DRINKING WATER QUALITY ASSESSMENT USING PHYSICO-CHEMICAL PARAMETERS AND WATER QUALITY INDEX OF PEDAPADU MANDAL,WEST GODAVARI DT, AP, INDIA.

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Abstract:

Pedapadu is a Mandal in West Godavari District of Andhra Pradesh State, India. Pedapadu Mandal Head Quarters is Pedapadu town . It belongs to Andhra region ..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. Physio graphically 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 Pedapadu mandal to cater the water demand of the population. It is in this context, the ground water quality is determined in Pedapadu mandal in the upland area of the West Godavari dt. 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 (SO_4^{2-}), Iron (Fe), DO, BOD, COD, Total alkalinity (TA) and Nitrate (NO_2^-) concentration present in ground water. Also all parameters were compared with ICMR standards of water quality. In the present research paper water samples of Pedapadu mandal was classified on the basis of TDS and TH..

Index Terms: **Ground Water, Physico-Cheml Analysis, TH, TDS. -**

I. INTRODUCTION:

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. Human alteration of the landscape has an extensive influence on watershed hydrology. 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 Pedapadu mandal 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 groundwater. 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:

Pedapadu is a Mandal in West Godavari District of Andhra Pradesh State, India. Pedapadu Mandal Head Quarters is Pedapadu town . It belongs to Andhra region .. 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. The main source of drinking water is ground water except in very few places where it is surface water. GPS values and soil types are represented Table.1.

Table.1.Location GPS values and Soil types of Pedapadu Mandal

S. No	Name of the Village	GPS Values				Geology / Soil type	Health	Landmark	Command Population
		Latitude & Longitude	Elevation (m)	Bore Depth (Ft)	Water Table (Ft)				
1.	Buragagudem	N $16^0$41'051" E $81^0$05'544"	51	500	200	Black Cotton Soil	Good	Near Anganwadi	3000
2.	Edulakunta	N $16^0$38'524" E $81^0$05'201"	14	-----	-----	Black Cotton soil	Good	Near church	2500
3.	Epuru	N $16^0$38'789" E $81^0$58'504"	38	300	100	Black Cotton Soil	Good	Near substation	2500
4.	Gogunta	N $16^0$35'034" E $81^0$00'484"	29	-----	------	Alluvial soil	Good	Near co-operative	5000
5.	Kalaparru	N $16^0$40'141" E $81^0$00'595"	32	300	100	Black Cotton Soil	Good	Near church	3500
6.	Kokkirapadu	N $16^0$41'136" E $81^0$00'383"	33	250	80	Black Cotton Soil	Good	Near temple	4000
7.	Koniki	N $16^0$33'971" E $81^0$01'944"	29	------	-----	Alluvial Soil	Good	Near Ro plant	4500
8.	Kothuru	N $16^0$40'908" E $81^0$05'000"	60	550	300	Black Cotton Soil	Good	Near Panchayathi	6000
9.	Mupparru	N $16^0$39'803" E $81^0$04'997"	62	550	350	Black Cotton Soil	Good	Near school	4000
10.	Nandikeswarapuram	N $16^0$38'099" E $81^0$00'832"	30	300	150	Alluvial Soil	Good	Near church	2500
11.	Pedapadu-I	N $16^0$37'561" E $81^0$01'556"	28	300	150	Alluvial Soil	Good	Near church	5000

12.	Pedapadu-II	N 16⁰38'274" E 81⁰02'059"	27	300	120	Alluvial Soil	Good	Near Panchayathi	4500
13.	Punukollu-I	N 16⁰38'002" E 81⁰00'707"	47	350	150	Black Cotton Soil	Good	Near temple	2000
14.	Punukollu-II	N 16⁰38'989" E 81⁰01'143"	42	350	150	Black Cotton Soil	Good	Near temple	2500
15.	Rajupeta	N 16⁰37'300" E 81⁰01'447"	32	300	100	Black Cotton Soil	Good	Near school	4000
16.	Sakalakothapalle	N 16⁰35'826" E 81⁰01'813"	24	------	------	Alluvial Soil	Good	Near Panchayathi	2500
17.	Satyavole	N 16⁰35'932" E 81⁰01'833"	24	------	------	Black Cotton Soil	Good	Near Panchayathi	4000
18.	Tallagudem	N 16⁰39'805" E 81⁰04'998"	63	500	300	Black Cotton Soil	Good	Outside of the village	3000
19.	Vasanthavada-I	N 16⁰37'302" E 81⁰59'998"	25	-----	-----	Alluvial Soil	Good	Near hospital	4500
20.	Vasanthavada-II	N 16⁰37'302" E 81⁰59'998"	25	-----	-----	Alluvial Soil	Good	Near school	4500

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.

