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Studies on Seasonal Variation of Groundwater Quality in the Suddagedda Basin, Eastgodavari District, A.P.

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Abstract

The present study is to assess the seasonal variations of the hydrochemistry and quality of the groundwater in the suddagedda basin. Fifteen groundwater samples were collected from the observation wells during the pre-monsoon and post-monsoon, 2019. Hydrochemical analyses including major and minor elements were done for the spatial distribution of the element concentrations and for the assessment of seasonal variations. Based on the results of the field investigations, it has been indicated that the quality of groundwater has observed in both the seasons were distinctly different**.** It is recommended that during the pre-monsoon periods, pumping from bore wells be minimized to control the quality variation.

Key Words: Hydrogeochemistry; ground water quality,Kakinada.

Introduction

Water is a dynamic renewable natural resource. Its availability with good quality and adequate quantity is very important for human life and other purposes. In general, the quality of water is equally important as the quantity. Thus water quality is considered to be an important contributing factor to predict the possible environment changes associated with social and economic development. In developing countries around 3.4 million peoples mostly children, sufer from water borne diseases every year due to groundwater contamination (WHO). Nowadays, surface water quality became a critical issue in many countries; especially due to the concern that freshwater will be a scarce resource in the future therefore, water quality monitoring program is necessary for the protection of freshwater resources. Monitoring programs of aquatic systems play a significant role in water quality control since it is necessary to know the contamination degree so as not to fail in the attempt to regulate its impact. However, the quality is difficult to evaluate from a large number of samples, each containing concentrations for many parameters, thereby choosing the observation wells seasonally for the spatial and temporal assessment.

Groundwater chemistry based on the hydro chemical data is used for obtaining preliminary information on water types, classification of water resources for various purposes to different ground-water aquifers and study of different chemical processes (Saxena et al. 2003; Jalali 2007; Sarwade et al. 2007). Groundwater chemistry plays an important role for the study of groundwater quality in the coastal aquifers (Hem 1970). In the assessment of fresh groundwater potential, hydrochemistry plays an important role in coastal regions. Hydrochemical parameters were used to evaluate the seawater intrusion process, the knowledge of which can be helpful to control the water quality in the coastal areas (Mercado 1985). A number of studies on groundwater quality with respect to drinking and irrigation purposes have been carried out in the different parts of India (Subba Rao et al. 1999; Sujatha and Reddy 2003; Sunitha et al. 2005). The study area mostly comprise of predominantly agricultural land with varied

agricultural activities. Majority of the people in this region depend on agriculture (i.e., cultivators and agricultural laborers). Substantial amount of groundwater is being used in this area for both drinking as well as irrigation purposes. The purpose of the present study is to determine the hydrochemistry of groundwater, factors affecting the seasonal variations of groundwater quality, and classify the water in order to evaluate its suitability for domestic and agricultural uses.

Description of the study area

The present study area, Suddagedda basin is a typical east flowing river lying between rivers Yeleru, and Pampa having origin in Eastern Ghats and joining in Bay of Bengal. The basin lies between latitudes 17° 09' 10" and 17° 30' 45"N and longitudes 82° 08' 30" and 82°19' 15" E, forming part of the Survey of India topographical maps nos. 65 K/4, 65 K/8 in East Godavari district of Andhra Pradesh, India. The total catchment area is 658.3 sq.km upto river mouth. However, in present study the catchment area upstream of Gollaprolu is being considered for morphometric analysis, middle and lower parts of basin taken for hydrogeological, and geochemical studies due to inaccessibility of the upper catchement and sparse habitations, and kondakalva micro watershed considered for the groundwater modeling studies. The location of the basin is shown in Fig.1

