Seasonal Variations of Ground Water Quality and Contour Maps of Nidadavole Mandal of West Godavari District

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Abstract
Water plays an essential role in human life. Although statistics, the WHO reports that approximately 36% of urban and 65% of rural Indian were without access to safe drinking water.Fresh water is one of the most important resources crucial for the survival of all the living beings. It is even more important for the human being as they depend upon it for food production, industrial and waste disposal, as well as cultural requirement. Human and ecological use of ground water depends upon ambient water quality. India's declining ground water resources both in quality and quantity is a product of many driving factors. Though groundwater contamination is due to natural and anthropogenic activities, ground water pollution is mostly due to knowingly or unknowingly human activities.In order to understand water quality, it is very useful to display data in a visual manner. Because environmental data is also inherently spatial in nature (i.e. it varies geographically and due to environmental conditions), viewing the data in a way which displays this geographical variation is of particular use. For example, seeing where different water quality parameters are higher in concentrations can help explain causes and sources of contaminants. To this end, contour maps of each of the water quality parameters sampled were prepared. A contour map displays regions, each of which represents a constant value for a particular parameter. While these maps are based on average values, and hence do not give us detailed information about the parameters, they can give us a general idea of what is influencing their concentrations across the province.

Keywords
Contamination, Water Quality, Contour Maps

I. Introduction

Ground water is considered as one of the purest forms of water available in nature and meets the overall demand of rural as well as urban population. Ground water plugs a vital role in human life.Increase in urbanization, industrialization, agriculture activity and various human activities increase the pollution of surface water & ground water. Once the groundwater is contaminated, its quality cannot be restored back easily and we need to device ways and means to protect it (Maniyar, 1990). Consequently number of cases of water borne diseases has been seen which cause health hazards [Elizabeth and Naik, 2005; Aremu et al., 2011). An understanding of water chemistry is the bases of the knowledge of the multidimensional aspect of aquatic environmental chemistry which involves the source, composition, reactions and transportation of water. The quality of water is of vital concern for the mankind since it is directly linked with human welfare. Therefore, monitoring the quality of water is one of the essential issues of drinking water management (Shama et al., 2011). Considering the above aspects of groundwater contamination, the present study was undertaken to investigate the impact of the groundwater quality water samples at Nidadavolemandal of West Godavari district, A.P, India. To communicate information on the quality of water to the concerned citizens and policy makers, analysis of water is utmost important. It is thus, becomes an important factor for the assessment and management of ground water. Thus, in this research work an attempt has been made to assess the physical and chemical parameters of ground water .As the safe & potable drinking water is needed various treatment methods are adopted to raise the quality of drinking water. Water should be free from the various contaminations viz. Organic and Inorganic pollutants, Heavy metals, Pesticides etc. as well as all its parameter like pH, Electrical Conductivity, Calcium, Magnesium, Total Hardness, Carbonate, Bicarbonate, Chloride, Total Dissolved Solid, Alkalinity, Sodium, Potassium, Nitrate, DO should be within a permissible limit.During last decade, this is observed that ground water get polluted drastically because of increased human activities.Consequently number of cases of water borne diseases has been seen which a cause of health hazards.

II. Study Area

"Eluru" is the headquarters of the West Godavari district, one of the nine coastal districts of Andhra Pradesh State. Agriculture is the main stay of population in the district. The district is having both surface and ground water resource potential. The delta area is mainly served by surface irrigation, whereas in the upland areas of the district the irrigation is chiefly by ground water. Physiographically the district is divided into 2 natural regions. viz., Alluvial plain and upland areas.The different type of soils encountered in the district are red soils, black cotton soils, deltaic alluvial soils and coastal sands. In general, the ground water is suitable for drinking and irrigation purposes in crystallines, sedimentaries while that occurring in alluvium the water is not suitable for drinking purpose and irrigation purpose under ordinary conditions.

Water pollution is one of the major and most critical issues in India, as almost 70 per cent of the surface water resources and various groundwater reserves are contaminated by biological, toxic, organic and inorganic pollutants. Deep tube wells, hand pumps and private bore wells are the main sources for extraction of groundwater in the Nidadavolemandal to cater the water demand of the population. It is in this context, the ground water quality is determined in this mandal. In Physico-chemical analysis , various quality parameter are measured including pH, turbidity, electrical conductivity (EC), total dissolved solids (TDS),total hardness(TH),content of calcium (Ca^{2+}),magnesium (Mg^{2+}),chloride(Cl^{-}), sulphate ($S0_4^{2-}$), Iron (Fe), DO, BOD, COD, Total alkalinity (TA) and Nitrate (NO32-) concentration present in ground water. Also all parameters were compared with ICMR standards of water quality. In the present research paper water samples of Nidadavole mandal was classified on the basis of TDS.