V.Water Quality Index:

Water Quality Index (WQI) is a means by which water quality data is summarized for reporting to the public in a consistent manner. It is similar to the UV index or an air quality index, and it tells us, in simple terms, what the quality of drinking water is from a drinking water supply. The *WQI* is calculated by averaging the individual index values of some or all of the parameters within five water quality parameter categories: Water quality classification based on WQI value is represented in Table.2.

Table.2 .Water quality classification based on WQI value

WQI Value	Rating of Water Quality	Grading
0-25	Excellent water quality	A
26-50	Good water quality	B
51-75	Poor water quality	C
76-100	Very Poor water quality	D
Above 100	Unsuitable for drinking purpose	E

VI.Results and Discussion:

The water from the study area has no colour and odour. Taste of the water of the water sample in most of the locations pleasant in taste. Names of the 22 villages are represented in Table 1. The results of the physico-chemical analysis for 22 different villages in different seasons i.e., Pre monsoon and Post monsoon are represented in 4(a) and 4(b). Physicochemical characteristics and WQI Values of water samples in Pedapadu mandal including 20 villages and in two consecutive seasons were shown in Table 4(a) and 4(b) respectively and compared with IS Table -3 and WHO standards.

Table -3 Indian standards

Sl No.	Parameter	Desirable limit
1	Turbidity	1–5
2	pH	6.5–8.5
3	Total Hardness	200–600
4	Calcium	75–200
5	Magnesium	30–100
6	Chlorides	250–1,000
7	Sulfates	150–400
8	Nitrate	45 (no relaxation)
9	Fluoride	0.6–1.2
10	Chromium (Cr^{+6})	0.05
11	Alkalinity	200–600
12	BOD	30–100
13	TDS	500–2000
14	Oil and grease	0.5 (no relaxation)

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 Ca^{2+} was showed wide variation in all the accepted limits.Mg^{2+} values were within the limits. Sulphate data was low. Also classification on the basis of Total hardness shows that maximum samples contain higher values of hardness. TDS were in permissible limits except very samples where it is high.

Correlation Matrix is usually used to measure the strength of a linear relationship. A correlation or simple linear regression analysis can determine if two numeric variables are significantly linearly related. A correlation analysis provides information on the **strength** and **direction** of the linear relationship between two variables, while a simple linear regression analysis estimates parameters in a linear equation that can be used to **predict** values of one variable based on the other. In this present study, Correlation Matrix among different water quality parameters are represented in Table 5(a), and 5(b).

Table 4(a): Physicochemical Characteristics and WQI Values of
Water Samples in Pedapadu mandal (Premonsoon season)

S. No	Name of the Village	pH	EC µS/cm	TDS ppm	Alkalinity ppm	Total Hardness ppm	Calcium ppm	Magnesiu m ppm	Chloride ppm	Sulphate ppm	DO ppm	BOD ppm	WQI	Rating
1	Buragagudem	7.56	2880	1930	520	266	20	52.6	510.4	94.8	8	6	312.3	Unsuitable
2	Edulakunta	8.22	940	630	250	120	16	19.5	151.7	12.62	8	5.2	141.7	Poor
3	Epuru	7.58	1630	1090	310	250	28	43.8	269.4	20.23	7.2	4.8	198.2	Poor
4	Gogunta	7.02	880	590	240	114	16	18	106.3	12.02	6	3.6	121.4	Poor
5	Kalaparru	7.16	3600	2410	410	370	40	65.7	567.2	72.88	8	6	371	Unsuitable
6	Kokkirapadu	7.04	2590	1740	400	234	24	42.4	475	29.29	8.8	6.4	279.7	Very Poor
7	Koniki	7.3	1860	1250	240	150	15.2	27.2	344.5	33.41	5.6	4	212.8	Poor
8	Kothuru	6.71	2430	1630	420	230	24	41.4	425.4	40.11	8	6	263.2	Very Poor
9	Mupparru	7.84	1430	960	240	142	16	24.8	255.2	39.54	7.6	4.4	177.5	Poor
10	Nandikeswarapuram	7.2	3540	2370	492	320	68.9	36	680	72.7	6.8	5.2	363.4	Unsuitable
11	Pedapadu-I	7.52	620	420	190	96	12	16	87.9	18.34	8	6.8	114.5	Poor
12	Pedapadu-II	7.55	830	560	206	100	16	14.6	113.4	24.7	6.8	4	121.4	Poor
13	Punukollu-I	7.15	2590	1740	424	250	33.6	40.4	567.2	59	7.6	5.2	278.3	Very Poor
14	Punukollu-II	7.94	460	310	106	50	8	7.3	85.08	24.23	7.6	6	99.83	Good
15	Rajupeta	7.35	740	500	200	94	12	15.5	103.5	23.29	6	4.8	117.9	Poor
16	Sakalakothapalle	7.65	1060	710	190	104	12	18	170.1	35.42	10	7.2	150.2	Poor
17	Satyavole	7.46	760	510	160	82	10.4	13.6	198.8	25.05	7.2	4.8	116.9	Poor
18	Tallagudem	7.04	3740	2510	430	270	30.4	47.2	709	74.55	8	6	379.5	Unsuitable
19	Vasanthavada-I	6.81	3160	2120	400	240	27.2	41.9	652.2	51.11	7.6	5.6	325.8	Unsuitable
20	Vasanthavada-II	7.32	790	530	220	114	20	15.5	113.4	21.3	8	5.6	121.3	Poor
21	Vatluru	7.14	2100	1410	434	196	20	35.5	368.68	28.7	8.4	6	237	Very Poor
22	Vempadu	7.07	2500	1680	480	236	24	42.8	467.94	34.58	8	5.2	284.7	Very Poor

