

# Hydrochemical Studies along Coastal Areas of Nellore District, Andhra Pradesh

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**Abstract:** The groundwater quality in coastal parts of Nellore district, Andhra Pradesh is discussed with emphasis on their utility to drinking and agricultural purposes. Soils in the study area are sandy and clayey soils. The quality of groundwater is in general potable with pH showing a trend towards alkalinity. The hydro geochemical facies found in the area is Na-Cl.

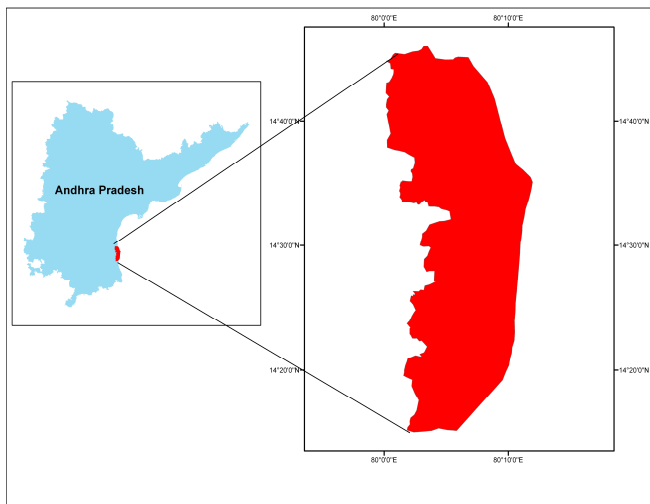
**Key words:** Agricultural Purpose, Coastal Aquifers, Drinking, Groundwater Quality, Nellore district

## I. INTRODUCTION

Stress on groundwater, both in terms of quality and quantity, are increasing rapidly to growing demands, significant changes in land use pattern, sea water intrusion, industrial effluents, domestic effluent etc. The need to assess the groundwater quality is becoming increasingly important as groundwater sources become more and more contaminated by seawater intrusion, industrial effluents and unsustainable agricultural practices.

## II. STUDY AREA

The study area (Fig.1) covering 5 coastal mandals – Alluru, Vidavaluru, Indukurupeta, Thotapalli Guduru and Muthukuru situated eastern part of S.P.S.R. Nellore district, Andhra Pradesh. Agriculture is the main occupation in the area. Soils in the study area are sandy and clayey. Coastal alluvium is the geological formation.



**Fig.1 Study Area**

## III. METHODOLOGY

Water samples collected in May 2012 from 36 selected dug wells and bore wells. They were analyzed for the physico-chemical constituents, such as hydrogen ion concentration (pH), total dissolved solids (TDS), total hardness (TH), calcium, magnesium, carbonate, bicarbonate, chloride, sulphate, sodium and potassium following the standard water quality procedures following necessary precautions (1) (Brown et. al., 1974 and (2) Hem, 1970).

## IV. RESULTS AND DISCUSSION

The quality of groundwater plays a significant role in the crop productivity and human as well as cattle health. Chemistry of groundwater in the study area is studied with respect to the major cations, calcium, magnesium, sodium and potassium and anions, carbonate, bicarbonate, chloride and sulphate. Chemically related properties such as pH, TDS, TH are also discussed.

Hydrogen-ion concentration (pH) in the study area is alkaline varies from 7.59 to 8.97.

The values of TDS indicate the general quality of the groundwater. The TDS values were obtained by multiplying factor of 0.64. The quality of groundwater is generally potable in all parts of the study except in certain patches with high concentration of more than 1500 mg/l of TDS. According to classification given by (3) Robinove *et.al.*(1958), groundwater in the study area in general are non-saline (less than 1000 mg/l of TDS) and in few patches they are slightly saline (1000-3000 mg/l of TDS). The concentration of TDS in the groundwater of the study area appears to be cumulative effect of drainage, lithology and local environmental factors.

Twort *et.al* (1974) classified the water with respect to total hardness (TH) as shown below.

Description
TH (mg/l)
Soft
<75
Moderate hard
75 – 150
Hard
150 – 300
Very hard
> 300

Total hardness ranges from 118 to 2199 mg/l with a general range of 150-300 mg/l.

Sodium is the most abundant cation in the groundwater with a common range of more than 200 mg/l and occasional minimum up to 110 mg/l and maximum up to 680 mg/l. The high concentration of sodium in the area is attributable to its contiguity to Bay of Bengal.