III. Water Sampling:

In present investigation water samples were collected in polythene bottles which were cleaned with acid water, followed by rinsing twice with distilled water. The water samples are chemically

analyzed. The analysis of water was done using procedure of standard methods.

IV. Methodology

- The pH and Turbidity was measured by using nepthalometrically using Systronics.
- EC was measured by using Elico.
- TDS was measured by using EUTECH(digital).
- Total hardness, calcium and magnesium were measured by EDTA Complexometric titration.
- Chloride was measured volumetrically by silver nitrate(precipitation) titrimetric method.
- Iron, Fluoride, Sulphate, phosphate, Nitrite was measured by using Systronics Spectrophotometer.
- Total alkalinity is determined by Acid Base titration.
- DO is measured by using Winkler's method.
- BOD is measured by using dilution method.
- COD by using Redox titration.

GPS Values and Soil Nature ofthe villages of NidadavoleMandal are shown in Table – 1. Names of the 22 villages are represented in Table 2. The results of the 19 physico-chemical parameters of water samples for 22 different villages in different seasons i.e., Pre monsoon, Monsoon and Post monsoon are represented in Table 3A, 3B & 3C respectively and compared with IS and WHO standards. Based on TDS the water samples are classified and shown in Table 4.

Table 1: GPS Values and Soil Nature of Nidadavole Mandal

S. No	Name of the Village	GPS Values	Geology / Soil type	Health	Landmark	Command Population
		Latitude & Longitude				
1.	Atlapadu	N 16°53'274" E 81°40'577"	Alluvial soil	Good	Near co-Panchayathi	3500
2.	D.Muppavaram	N 16°53'594" E 81°42'268"	Alluvial soil	Good	Near Black cotton soil	4000
3.	Gopavaram	N 16°54'904" E 81°41'887"	Alluvial soil	Good	Near ration depot	4500
4.	Jeedigunta	N 16°52'797" E 81°43'318"	Alluvial soil	Good	Near school	3000
5.	Kalavacharla	N 16°52'799" E 81°42'723"	Alluvial soil	Good	Outside of the village	3500
6.	Korumamidi	N 16°56'748" E 81°34'220"	Alluvial soil	Good	Near Panchayathi	4500
7.	Korupalle	N 16°51'933" E 81°43'586"	Alluvial soil	Good	Near Panchayathi	3500
8.	Munipalli	N 16°51'226" E 81°42'698"	Alluvial soil	Good	Outside of the village	2500
9.	Nidadavole (M)	N 16°54'364" E 81°40'577"	Alluvial soil	Good	Pottisreeramulu statue	10000
10.	Nidadavole (R)	N 16°54'940" E 81°40'354"	Alluvial soil	Good	Near substation	6000
11.	Pandalaparru	N 16°53'791" E 81°42'865"	Alluvial soil	Good	Near Panchayathi	3000
12.	Pendyala	N 16°51'682" E 81°44'617"	Alluvial soil	Good	Near Panchayathi	4500
13.	Purushothapalle	N 16°54'327" E 81°42'716"	Alluvial soil	Good	Near Panchayathi	5000
14.	Ravimatla	N 16°54'326" E 81°38'505"	Alluvial soil	Good	Near school	4500
15.	Sankarapuram	N 16°54'524" E 81°39'063"	Alluvial soil	Good	Near school	2500
16.	Settipeta	N 16°52'110" E 81°40'348"	Alluvial soil	Good	Near Panchayathi	4000
17.	Singavaram	N 16°53'199" E 81°39'570"	Alluvial soil	Good	Near school	3500
18.	Surapuram	N 16°55'688" E 81°37'843"	Black cotton soil	Good	Near Panchayathi	4000
19.	Tadimalla	N 16°55'859" E 81°36'125"	Black cotton soil	Good	Near anganwadi	3500
20.	Thimmarajupalem	N 16°54'708" E 81°39'389"	Black cotton soil	Good	Near school	4000
21.	Unakaramilli	N 16°55'983" E 81°37'387"	Red loamy soil	Good	RO plant	3500
22.	Vijjeswaram	N 16°55'338" E 81°43'543"	Alluvial soil	Good	Near school	5000

Table 2:

Villages in Nidadavole Mandal		
01.Atlapadu	09.Nidadavole (M)	17.Singavaram
02.D.Muppavaram	10.Nidadavole (R)	18.Surapuram
03.Gopavaram	11.Pandalaparru	19.Tadimalla
04.Jeedigunta	12.Pendyala	20.Thimmarajupalem
05.Kalavacharla	13.Purushothapalle	21.Unakaramilli
06.Korumamidi	14.Ravimatla	22.Vijjeswaram
07.Korupalle	15.Sankarapuram	
08.Munipalli	16.Settipeta	

