

Groundwater Quality In a Part of Western Delta of Krishna River in Andhrapradesh

Ravipati Venkata Ramana

Abstract— The management of groundwater quality is essential as we are utilizing groundwater for agriculture, domestic and Industrial purposes throughout the world. A detailed study has been carried out to assess the ground water quality in Vaddimukkala and Mulukudur villages in Ponnur mandal of Guntur district, Andhra Pradesh. The study area is covered by Recent alluvium. Groundwater occurs under unconfined to semi-confined conditions. The groundwater is analyzed for various physico-chemical parameters like p^H , EC, Na^+ , Ca^{2+} , Mg^{2+} , k^+ , HCO_3^- , CL^- , SO_4^{2-} and NO_3^- . Values of most of these parameters fall beyond the standard limits for drinking water. The EC and SAR values indicate that the groundwater is not suitable for irrigation purpose. Suitable remedial measures are suggested for sustainable development of ground water in the study area.

Index Terms— Mulukudur, Groundwater, quality, Andhrapradesh, Alluvium, Krishna, River basins

1 INTRODUCTION

THE Location: The area is located south of Ponnur and lies in between East longitude $80^{\circ}32'40''$ and $80^{\circ}39'00''$ and North latitude $16^{\circ}00'$ and $16^{\circ}05'$ and shown in map enclosed (fig1). The Vaddimukkala and Mulukudur villages are situated west side of the Tungabhadra drain which drains north to southwards into Bay of the Bengal.

2 GEOLOGY OF THE AREA

2.1 Physiography

The area is plain and has gentle undulating topography. towards Bay of Bengal. In general the drainage is not well defined and small patches of the drainage pattern has developed as irrigation channels and drains.

2.2 Hydrogeology

The area is covered by alluvium of Recent age. The alluvium is consisting of both sands and clays in this area. The alluvium comprises of permeable coarse to medium sands and all along the Tungabhadra drain and also in and around the villages of Vaddimukkala and Mulukudur. The permeable sandy

deposits occur down to a depth range of 15 to 20m, underlain by thick clay in which the quality of ground water is saline. Fresh Ground water occurs in sandy aquifer all along paleo channels and is under water table to confined conditions. Ground water is extracted by means of shallow filter points for irrigation purpose. The depth to water level varies from 2.5 to 3.5m below ground level. The thickness of alluvium sands range from 12 to 15m.

3 QUALITY STUDIES

During the preliminary hydro geological investigations carried out in Vaddimukkala and Mulukudur areas, it is observed that in the recent past, quality of ground water has deteriorated significantly. This feature is predominant in the areas nearer to Tungabhadra drain. Keeping in view of this quality problem in this area, chemical analysis data of ground water samples for the years 1974, and four ground water samples collected in various directions from each village during post monsoon, November-2015 and Pre monsoon, May-2016 is considered and compared. The data is presented in the table below.

- Research scholar, Department of Geology, Acharya Nagarjuna University, Guntur District, A.P. and Assistant Professor, Department of Civil Engineering, Vignana's University, Vadlamudi, Guntur District, A.P. E-mail: ramanarv1992@gmail.com

TABLE 1
SHOWING THE CHEMICAL ANALYSIS OF GROUND
WATER SAMPLES IN VADDIMUKKALA AND MULUKUDUR
VILLAGES IN GUNTUR DISTRICT (IN MEQ/L)

Chemical Parameter	A-VADDIMUKKALA Village (Post- monsoon, November-2015)				
	1974	1	2	3	4
pH	7.80	7.94	7.95	7.90	7.92
E.C (micro siemens/cm)	1.80	2.55	2.58	2.57	2.53
CO ₃ (meq/l)	-----	0.4	0.42	0.45	0.43
HCO ₃	9.80	4.22	4.24	4.20	4.22
Cl	8.30	17.94	17.93	17.80	17.98
SO ₄	Trace	7.02	7.03	7.04	7.02
Ca ²⁺	2.20	2.82	2.83	2.80	2.87
Mg	4.30	4.16	4.14	4.10	4.12
Na ⁺	9.80	6.54	6.51	6.52	6.50
K ⁺	0.18	0.27	0.29	0.28	0.29
RSC	3.30	---	---	---	---
SAR	3.00	1.96	1.97	1.99	1.94
Ratio Cl/HCO ₃	0.84	4.25	4.23	4.24	4.26

