Evaluation and characterization of groundwater in and around of Narsampet area Warangal District, Telangana, India

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***Abstract*- The aptness of water for domestic purposes can be resolute by groundwater quality. A total of Fifty-four groundwater samples were collected during pre and post monsoon in the NARSAMPET AREA WARANGAL DISTRICT, TELANGANA, INDIA. Chemical analysis was carried out for pH, EC and major ion concentrations. All samples were analyzed in the laboratory as per the standard procedures for hydrochemistry and hence its quality for domestic purposes. The pre monsoon chemical data base is compared with drinking water standards of WHO 1984 the permissible limits of TDS, Ca2+, Mg2+, Cl-, NO3, F, SO4, and HCO3 are exceeding the limits and whereas pH values are within the WHO limits. Similarly, the post monsoon chemical data base is also showing the similar trend in both the seasons for parameters like TDS, Ca2+, Mg2+, Na+, K, Cl-, NO3, F, SO4 and HCO3 indicates the multiple sources of solute dissolved in groundwater. All the samples exceed the permissible limits but this sample numbers 30, 35, 36, 37, 38, 40, 50, 53 and 54 show much elevated values.**

Index Terms- Groundwater, Geologic Formation, Water quality, Warangal District, Telangana.

INTRODUCTION

In India, more than 75% of population depends on agriculture for their livelihood. Agriculture plays a vital role in our country's economy. Moreover, it is the greatest user of water, accounting for about 80% of all consumption. However, about 70% of irrigation water is wasted in runoff or inefficient irrigation system *(World Bank, 2005)*.Groundwater quality is an important factor in groundwater resource evaluation. Groundwater contains chemical ions carried in solution depending upon its interaction with aquifer material, rate of groundwater movement, ion exchange capacity and the source of groundwater. A detailed quality survey has been carried out in the study area to understand the groundwater suitability for domestic and agricultural purposes. As water moves slowly through the subsurface porous media, it can remain for extended periods of time in contact with minerals present in the soil and bedrock and become saturated with dissolved solids from these minerals. This dissolution process continues until chemical equilibrium is reached between the water and the minerals with which it is in contact. The resource can be optimally used and sustained only when the quantity and quality of the groundwater is assessed. In this present scenario, the increasing population is leading to the over exploitation of resources resulting in them Decline (Satish Kumar et al. 2016).

Recently various researchers have carried out groundwater study for drinking and irrigation water standards using different indices and plots (Rao and Rao 2010; Rao et al. 2012; Bhardwaj and Sen Singh 2011; Prasanna et al.2011; Akbal et al. 2011; Nosrati and Van Den Eeckhaut2012; Sharma et al. 2012; Gupta et al. 2012). Besides these, Machender et al. (2013) have carried out groundwater and surface water study in a Chinnearu river basin to distinguish the groundwater and surface water for drinking and irrigation use. He concludes that most of the groundwater samples are within permissible limits of drinking and irrigation use. The samples that have higher concentration are due to water–rock interaction. Besides these, extensive studies on water quality have been carried out by various workers (Majumdar and Gupta 2000; Dasgupta and Purohit2001; Khurshid et al. 2002; Sujatha and Reddy 2003; Aravindan et al. 2004, 2010; Sreedevi2004; Sunitha et al. 2005; Subba Rao 2006; Shankar et al. 2010, 2011).

The main objective of the article is to determine the groundwater quality for drinking and irrigation purposes, and compared the chemical analysis data of the groundwater with the water quality standards.

STUDY AREA

The study area Narsampet is a town in Warangal (rural) district of Telangana. The study area is about 187.11 sq. km. Geographical location North Lat. of 17^0 55'29 "East Long. of 70^0 52' 31" It falls in SOI Top sheet No.56 N/16 and O/13(Fig 1). The study area is about 40 km from Warangal and 190 km from Hyderabad. Narsampet area is a historical place. Before Independence the administrative unit of Narsampet was officially known as Pakhal Taluka because of its proximity to the area's lifeline the Pakhal lake, largest lake in the region built by the Kakatiya rulers. Over the years, the area has grown into the town in Warangal district. In the Pakhal forest have with sufficient sedimentary deposits like Dolomites, Shales, Sandstones, coal, Guduru Iron also available here near the Narsampet so it will be good development area. The central government had declared from Sirocha (maharastra) to Tirupathi high way in the Narsampet city with NH. 365.Narsampet area is a tributary of Munneru River. This area experiences a typical tropical climate with a distinct hot summer, the temperature shoots to a maximum of 49°C during March to June, a good rainy season from July to September (1300mm) and a mild winter during October to February (6°C to 22°C). The relative humidity of the area varies over a wide range from Nil during mid-Winter to 100% in peak summer with a mean variation of 13 to 96%. An isolated patch of red and red loamy soils is also observed around Central Part of the Block Cotton Soil as well as Borders of the study area.