Table 3A : Physico-chemical parameters of water samples of Nidadavole mandal in Premonsoon season

	Physical				Chemical												Biological		
S. No	pH	EC	TDS	Turbidity	Alkalinity	Total Hardness	Sodium	Potassium	Calcium	Magnesium	Iron	Chloride	Fluoride	Sulphate	Phosphate	Nitrite	DO	COD	BOD
		µS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	6.5 to 8.5	----	500	001	200	200	....	....	75	30	0.30	250	1.0	200	----	0.50	----	----	----
1.	7.2	1500	1010	0	424	230	61.2	6.9	41.6	30.7	0	226	1.3	2.9	0	0	8	4.8	6
2.	7.6	1160	780	2	484	188	33.8	12.5	40	21.4	0	122	1.3	14	0	0	8.8	14.4	6
3.	7.2	840	560	0	394	148	37	12.3	40	11.7	0	64	1.1	5	0	0.4	8.4	14.4	4
4.	7.7	1040	700	5	480	198	24	11.9	52.1	16.5	0	78	1.3	11	0	0	11.2	6.4	7.2
5.	7.3	790	530	21	406	218	42	6.8	42.4	27.3	0.13	47	1.4	10	0	0	8.4	4.8	3.6
6.	8.2	1380	920	0	200	140	26	2.8	28.8	16.5	0	270	0.5	19	0	0.2	9.2	17.6	5.2
7.	7.3	1550	1040	0	594	168	53	5.1	49.6	10.7	0	139	1.2	27	0	0.3	8.4	8	7.2
8.	7.2	1500	1010	4	432	236	42	13	46.4	29.2	0	239	0.9	11	0	0	8.4	3.2	6
9.	7.5	1200	800	2	708	190	33	4.2	35.2	24.8	0	211	1.1	45	1.9	0.2	9.2	16	6
10.	7.44	1000	670	0	342	160	66	6.2	28.8	21.4	0	82	0	8.5	0	0.5	8	0	5.2
11.	7.6	1600	1070	2	576	210	72	7	46.4	21.9	0	153	1.2	19	0	0	9.6	6.4	6
12.	7.6	950	640	4	480	148	34	12	30.4	17.5	0	58	1.1	7	0	0	8	8	4.8
13.	7.2	2350	1580	6	610	298	25	11	59.3	36.5	0	299	1.1	32	0	1.0	8	24	5.6
14.	7.2	2380	1600	0	594	236	35	4.8	62.5	19.5	0	323	1.2	17	0	0	8.4	4.8	6.8
15.	7	1460	980	0	338	214	41.3	5.7	60.1	15.6	0	228	0.9	10	0.4	0	9.2	0	6
16.	7.33	1690	1130	0	290	244	57.2	6.5	40	35	0	210	0	29	0	0.2	10	3.2	7.6
17.	6.9	1280	860	0	386	198	62.2	3.8	43.2	21.9	0	235	0.8	14.2	0	0	9.2	7.2	4.8
18.	7	1540	1030	0	254	196	72	3.2	39.2	23.8	0	224	0.5	10	0	0.5	8	14.4	5.2
19.	7	1200	800	4	316	140	76	12.7	32	14.6	0	107	0.5	6	0	0.5	8	14.4	4.8
20.	7.24	1460	980	0	350	160	31	13.6	28.8	21.4	0	163	0.5	11	0	0.5	7.2	3.2	4.4
21.	7.2	730	490	0	184	126	24	4.5	39.2	6.8	0	119	1.1	37	1.45	0	8.8	3.2	7.2
22.	7.5	300	200	2	142	68	45	12.8	20.8	3.9	0	31	1.4	4	0.9	0	9.2	11.2	6.4

Table 3B : Physico-chemical parameters of water samples of Nidadavole mandal in Monsoon season