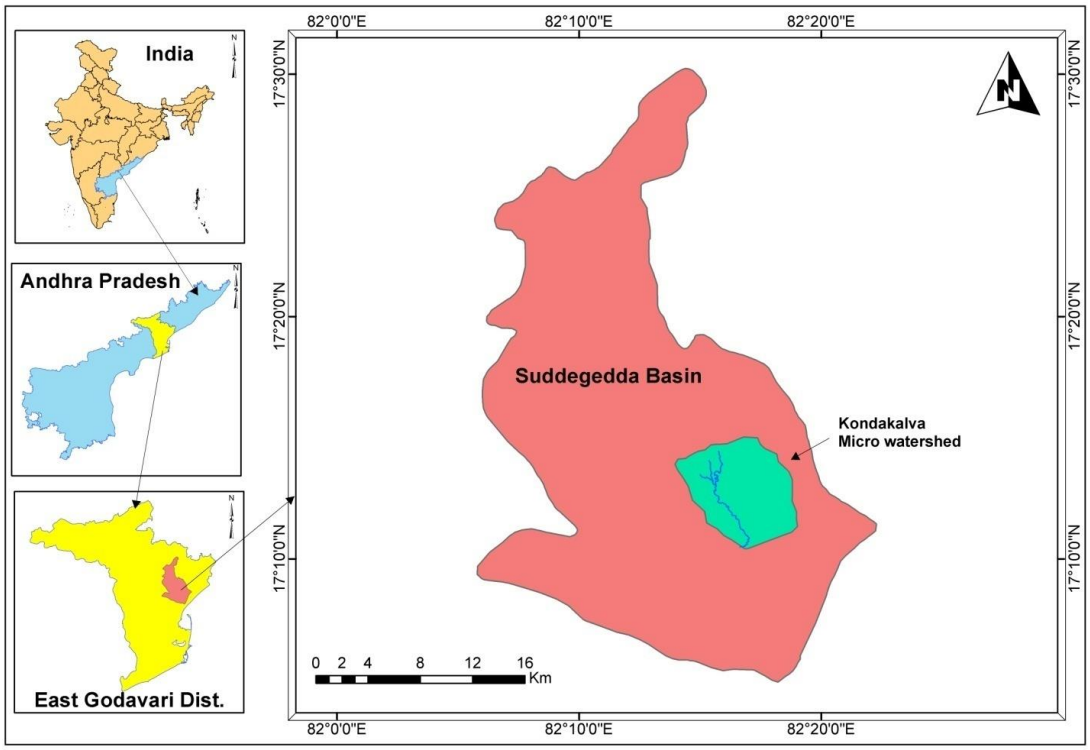

Fig.1 Location map of the study area

Materials and methods

Samples for groundwater quality study were collected from the open dug wells in use for domestic and irrigation purposes as well as a hand pump and power-driven pump for domestic water supply and irrigation.

For open dug wells, a weighted bucket was used to collect a sample from an open well about 30 cm below the surface of the water. Samples from the bore wells were collected after running the wells for about 15 minutes to

ensure that the sample represented the source of groundwater from which it was collected. Each sample bottles were also rinsed out several times before filling. The water samples for analysis of physicochemical parameters were collected in white high-density polyethene bottles.

Water samples from the dug wells as well as the bore wells were collected during the pre & post-monsoon seasons 2019 for detailed analysis. Attention has been given to collect fresh samples from hand pumps and dug wells so that the samples collected represented the quality of groundwater of the concerned aquifer.

Analysis of samples

Parameters like pH, temperature and conductivity were measured at the collection site with portable water analyser kit and the remaining parameters were analysed in the laboratory. Different parameters were analysed by Standard Methods (APHA 2005).

Cations like sodium and potassium were determined by flame photometer. Calcium and magnesium were determined by EDTA titration methods. Anions like carbonate and bicarbonate were calculated monographycally by acidimetric method. Chloride was determined by using silver nitrate titration method and sulphate by turbid metric method using a spectrophotometer having light path 2.5 cm. Nitrate was determined by UV spectrophotometric method. Apart from that, alkalinity was determined by titrimetric method and hardness was analysed by EDTA titrimetric method. After conducting the analysis of the water samples the major and minor ions,validation tests in terms of cation-anion balance was conducted for each sample. Necessary reanalysis has been done wherever the error exceeded 10%. The analysis results are tabled in 1.

Results and Discussion

In the present study area, the pH of the groundwater in both pre and post seasons are alkaline nature. The descriptive statistics of pre and post seasons in the basin are presented in Tables 1 & 2. The hydrogen ion concentration (pH) of the groundwater in the pre monsoon varies from 6.9 to 8.20 with mean of 7.5 and as well as in post monsoon range from 6.5 to 8.1 with mean of 7.5 during the year of 2019. In premonsoon (Fig.2) more than 7.0 have been recorded in the central part and above 8.0 as isolated patches in the central and northern area. However, pH less than 7 is found in the water samples from the isolated patch of the area, where the water is acidic. In post monsoon the pH levels between 7.5 to 8.1 are found in all most all part of the area except northern and in some eastern patches, where it is more than 7 and less than 7.5 is found as isolated patches in the entire study area. Thus, the groundwater samples at a few locations of the study area showacidic nature since the pH value of the samples was found as less than 7 During the study period. At the same time, about 25% of the groundwater samples showed significantly lower values of pH, this might be attributed to the ionic interaction (Asa Rani and Suresh Babu, 2008).

Table. 1 Chemical analysis of groundwater samples in Suddagedda basin pre-monsoon 2019(mg/l)