MATERIALS AND METHODS

A total of 54 groundwater samples were collected covering the entire study area (Fig. 2). The water samples were collected for post-monsoon and premonsoon seasons with in situ measurement of pH and EC. Water samples were collected in a plastic container of 1-L capacity for detailed chemical analysis from all observation dug wells. The containers were numbered serially along with a proper record of well/sample location, date, static water level, and prior to the sampling. Groundwater samples were collected after the well was subjected to pumping for at least 5–10 min to obtain the composite sample. The pH and EC of the groundwater of the wells were measured by using HACHHQ40d and its in situ values are recorded. The samples were collected and stored below 4^0C and analysed in the laboratory. Total dissolved solids(TDS) were calculated from EC with cation factor of multiple 0.64 (Brown et al. 1970). Water samples collected in the field were analysed for chemical constituents, such as Total dissolved solids (TDS), Total hardness (TH),Calcium (Ca), Magnesium (Mg), Total alkalinity (TA),Carbonates (CO_3), Bicarbonates (HCO^3), Sodium (Na),Potassium (K), Chloride (Cl), Nitrate (NO_3), and Sulfates(SO^4), were analysed following the standard procedure of(APHA 1995). The analytical results were evaluated indetail and compared with water quality guidelines of WHO(1984). A brief description of the physico-chemical attributes of groundwater is discussed. EC, pH, chloride (Cl^-),fluoride (F^-), and nitrate (NO_3^-) were analysed using multiple parameters ion meter model Thermo Orion 5 Star.Sulfate (SO_4^{-2}) was measured using a double beam UV–Visspectrophotometer model Perkin Elmer Lambda 35 byturbid-metric, stannous chloride, and molybdosilicate, respectively. Sodium (Na^+), potassium (K^+), calcium (Ca^{+2}), and magnesium (Mg^{+2}) were analysed using flame photometer model CL-378 (Elico, India). Total hardness was determined by EDTA titrimetric method. TDS was measured gravimetrically. Total carbonate and bicarbonate alkalinities were measured by acid–base titration.

RESULTS AND DISCUSSION

The analytical results of physical and chemical parameters of the groundwater for the present study are shown in tables These were compared with the standard guideline values as recommended by the WHO for drinking and public health purposes. The fluctuation of water level from post monsoon to pre-monsoon is very low; the effect on TDS concentration is also very low. A brief description of the important physico-chemical attributes of groundwater are discussed.

Hydrogen ion (pH)

In the study area the pH of the pre monsoon samples varies from 6.84 to 7.95and the central part and periphery of southern part showing an elevated value and all samples are within the limits. Whereas post monsoon season pH of the samples varies from 6.9 to 8.04 and its spatial distribution is also in the same manner of pre monsoon and the rise of pH value could be due to surface water interaction with groundwater and agriculture run off (Figure. 3a,b)

Total dissolved solids (TDS)

In the study area TDS concentration monitored for two different seasons namely pre monsoon and post monsoon was found to vary from 177 to 2136mg/l and 146 to 1712mg/l respectively. The spatio-temporal variations of TDS concentration in groundwater for two seasons are shown in (figures. 4a, b). In middle and southern part of the study area high elevated values are observed. Whereas reaming study area TDS ranges from 100 - 1100mg/l. The decreasing trend is noted in TDS values of post monsoon due to dilution by rain water.

Calcium and magnesium

Among the cations, Ca content shows seasonal variation and maximum samples in all the seasons fall exceed the permissible limit (75 mg/L). The Calcium concentration in groundwater was found varying from 21-303mg/l and 31-363mg/l in pre and post monsoon periods respectively. The content up to 1,800 mg/L does not impair any physiological reaction in man (Lehr et al. 1980). High concentration of Ca is not desirable in washing, laundering, and bathing. Although the sources of Ca in groundwater resources are mainly the crystalline limestone associated with khondalitic rocks, the prolonged agricultural activities prevailing in the study area may also directly or indirectly augment the mineral dissolution in groundwater (Bohlke 2002).

The content of Mg is comparatively less than that of Ca. The magnesium concentration in groundwater was found to vary from 7-214mg/l and 14-245mg/l in pre and post monsoon seasons respectively. The very high concentration of magnesium value is observed in the study area. This indicates influence of anthropogenic activity on groundwater quality. The high concentration of Mg^{2+} value more than 30mg/l can lead to a disease called encephalitis (figures 5a,b &6 a,b).

Sodium and potassium

Na is one of the important naturally occurring cations and its concentration in fresh waters is generally lower than that of Ca and Mg. But in the present investigation, the average concentration of Na is comparatively higher than that of Ca and Mg. For aesthetic reason, the guideline value given by WHO is 200 mg/L. Comparatively higher values were recorded with variation from 16-481mg/l and 413-389mg/l during pre and post monsoons respectively. A patch of high concentration of sodium value was identified during pre and monsoons seasons. The potassiumconcentration in groundwater was found to vary from 0.8–21mg/l and 0.7-17.5mg/l in pre and post monsoon seasons respectively. High concentration of potassium was observed in the southern part of the study area at Narsampet village (figures 7a,b&8a,b).