Chemical Parameter	B – Mulukudur Village(Post monsoon, November-2015)				
	1974	1	2	3	4
pH	7.90	8.05	8.08	8.00	8.03
E.C (micro siemens/cm)	1.40	2.20	2.25	2.23	2.26
CO ₃ (meq/l)	-----	0.55	0.58	0.54	0.50
HCO ₃	10.20	4.31	4.34	4.30	4.32
Cl	5.00	18.36	18.31	18.00	18.27
SO ₄	3.30	3.82	3.76	3.89	3.85
Ca ²⁺	1.00	2.46	2.49	2.40	2.44
Mg	4.10	4.82	4.85	4.80	4.92
Na ⁺	7.10	4.32	4.38	4.34	4.39
K ⁺	0.08	0.36	0.32	0.35	0.38
RSC	4.90	---	---	---	---
SAR	3.20	1.54	1.51	1.49	1.52
Ratio Cl/HCO ₃	0.49	4.26	4.22	4.19	4.23

Chemical Parameter	A-VADDIMUKKALA Village (Pre- monsoon, May-2016)				
	1974	1	2	3	4
pH	7.80	8.52	8.57	8.54	8.56
E.C (micro siemens/cm)	1.80	2.72	2.73	2.71	2.70
CO ₃ (meq/l)	-----	0.64	0.62	0.60	0.63
HCO ₃	9.80	2.52	2.54	2.50	2.51
Cl	8.30	14.42	14.45	14.40	14.46
SO ₄	Trace	7.39	7.36	7.38	7.35
Ca ²⁺	2.20	5.65	5.62	5.60	5.66
Mg	4.30	15.93	15.94	15.90	15.96
Na ⁺	9.80	16.93	16.96	16.95	16.98
K ⁺	0.18	0.72	0.69	0.68	0.70
RSC	3.30	---	---	---	---
SAR	3.00	9.18	9.15	9.13	9.14
Ratio Cl/HCO ₃	0.84	5.74	5.74	5.76	5.73

Chemical Parameter	B – Mulukudur Village(Pre monsoon, May 2016)				
	1974	1	2	3	4
pH	7.90	8.52	8.56	8.50	8.54
E.C (micro siemens/cm)	1.40	2.50	2.53	2.54	2.52
CO ₃ (meq/l)	-----	0.98	0.96	1.00	0.98
HCO ₃	10.20	2.58	2.55	2.60	2.54
Cl	5.00	17.51	17.52	17.50	17.55
SO ₄	3.30	4.98	4.96	5.01	4.97
Ca ²⁺	1.00	6.04	6.03	6.00	6.06
Mg	4.10	11.16	11.11	11.10	11.12
Na ⁺	7.10	18.34	18.29	18.26	18.31
K ⁺	0.08	0.57	0.53	0.55	0.58
RSC	4.90	---	---	---	---
SAR	3.20	9.58	9.66	9.62	9.60
Ratio Cl/HCO ₃	0.49	6.79	6.87	6.73	6.91

TABLE 2
CHLORIDE/BICARBONATE RATIO AS PER
REVELL'S CLASSIFICATION

S. NO	Name of Category	Range Ratio of Chlorite/ Bicarbonate
1	Non-contaminated (fresh water)	<1
2	Slightly contaminated	1-2
3	Moderately contaminated	2-6
4	Injuriously contaminated	6-15
5	Highly contaminated	15-25
6	Very highly contaminated sea water	>25

It is observed from table-1 that the Chloride / Bicarbonate (Cl/HCO_3) ratio of ground water in Vaddimukkala area is 0.84 in 1974 ranges from around 4.25 to 5.74 during post monsoon, November-2015 and Pre monsoon, May-2016 respectively. The Chloride /bicarbonate (Cl/HCO_3) ratio is 0.49 in Mulukudur area in 1974 ranges from around 4.23 and 6.83 during post monsoon, November-2015 and Pre monsoon, May-2016 respectively. Thus so an attempt is made to estimate the contamination of ground water in study area.

