

# Assesment of Ground Water Quality - Polavaram Mandal, Westgodavari District, Andhra Pradesh, India

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## Abstract

Water is an essential resource for life on the earth. Ground water is the major source of water for drinking, agricultural, and industrial desires. India is the largest user of groundwater in the world. In major part of our country ground water is the main source of drinking water. In the present study polavaram mandal is chosen to assess the quality of drinking water. Samples were collected from all the 12 villages in the Mandal and assessed for the suitability of human consumption. Physico-chemical parameters such as PH, EC, Total Dissolved Solids, Total Hardness, alkalinity, Na, K, Ca, Mg, Fe, Cl, F, NO<sub>3</sub>, SO<sub>4</sub>, PO<sub>4</sub>, DO, COD and BOD were determined using procedure of standard methods. The statistical analysis of the samples yielded the range of the variation, mean, standard deviation and co-efficient of variation. The results of hardness were compared with WHO and ICMR standards.

## Keywords

Ground Water, Statistical Data, Hardness, Polavaram Manadal

## I. Introduction

The water is essential for humanbeing, since it is directly linked with human activities. It is a matter of history that fiscal pollution of drinking water causes water born diseases which wiped out entire population of these cities. At present, the water born diseases and epidemics still booms large on the horizons of developing countries. Water is the most widely distributed and abundant substance found in nature. Most of the planet is enriched with water, but most of this water is not used for drinking purpose, because 97% is sea water and only 3% is fresh water, out of which 2% is polar ice caps and glaciers, only 1% water is available for potable use. Human induced influences on surface water quality reflect not only waste discharge directly into a stream, but also include contaminated surface runoff. The quality of ground water is most commonly affected by waste disposed and land use. One major source of contamination is the storage of waste materials in excavations, such as pits or mines. Water soluble substances that are disrupted, spilled, spread or stored on the land surface may be filled eventually. One cause of water contamination is the disposal of waste materials directly on the land surface. Example sludge, garbage and industrial wastes. The waste may occur as individual mounds, or it may be spread over the land. If the waste material contains soluble substances, during the past two decades, investigators have taken a serious look at the environmental effects of dumps. As rain water infiltrates through trash in dump, it accumulates an ample assortment of chemical and biological substances. The resulting fluid or leachate may be highly mineralized and as it infiltrates, some of the substances it contains may not be removed or degraded .

Fertilizers and pesticides are highly toxic and in countless cases, quite mobile in the subsurface. Numerous compounds, however, become quickly attached to fine-grained sediments, such as organic matter and clay and silt particles. In many heavily fertilized areas, the infiltration of nitrate, a decomposition product of ammonia fertilizer has adversely affected ground water. The consumption of nitrate rich water leads to a disease in infants known as “blue babies” (methemoglobinemia). The extent of enteric diseases in different areas depends upon the extent to which certain water is exposed to contamination. The incidence of typhoid fever, bacillary dysentery, infectious hepatitis and other enteric infections in many countries may transmit through water. Cholera is still a wide spread water carried disease in some developing countries.

The main objective of the present study is to assess the quality of the ground water in polavaram mandal by determining various physico-chemical parameters by standard analytical methods. In present study for the analysis we collected 12 samples from different locations of polavaram mandal during three seasons. The 20 parameters were analysed and the results of analysis were compared with WHO and Indian standards.

## II. Study Area

The West Godavari district is one of the 13 districts of Andhrapradesh. It occupies an area of approximately 7700 square kilometres. It has 46 Mandals out of which 24 are in Upland Region. Study area comprises of 12 panchayats in Polavaram Mandal it lies between 17.20823 to 17.34725 Latitude and 81.60383 to 81.9988 Longitude. Geomorphologically the district can be divided into two major regions viz., alluvial deltaic region and upland areas. The deltaic region mostly constitutes black cotton soils and the upland areas are dominated by the red soils.