Chloride (Cl)

The usage of huge fertilizer for paddy cultivation also plays a vital role as the source of chloride. The maximum permissible limit for Cl in drinking water is 250–1,000 mg/L (WHO 1993).The spatial variation of chloride concentration during pre and post monsoon period in groundwater are shown respectively chloride concentrations in groundwater were found varying from 7-872mg/l and 6-699mg/l. A patch of high Cl concentration is identified in pre and post monsoon samples at rajpally, Mukundapur, timmapet and Kondapur villages. The high Cl concentration close to these villages clearly indicates the influence of discharge of domestic sewage into wells (figures 9a,b).

Nitrate

Nitrate in the study area is found to be comparatively very low in concentration. However, the season wise averagesshow slightly higher values during post-monsoon. The Nitrate values in the pre and post monsoons samples rages form 0-319mg/l and 0.6-254mg/l respectively (figures10ab).

Fluoride

The concentration of fluoride in pre and post monsoon samples ranges from 0.5-7mg/l and 0.4-

5.61mgl respectively. Slightly Decreasing trend is observed in post monsoon samples from pre monsoon samples and observation fluoride values are crossing the WHO limits in pre and post monsoon seasons (figures 11a,b).

Sulphate

Sulfate is a major anion present in water. The sources of Sulfate in rocks are sulfur minerals, sulfides of heavy metals of which are of common occurrence in the igneous and metamorphic rocks. The sulfate concentration in groundwater was found to vary from 5-269mg/l and 4-218mg/l in pre and post monsoon seasons. Sothern and western part of the area showing high concentration in both the seasons (figures 12ab).

Bicarbonate

The-carbonate and bicarbonates contribute to all the alkalinity or acid neutralizing power of water. The surface water bodies are rich in bicarbonates compared to groundwater. Bicarbonate rich groundwater shows the aquifer is directly recharged by the surface water. The carbonates are absent in waters with the pH values less than 8.3. The Bicarbonate in groundwater is found to vary from 192-824mg/l and 158-747 mg/l in pre and post monsoons respectively (figures. 13a,b).

CONCLUSION

The concentrations of cations and anions are exceeding limits for drinking water standards except pH values. But few samples were exceeding the limits are observed to be in different kind of geological and anthropogenic activities were carried out near the samples in the study area.