S.No	Village Name	pH	EC	TDS	HCO_3	Cl	SO_4	NO_3	F	Ca	Mg	Na	K	TH
1	Vannepudi	7.66	1825	1168	280.0	332.5	102.50	16.28	0.64	56	63.21	235	4.40	400
2	Gollaprolu	7.58	1449	927.36	330.0	237.5	55.00	0.04	0.41	64	43.76	175	4.80	340
3	Tatiparthi	7.55	1182	756.48	250.0	161.5	75.40	9.78	0.48	56	29.17	133	34.40	260
4	Chendurthi	7.48	2126	1360.64	250.0	361.0	156.48	35.54	0.55	136	19.45	285	14.20	420
5	Vakapalle	7.51	2566	1642.24	300.0	475.0	136.40	45.92	0.41	112	63.21	310	55.80	540
6	Venkat nagaram	7.36	3153	2017.92	460.0	617.5	202.40	3.28	0.21	184	58.34	395	0.60	700
7	Shanthi Ashram	7.35	2144	1372.16	270.0	351.5	102.50	54.57	0.54	128	48.62	241	20.30	520
8	Lampaka Lova	7.92	494	316.16	130.0	47.5	12.50	10.38	0.36	40	9.72	42	12.40	140
9	Peddipalem	7.65	927	593.28	150.0	190.0	33.50	1.29	0.46	56	14.59	78	71.70	200
10	Vemulapalem	7.25	909	581.76	200.0	142.5	44.22	2.10	0.31	80	14.59	70	34.60	260
11	China sankarlapudi	7.16	1913	1224.32	370.0	266.0	113.50	22.98	0.30	96	53.48	180	74.70	460
12	Veldurthi	7.95	988	632.32	150.0	199.5	52.10	0.95	0.56	40	24.31	116	31.10	200
13	T.Rayavaram	8.19	1548	990.72	240.0	285.0	100.00	4.86	0.67	56	48.62	193	5.10	340
14	Donthamuru	7.69	2085	1334.4	320.0	408.5	123.47	4.99	0.29	80	48.62	295	3.70	400
15	Rachapalle	7.19	1606	1027.84	230.0	313.5	77.70	10.65	0.40	88	34.03	197	4.60	360

Table. 2 Chemical analysis of groundwater samples in Suddagedda basin post-monsoon 2019(mg/l)

S.No	Village Name	pH	EC	TDS	HCO_3	Cl	SO_4	NO_3	F	Ca	Mg	Na	K	TH
1	Chebrolu	7.01	592	378.88	140	66.5	33	7.62	0.391	56	15	42.64	3.7	200
2	Chinna jaggampeta	7.89	1046	669.44	250	123.5	87	2.57	0.682	40	39	120	3.7	260
3	P.Timmapuram	7.53	1732	1108.48	330	237.5	156	8.57	0.721	96	49	180.34	22.8	440
4	Kodavali	7.69	2395	1532.8	250	380	229	48.58	0.36	88	58	188	259.9	460
5	Pothuluru	7.39	2348	1502.72	380	266	202	53.13	0.477	104	88	200	83.2	620
6	Chintaluru	7.36	503	321.92	130	76	8	0.85	0.236	24	24	35.64	9.2	160
7	Sarabhavaram	7.86	953	609.92	200	180.5	8	2.02	0.344	40	39	93.65	8.2	260
8	Uttarakanchi	7.83	958	613.12	230	123.5	51	5.31	0.462	32	34	117	2.9	220
9	Podurupaka	7.83	1812	1159.68	340	228	123	31.13	0.295	120	39	201	4.3	460
10	Ravutulapalem	7.7	1161	743.04	250	114	76	23.22	0.363	40	53	105	22.4	320
11	Pedasankarlapudi	8.02	1119	716.16	270	133	64	9.07	0.601	32	58	75.2	59.6	320
12	Prathipadu	7.79	1619	1036.16	270	313.5	54	11.39	0.512	24	63	225	2.6	320
13	Eluru	7.4	3913	2504.32	800	522.5	303	20.89	0.704	144	97	550	1.9	760
14	Dharmavaram	7.44	1025	656	230	142.5	51	7.32	0.254	40	39	114	4.9	260
15	Vommangi	7.51	1957	1252.48	260	294.5	135	41.84	0.362	24	83	251	17.8	400