Chloride is dominant anion of ocean water, and normally occurs in only small amounts in fresh ground water. On the other hand, bicarbonate is usually most abundant anion in ground water and occurs in only minor amounts in sea water. The chloride-bicarbonate ratio, more than 2.5 indicates the injuriously contaminated ground water with sea water. Accordingly the ratio is 0.84 in Vaddimukkala and 0.49 in Mulukudur during the year 1974 indicates that there is no contamination of ground water during that period. The ratio in Vaddimukkala and Mulukudur villages ranges from 4.25 and 4.23 in post monsoon, November-2015 to 5.74 and 6.83 in the Pre monsoon, May-2016 respectively indicating the injuriously contamination of ground water with sea water.

The quality deterioration of ground water in the area may be due to increasing in ground water development through filter points and subsequently ingress of back waters from Tungabhadra drain. The number of filter points increased to 200 in Chintalapudi and 250 in Machavaram areas.

In the study areas the aquifer is highly potential because of paleo channel (old buried river channel) which runs north

to south and passing through the villages of Vaddimukkala and Mulukudur.

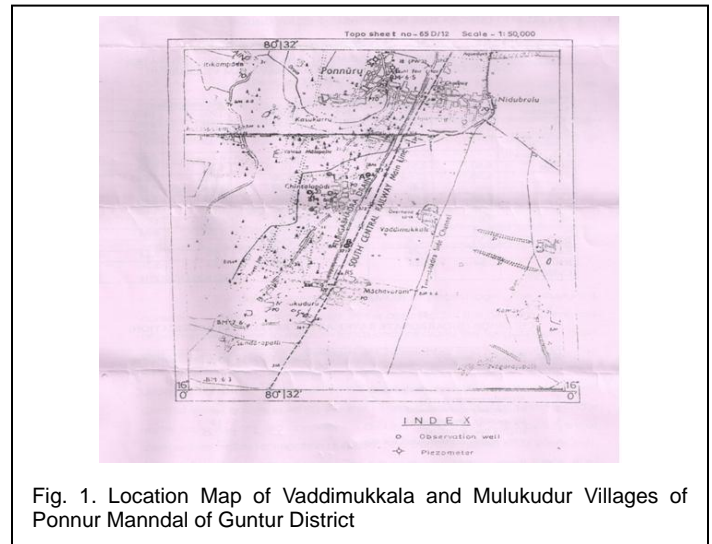


Fig. 1. Location Map of Vaddimukkala and Mulukudur Villages of Ponnur Mandal of Guntur District

In spite of the fact that the exploitation of ground water in the area is more, there is no declination of water table because of potential aquifer in the burned channels.

The more or less stable ground water level maintained also may be due to the contribution of back water from drain. These two factors are responsible for stable condition of the water table. This stable nature of water table is confirmed with water levels recorded in Ponnur and Bapatla Observation wells. It is observed that in Ponnur observation well, the water level varies between 0.97 to 3.5m below ground level. In Bapatla observation well, the water level varies from 0.85 to 2.35m below ground level. However, the studies indicated that the wells which are nearer to the drain shows a decrease in ground water quality than the wells which are far away. The quality deterioration is due to the discharges of back water from Tungabhadra drain into the ground water. It is observed that the Tungabhadra drain is almost on the Paleo channel. But the effect on the quality of ground water is observed only from villages of Vaddimukkala and Mulukudur upto which back water from sea is observed.

4 CONCLUSION

Based on the hydrogeological investigations and considering the historical quality data, it is opined that in the villages of Vaddimukkala and Mulukudur closer to the Tungabhadra drain show deterioration of quality observed that the ingress of back water from Tungabhadra drain into ground water causes for the deterioration of quality.

Keeping in view of the above problem, the following measures can be taken up to prevent deterioration of ground

water qualify in the area.