Table 4(b): Physicochemical Characteristics and WQI Values of Water Samplesin Pedapadu Mandal (Post Monsoon Season)

S. No	Name of the Village	pH	EC µS/cm	TDS ppm	Alkalinity ppm	Total Hardness ppm	Calcium ppm	Magnesium ppm	Chloride ppm	Sulphate ppm	DO ppm	BOD ppm	WQI	Rating
1	Buragagudem	7.04	2780	1860	578	264	53.7	31.6	475	69	8.4	6	295.9	Very Poor
2	Edulakunta	8	950	630	242	118	25.6	13.1	153	16.6	8.4	5.6	140.9	Poor
3	Epuru	7.44	1550	1040	322	234	56.1	22.9	262	21.8	8.4	5.6	189.1	Poor
4	Gogunta	7.52	850	560	272	128	29.6	13.1	102	9.5	9.2	6	127.5	Poor
5	Kalaparru	7.41	2210	1480	398	260	62.5	25.3	397	51.7	8	5.2	245.9	Very Poor
6	Kokkirapadu	6.95	2490	1670	404	266	64.9	25.3	493	47.4	9.2	6.4	267.9	Very Poor
7	Koniki	7.64	2360	1580	310	200	31.2	29.7	482	49.5	6.4	4.4	260	Very Poor
8	Kothuru	7.15	2560	1710	530	272	58.5	30.6	451	60.6	8.8	6.4	278.6	Very Poor
9	Mupparru	7.63	3490	2340	448	306	60.1	35.5	749	92	8	4.8	356.3	Unsuitable
10	Nandikeswarapuram	6.91	3490	2340	456	364	72.1	44.8	752	93.2	8.8	6.8	360.3	Unsuitable
11	Pedapadu-I	7.73	660	440	230	96	20	11.2	85	6.1	8.8	8	123.7	Poor
12	Pedapadu-II	7.62	340	230	132	68	16	8.7	35	6.9	8.8	5.6	81.83	Good
13	Punukollu-I	7.13	2540	1700	454	260	52.1	31.6	439	18	9.2	6	272.9	Very Poor
14	Punukollu-II	7.7	370	250	140	62	11.2	8.2	50	6.3	9.2	6	86.28	Good
15	Rajupeta	7.59	580	390	214	84	19.2	8.7	65	7	8	5.2	103.2	Poor
16	Sakalakothapalle	7.62	770	520	140	96	20	11.2	119	34.5	9.6	6	119.1	Poor
17	Satyavole	7.5	720	480	160	80	16	9.7	102	31.5	8.4	5.6	114.8	Poor
18	Tallagudem	7.66	3580	2400	424	290	61.7	33.1	773	93.7	9.2	6.4	369.7	Unsuitable
19	Vasanthavada-I	7.8	640	430	140	80	14.4	10.7	120	12.9	8.8	6.8	116	Poor
20	Vasanthavada-II	7.64	640	430	130	80	15.2	10.2	120	12.5	5.2	2	98.94	Good
21	Vatluru	7.33	1380	920	294	184	38.4	21.4	234	23.1	9.2	6	172.6	Poor
22	Vempadu	7.52	2380	1600	400	334	60.9	44.3	475	34.5	9.2	8.4	277.3	Very Poor