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FIGURES

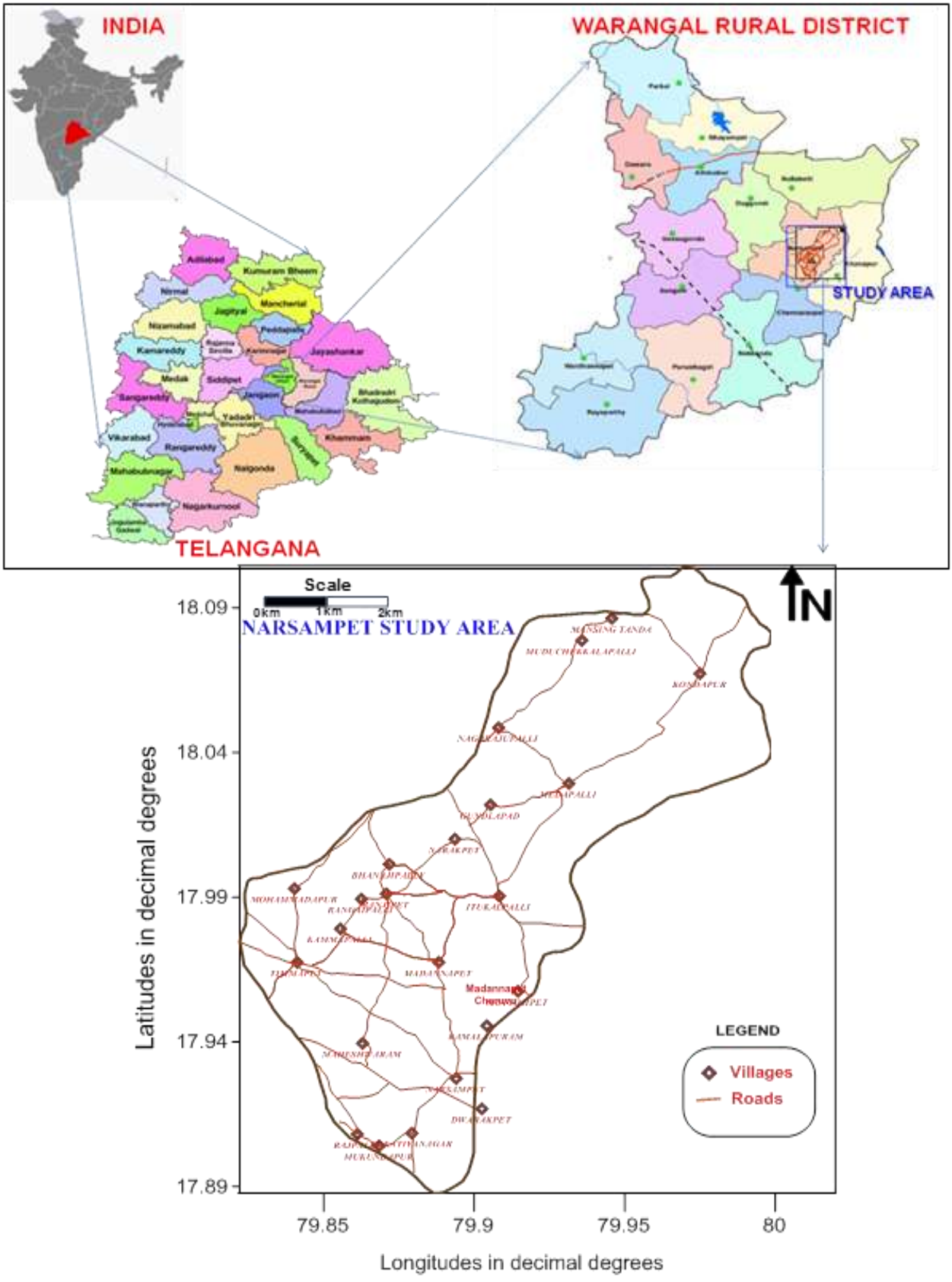

Figure 2 Well inventory map of the study area.

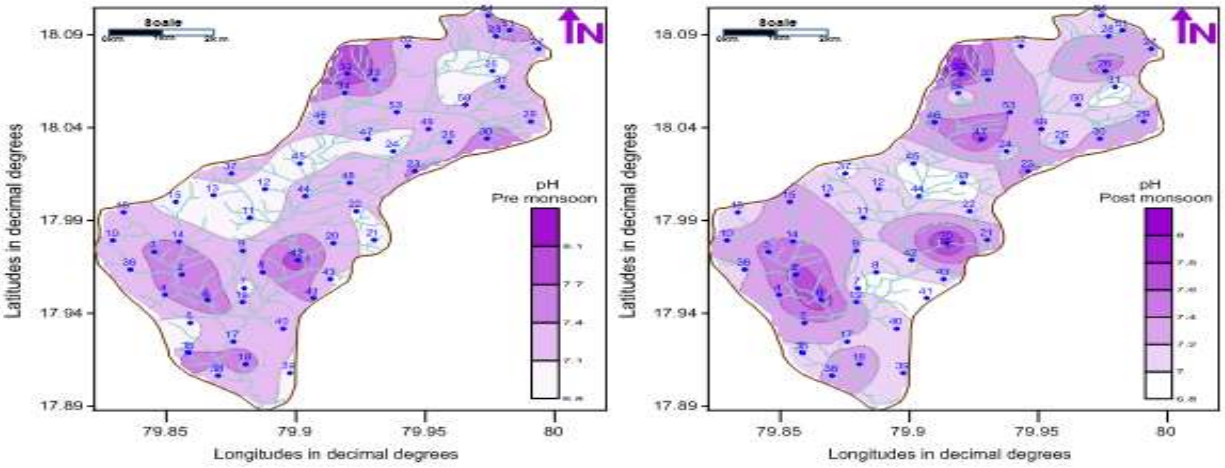

Figure 3 pH contour map of pre and post monsoon seasons of the study area

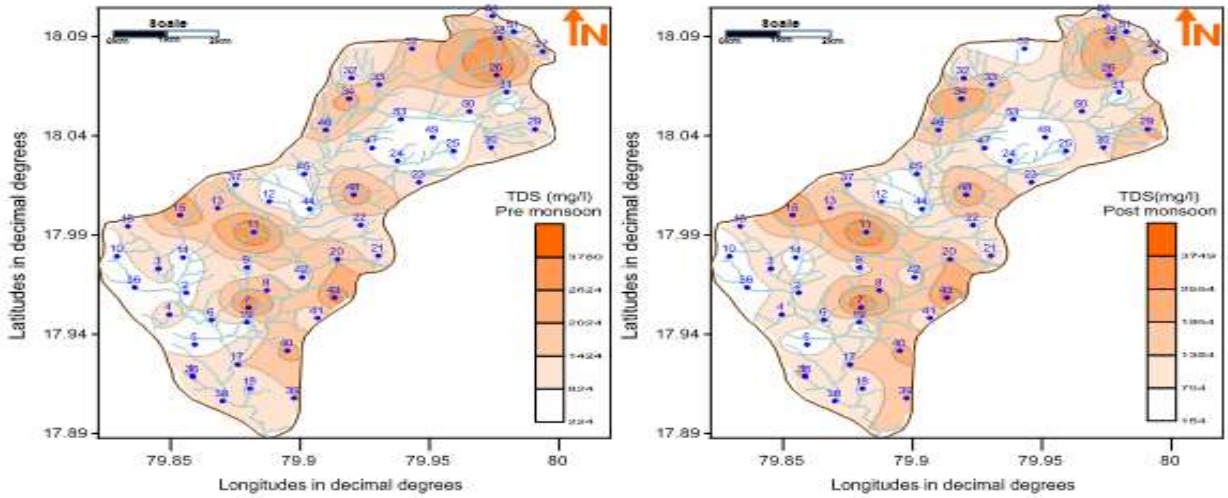

Figure 4TDS concentration map of pre and post monsoon seasons of the study area.