Calcium content is less than sodium and it varies from 16 to 320 mg/l with a general range of less than 50 mg/l.

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Potassium concentration varies from 1 to 40 mg/l but around 72% of the cases it shows less than 10 mg/l. The concentration of weak acidic anions carbonate and bicarbonate is controlled by dissolved CO<sub>2</sub>. Carbonate ion is present in around 40% of the samples and it varies from 20 to 60 mg/l. Bicarbonate ion ranges from 50 to 1100 mg/l with a general range of < 250 mg/l. The groundwater quality of the study area is shown in Table 1.

Table 1 : Groundwater Quality of Nellore District (MAY 2012)

S.No	Location	Type of Well	pH	TDS	CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Na	K	Ca	Mg	TH	SAR	RSC
1	Alluru	Dug well	8.61	2728	60	400	356	211	400	21	136	114	1238	4.94	15.6
2	Bharachalam	Dug well	8.04	877	20	250	250	28	110	2	64	73	460	2.23	-3.8
3	Mypada	Dug well	8.56	776	40	290	180	3	130	2	56	53	358	2.99	0.56
4	Mypada	Bore well	8.41	2990	40	480	640	437	680	15	56	88	502	13.2	0.36
5	Indukurpeta	Bore well	8.97	726	20	290	140	36	106	4	24	73	360	2.43	2.97
6	Mothukur	Bore well	8.5	2102	40	310	800	92	320	8	48	204	960	4.40	12.2
7	Pallipadu	Bore well	8.28	428	-	140	90	50	110	1	16	19	118	4.4	0.44
8	Ponuru	Bore well	8.59	600	20	100	140	100	130	2	24	39	220	3.81	2.01
9	Nedumusal	Bore well	8.15	743	-	60	290	104	150	3	32	49	282	3.89	4.43
10	Mudivarthipalem	Bore well	8.35	524	20	230	50	69	120	2	32	24	179	3.5	1.43
11	Gangapatnam	Bore well	7.78	525	-	200	280	100	210	4	40	49	302	5.26	2.03
12	Badrachalam	Bore well	8.15	944	-	370	160	102	520	6	24	29	179	16.89	3.82
13	Pallipadu	Bore well	8.28	428	-	140	90	50	110	1	16	19	118	4.4	0.44
14	Ponuru	Bore well	8.59	600	20	100	140	120	130	2	24	39	220	3.81	2.01
15	Nedumusal	Bore well	8.15	743	-	60	290	104	150	3	32	49	282	3.89	4.43
16	Mudivarthipalem	Bore well	8.35	524	20	230	50	69	120	2	32	24	179	3.9	1.43
17	Gangapatnam	Bore well	7.78	925	-	200	280	100	210	4	40	49	302	5.26	2.03
18	Mypada	Bore well	8.41	2490	40	480	640	437	680	15	56	88	502	13.2	0.36
19	Mypadupampalem	Bore well	8.37	1690	40	310	490	204	470	21	32	53	298	11.84	1.04
20	Ramsudupalem	Bore well	7.88	3724	-	600	1400	204	670	40	240	190	1382	7.84	15.6
21	Krishnapuram	Bore well	8.04	1478	-	400	390	162	450	11	24	34	200	13.84	4
22	Konuru	Bore well	7.59	1091	-	260	260	147	300	9	32	39	240	8.41	0.39
23	Somarajupalli	Bore well	8.25	2230	-	630	540	265	670	18	16	63	299	16.85	6.62
24	Narasapuram	Bore well	8.28	1328	-	310	460	36	410	8	32	24	179	13.39	2.63
25	Mothali	Bore well	8.59	531	20	120	170	17	150	2	16	24	139	5.54	0.03
26	Konurika	Bore well	7.85	641	-	200	130	91	160	2	24	34	200	4.92	0
27	Ravuru	Bore well	7.82	1008	-	220	250	180	240	3	40	44	281	6.23	1.22
28	Addampasaram	Bore well	8.21	585	-	120	100	175	130	1	40	24	199	4.01	1.57
29	Laburu	Bore well	8.57	733	20	60	230	139	200	2	32	24	179	6.51	1.97
30	Pothurajupalle	Bore well	8.08	925	-	50	300	224	250	4	32	34	220	7.33	-3.4
31	Jaggaduruvu	Bore well	8.05	1126	-	250	270	213	270	6	48	44	301	6.77	1.02
32	Gowandipalem	Bore well	8.55	586	20	130	180	39	150	1	24	29	179	4.87	0.58
33	Pamulapalem	Bore well	8.26	925	-	80	310	178	230	3	40	34	240	6.46	-3.2
34	Chimatooru	Bore well	7.91	515	-	100	150	75	120	2	32	29	199	3.7	1.98
35	Kudipalem	Bore well	8.15	4463	-	1100	1300	372	590	30	320	340	2199	5.47	-22
36	Ramsudupalem	Bore well	8.54	1386	40	220	520	45	300	11	56	73	440	6.22	-3.6

