	10	14	27	439	18	35	85	2	14
14	7.21	1000	640	295	74	35	55	39	573	24	71	447	2	6
15	7.3	890	569.6	120	32	10	24	15	354	30	58	107	0.9	3
16	7.43	1390	889.6	200	35	9	48	20	213	15	35	238	2	5
17	6.92	1000	640	500	80	10	187	9	348	0	122	986	0.9	76
18	7.6	1300	832	185	50	10	34	24	299	144	58	341	1	4
19	7.12	1020	652.8	85	48	18	18	10	366	30	37	103	2	8
20	6.98	1000	640	440	25	12	95	50	226	21	58	496	0.8	73
21	6.86	1000	640	500	72	10	79	75	396	12	71	496	2	100
22	7.17	1150	736	145	33	10	30	17	299	18	37	107	1	50
23	7.02	1560	998.4	245	50	12	42	34	335	18	37	178	0.9	3
24	7.3	1570	1004.8	85	72	16	16	11	403	30	35	96	4	84
25	7.02	1000	640	335	40	14	50	51	226	24	37	373	2	2
26	7.34	1200	768	135	40	10	16	24	311	123	37	110	2	70
27	6.9	1380	883.2	170	43	9	34	21	354	24	35	96	3	14
28	6.84	1000	640	360	53	15	67	48	262	18	117	394	2	80
29	6.98	1000	640	420	36	16	87	50	232	27	61	383	1	2
30	7.17	1320	844.8	140	40	11	34	19	268	21	35	110	0.9	69
31	6.93	1800	1152	245	43	10	63	22	317	6	37	270	1	100
32	6.92	2569	1644.16	324	37	12	45	15	435	19	42	320	1.1	64
33	7.2	1568	1003.52	329	42	15	2	72	558	21	39	192	0.42	28
34	7.3	2501	1600.64	423	52	18	63	28	328	23	42	498	1	49
35	6.82	1908	1221.12	142	64	11	42	2	446	25	30	257	2.9	19
36	6.95	1856	1187.84	272	35	10	52	0.8	442	32	37	152	1.2	75
37	7.12	856	547.84	113	44	16	4	25	312	15	27	105	1.04	25
38	7.26	3689	2360.96	634	55	19	72	43	421	4	38	675	0.8	61
39	7.35	2750	1760	234	68	9	38	19	534	22	37	235	1	120
40	7.23	2487	1591.68	263	52	12	62	12	525	26	51	196	1	43
41	6.96	2985	1910.4	489	49	16	56	18	528	2	46	325	0.9	67
42	6.91	1586	1015.04	212	36	18	71	2	329	4	43	215	0.9	25
43	7.36	1542	986.88	209	51	13	38	18	297	3	36	193	0.8	57
44	7.52	1624	1039.36	236	46	9	52	9	587	1	39	189	0.94	31
45	6.78	2842	1818.88	475	49	15	74	2	456	2	29	548	0.89	24

Table 4. Analytical data of the groundwater of the study area for Post-monsoon season (mg/l).

S.NO	pH	EC	TDS	TH	Na	K	Ca	Mg	HCO3	CO3	SO4	Cl	F	NO3
1	7.9	896	573.44	170	86	6	58	6	268	18	54	124	0.35	43
2	6.97	2912	1863.68	335	200	113	130	3	677	33	46	444	0.7	46
3	7.7	1232	788.48	145	115	82	8	31	287	15	39	185	0.59	27
4	6.99	2016	1290.24	275	172	24	108	1	378	18	74	312	0.31	19
5	6.9	2520	1612.8	455	165	41	155	17	299	21	35	469	0.45	41
6	7.1	1736	1111.04	350	112	3	80	37	232	0	54	295	0.3	49
7	7.25	1848	1182.72	405	93	3	98	21	177	0	67	355	0.32	41
8	6.95	2016	1290.24	255	147	35	116	28	421	12	31	351	0.39	64
9	6.8	1050	672	154	154	41	48	18	357	14	52	157	0.56	32
10	7.24	1040	665.6	165	128	36	56	24	3	11	40	149	0.42	29
11	7	2636	1687.04	168	200	200	64	35	185	21	40	376	0.32	45
12	6.95	789	504.96	70	157	5	37	9	213	23	49	182	0.34	5
13	7.36	1008	645.12	145	128	2	16	22	525	18	33	64	0.23	33
14	7.2	910	582.4	309	132	4	68	43	526	21	64	320	0.87	11
15	7.5	980	627.2	132	157	6	48	19	363	27	48	102	0.34	4
16	7.6	1204	770.56	211	132	9	106	24	214	16	32	221	0.95	8
17	6.9	899	575.36	513	125	12	192	10	327	21	117	905	0.28	79
18	6.8	1195	764.8	179	110	5	56	19	286	142	41	321	0.36	5
19	7.1	896	573.44	91	124	4	34	12	354	28	31	115	0.99	11
20	7.35	857	548.48	451	95	21	140	47	216	16	54	405	0.38	72
21	6.8	892	570.88	496	131	16	123	71	402	17	65	478	0.46	85
22	7.4	1058	677.12	152	128	20	58	16	311	25	42	125	0.74	41
23	7	1287	823.68	254	156	7	53	37	345	22	35	157	0.95	2
24	7.26	2072	1326.08	145	200	4	22	22	665	15	30	266	1.89	64
25	6.99	2856	1827.84	625	146	45	165	52	329	15	45	561	1.3	45
26	6.9	1120	716.8	142	165	8	31	21	325	119	32	204	0.29	75
27	6.99	1736	1111.04	230	158	2	72	12	592	15	74	167	1.65	71
28	7.28	982	628.48	372	153	9	123	42	271	13	114	259	0.35	75
29	6.7	935	598.4	415	162	5	138	53	237	26	56	234	0.34	8
30	6.9	1083	693.12	168	144	12	46	22	249	17	49	187	0.56	65
31	7.35	1594	1020.16	294	133	15	135	27	334	4	51	246	0.64	85
32	7.26	2464	1576.96	330	123	6	144	17	464	0	56	476	0.83	49
33	7.5	1456	931.84	340	176	23	4	80	567	24	31	170	0.13	22
34	7.69	2352	1505.28	435	164	4	118	34	342	0	31	515	0.66	45
35	7.66	1792	1146.88	155	200	4	58	3	452	30	22	369	2.7	12
36	7.69	1736	1111.04	280	160	64	110	1	433	36	46	231	0.66	60
37	7.58	672	430.08	120	73	5	6	26	293	9	24	61	0.52	15
38	7.16	3584	2293.76	640	200	6	180	46	439	0	46	767	0.43	52
39	7.21	2520	1612.8	240	200	200	58	23	543	24	30	351	0.94	105
40	7.31	2296	1469.44	275	151	200	86	15	512	15	54	351	0.34	45
41	7.49	2800	1792	500	158	7	161	24	512	0	54	479	0.61	75
42	7.46	1120	716.8	220	75	3	84	3	323	0	45	160	0.23	26
43	7.6	1400	896	215	91	3	46	25	286	0	43	216	0.25	60
44	7.38	1512	967.68	245	133	4	78	12	591	0	31.4	164	0.43	38
45	7.25	2744	1756.16	485	195	7	186	5	488	0	28.6	650	0.38	30