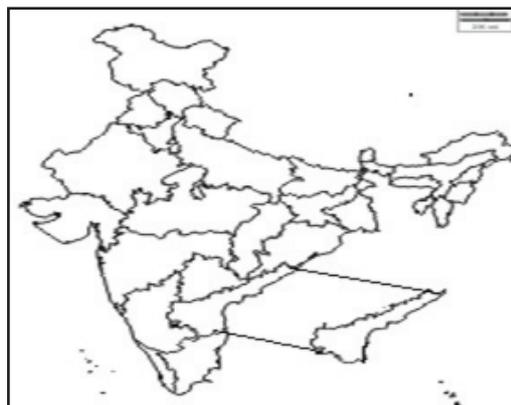


Fig. 1:View of AP in India

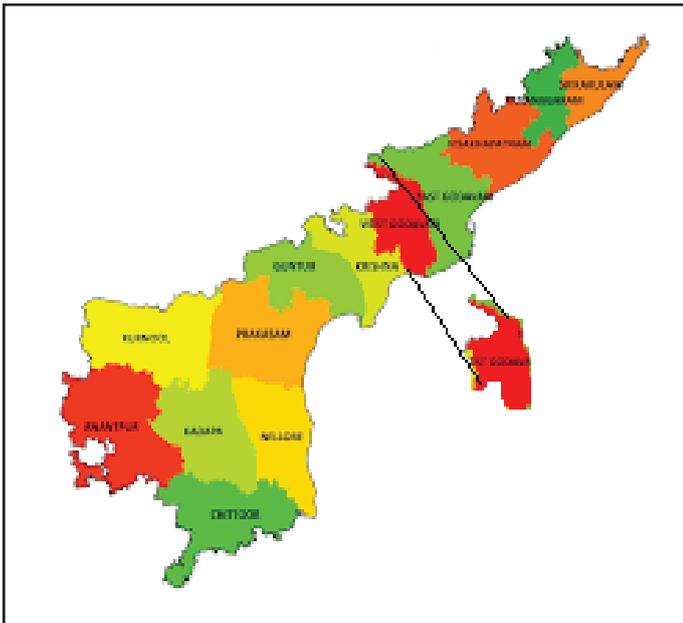


Fig. 2: View of West Godavari in AP



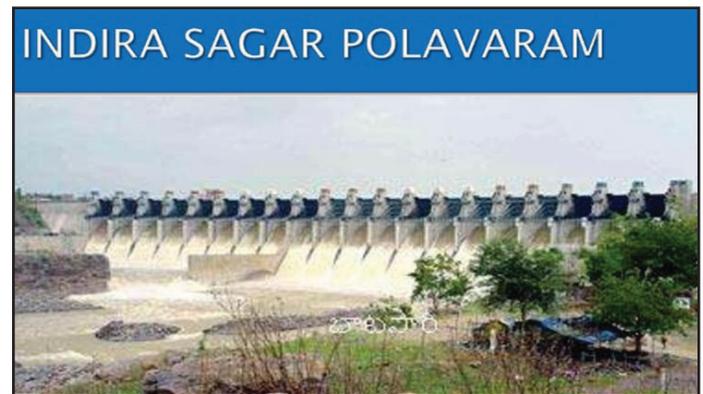
Fig. 3: View of Polavaram in West Godavari District

**III. About Polavaram**

In July 1941, the first conceptual proposal for the project came from the erstwhile Madras Presidency, later Diwan Bahadur and L. Venkatakrishna Iyer, the chief engineer in the Presidency’s irrigation department, made the first survey of the project site and made a definitive proposal for a reservoir at Polavaram. Sri Iyer not only visioned cultivation of 350,000 acres (140,000 ha) over two crop seasons through this project, but also planned for a 40 megawatt hydroelectric plant within the project. The entire project was estimated to cost about 65 millions. The old final designs of Polavaram dam was planned at full reservoir level (FRL) 208 ft MSL (Mean Sea Level) with 836 tmcft gross storage capacity and 150 MW hydroelectric plant. By 1946–47, the estimated cost rose to 1.29 billion. It was named the “Ramapada Sagar Project” since the backwaters of the reservoir would touch the Lord Rama temple at Bhadrachalam. In the old finalised project

design by Dr. K.L. Rao, the right bank canal of Polavaram project was extended to south of Krishna River to serve irrigation needs in old Guntur district by envisaging aqueduct across the Krishna River.