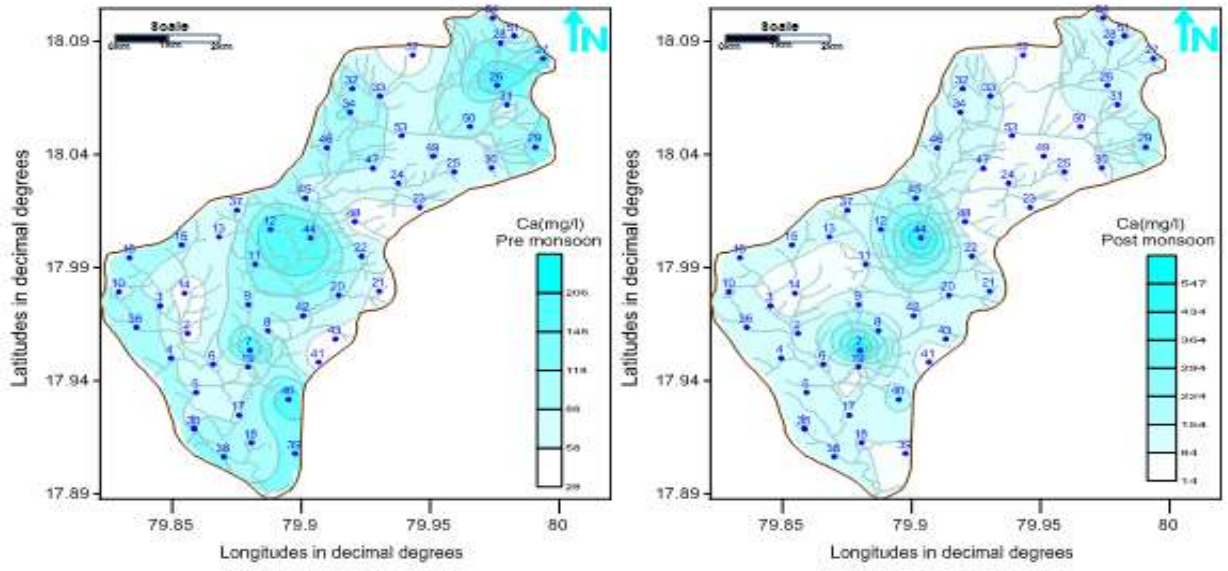

Figure 5Ca concentration map of pre and post monsoon seasons of the study area.