	Physical				Chemical												Biological		
S. No	pH	EC	TDS	Turbidity	Alkalinity	Total Hardness	Sodium	Potassium	Calcium	Magnesium	Iron	Chloride	Fluoride	Sulphate	Phosphate	Nitrite	DO	COD	BOD
		µS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	6.5 to 8.5	----	500	001	200	200	....	....	75	30	0.30	250	1.0	200	-----	0.50	----	-----	----
1.	7.1	1380	920	0	336	220	60	9	45.6	25.8	0	215	0.64	42.3	0	0	8.8	4.8	6.0
2.	7.6	1040	700	0	390	174	35	14	42.4	16.5	0	103	0.63	12.2	0	0.13	8.4	24	4.8
3.	7.3	780	520	0	326	126	39	13	41.6	5.3	0	62	0	2.6	0	0.57	7.6	3.2	4.8
4.	7.4	1180	790	0	470	196	28	12.5	46.4	19.4	0	89	0	14.1	0	0.02	7.2	3.2	3.6
5.	7.4	1300	870	10	366	220	43	8	53.7	20.9	0	212	0	8.3	0	0.6	6.4	12.8	2.4
6.	7.5	1490	1000	0	290	206	24	4	56.1	16	0	246	0	21.6	1.95	0	7.6	0	5.6
7.	7.3	1410	950	0	476	216	55	5.6	44.8	25.3	0	137	0	29.6	0	0	6.8	3.2	4.4
8.	7.4	1420	950	1	344	210	40	14	44.8	23.8	0	263	0	13.2	0	0.14	8.4	4.8	4.4
9.	7.5	1970	1320	0	574	186	46	4.8	33.6	24.8	0	255	0	38.2	0	0.12	8.4	6.4	6.0
10.	7.7	2190	1470	0	652	254	69	6.8	32	42.4	0	195	0.11	35.6	5.68	0.7	7.2	11.2	5.6
11.	7.6	1470	990	0	490	208	75.3	8	43.2	24.3	0	145	0	28.3	0	0.05	7.6	6.4	4.4
12.	7.6	950	640	3	380	146	38	15	29.6	17.5	0	68	0	13.6	0	0	6.4	6.4	2.4
13.	7.4	2170	1460	0	550	286	28	12	56.1	35.5	0	289	0	54.1	0	0.57	8.8	16	6.4
14.	7.2	1400	940	0	306	202	38	5	56.1	15.1	0	227	0	38	3.0	0	7.6	0	5.2
15.	7.1	1400	940	0	300	206	43	5.9	53.7	17.5	0	218	0	37.8	2.9	0	7.2	0	4.4
16.	7.4	1550	1040	1	304	234	58	8	49.6	26.8	0	265	0	59.5	2.58	0	7.6	0	5.6
17.	7.5	1480	990	0	432	210	63	6	44	24.3	0	219	1.3	17	0	0	8.8	11.2	6.4
18.	7.4	1510	1010	0	250	216	75	5	67.3	11.3	0	237	0	38	3.03	0.03	8.0	3.2	4.8
19.	7.0	510	340	0	170	86	79	14	24	6.3	0	54	0.05	9.9	2.28	0	8.0	0	6.0
20.	7.2	1320	880	2	376	156	32	15	27.2	21.4	0	157	0	27.7	3.03	0.03	5.6	0	3.6
21.	7.2	730	490	0	184	126	25	6	39.2	6.8	0	119	1.1	37.0	1.45	0	8.8	3.2	7.2
22.	7.7	270	180	0	116	58	46	14	14.4	5.3	0	27	1.06	1.75	0	0	8.0	0	5.2

Table 3 C: Physico-chemical parameters of water samples of Nidadavole mandal in Postmonsoon season