In 1980, the Chief Minister of Andhra Pradesh T. Anjaiah laid the foundation stone for the project. The project is stalled till YSR Reddy in 2004 the chief minister of AP took the project to work. YSR got the required permissions for the projects before he died. For polavaram project, Site clearance was obtained from the Centre on 19 September 2005, environmental clearance on 25 October 2005, R & R clearance on 17 April 2007, wildlife sanctuary clearance on 19 Sept 2008, forest clearance on 26 Dec 26 2008 and technical advisory committee clearance on 20 January 2009. Progress of polavaram hit road block post YSR death. later, Polavaram project is declared as national project through AP special re-org act in 2013.



**IV. Water Sampling**

In present investigation 12 water samples from Polavaram mandal are collected. The water samples were collected in polythene bottles which were cleaned with acid water and hot water followed by rinsing twice with distilled water. The water samples were analyzed by using procedures of standard methods.

**V. Objectives**

To assess the ground water quality and its suitability for drinking purpose in the study area.

**VI. Methodology**

The pH was measured by using Eutech ion- 2700 PH meter and EC was measured in electrical conductivity meter 304. Total hardness, calcium, magnesium were measured by EDTA titration methods. Total alkalinity was determined volumetrically. Sulphate was determined by Turbidimetric method using digital Nephelo turbidity meter 132. Fluoride and chloride content in water was determined by using ion selectivity meter Eutech ion -2700. The Physico-chemical analysis was carried out according to standard methods. Iron, nitrite and phosphate were determined by spectrophotometer. DO, BOD, COD were determined using standard methods.

Table 1: Mean values of September, January, May months data

Sample Code	pH	E.C	TDS	Alkalinity	Hardness	Sodium	Potassium	Calcium	Magnesium	Chloride	Fluoride	Sulphate	DO	COD	BOD
4:1:1S	7.66	1033.33	661.33	378.67	263.33	68.33	3.73	52.05	32.48	202.63	0.67	20.33	3.73	17.07	1.20
4:1:2S	7.51	700.00	448.00	336.00	188.33	31.33	9.37	46.04	17.86	75.63	0.56	14.67	3.87	22.93	1.33
4:2:1S	7.79	766.67	490.67	321.33	195.00	25.33	7.90	43.38	21.52	63.02	0.41	28.00	4.00	25.07	0.40
4:3:1S	7.78	700.00	448.00	329.33	138.33	22.67	9.73	24.03	19.08	29.76	0.99	30.33	3.93	19.20	1.07
4:4:1S	7.65	1333.33	853.33	638.00	273.33	12.03	5.40	57.47	28.67	87.13	1.80	44.67	4.00	15.47	1.33
4:5:1S	7.88	600.00	384.00	272.00	130.00	88.33	6.60	30.02	13.40	25.71	0.24	25.00	4.40	14.93	1.27
4:6:1S	7.99	700.00	448.00	393.33	230.00	13.27	2.07	49.43	25.98	25.87	0.19	8.00	4.53	17.60	1.33
4:6:2S	7.64	933.33	597.33	461.33	281.67	49.50	7.37	59.42	32.48	40.47	0.10	18.67	4.53	15.47	1.53
4:7:1S	7.80	633.33	405.33	260.00	168.33	20.83	7.90	43.39	14.62	52.07	0.19	15.67	4.27	12.27	0.80
4:7:2S	7.80	1000.00	640.00	383.33	210.00	48.00	6.40	51.43	19.89	40.08	0.20	40.33	4.87	32.00	1.13
4:8:1S	7.76	1366.67	874.67	603.33	311.67	52.00	4.27	58.79	40.19	598.00	0.45	49.00	4.00	21.87	1.00
4:9:1S	7.95	566.67	362.67	315.33	106.67	74.33	2.68	30.05	7.71	17.31	0.19	6.33	4.80	19.73	1.20

**VII. Results and Discussion**

Physical and chemical parameters of water samples have been tested. Which are collected from the study area. Physical parameters that were tested are TDS, EC, P<sup>H</sup>. While chemical parameters have been tested were TA, Cl, SO<sub>4</sub>, Ca, Mg, TH, Na, K, F etc. The results of analysis were then compared with and discussed with WHO standards.