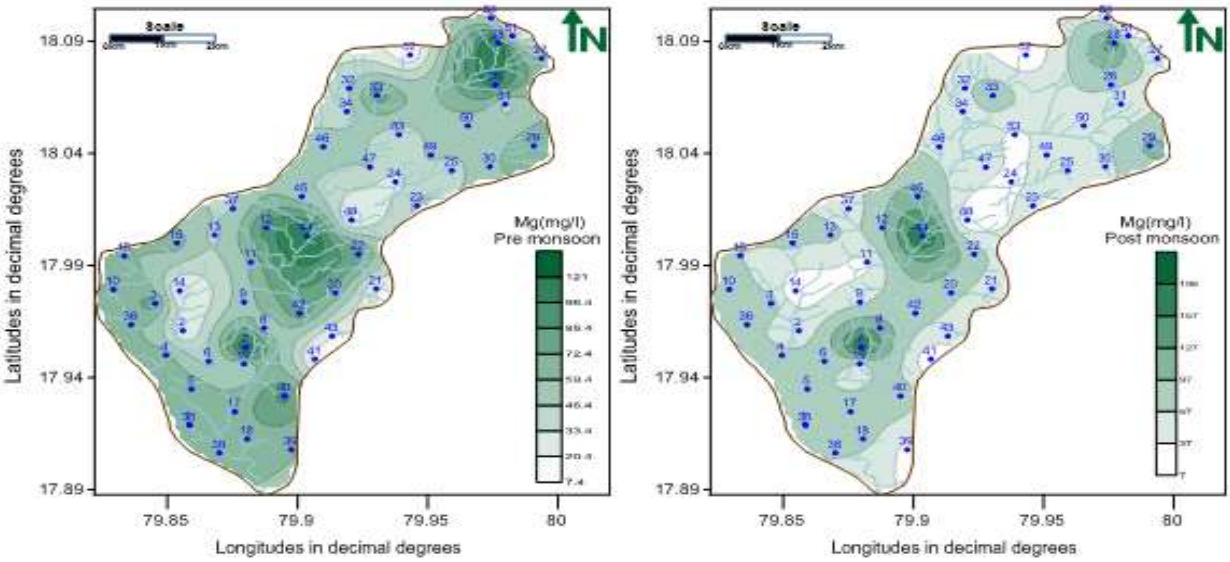

Figure 6 Mg concentration map of pre and post monsoon seasons of the study area

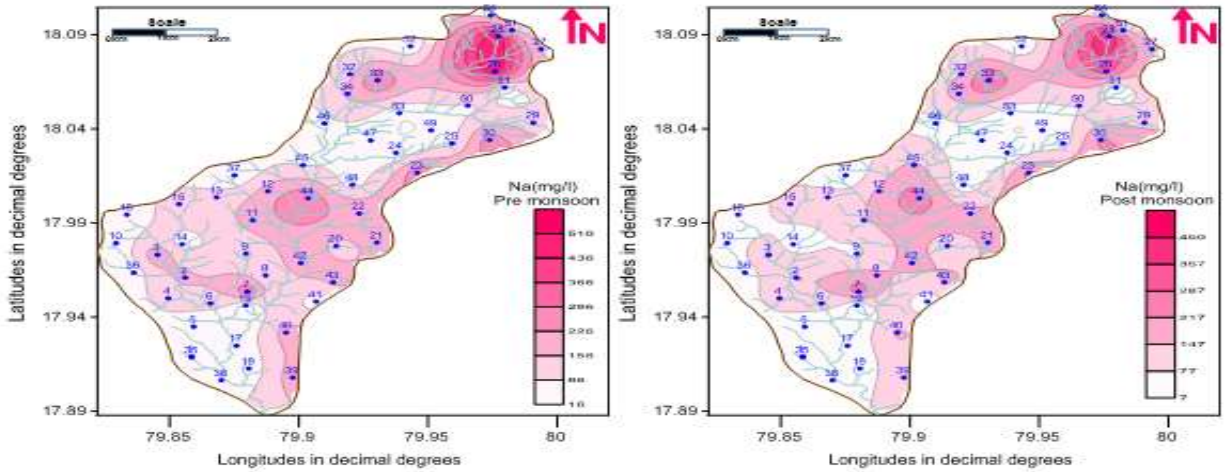

Figure 7 Na concentration map of pre and post monsoon seasons of the study area

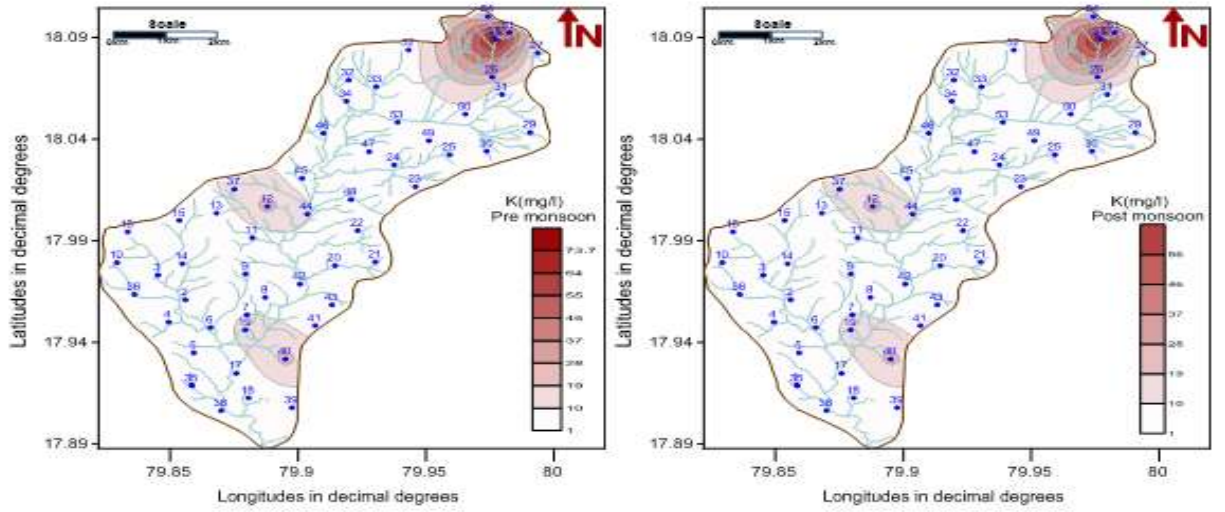

Figure 8 Potassium concentration map of pre and post monsoon seasons of the study area