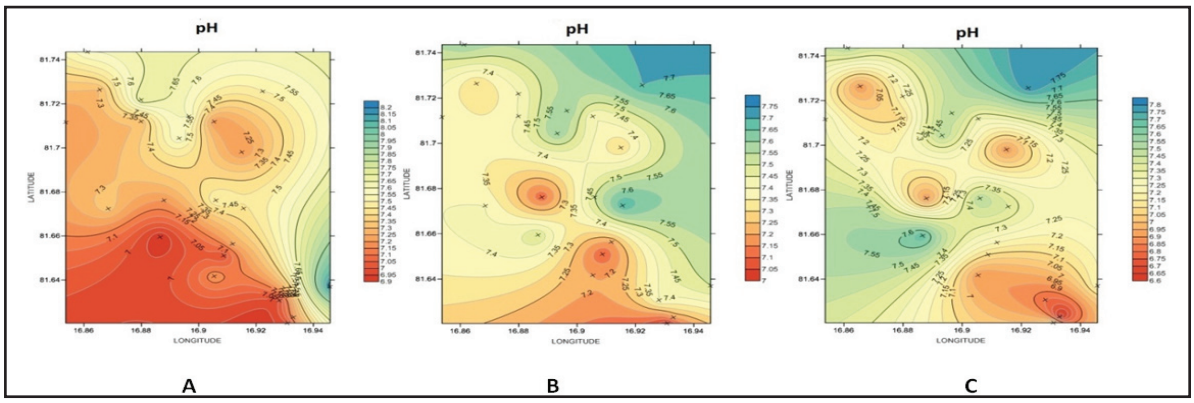
S. No	Physical				Chemical												Biological		
	pH	EC	TDS	Turbidity	Alkalinity	Total Hardness	Sodium	Potassium	Calcium	Magnesium	Iron	Chloride	Fluoride	Sulphate	Phosphate	Nitrite	DO	COD	BOD
		µS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	6.5 to 8.5	-----	500	001	200	200	....	....	75	30	0.30	250	1.0	200	-----	0.50	-----	-----	-----
1.	6.9	1550	1040	0	306	212	63	6.4	35.2	30.2	0	230	0.55	35.23	0	0	4.8	0	1.6
2.	7.5	1160	780	1	366	172	35	12.1	42.4	16	0	113	0.48	14.3	0	0	4.4	4.8	0.4
3.	6.9	890	600	0	332	150	38	12.1	41.6	11.2	0	64	0	3.43	0	0	5.2	6.4	1.2
4.	7.2	1270	850	0	436	188	26	11	37.6	22.9	0	72	0	13.04	0	0.31	4.0	8.0	0.8
5.	7.1	2020	1350	1	330	304	43	6.4	77.7	26.8	0	369	0	7.96	0	0	4.8	17.6	0.8
6.	7.2	1630	1090	0	292	184	27	2.4	57.7	9.7	0	265	0	22.4	0	0	5.2	0	2.0
7.	6.9	1790	1150	0	492	228	54	5	47.2	21.9	0	149	0	34.7	0	0.16	4.0	11.2	0.8
8.	7.3	1530	1020	0	328	202	43	12	42.4	23.4	0	230	0	10.15	0	0	4.8	1.6	1.2
9.	7.5	1570	1050	0	444	98	34	4.1	19.2	12.1	0	108	0	20.38	0.72	0.21	4.4	14.4	1.6
10.	7.4	2150	1440	0	608	180	67	6.1	29.6	25.8	0	220	0	40.70	1.48	0	5.6	1.6	2.4
11.	7.5	1620	1090	0	490	196	73	6.8	40	23.4	0	137	0	31.74	0	0	4.8	0	0.8
12.	7.5	1000	670	5	392	134	35	11	27.2	15.6	0	57	0	10.00	0.55	0	4.8	6.4	0.8
13.	7.3	2260	1520	0	570	272	26	10	57.7	31.1	0	265	0	45.40	0	2.0	6.4	20.8	2.0
14.	6.9	2170	1460	0	486	200	36	4.6	50.5	18	0	262	0	45.20	0	0	3.6	1.6	1.2
15.	7.1	1480	990	0	298	196	42	5.1	53.7	15.1	0	206	0	32.94	0.13	0	5.2	4.8	1.6
16.	7.5	1540	1030	0	282	238	58	6.2	44.8	30.6	0	216	0	19.13	0	0	7.6	6.4	4.4
17.	7.7	970	650	1	412	285	63	3	72.1	25.3	0	248	0.85	15.8	0	0.10	7.6	4.8	5.6
18.	6.8	1480	990	0	236	180	73	3	62.5	5.8	0	206	0	31.74	0.96	0.04	4.8	3.2	1.2
19.	7.1	1060	710	0	260	140	77	12	39.2	10.2	0	113	0	19.61	0	0	5.2	0	1.2
20.	7.2	1210	810	0	312	128	32	13.2	32.8	11.2	0	126	0	20.00	0	0	4.0	0	0
21.	6.6	760	510	0	144	110	25	4.1	30.4	8.2	0	102	0	8.04	1.10	0	5.2	3.2	0.8
22.	7.8	310	210	0	124	54	46	12.2	12	5.8	0	24	0	0	0.68	0	5.2	4.8	0.8

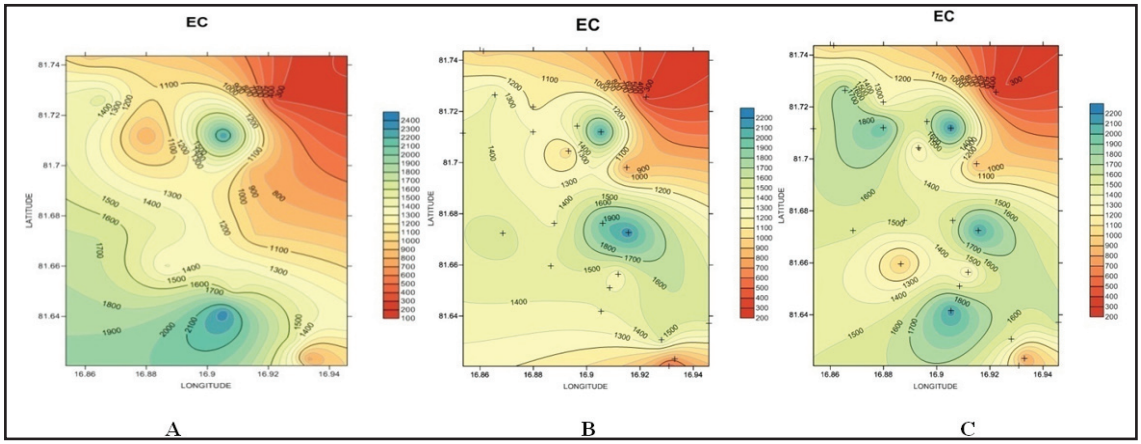
Table 4: TDS of Nidadavole Mandal and Salinity