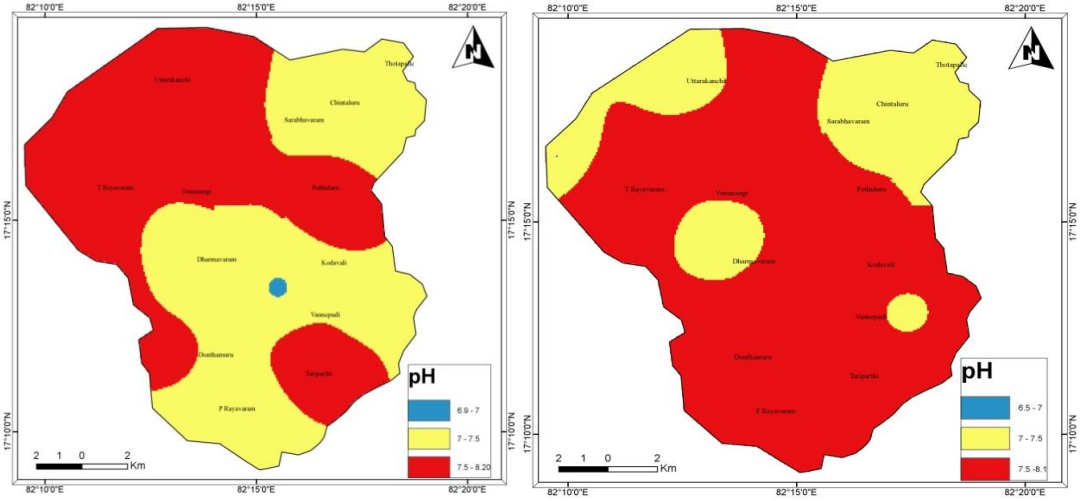

Fig. 2 Spatial distribution map of pH in pre and post monsoon 2019

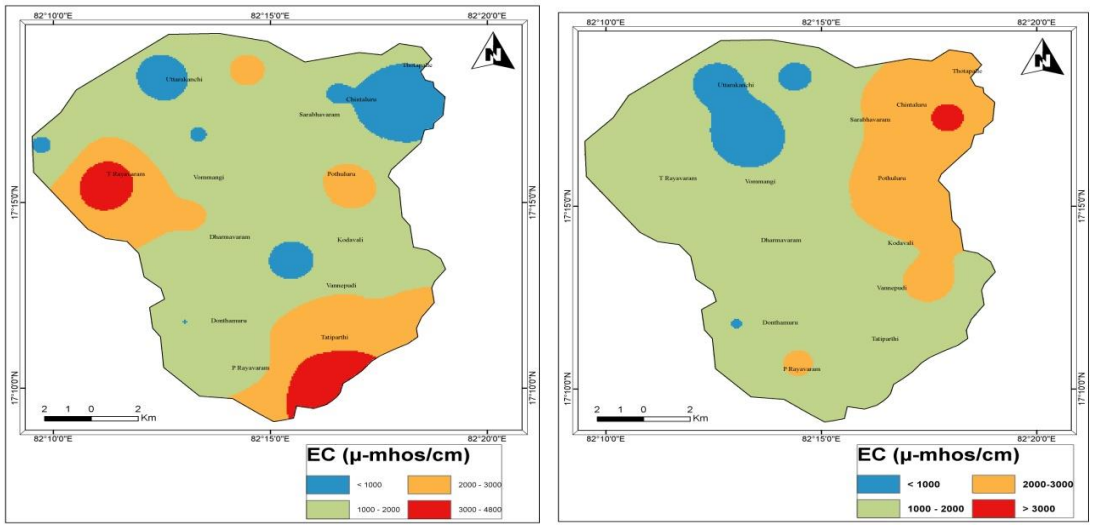

Fig. 3 Spatial distribution map of EC in pre and post monsoon 2019

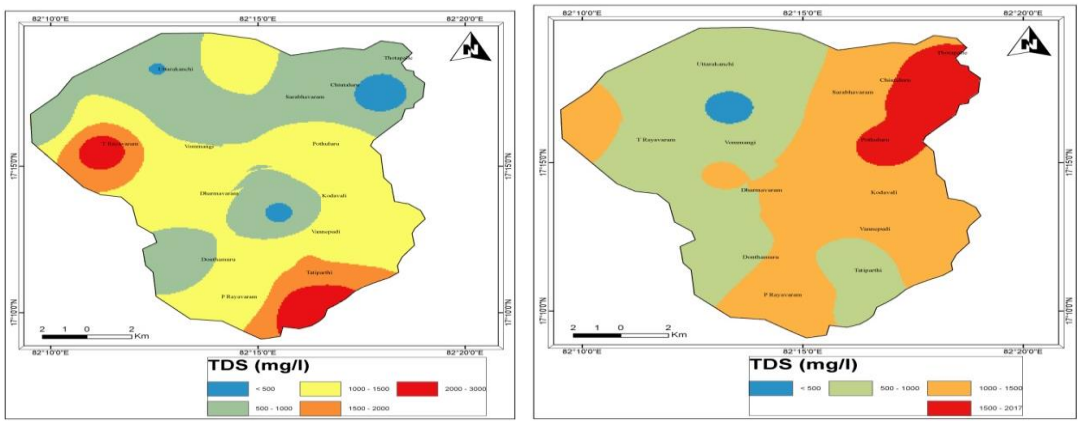

Fig.4 Spatial distribution map of TDS in pre and post monsoon 2019

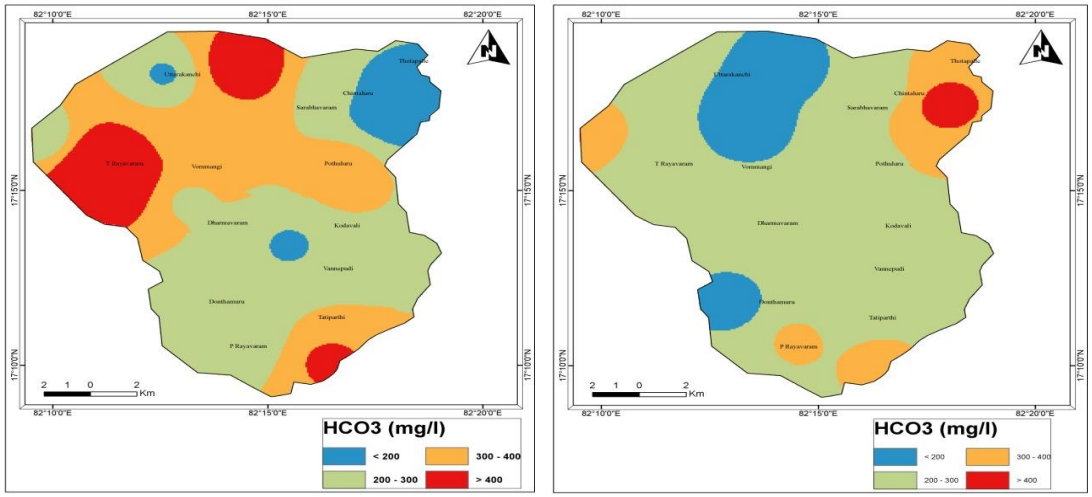

Fig. 5 Spatial distribution map of HCO_3 in pre and post monsoons 2019

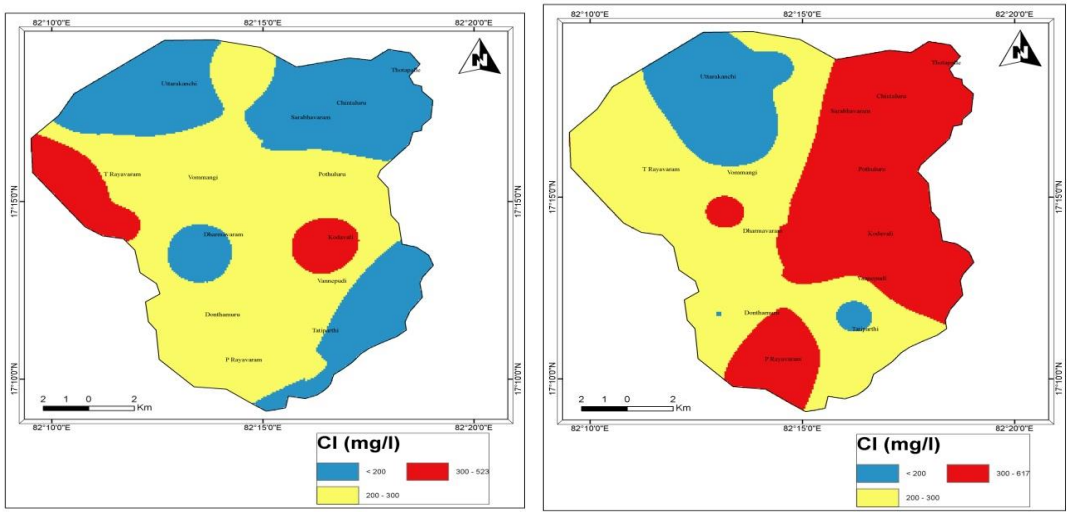

Fig. 6 Spatial distribution map of Cl in pre and post monsoons 2019

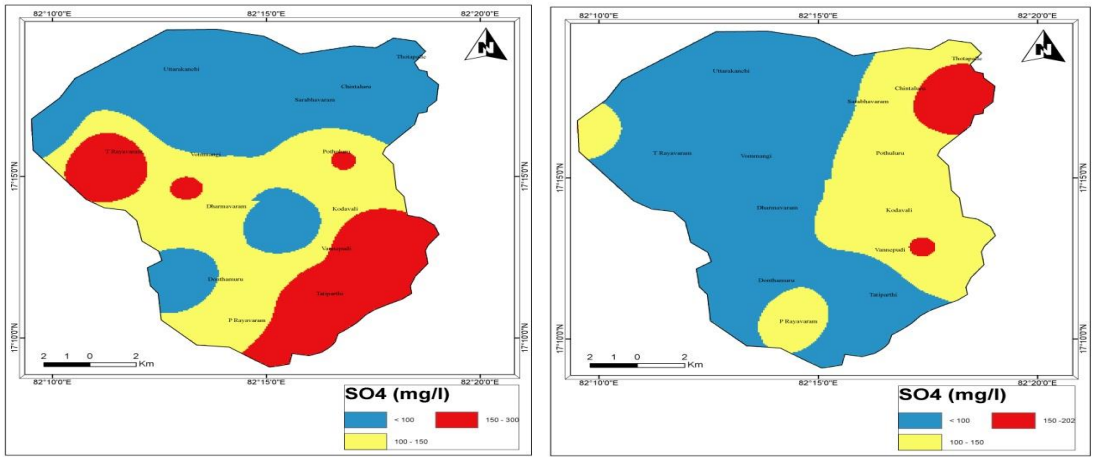

Fig. 7 Spatial distribution map of SO_4 in pre and post monsoon 2019