1. Tidal regulators are to be constructed on the drain to prevent back waters in the area at suitable places after consulting with Drainage Engineers.
2. Exploitation of ground water to be controlled and regulated.
3. Artificial recharge wells are to be constructed in the contaminated area. For recharging these wells, surface water from canal can be used. However the quality of ground water cannot be improved by constructing the recharge wells, unless the prevention measures are taken to arrest the back water from the drains.
4. The ground water department will monitor the quality of ground water by establishing observation wells in the area.

REFERENCES

- [1] Ground water information of Guntur district, Andhra Pradesh cgwb.gov.in/district_profile/ap/guntur.pdf
- [2] Mustafa, W. Somasundaram, S.S.N., Shahul Hameed, P. and Palaniappan, R. (1999). Evaluation Of Ground Water Quality In Tiruchirappalli City. *Indian J. of Environ. Protection*. 19 (4); 284 – 289.
- [3] Note on Ground water quality of Ponnur Mandal in 1974 by A.P. STATE GROUND WATER BOARD.
- [4] **Hydrogeology: Principles and Practice [Import] [Paperback]** Kevin Hiscock (Author)
- [5] **Applied Hydrogeology (4th Edition) [Hardcover]** [C.W. Fetter Jr](#)
- [6] A comprehensive Hydrogeochemical Assessment on Groundwater Quality Along the Four Lanned National Highways 7 Corridor in Tamilnadu.—Indian journal Environmental Protection, Vol.34, No.9, September 2014. P.n0:753-764.
- [7] Assessment of physico chemical quality of drinking water in tribal areas of Madagada Panchayat, Araku Valley Mandal, Vishakhapatnam District, A.P. India. P.no:41.—National seminar on Renewable Energies, Ecosystem and Sustainable Environmental Management 20-21, February, 2014.
- [8] An assessment of water quality in 16 bore wells of Autonagar, Vijayawada city. P.no:42.—National seminar on Renewable Energies, Ecosystem and Sustainable Environmental Management 20-21, February, 2014.
- [9] An assessment of water quality at Badvel Municipality, Kadapa District, A.P.-India. P.no:50.—National seminar on Renewable Energies, Ecosystem and Sustainable Environmental Management 20-21, February, 2014.
- [10] Groundwater Monitoring and Management through hydro geochemical modeling approach by S.Chidambaram, K.Srinivasamurthy.www.ikbooks.com-- J.K. International Publishing House Pvt.Ltd.
- [11] Recent trends in water research hydrochemical and hydrological principles by Al. Ramanathan, R. Arthar James.
- [12] An assessment of groundwater resources and management by D.Chandra Shekaran, S.K.Singh
- [13] Alfred P. Bernhart. (1973). Protection Of Water Supply Wells From Contamination By Wastewater. *Ground water*. 11 (3); 9 – 15.
- [14] APHA (1995) standard methods for examination of water and

wastewater. American Public Health Association, Washington.

- [15] Sheryl, R.W., Sherry, L.S. and John, A.C. (1994). Biogeochemical Evaluation Of Domestic Wastewater In Septic Systems. Conceptual Model. *Groundwater*. 32 (6); 905-920.
- [16] Purandara, B.K., Varadarajan, N. and Jayashree, K. (2003). Impact Of Sewage On Ground Water Quality – A Case Study. *Poll. Res.* 22 (2); 189 – 197.
- [17] Tole.M.P. (1997). Pollution Of Ground Water In The Coastal Kwaile District, Kenya. Proceedings of the 5th scientific assembly of the international association of hydrological sciences, Rabat, Morocco 240; 287 – 297.
- [18] Shriparna Saxena and Paradeep Shrivastava (2002). Ground Water Quality Of A Typical Urban Settlement: A Case Study Of Impact Of Town Planning. *Pollution Research*. 21 (2); 223 – 226.
- [19] Sinton.L.W. (1986). Microbial Contamination Of Alluvial Gravel Aquifers By Septic Tank Effluent. *Water, Air and Soil pollution*. 28 (3-4); 407 – 425.