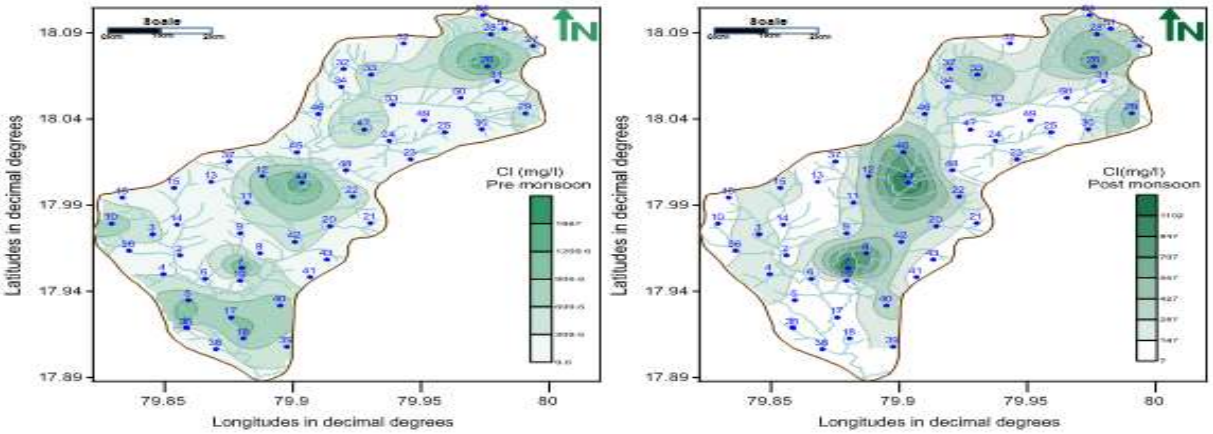

Figure 9 Chlorides concentration map of pre and post monsoon seasons of the study area

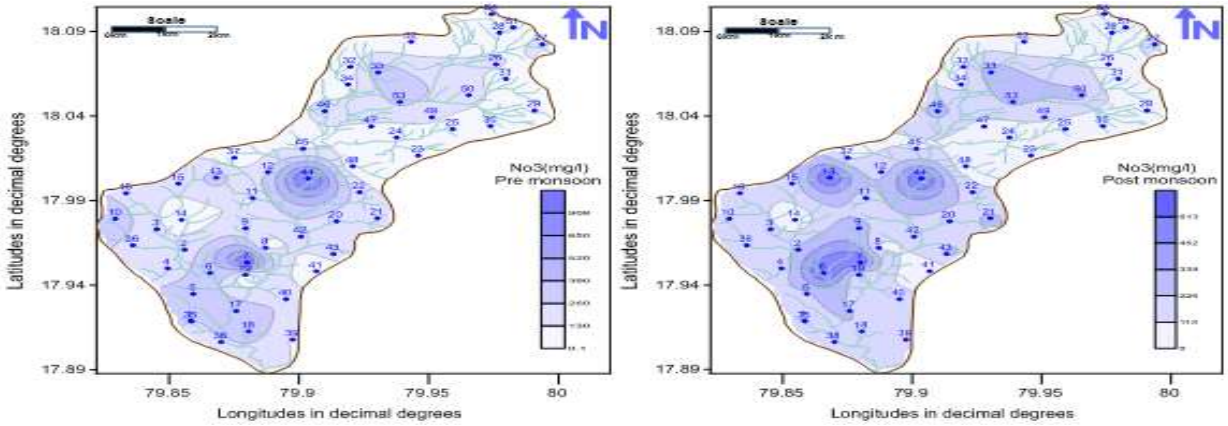

Figure NO3 concentration map of pre and post monsoon seasons of the study area

Tables

Table 1Major ion chemistry of groundwater samples, Post monsoon (All the parameters are in mg/l except pH)

WELL No	Well type	pH	TDS	Ca	Mg	Na	K	HCO3	Cl	SO4	NO3	F
NRSPT 1	D/W	7.2	1727	81	76	27	1.4	202.6	61	38	224	0.8
NRSPT 2	B/W	7.70	767	110	50	150	3.8	350.0	65	80	240	2.4
NRSPT 3	D/W	7.50	1330	89	81	162	2.2	140.0	336	37	152	2.5
NRSPT 4	D/W	7.40	1230	114	72	114	2.6	150.0	277	60	150	1.2
NRSPT 5	B/W	7.4	240	137	71	29	3.1	242.1	133	28	203	1.0
NRSPT 6	D/W	7.80	1080	88	75	108	4.5	61.0	67	17	603	3.1
NRSPT 7	B/W	6.90	3457	541	194	265	8.7	58.6	1089	360	606	0.7
NRSPT 8	D/W	7.00	2036	189	110	156	3.9	48.8	704	111	88	2.0
NRSPT 9	D/W	7.20	963	118	59	59	2.5	48.8	177	41	271	2.4
NRSPT 10	B/W	7.30	425	79	75	27	1.2	200.0	60	38	221	0.6
NRSPT 11	D/W	7.2	3750	62	27	140	1.4	60.8	213	86	143	1.4
NRSPT 12	D/W	7.2	466	197	92	161	16.2	71.7	405	242	178	1.5
NRSPT 13	D/W	7.2	1544	90	76	110	4.7	61.8	68	17	610	3.1
NRSPT 14	B/W	7.40	181	14	8	28	3.6	105.0	17	9	2	0.5