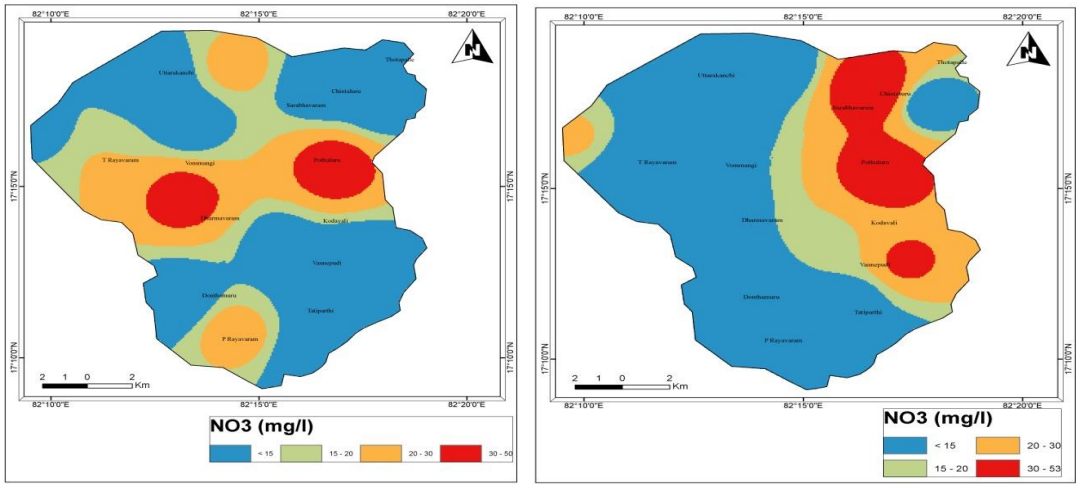

Fig. 8 Spatial distribution map of Nitrate in pre and post monsoons 2019

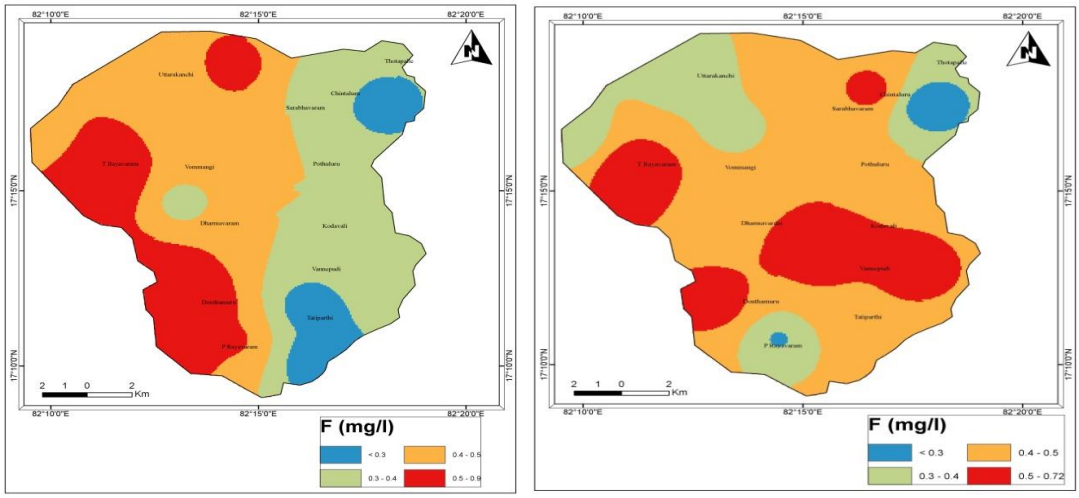

Fig. 9 Spatial distribution map of Fluoride in pre and post monsoons 2019

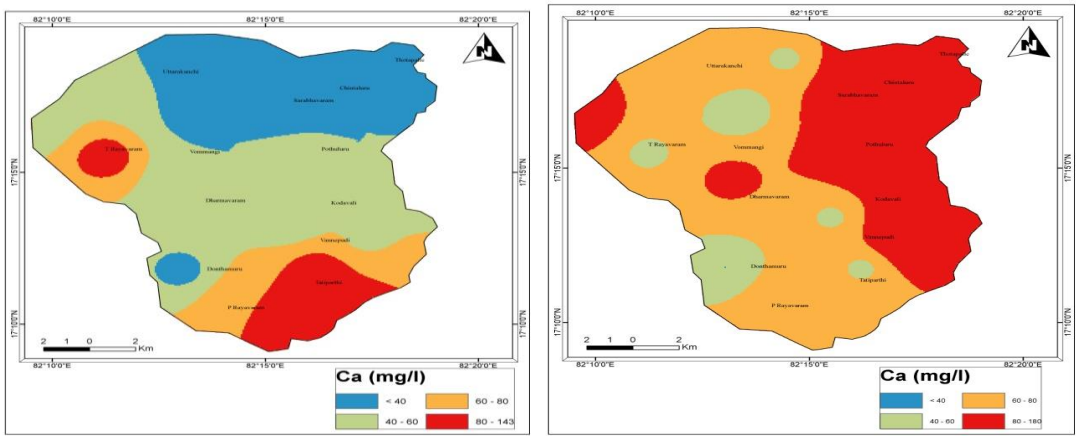

Fig. 10 Spatial distribution map of Ca in pre and post monsoons 2019

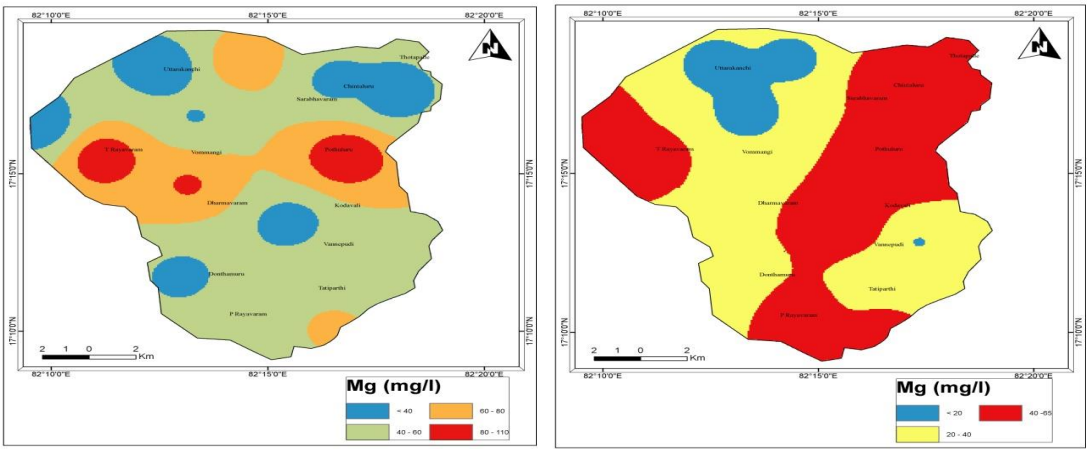

Fig. 11 Spatial distribution map of Mg in pre and post monsoons 2019

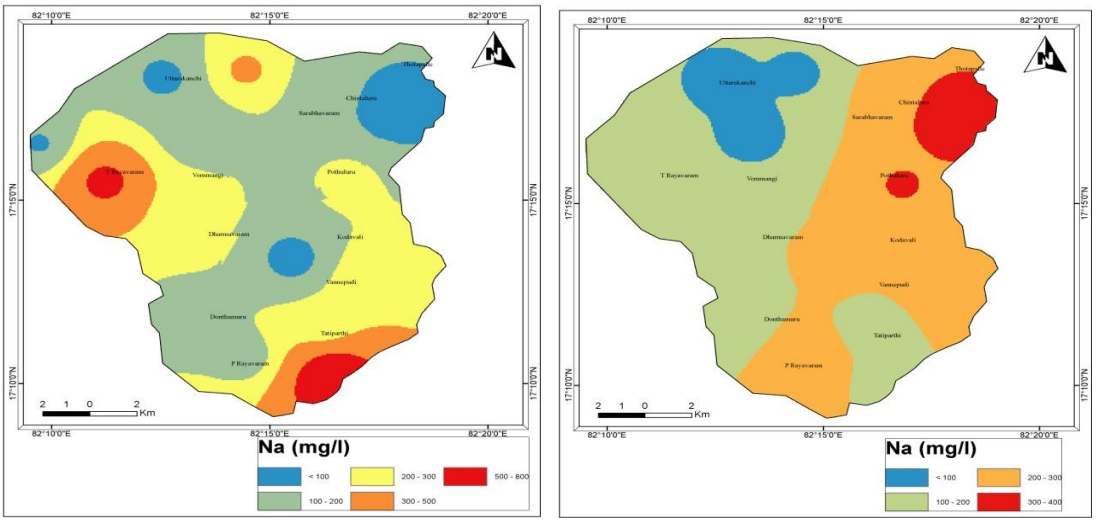

Fig. 12 Spatial distribution map of Na in pre and post monsoons 2019

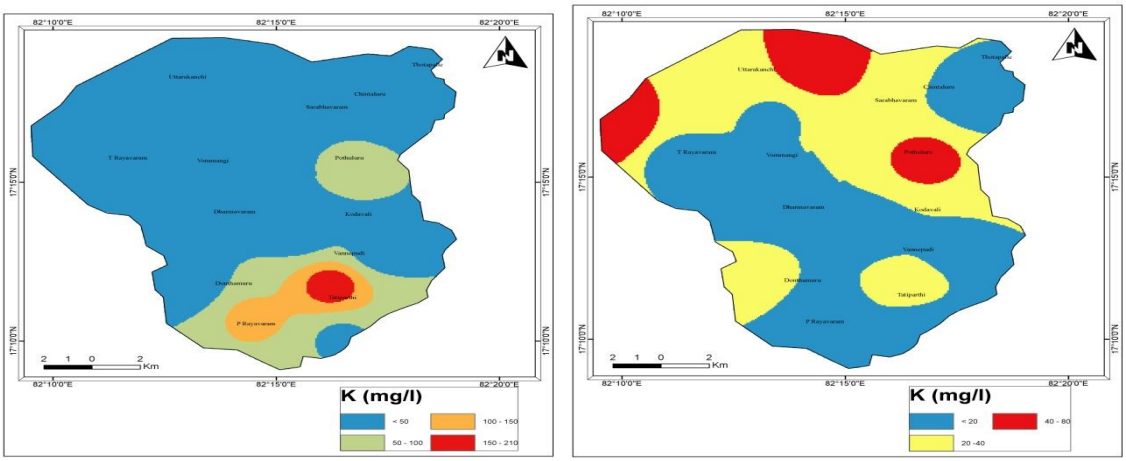

