Assessment Of Ground Water Quality Status Based On Water Quality Index Method In Two Coastal Villages, Tekkali And Bhavanapadu Of Srikakulam District In Andhra Pradesh, India

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Abstract : The present work of the authors deals with the analysis of the various water quality para meters, viz. p**H**, electrical conductivity, total dissolved solids, total hardness, fluoride, chloride, calcium, magnes ium, sodium, potassiumand to assess the water quality in bore well and well water samples of two coastal villages Bhavanapadu a nd Tekkali of srikakulam district of Andhra Pradesh based on Water Quality Index method. From each of the villag e, different sampling stations were identified and water samples were collected by composite sampling methods and analyzed for various parameters mentioned above. The results were compared with the values stipulated by Indian S tandards (IS : 10500) for drinking water quality. The water quality index of the ground water samples analyzed is f ound to be be- yond the standard values and hence the water in the said villages under study is not recommended for human consumption.

Keywords : Ground water quality, srikakulam district, statistical approach, WQI .

Introduction

The quality of water is assigned on the basis of the physical, chemical and biological characteristics of water[1]. It is a measure of the condition of water rela- tive to the requirements of one or more biotic species and or to any human need or purpose[2]. It is more frequently used by reference to a set of standards against which compliance can be assessed. The most common standards used to assess water quality relate to health of ecosystems, safety for human contact and drinking water.

Water Quality Index (WQI) is one of the most effec- tive tools[3-6] to obtain information on the quality of waterto the concerned residents and policy makers. It thus be comes an important parameter for the assessment and management of ground water in a defined area. WQI isd

defind as a rating reflecting the composite influence of the water under examination is graded as below.

WQI level[a]	Water quality status[a]
0–25	Excellent water quality
26–50	Good water quality
51–75	Poor water quality
76–100	Very poor water quality
>100	Not suitable for drinking

[a]Based on Chatterji and Raizuddin 2002.

The water quality index calculations are as follows :

$W_i = k/S_i$

where W_i is the unit weight of and S_i is the standard for i-

th parameter and K is the proportionality constant.

$Q_i = 100 V_i/S_i$

where Q_i is the sub index of the i-th parameter, V_i is the

different water quality parameters. It is calculated from the point of view of the suitability of groundwater for human consumption. Based on the WQI values obtained,

monitored value of i-th parameter and WQI is calculatedas follows :

$WQI = S Q_i W_i / S W_i$

Exper imental

Study area :

Srikakulam (Fig. 1) district is in the north coastal Andhra Pradesh, India, adjoining Bay of Bengal. It is situated within the geographical co–ordinates of 18.277481 and 18° 16' 38.9316" Nof the northern latitudes and 83–00¢ and 83–45² of the eastern longitudes This is a declared backward district and most of the residents are fishermen below poverty line. There are 8 villages and 16 hamlets constituting of 9878 fisherman constituting 80 percent of population The villages are situated in santhabommali and tekkali mandals. The present work was carried out
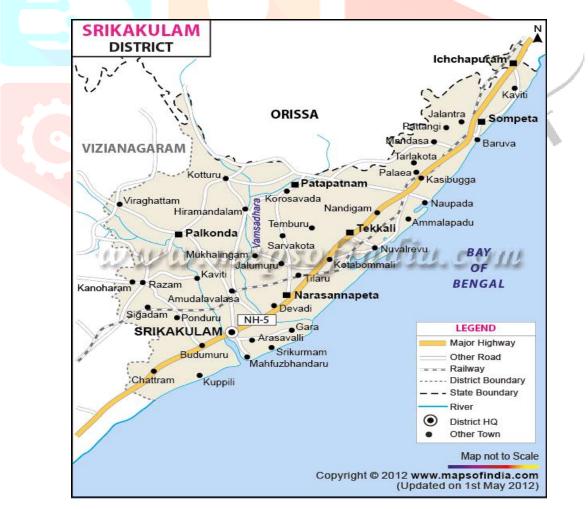

Fig. 1. srikakulam district map of Andhra Pradesh.

for the two villages tekkali and bhavanapadu of santhabommali and tekkali mandal. tekkali 18.6058° N, 84.2302° E is a mandal in srikakulam district of Andhra Pradesh, India. The village bhavanapadu(Fig. 2) is situated between 18.5498° N, 84.2338° E and Kakarapalle (Fig. 3) is situated between17.6016° N, 83.0120° E . The villages have only ground water source for human consump– tion and there is no protected water supply for this region either by Government or by any NGO. As such this study of water in open and bore wells assumes importance in projecting the situation.