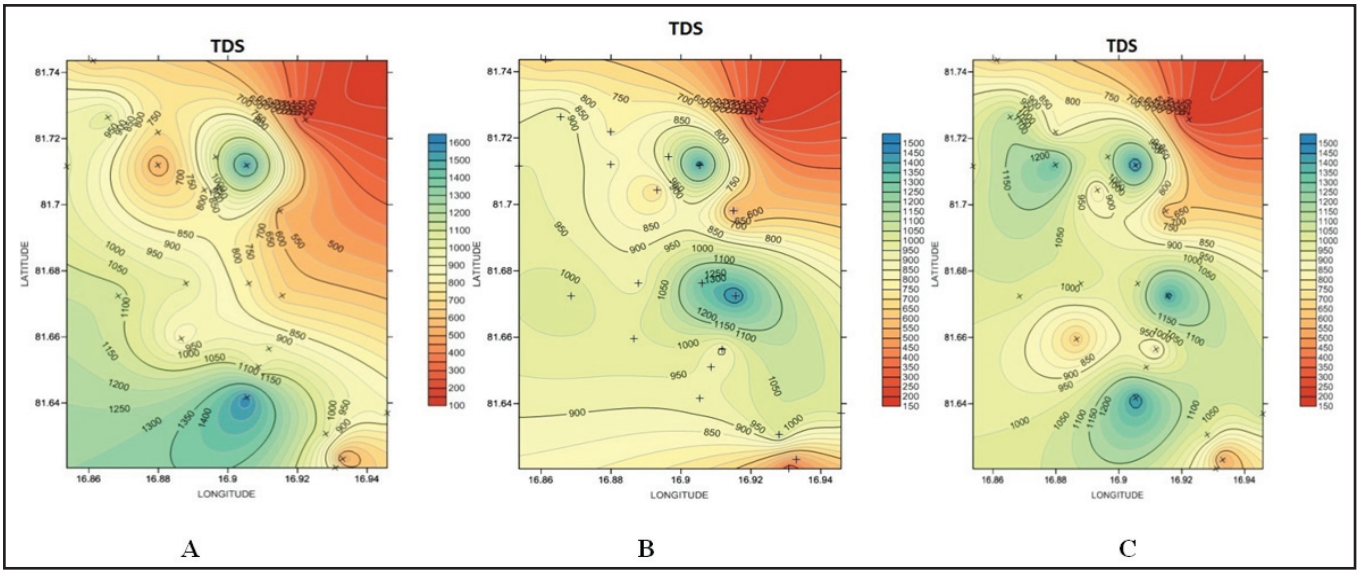
Water Type	TDS (mg/l)	No of Samples exceeds the limit		
		Premonsoon	Monsoon	Postmonsoon
Non Saline	<1000	14	16	11
Slightly Saline	1000-3000	08	06	11
Moderately Saline	3000-10000	Nil	Nil	Nil
High Saline	>100000	Nil	Nil	Nil

Contour Maps

Contour maps of ground water analysis of Nidadavole mandal in three seasons are shown below. Different parameters like pH, EC, TDS, TH, Calcium and Magnesium in three seasons are shown as A, B, C for Premonsoon, Monsoon and Postmonsoon respectively.