Fig. 13 Spatial distribution map of K in pre and post monsoons 2019

In the present study area, EC of the groundwater in pre monsoon showing high values south and central part of the area and in post monsoon low EC values in the area. EC of the groundwater in the pre monsoon varies from 491 to 4792 with mean of 1788 and as well as in post monsoon range from 494 to 3153 µ-mhos/cm with mean of 1661µ-mhos/cm EC of the groundwater in the pre monsoon varies from 491 to 4792 with mean of 1788 and as well as in post monsoon range from 494 to 3153 µmhos/cm with mean of 1661µ-mhos/cm (Fig. 3)

In the present study area, TDS of the groundwater in pre monsoon showing high values south and central part of the area and in post monsoon high EC values observed towards the central and southern part of the area. TDS of the groundwater in the pre monsoon varies from 314 to 3066 mg/l with a mean of 1144 mg/land as well as in post monsoon ranges from 316 to 2017 mg/l with a mean of 1063 mg/l (Fig. 4)

In the present study area, TH of the groundwater in the pre monsoon varies from 200 to 640 mg/l with a mean of 356 mg/l and as well as in post monsoon ranges from 140 to 700 mg/l with a mean of 369 mg/l. However, the samples located in study area are within the permissible limit of drinking water standard (BIS, 1991).