Fig. 2. bhavanapadu village under study.

Sampling :

From each of the villages under study, different sampling stations were identified and samples were collected from open wells and bore wells. In total 11 sampling stations were identified and chosen for water sampling in the two villages. All the 6 sampling stations in the village Tekkali are bore wells and in Bhavanapadu village out of 5 stations, 4 are open wells and one a bore well. Composite sampling procedures were carried out for collection of water samples. The water samples were collected in clean high quality polyethyene bottles. EC, temperature, pH and DO of the collected samples were measured on the spot. The present work was carried out during October 2010 to May 2011. The data of different sampling sta–

Fig. 3.kakarapalle village under study.

tions is presented in Table 1.

Methodology :

standard methodsof APHA were used for the analysis of water samples. All the chemicals and reagents used were of AR grade and the aqueous solutions were freshly prepared with double distilled water.

Dissolved oxygen (DO) of the samples was determinedon the spot by a DO meter with a gold electrode. An

Table 1. Details of sampling stations chosen

Sr. No.	Name of the village	Sampling station No.	Type of the sampling station
1.	tekkali	1	Bore well
2.		2	Bore well
3.		3	Bore well
4.		4	Bore well
5.		5	Bore well
6.		6	Bore well
7.	bhavanapadu	1	Open well
8.		2	Open well
9.		3	Open well
10.		4	Open well
11.		5	Bore well

ELICO scanning visible spectrophotometer (SL–177) with 1 cm glass cell was used for the determination of nitrite in the water samples. An ELICO flame photometer (CL- 361) was used for the determination of sodium and potassium. For the pH measurements ELICO digital pH–meter (LI–127) and for conductance measurements ELICO con- ductivity meter (CM–180) were used.

Results and discussion

The measured values of various physico-chemical pa- rameters for analyzed water samples collected from the two villages under study are presented in Tables 2 and 3. The last column of the Tables 2 and 3 gives desirable values of each of the observed parameter as prescribed by

Table 2. Physico-chemical characters of the tekkali village in post monsoon and in summer

	Post monsoon						Summer						IS:10500
	1	2	3	4	5	6	1	2	3	4	5	6	
pH	7.7	6.3	7.5	8.2	7.4	7.5	8.3	7.5	6.9	9.2	8.6	7.9	6.5–8.5
EC	700	700	800	600	700	900	1000	1000	100	1100	1100	900	500
TDS	12540	14670	13490	9520	7420	16290	10540	11670	12490	8520	7420	14290	500
THW	305	405	408	509	452	350	355	467	454	556	385	382	300
Ca	76.8	76.8	86.3	101	93.1	74.8	81.1	86.1	97.1	128.2	94.6	88.1	70
Mg	76.8	124	118.1	152	133	100.2	96.5	142.5	130.1	150	98	103	30
Na	114	114	145	96	90	94	124	114	152	100	96	101	100
K	2.5	4.3	6.3	10.2	2.3	5.5	6.3	4.3	3.1	2.3	10.2	2.2	20
Fe	4.2	5.3	6.1	3.8	4.1	5.1	3.2	3.9	3.2	2.2	3.1	5.4	3
Cl	492	552	525	384	351	492	551	584	625	652	492	550	250
PO_4	4	5	5	4	4	4	4	5	3.4	1.4	4	1.5	10
NO_2	0.1	0.2	0.3	0.3	0.5	0.4	0.1	0.2	0.3	0.3	0.5	0.4	1
F	0.2	0.2	0.4	0.8	0.6	0.4	0.6	0.8	0.4	0.2	0.2	0.4	1.2