**Quality Criteria for Groundwater Utilization Drinking Purpose**

According to World Health Organization (WHO), about 80% of the prevalent diseases are caused by contaminated water. The drinking water specification standards has established by (5) WHO (1971), (6) Indian Council of Medical Research (ICMR, 1975) and Indian Standard Institute (7) (ISI, 1983) are given in the Table 2.

**TABLE 2: Standards for drinking water and Groundwater quality in the Study area**

Const ituent (mg/l)	WHO (1971)		ICMR (1975)		ISI (1983)		Study Area		
	Min. acceptable	Max. allowable	High est desirable	Max. permissible	High est desirable	Max. permissible	M in .	M a x.	Ge n e r a l R a n g e
pH (units)	7.0 - 8.5	6.5- 9.2	7.0- 8.5	6.5- 9.2	7.0- 8.5	6.5- 9.2	7.5	8.9	8.0 - 8.5

TDS	500	1500	500	1500	500	1500	4	4	500
Total Hardness	100	500	300	600	300	600	1	2	150
Calcium	75	200	75	200	75	200	1	3	<50
Magnesium	50	150	50	100	30	100	1	3	<50
Chloride	200	600	200	1000	250	1000	5	1	250
Sulphate	200	400	200	400	150	400	3	4	<10
Nitrate	50	100	20	45	45	45	-	-	-
Fluoride	0.9	1.1	0.6	1.5	0.6- 1.2	1.5	-	-	-

Generally the TDS of groundwater in the study area are within the permissible limit except in some areas as in clay and aquaculture areas.

Incidences of cardiovascular diseases are found to be more in the areas of soft waters than to those of hard waters (8), Crawford, 1972). In the study area, the waters are moderately hard to very hard category (Table 1).

Sodium is found to play a significant role in the human metabolism as sodium restricted diet is recommended to the patients suffering from hypertension and other heart diseases. According to (9) Davis and Dewiest (1966) and (5) WHO (1971), the maximum permissible limit for Na is 200 mg/l. Sodium is the dominant cation in the study and found to be more than permissible limit in around 53% of the wells in the study area.

Magnesium and calcium show more or less similar concentration of 19 to 340 mg/l and 16 to 320 mg/l respectively with a general range of less than 50 mg/l. But magnesium is found to be dominant in 64% of the area.

The bicarbonate levels in the study area ranges from 50 to 1100 mg/l with a general range of less than 250 mg/l. Except in one well, the bicarbonate concentration in the present investigation is below the upper limit (500 mg/l) as per the (9) Davis and Dewiest, 1966).

**Agricultural Purpose**

The important factors influencing the water quality for irrigation are silt, total salt concentration, and specific toxic ions like sodium, chloride and bicarbonates. The quality of groundwater for irrigation is evaluated in the present investigation with respect to Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC) (10) (Todd, 1980). The values of these agricultural indices were arrived at using the formulae:

Indices	Formula / equation	Common range in the area
SAR	$SAR = \frac{Na}{\sqrt{(Ca + Mg) / 2}}$ (U.S. Salinity Lab. Staff, 1954)	Less than 10
RSC	$RSC = (CO_3 + HCO_3) - Ca + Mg$	Negative values

**V. CONCLUSION**

In general, the quality of groundwater in the study area is potable as per ISI standards (< 1500 mg/l of TDS) with



moderately hard water to very hard category. The dominant cation is sodium it is found to be more than permissible limit (> 200 mg/l) in around 53% of the wells, and dominant anion is chloride in the study area. According to agricultural purpose, the SAR and RSC are under suitable category with less than 10 and negative values respectively (Table 1).

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