NRSPT 15	B/W	7.4	2535	116	73	115	2.7	151.9	281	61	152	1.2
NRSPT 16	D/W	7.00	941	130	67	27	2.1	230.0	126	26	193	0.2
NRSPT 17	D/W	7.2	1470	83	78	29	1.8	207.9	63	40	230	1.3
NRSPT 18	D/W	7.4	726	82	77	28	1.6	205.2	62	39	227	1.0
NRSPT 19	B/W	7.30	574	79	49	9	5.2	300.0	13	11	93	0.3
NRSPT 20	D/W	7.9	2020	117	74	117	2.8	153.8	284	62	154	1.3

WELL No	Well type	pH	TDS	Ca	Mg	Na	K	HCO3	Cl	SO4	NO3	F
NRSPT 21	B/W	7.3	1049	113	51	154	4.1	358.7	67	82	246	2.5
NRSPT 22	D/W	7.1	991	91	83	166	2.5	143.6	345	38	156	2.6
NRSPT 23	D/W	7.50	1165	51	52	236	1.8	400.0	178	72	88	1.7
NRSPT 24	D/W	7.10	425	79	30	7	2.5	300.0	12	12	8	0.4
NRSPT 25	D/W	7.10	615	62	51	47	1.2	360.0	28	16	38	0.4
NRSPT 26	D/W	7.60	2403	156	75	324	56.9	80.5	700	300	84	0.5
NRSPT 27	D/W	7.40	1461	141	51	140	7.1	58.6	391	130	157	0.6
NRSPT 28	D/W	7.20	2775	133	149	451	40.6	65.9	488	1000	36	1.1
NRSPT 29	D/W	7.30	2001	195	106	132	6.2	43.9	550	242	116	0.7
NRSPT 30	B/W	7.30	1217	63	58	232	1.2	280.0	163	263	0	1.2
NRSPT 31	D/W	6.80	338	72	37	37	2.1	360.0	27	15	0	0.7
NRSPT 32	D/W	8.00	1133	147	61	140	5.1	200.0	314	100	88	1.0
NRSPT 33	B/W	7.30	1910	97	95	314	2.2	90.3	490	82	302	1.5
NRSPT 34	D/W	7.00	2720	135	45	180	4.0	630.0	200	75	70	1.7
NRSPT 35	D/W	7.1	728	135	70	28	2.8	239.0	131	28	200	0.8
NRSPT 36	B/W	7.2	221	131	68	27	2.4	233.0	127	27	195	0.4
NRSPT 37	D/W	7.0	1330	80	49	9	5.4	303.7	13	11	94	0.3
NRSPT 38	D/W	7.3	1212	133	69	28	2.6	236.0	129	27	198	0.6
NRSPT 39	D/W	7.00	1837	62	27	139	1.2	60.0	210	85	141	1.4
NRSPT 40	B/W	7.10	2152	195	91	159	15.9	70.8	400	239	175	1.5

WELL No	Well type	pH	TDS	Ca	Mg	Na	K	HCO3	Cl	SO4	NO3	F
NRSPT 41	B/W	6.9	842	15	8	28	3.8	106.4	17	9	2	0.5
NRSPT 42	D/W	7.2	984	90	82	164	2.3	141.8	340	38	154	2.6
NRSPT 43	D/W	7.1	2960	111	51	152	3.9	354.3	66	81	243	2.5
NRSPT 44	D/W	7.0	368	548	196	268	8.9	59.4	1102	364	613	0.7
NRSPT 45	B/W	7.0	700	191	112	158	4.0	49.5	713	112	89	2.0
NRSPT 46	D/W	7.4	1662	120	60	59	2.7	49.5	179	42	274	2.4
NRSPT 47	B/W	7.70	639	83	47	37	1.1	310.0	64	9	67	0.3
NRSPT 48	D/W	6.9	2631	15	9	29	3.9	107.7	18	9	2	0.5
NRSPT 49	D/W	7.20	604	81	44	13	1.0	250.0	40	12	136	0.3
NRSPT 50	D/W	7.00	944	78	61	77	5.5	150.0	85	53	260	0.4
NRSPT 51	D/W	7.20	944	76	32	145	40.8	70.0	232	158	22	0.6
NRSPT 52	D/W	7.10	154	24	8	13	3.3	110.0	8	7	0	0.4
NRSPT 53	D/W	7.40	461	70	30	20	1.0	375.0	230	30	250	1.2
NRSPT 54	D/W	7.10	1229	122	55	112	13.1	70.8	279	230	1	0.7