Table 3. Physico-chemical characters of the bhavanapadu village in post monsoon and in summer

	Post monsoon					Summer					IS:10500
	1	2	3	4	5	1	2	3	4	5	
pH	8.1	8.3	8.6	8.5	8.6	8.4	8.3	8.5	8.3	8.3	6.5–8.5
EC	8200	7500	7700	8100	600	8000	8200	8100	8200	800	500
TDS	5610	5705	6100	5985	650	5650	5785	6185	5995	750	500
THW	1376	1275	1305	1290	617	1381	1291	1345	1301	717	300
Ca	212	205	210	221	210	222	212	205	210	105	70
Mg	476	455	460	458	100	641	652	632	652	210	30
Na	1146	1005	1020	1050	54	1200	1050	1080	1125	55	100
K	50	48	50	48	12	90	100	98	95	14	20
Fe	27	25	27	25	4	27	25	27	25	5	3
Cl	2116	1890	1954	1986	650	2663	2428	2205	2418	780	250
PO_4	12	11	12	11	9	9	10	9	7	7	10
NO_2	1.5	1.2	1.4	1.2	0.5	1.2	1.1	1.2	1.1	0.5	1
F	0.8	0.8	0.7	0.8	0.4	0.8	0.8	0.7	0.8	0.4	1.2

IS : 10500 in bold letters for comparison and conclusion. *pH* : During post monsoon, in the village Tekkali, the six sampling stations selected under study have a maximum pH of 8.2 and a minimum pH of 6.3, in summer the maximum being 9.2 and a minimum 6.9. Water samples analyzed from the selected sampling stations of the village Bhavanapadu were found to have a maximum pH of 8.6 and a minimum pH of 8.1 in post monsoon and a maximum of 8.5 and a minimum of 8.3 in summer season. The value of pH, for the two villages was found to be well within the prescribed standard limits of 6.5–8.5. During summer, a maximum pH of 9.2 was found in the waters of the village Tekkali, indicating a slight alkaline nature for the water. No appreciable difference in pH was indicated in open or bore well water.

Electrical conductance and TDS :

Electrical conductivity (EC) is one of the most important parameter in assessing water quality. As the value of EC increases rapidly, it indicates the higher content of dissolved solids in the water samples analyzed. For the water samples analyzed from the village Tekkali, maximum EC of 1100 ms/cm was found in summer. The maximum EC found for the water samples analyzed from the village Bhavanapadu was found to be 8200 ms/cm both in post monsoon as well as in summer. There is a marked tenfold difference in the value in open and bore wells as observed. The prescribed limit for EC by Indian Standards is 500 ms/cm. For the water samples analyzed from the two villages, it was found to be beyond the standard value prescribed, even in the bore well. As the two villages under study are situated on the shore line of Bay of Bengal, intrusion of salt water into the ground water table is predicted as the reason for increased EC.

The value of TDS was found to be ranging from 7420–16290 mg/L in tekkali and 650–6180 in bhavanapadu village in the two seasons under study. The value of TDS was found to be the highest, i.e. 16920 mg/L in the village Tekkali during November 2010 (post monsoon). The concentration of total dissolved solids in the ground waters of the two villages was found to be extremely high. It was classified that the water having TDS greater than 5000 mg/L as saline water[11].

In the open wells, the increased EC or TDS is predicted to be due to solvent water evaporation into atmosphere, which is prevented in bore wells.

Total hardness of water (THW) : It was found that a minimum of 305 mg/L and a maximum of 509 mg/L were observed as total hardness of water for the water samples analyzed in the village Tekkali collected from selected sampling stations during post monsoon. During summer a minimum concentration of 382 mg/L and a maximum of 556 mg/L were observed. These observed values were found to be in the permissible limit value i.e. 600 mg/L prescribed by Indian standards. From the results it was

found that the ground water analyzed from the village is not suitable for human consumption with respect to total hardness of water as the reported value is beyond the prescribed desirable limit values.