**p<sup>H</sup>:** P<sup>H</sup> of the water is a measure of hydrogen ion concentration in water.(measure of balance between hydrogen ion &hydroxyl ion). The limits of p<sup>H</sup> value for drinking is specified as 6.5-8.5. The mean values of p<sub>H</sub> for the ground water samples in the study area varies from 7.65-7.99.which shows that in the study area the ph values are not exceeded the standard limit however these are slightly alkaline in nature. ph has no direct effect on human health but its higher ranges increases the scale formation in water heating apparatus.

**EC:** pure water is not a good conductor of electric current but a good insulator. EC is a measure of concentration of ion in water, which enhance the EC. The amount of TDS determines the EC. The mean values of EC of the ground water is varying from 566.67 to1366.67 μS/cm.

**TDS:** The water has the ability dissolves wide range of in-organic and organic minerals. These dissolved salts give unwanted taste & diluted colour to water. As per Who standards the TDS of water must be in the range of 50-200ppm.In the study area ,the mean values of TDS range is 362.67-874.67ppm.these ranges are acceptable and concentration of TDS is not harmful.

**ALKALINITY:** Alkalinity of water mainly is due to presence of hydroxide, carbonates and bi-carbonates. water requires moderate concentration of alkalinity to stable the effect of acidity. WHO standards of alkalinity are 300-600ppm. The mean values of the alkalinity ranges from 260-638ppm(sample no . 5 has high value of alkalinity, remaining all are within the range).indicating that only one sample exceeding the recommended limit.

**HARDNESS:** Hardness of water is characterised with high mineral content which are useful for human when they are present in th desirable limit. according to WHO standards hardness of water should be with200-400ppm. The mean values of hardness ranges from106.67-281.67ppm.which shows that all the samples

are within the range.

**SODIUM:** Sodium is a silver white metallic element and found in less quantity in water. Require range of sodium in water is desirable for human health as it presents many fatal diseases like kidney damages, hypertension, headache etc. The prescribed safe limit of sodium as per WHO is 200mg/l. The mean values of some of the ground water samples cross the limit, remaining all the samples are within the range of12.03-88.33ppm.

**POTASSIUM:** Potassium is necessary for human living organism functioning hence found in all animal and human tissues. its concentration is quite lowered compared to remaining parameters. But plays vital role in body function like heart protection, regulating of B.P, protein dissolution, etc. The mean values of potassium is observed between 2.07-9.73ppm which indicates all the samples are within the range.

**MAGNESIUM:** Magnesium is the 8<sup>th</sup> most abundant element on earth crust.It is essential for proper functioning of living organisms and found in minerals like dolomite, magnesite etc. The quantity of Mg is low except sample 5 .Remaining all other samples are in within the range 35-70 ppm .

**CALCIUM:** Calcium is 5th most abundant element on the earth crust and is an essential and nutritional element for humans. which prevents cardio disorder and proper functioning of metabolic process and is also useful for bones. About 95% of the calcium in human body &stored in bones and teeth. The high deficiency of calcium is cause rickets, poor blood clotting, bones fracture etc. The permissible range of calcium in drinking water as per WHO is 75-100 ppm. The mean values of calcium in the study area ranges from 24.03-59.42ppm

**CHLORIDE:** Chloride is mainly due to dissolution of NaCl, KCl, sewage waste etc.It is the important for the metabolism activity in human body and other main physiological process. According to WHO standards the concentration of chloride should be within 250-1000ppm. In the study area chloride mean values ranges from 24.03-59.42ppm thus all the sample have lower value of concentration of chloride.