TDS
TDS
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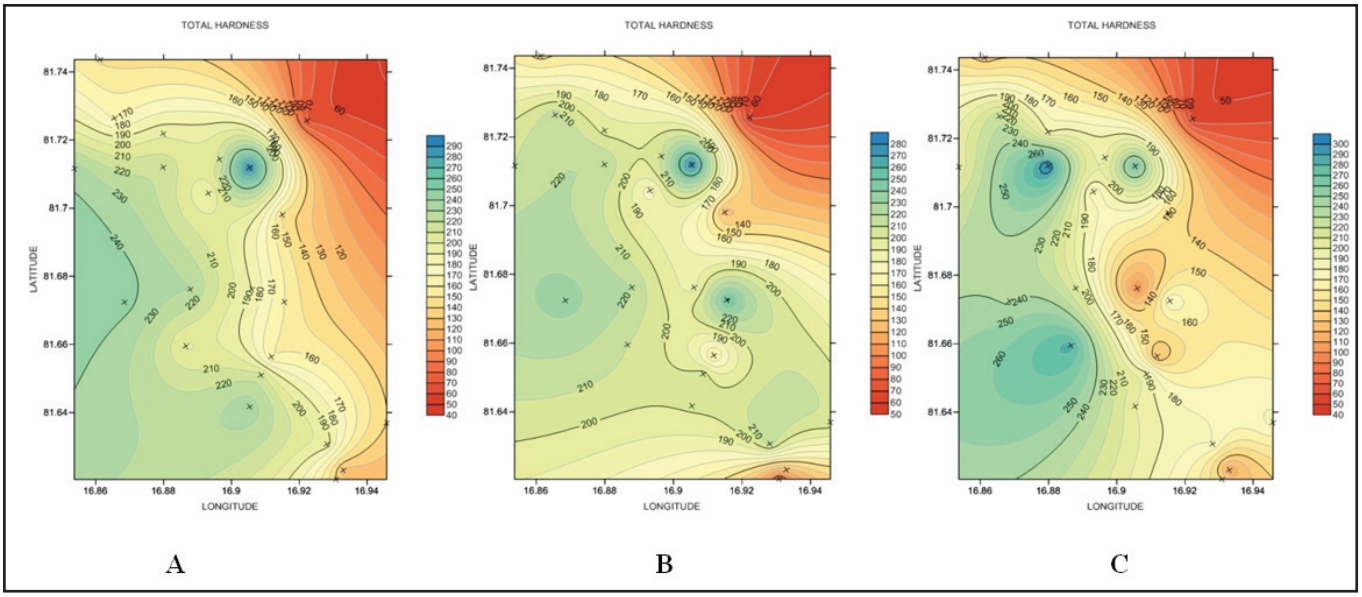
LATITUDE
LONGITUDE
A
B
C


TOTAL HARDNESS
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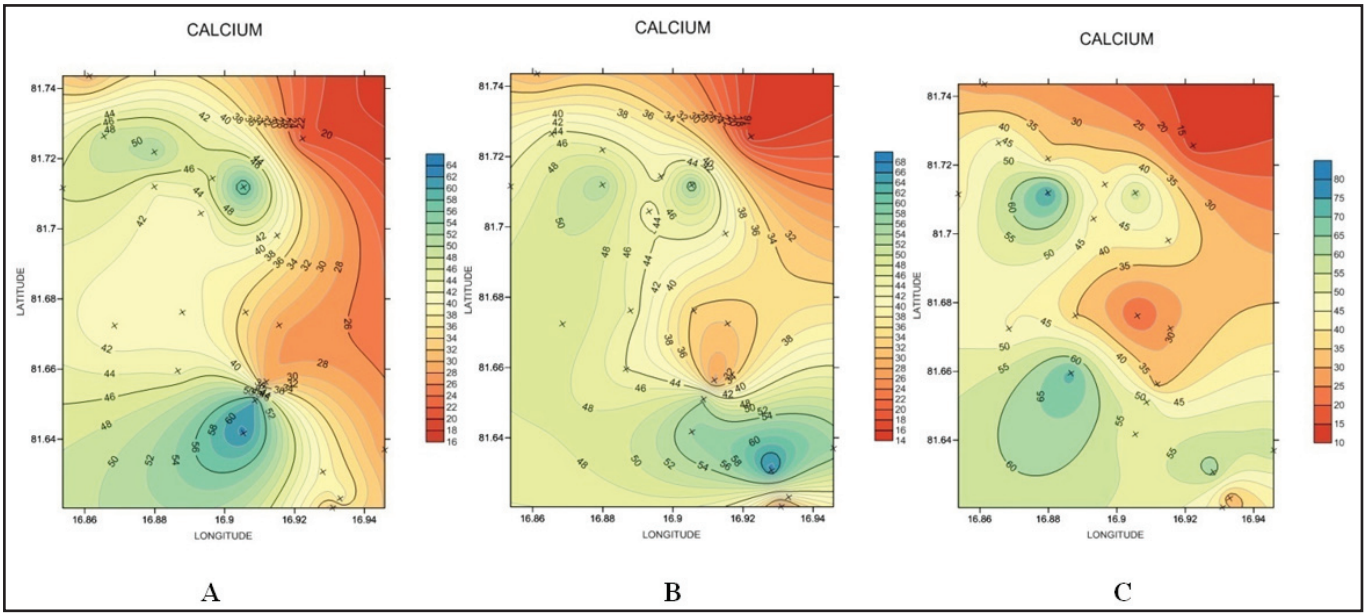
B
C