Water samples analyzed from the village Bhavanapadu were found to have a minimum total hardness of 617 mg/L and a maximum of 1376 mg/L during post monsoon. During summer a minimum total hardness of 717 mg/L and a maximum of 1381 mg/L were found for the same samples collected from the village under study. All the water samples analyzed in the village Bhavanapadu are found to be beyond the permissible limit value. From these observations it is found that the water analyzed is hard in nature even in bore wells and cannot be used for human consumption, agriculture or industrial purpose.

Calcium and magnesium :

From the analysis of results, it was found that calcium concentration in the water samples analyzed from the village Tekkali was found to have a maximum of 101 mg/L during post monsoon and 128.2 mg/L during summer, a minimum concentration of 74.8 mg/L during post monsoon and 81.1 mg/L in summer. All the samples analyzed from the village were found to have concentration of calcium beyond the standard prescribed value. The water samples analyzed from the village Bhavanapadu were found to have maximum concentration of 221 mg/L and a minimum of 205 mg/L during post monsoon, during summer a maximum concentration of 222 mg/L and a minimum of 105 mg/L were found. All the samples analyzed from the village Bhavanapadu have the concentration of calcium beyond the permissible limit value, i.e. 200 mg/L. Higher concentrations of calcium in drinking water can cause blocks in heart nerves as it was reported by WHO, hence the water samples analyzed are not fit for drinking purpose[13].

The concentration of magnesium in the water samples analyzed from the village Tekkali was found to be beyond the permissible limit i.e. 100 mg/L. In the village Bhavanapadu, the water samples were found to have the high concentration of magnesium. During summer it was found to be as 652 mg/L. The samples collected from the village Bhavanapadu were found to have extremely higher concentrations of calcium as well as magnesium compared to the other village. As magnesium is the second highest contributing component in sea water and as the village is very near to the shoreline due to mixing of sea water into the fresh waters the highest concentrations of magnesium were found.

It is observed that in the bore well water of Bhavanapadu village, the calcium ion concentration was halved and that of magnesium ion is doubled from post monsoon to sum– mer. For further study, unfortunately, another bore well was not found in that village.

Sodium and potassium :

The concentration of sodium in the water samples analyzed from the village Tekkali was found to be slightly higher than the prescribed standard values during the two seasons. However, concentration of potassium in the water samples of the village was found to be well within the prescribed standard value.

Water samples collected from the village Bhavanapadu were found to have the concentrations of sodium and potassium beyond the permissible limit values prescribed. As the village Bhavanapadu is just 0.5 km away from the sea shore and due to the intrusion of salt water into the ground water shall be the reason for increase in the concentration of the ions analyzed. Whereas, the village Tekkali is away from sea shore, when compared to the former, the concentration of sodium was found to be slightly higher and potassium in the prescribed limits.

Chloride : The concentration of chloride was found to vary from 351–652 ppm in Tekkali village and 650– 2663 ppm in Bhavanapadu village. A concentration of 2663 mg/L of chloride was found for the water samples analyzed from the village Bhavanapadu during summer. It was found that the concentration of chloride is much higher than the standard values prescribed by the Indian standards, during the two seasons under study. The water samples analyzed from the village Bhavanapadu were found to have the highest concentration of chloride, making the water not suitable for human consumption or industrial or agriculture purposes.

Phosphate : Water samples analyzed from the two vil- lages under investigation were found to have the concentration of phosphate ranging from 4-5 mg/L during the post monsoon and 1.5-5 mg/L during summer in the village Tekkali and that of 9-12 mg/L during post mon- soon and 7-10 mg/L during summer in the village Bhavanapadu. The concentration of phosphate in the waters of the village Tekkali was found to be well within the prescribed standard value, the same of which was found to be slightly higher in the village Bhavanapadu.