**FLUORIDE:** The application of agricultural fertilizers, phosphates are the sources of fluoride in water. The mean value

of the fluoride in the study area ranges from 0.10-1.80ppm. which indicates that sample no.5 exceeding the the permissible limit of 1.5ppm. remaining all the samples are within the limits. excess of fluoride in water leads to fluorosis

**SULPHATE:** Sulphates concentration in the water ranges from 2000-400ppm as per the WHO standards. The mean values of sulphate ranges from 6.33-49.00ppm. the results exhibit that the concentration of sulphate is lower than the standard limit.

Table 2: Linear Correlation Analysis of Mean values of September, January, May months data

	pH	E.C	TDS	Alkalinity	Hardness	Sodium	Potassium	Calcium	Magnesium	Chloride	Fluoride	Sulphate	DO	COD	BOD
pH	1.000														
E.C	-0.417	1.000													
TDS	-0.417	1.000	1.000												
Alkalinity	-0.319	0.919	0.919	1.000											
Hardness	-0.437	0.858	0.858	0.817	1.000										
Sodium	0.156	-0.118	-0.118	-0.222	-0.209	1.000									
Potassium	-0.517	-0.224	-0.224	-0.306	-0.257	-0.276	1.000								
Calcium	-0.443	0.763	0.763	0.721	0.934	-0.228	-0.254	1.000							
Magnesium	-0.376	0.824	0.824	0.777	0.955	-0.149	-0.232	0.792	1.000						
Chloride	-0.186	0.684	0.684	0.587	0.614	0.144	-0.262	0.458	0.696	1.000					
Fluoride	-0.424	0.512	0.512	0.544	0.236	-0.408	0.120	0.105	0.243	0.077	1.000				
Sulphate	-0.261	0.791	0.791	0.654	0.474	-0.100	0.146	0.353	0.497	0.549	0.502	1.000			
DO	0.604	-0.300	-0.300	-0.192	-0.285	0.266	-0.322	-0.096	-0.396	-0.392	-0.576	-0.252	1.000		
COD	-0.034	0.145	0.145	0.009	0.009	0.004	0.098	0.080	-0.021	0.105	-0.151	0.341	0.197	1.000	
BOD	-0.193	0.116	0.116	0.293	0.200	0.223	-0.245	0.208	0.152	-0.137	0.096	-0.181	0.241	-0.273	1.000

The correlation coefficient matrix for the results of different water quality parameters mean values of September, January, May months data from polavaram Mandal is presented in tables 2 indicates that Alkalinity strongly co-related with TDS and EC (r=0.919,0.919 respectively).Hardness is strongly co-related with EC,TDS and Alkalinity(r=0.858,0.858 and 0.817 respectively) which indicates major part in TDS is taken by hardness producing salts. Ca & Mg strongly correlated with hardness(r=0.9340,0.955 respectively) and compare to all other. Cl-moderately correlated with Ca & Mg(r=0.458,0.696 respectively) SO42- is also moderately correlated with Ca & Mg(r=0.353,0.497).Alkalinity takes major part in the TDS which indicates water is basic in nature.

**VIII. Conclusion**

The laboratory analysis of physical and chemical parameters of collected water samples from polavaram Mandal indicating that almost all samples are suitable for drinking except sample no’s 5,11. The pH values of water were above the neutral limit (>7) and falls in the alkaline range .The values of TDS and TH are within the range .The TA values of all the samples are with in the range except sample no 5, which has more than 600 ppm .Some samples less than 300 ppm.The concentrations of Ca, Mg and So42- were below the desirable limit except in case of Mg for sample no 11.The Flouride concentration for sample no 5 is 1.8 ppm which has higher than the permissible liit remaining all the samples values below the desirable limit .therefore inorder to rescue precious human lives from water related diseases current study suggests regular monitoring of ground water quality should be practiced.

**IX. Acknowledgement**

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