In the present study area, TA of the groundwater in both pre and post monsoons are showing high values towards south and central part of the area. in the pre monsoon, the total alkalinity varies from 72 to 507 mg/l with mean of 274mg/l and is found to be lower in the western parts of the study area, and in post monsoon range from 68 to 527mg/l with mean of 302 mg/l.

The groundwater samples collected from both pre and post monsoons contain low carbonate i.e. less than 18 mg/l.The HCO_3 of the groundwater in both pre and post monsoons are showing high values towards the west and central part of the study area. HCO_3 of the groundwater in the pre monsoon varies from 1.2 to 790 mg/l with a mean of 306 mg/l and as well as in post monsoon ranges from 130 to 460 mg/l with a mean of 262 mg/l. (Fig. 5)

In the present study area, Cl content of the groundwater in pre monsoon showing high values in the central and southern part of the study area, and post monsoon showing the higher values in the eastern part of the study area.Cl content of the groundwater in the pre monsoon varies from 38 to 1140 mg/l with a mean of 290 mg/land as well as in post monsoon ranges from 47.5 to 617 mg/l with a mean of 292 mg/l (Fig. 6) However, the chloride concentration is below 250 mg/l both pre and post monsoons in the upper part of the study area.

In the present study area, SO_4 of the groundwater in pre monsoon showing high values in the central and southern part of the study area, and post monsoon showing the higher values in the eastern part of the study area. SO_4 of the groundwater in the premonsoon varies from 4.4 to 306 mg/l with a mean of 114 mg/l and as well as in post monsoon ranges from 12.5 to 202 mg/l with a mean of 92 mg/l in the year (Fig. 7).

In the present study area, $NO_3$of the groundwater in pre monsoon showing high values in the central part of the study area, and post monsoon showing the higher values in the eastern part of the study area. NO_3 of the groundwater in the pre monsoon varies from 50 to 229 mg/l with a mean of 15 mg/l and as well as in post monsoon is ranging from 0.4 to 54 mg/l with a mean of 14 mg/l (Fig. 8).

There is no instance of fluoride is in the study area. In the case of pre monsoon the fluoride varies from 0.19 mg/l to 0.9 mg/l. In the post monsoon, the fluoride varies from 0.2 mg/l to 0.6 mg/l. In this case, the lower concentrations are recorded major northern part of the area (Fig. 9).

In pre monsoon, the calcium content is found to be higher near the southern part of the area.The lowest values below 16 mg/l are recorded at the northern part and medium concentration varies from 40 to 60 mg/l is observed in

the central part of the study area. In the post monsoon it is found low values less than 60 mg/l at the western of the study area (Fig. 10). The highest value is recorded in the eastern part of the study area.

In the present study area, Mg of the groundwater in pre monsoon showing high values in the central part of the study area, and post monsoon showing the higher values in the eastern part of the study area. Mg of the groundwater in the pre monsoon varies from 24 to 106 mg/l with a mean of 53 mg/l and as well as in post monsoon range from 9 to 63 mg/l with a mean of 38 mg/l in year (Fig. 11).

In the present study area, Na of the groundwater in pre monsoon showing high values in the central and southern part of the study area, and post monsoon showing the higher values in the eastern part of the study area. Na of the groundwater in the pre monsoon varies from 14 to 802 mg/l with a mean of 225 mg/l and as well as in post monsoon range from 42 to 395 mg/l with a mean of 196 mg/l during the year of 2019 (Fig. 12).

In the study area, K of the groundwater in pre monsoon showing high values in the southern part of the study area, and post monsoon showing the higher values in the eastern part of the study area. K of the groundwater in the pre monsoon varies from 2.2 to 209 mg/l with a mean of 36 mg/l, and as well as in post monsoon range from 0.6 to 75 mg/l with a mean of 25 mg/l (Fig. 13)

Conclusion

Understanding temporal and spatial variability of groundwater quality is important due to its influence on hydrogeochemical processes controlling the chemical composition of groundwater in both seasons and also for the efficient management of water resources. This research presents a case study of temporal seasonal variations of groundwater quality in the Suddegedda grondwater basin, the results indicate that have different temporal variations during pre and post monsoons 2019, in the study area. Over exploitation of groundwater from the fresh water pockets near the coast may be the main driving force affecting the water quality in the Suddegedda groundwater basin, The study results can help in the management of water resources and allow better prediction, risk assessment and management caused by and anthropogenic activities and others.

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