Nitrite : The concentration of nitrite was found to be varying from 0.1-0.5 mg/L in the ground waters of the village Tekkali during the two seasons and 0.5-1.5 mg/L during post monsoon, 0.5-1.2 mg/L during summer for Bhavanapadu village. It was found that the concentration of nitrite analyzed in the ground water samples of the Tekkali village is well within the standard limit value according to Indian standards as well as EPA standards, but the same was found to be higher in the water in the village Bhavanapadu. High levels of nitrites in drinking water can cause problems to young children and farm animals. As nitrites bind very strongly to hemoglobin and can affect the ability of blood to carry and release oxygen. Long term consumption of higher levels of nitrites can cause dieresis, increased levels of starchy deposits and hemorrhage in spleen. Hence from the data, it can be inferred that the ground water analyzed from the village Bhavanapadu, is harmful to human consumption with respect to nitrites[12].

The two villages Tekkali and Bhavanapadu are situated on the shoreline of Bay of Bengal in the district of Vizianagaram, Andhra Pradesh. The two villages are in Pusaptirega mandal of the district. These are 7 km away from each other. The distance between shoreline and the village Tekkali is about 5 km and that of the village Bhavanapadu is about 1 km. As the village Bhavanapadu is very near to the shoreline, due to which the concentration of parameters such as electrical conductivity, total dissolved solids, total hardness, chloride, calcium, magnesium, sodium, and potassium were found to be the highest in the village for the two seasons under study compared to that of Tekkali village. The increase in the concentration of all the parameters under study, in the village is Bhavanapadu is due to the mixing of sea water into the fresh water aquifers of the village[14]. Though, the village Tekkali also on the shoreline of Bay of Bengal at a distance about 5 km from the shore the extent of mixing of salt water into the fresh waters of the village is comparatively less and hence the lower concentration of the parameters than those of the village Bhavanapadu was observed.

Fluoride ion concentration in the ground water samples analyzed in the villages under the study was found to be well within the standard values prescribed.

Water quality index of the two villages under study was assessed from important physico-chemical parameters in different seasons, such as post monsoon and summer. Season wise Water Quality Index values are presented in Tables 4, 5, 6, 7 and 8. Correlation matrix data is presented in Table 9.

The water quality index obtained for the analyzed samples collected from the village Tekkali was found to be 92.4 during post monsoon and 84.8 in summer and that of the village Bhavanapadu was 333.3 in post monsoon and

Table 4. Unit weight calculation

1.	pH	8.5	0.11764706		0.029557
2.	EC	300	0.00333333		0.000837
3.	TDS	500		0.002	0.000502
4.	THW	300	0.00333333		0.000837
5.	Ca	75	0.01333333		0.00335
6.	Mg	50		0.02	0.005025
7.	Na	20		0.05	0.012562
8.	K	10		0.1	0.025124
9.	Fe	3	0.33333333		0.083745
10.	Cl	250		0.004	0.001005
11.	PO_4	2		0.5	0.125618
12.	NO_2	0.5		2	0.502473
				WQI	3.14698039

Table 5. WQI of the water samples collected from the villagetekkali in post monsoon

Parameter	V_i	S_i	Q_i	W_i	$W_i Q_i$
pH	7.4	8.5	93.3	0.029557	2.75769
EC	733.3	300	244.4444	0.000837	0.204711
TDS	12322	500	2464.333	0.000502	1.238261
THW	404.8	300	134.9444	0.000837	0.11301
Ca	84.82	75	113.0889	0.00335	0.378827
Mg	117.4	50	234.8	0.005025	1.179806
Na	108.8	20	544.1667	0.012562	6.835726
K	5.183	10	51.83333	0.025124	1.302242
Fe	4.767	3	158.8889	0.083745	13.30623
Cl	466	250	186.4	0.001005	0.187322
PO_4	4.333	2	216.6667	0.125618	27.21729
NO_2	0.3	0.5	60	0.502473	30.14838
F	0.433	1.2	36.11111	0.209364	7.560357
				WQI	92.42984