Table 5(a): Pedapadu Mandal Correlation Matrix of Premonsoon season

	pH	EC	TDS	Alkalinity	Total Hardness	Sodium	Potassium	Calcium	Magnesium	Chloride	Fluoride	Sulphate	DO	COD	BOD
pH	1														
EC	0.008624	1													
TDS	0.009187	0.99999	1												
Alkalinity	0.050022	0.915974	0.916309	1											
TotalHardness	-0.00472	0.950269	0.950373	0.914878	1										
Sodium	0.210225	-0.24964	-0.24874	-0.27656	-0.34363	1									
Potassium	0.413556	-0.33113	-0.32982	-0.2741	-0.40381	0.509681	1								
Calcium	-0.02416	0.875805	0.875674	0.887988	0.971332	-0.37523	-0.41831	1							
Magnesium	0.014151	0.970536	0.970859	0.891474	0.973724	-0.29489	-0.36822	0.891671	1						
Chloride	0.018245	0.94178	0.942131	0.834475	0.875485	-0.16347	-0.12838	0.790095	0.910237	1					
Fluoride	-0.72783	-0.16588	-0.16739	-0.24098	-0.23659	-0.04012	-0.2644	-0.21629	-0.24333	-0.16753	1				
Sulphate	0.047962	0.916603	0.916879	0.810515	0.775703	-0.08956	-0.25534	0.674161	0.831291	0.857669	-0.04912	1			
DO	0.088208	-0.30268	-0.30306	-0.16492	-0.13977	-0.2802	-0.172	-0.06248	-0.2063	-0.39596	-0.04006	-0.47075	1		
COD	-0.07853	0.288357	0.289577	0.217342	0.240307	0.13987	0.0486	0.177022	0.288018	0.36723	-0.04384	0.20974	-0.03738	1	
BOD	0.055923	-0.16403	-0.16482	-0.0446	-0.01623	-0.09056	-0.18536	0.045976	-0.07496	-0.25087	-0.06709	-0.36199	0.871758	-0.05217	1

Table 5(b): Pedapadu Mandal Correlation Matrix of Postmonsoon season

	pH	EC	TDS	Alkalinity	Total Hardness	Sodium	Potassium	Calcium	Magnesium	Chloride	Fluoride	Sulphate	DO	COD	BOD
pH	1														
EC	-0.19648	1													
TDS	-0.19483	0.999992	1												
Alkalinity	-0.63643	0.577878	0.576662	1											
TotalHardness	-0.57339	0.570665	0.569853	0.895707	1										
Sodium	0.364163	-0.20325	-0.20259	-0.31685	-0.45482	1									
Potassium	0.363636	-0.09993	-0.09807	-0.30292	-0.35947	0.72957	1								
Calcium	-0.61591	0.557265	0.556348	0.900955	0.975823	-0.50215	-0.3873	1							
Magnesium	-0.4992	0.554706	0.554045	0.843634	0.973221	-0.38061	-0.31076	0.899454	1						
Chloride	-0.45817	0.634621	0.63432	0.824094	0.929517	-0.32523	-0.29735	0.880517	0.932378	1					
Fluoride	-0.2005	0.201599	0.201944	0.208742	0.372334	-0.06208	-0.05639	0.238199	0.493845	0.501951	1				
Sulphate	-0.39221	0.651896	0.651672	0.715527	0.778284	-0.29	-0.17119	0.746837	0.770692	0.908432	0.435491	1			
DO	-0.24805	-0.00565	-0.00652	0.192893	0.194663	-0.08254	-0.09367	0.260056	0.116181	0.075904	0.09824	-0.01965	1		
COD	0.034933	0.335265	0.334726	-0.03088	0.08334	0.01186	-0.21474	0.069323	0.093376	0.141058	0.284763	0.083908	0.050341	1	
BOD	-0.17457	0.067429	0.065582	0.317544	0.313063	-0.12371	-0.17105	0.290666	0.32089	0.136726	0.159511	0.029322	0.637931	0.242448	1

Conclusion:

This study shows that ground water is the only source for people in the study area and the results indicate not much considerable variation. In few areas TDS is comparatively high, thus if people drink water then health problems like stomach diseases and gastric troubles may arise. Total hardness is the main problem in this area. Also the contamination is found to be due to both anthropogenic as well as from geological sources. It must be noted that a regular analysis must be done to ensure that the quality of water in this area is not contaminated.

Observed results shows that the technology to be applied for the treatment of ground water is source dependent and in most cases, effective and simple treatment solutions are sufficient without blindly implementing RO Technologies.

Acknowledgements:

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