CALCIUM
CALCIUM
CALCIUM
LATITUDE
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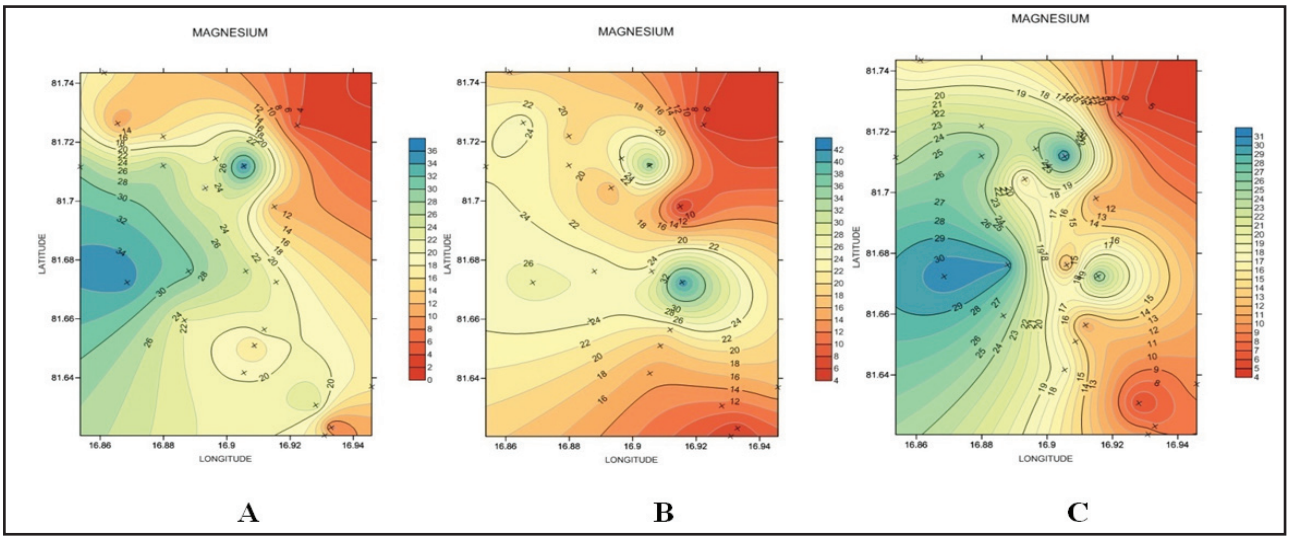

V. Results and Discussion

The water from the study area has no colour. Taste of the water of the water sample in most of the locations is pleasant in taste. The pH of water shows variation in its ranges. It indicates that they are in range of water quality parameter permissible limits. The EC of water samples shows wide variation in all the samples. TA within the limits. Chloride content in water is low, the fluoride content in water is low due to this no dental and Skelton problem arises in the study area. The value of DO, BOD, COD were in limits. Turbidity was higher of all the observed parameters of almost all the samples . The Ca2+ was showed wide variation in all the accepted limits.Mg2+ values were within the limits. Sulphate data was low. Total hardness shows that maximum samples contain higher values of hardness. TDS were in permissible limits except few samples where it is high.

VI. Conclusion

pH is a measure of the amount of acidity in the stream. A low pH indicates more acidity. Turbidity is a cloudiness or haziness of water caused by individual particles that are too small to be seen without magnification. This suspended solid matter is very small and will settle very slowly, or not at all, if the sample is regularly agitated or the particles are colloidal. Turbidity is increased in urban areas, as well as in areas that have activities that increase the amount of particles in water, such as agricultural activity. Conductance or conductivity is defined as the amount of ionic material (i.e. salts) dissolved in the water. Conductivity of waterbodies tends to be higher in urban areas and near highways, as it is influenced by road salt and fertilizer application. In addition, conductivity of a water body can be influenced by the conductivity of rain water . Total hardness is a primary function of carbonate and bicarbonate content in water.

Calcium is found naturally in certain types of rocks, as well as in landfill leachate and wastewater effluent. Burning of fossil fuels can contribute to calcium in water bodies. It is also found in road salts, and as such may be higher in urban areas or near highways. Magnesium is found in landfill leachate, as well as road salts. Higher value of TDS is due to the Calcium and Magnesium.

Hence, consistent monitoring measures are very important to assess the impact of the percolation of the wastewater, causing contamination of the groundwater in the study area, and a preventive mechanism coupled with remedial measures is necessary for the benefit of mankind. It is also recommended that water analysis should be carried out from time to time to monitor the rate and kind of contamination. It is need of human to expand awareness among the people to maintain the cleanness of water at their highest quality and purity levels to achieve a healthy life

VII. Acknowledgements

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