Sr. No.   Parameter   Standard value W_i Q_i

Table 6. WQI of the water samples collected from the village tekkali in summer

Parameter	V_i	S_i	Q_i	W_i	$W_i Q_i$
pH	8	8.5	93.3	0.029557	2.75769
EC	866.6667	300	288.8889	0.000837	0.241931
TDS	10821.67	500	2164.333	0.000502	1.087519
THW	433.1667	300	144.3889	0.000837	0.120919
Ca	95.86667	75	127.8222	0.00335	0.428181
Mg	120.0167	50	240.0333	0.005025	1.206103
Na	114.5	20	572.5	0.012562	7.191644
K	4.733333	10	47.33333	0.025124	1.189186
Fe	3.5	3	116.6667	0.083745	9.770307
Cl	575.6667	250	230.2667	0.001005	0.231406
PO_4	3.216667	2	160.8333	0.125618	20.2036
NO_2	0.3	0.5	60	0.502473	30.14838
F	0.433333	1.2	36.11111	0.209364	7.560357
				WQI	82.13722

Table 7. WQI of the water samples collected from the village bhavanapadu in post monsoon

Parameter	V_i	S_i	Q_i	W_i	$W_i Q_i$
pH	8.42	8.5	97.7	0.029557	2.887742
EC	6420	300	2140	0.000837	1.792154
TDS	4810	500	962	0.000502	0.483379
THW	1173	300	390.8667	0.000837	0.327333
Ca	211.6	75	282.1333	0.00335	0.945096
Mg	389.8	50	779.6	0.005025	3.917279
Na	855	20	4275	0.012562	53.7018
K	41.6	10	416	0.025124	10.45144
Fe	21.6	3	720	0.083745	60.29675
Cl	1719	250	687.68	0.001005	0.691081
PO$_4$	11	2	550	0.125618	69.09003
NO$_2$	1.16	0.5	232	0.502473	116.5737
F	0.7	1.2	58.33333	0.209364	12.21288
				WQI	333.3707

317.8 in summer.

This water quality rating study clearly shows that the water of the two villages in not suitable for human consumption. It is also observed that the WQI of the village Bhavanapadu was found to be very high in the two seasons compared to Tekkali. The above water quality assessment was supported by the physico-chemical parameter variations observed during the different seasons in the two villages.

It was found in literature[15-19] that the quality of water

Table 8. WQI of the water samples collected from the village kakarapalli in summer

Parameter	V_i	S_i	Q_i	W_i	$W_i Q_i$
pH	8.36	8.5	97.7	0.029557	2.887742
EC	6660	300	2220	0.000837	1.85915
TDS	4873	500	974.6	0.000502	0.48971
THW	1207	300	402.3333	0.000837	0.336936
Ca	190.8	75	254.4	0.00335	0.852194
Mg	557.4	50	1114.8	0.005025	5.601568
Na	902	20	4510	0.012562	56.65383
K	79.4	10	794	0.025124	19.94818
Fe	21.8	3	726.6667	0.083745	60.85506
Cl	2098.8	250	839.52	0.001005	0.843672
PO$_4$	8.4	2	420	0.125618	52.75966
NO$_2$	1.02	0.5	204	0.502473	102.5045
F	0.7	1.2	58.33333	0.209364	12.21288
				WQI	317.8051

can be assessed using correlation matrix data obtained for the parameters analyzed. From the correlation matrix data, it was found that a positive correlation between pH-Ca, pH-K, EC-TDS, EC-Cl, TDS-Cl, Ca-THW, Mg-TH and Na-Cl during summer with the highest correlated parameters as Ca-THW (0.8960) and Mg-THW (0.9883) during post monsoon season in the village Tekkali. During summer positive correlation was observed for Ca-THW, Mg-THW, Na-Cl, Mg-Cl, EC-pH and EC-K. From this data it is clear that the quality of the water of the village is predominantly influenced by the parameters mentioned as above.

EC-TDS, EC-THW, EC-Mg, EC-Na and EC-Cl, Ca-THW and Mg-THW are the parameters which are posi-tively correlated to each other in the two seasons under study for the water samples analyzed in the village Bhavanapadu. And the quality of the water samples of the village is majorly influenced by these parameters which also evident from the physico-chemical parameters analyzed and the WQI calculations done.

Conclusions

From the analyses report, it was observed that all the parameters analyzed except fluoride and to some extent potassium were found to be beyond the limits prescribed. Water Quality Index (WQI) values of the water samplesanalyzed for the village Tekkali was found to be 92.4

Table 9. correlation matrix of the physico-chemical characters of the water samples analyzed

CHP PM	pH	EC	TDS	THW	Ca	Mg	Na	K	Cl
pH	1								
EC	−0.17557	1							
TDS	−0.41127	0.698057	1						
THW	0.212901	−0.56509	0.63604	1					
Ca	0.559571	0.63465	−0.825	0.896602	1				
Mg	0.083205	−0.50575	−0.54184	0.988367	0.819133	1			
Na	−0.19149	0.182647	0.369013	−0.24492	−0.22545	−0.23659	1		
K	0.472788	−0.21619	−0.00043	0.60641	0.545873	0.594746	0.023953	1	
Cl	−0.57398	0.465885	0.885485	−0.61422	−0.78781	−0.52675	0.674413	−0.129	1
CHP S	pH	EC	TDS	THW	Ca	Mg	Na	K	Cl
pH	1								
EC	0.788843	1							
TDS	−0.72018	−0.49558	1						
THW	0.198501	−0.04326	−0.22224	1					
Ca	0.55062	0.085872	−0.46115	0.840889	1				
Mg	−0.05059	−0.14428	−0.035	0.950501	0.632429	1			
Na	−0.75714	−0.88251	0.404666	−0.02257	−0.24119	0.1375	1		
K	0.246012	0.343267	−0.64428	−0.52601	−0.33399	−0.58111	−0.23888	1	
Cl	−0.09297	−0.38583	0.158279	0.837272	0.641557	0.850488	0.394196	−0.78915	1
KDPM	pH	EC	TDS	THW	Ca	Mg	Na	K	Cl
pH	1								
EC	−0.48795	1							
TDS	−0.38833	0.991293	1						
THW	−0.53113	0.996072	0.983648	1					
Ca	0.165395	0.217483	0.183801	0.161776	1				
Mg	−0.49395	0.998027	0.992848	0.997262	0.157002	1			
Na	−0.53681	0.997814	0.983245	0.999175	0.187072	0.997189	1		
K	−0.47025	0.995726	0.994652	0.996101	0.142142	0.999061	0.994486	1	
Cl	−0.52812	0.997466	0.982521	0.999042	0.203362	0.995918	0.999593	0.993682	1
KDS	pH	EC	TDS	THW	Ca	Mg	Na	K	Cl
pH	1								
EC	0.359952974	1							
TDS	0.41084152	0.99654561	1						
THW	0.455266388	0.98787927	0.984986	1					
Ca	0.344472072	0.98955205	0.977477	0.992014	1				
Mg	0.334749107	0.99948681	0.993618	0.986467	0.992	1			
Na	0.383348921	0.99041795	0.98394	0.995971	0.996	0.9913	1		
K	0.363519227	0.99633623	0.995338	0.976314	0.976	0.9944	0.9756	1	
Cl	0.287568427	0.97388702	0.955246	0.979055	0.996	0.979	0.989	0.9549	1

during post monsoon and 84.8 in summer and for the village kakarapalli 333.3 in post monsoon and 317.8 in sum- mer. From the water quality rating data, it was found that the ground water analyzed is not suitable for drinking andhence, the author's report that the ground water analyzed is not suitable for drinking purpose based on the WQI rating. The authors advise the administration to caution the residents and arrange supply

of protected water to theresidents of the villages in view of the fact that there is salt water intrusion into the ground water table as such the ground water is not fit for human consumption.

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