PHYSICO-CHEMICAL AND COMPARATIVE ANALYSIS OF UNDERGROUND WATER OF MOGALTHUR MANDAL, WEST GODAVARI DISTRICT IN ANDHRA PRADESH, INDIA

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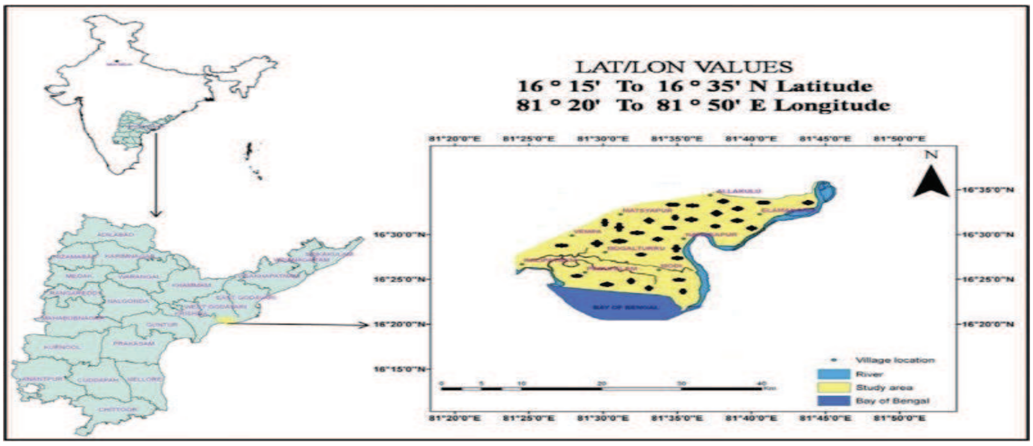
Abstract: Due to naturally occurring and anthropogenic activities the quality of ground water has been deteriorating all around world. In this study the physical-chemical characteristics of ground water samples were investigated in pre- monsoon season (April-May) with a view to identify the groundwater quality for its potability and irrigational use. The water samples were collected across 15villages of West Godavari district, Andhra Pradesh in Mogalthur mandal. The samples collected were analyzed for pH, Colour, TDS, EC, Total alkalinity, Total hardness, Turbidity, Calcium, Sulphates, Nitrates, Chlorides, Iron and Fluorides. The results show salinity slightly high, which is a clear indication of change in the quality of ground water due to excessive irrigational and aqua cultural activities, cautioning appropriate steps that have to be initiated to maintain the sustainability of the ground water eco system.

Keywords: Ground water, Sustainability, Eco system, Bore wells, TDS.

Introduction: Water is called elixir of life and is a basic commodity on planet Earth without which life is not perishable. It is difficult to visualize the sustenance of any life forms without this resource. Knowing this fact, the human race continues to pollute this resource both by its actions and deeds. It was estimated that nearly 780 million people in the world lack access to good quality drinking water while around 2.5 billion people lack improved sanitation [1]. In India it was estimated that about 65% of water used for irrigation and 85% of drinking water sources depends on ground water resources. However, it was estimated that within the next 20 years, 60% of groundwater resources will be in a critical state of degradation if current usage of ground water continues. Under natural conditions groundwater is generally fresh, but may not of good chemical quality. India's declining ground water resources both in quality and quantity is a product of many driving factors. Though groundwater contamination is due to natural and anthropogenic activities, ground water pollution is mostly due to knowingly or unknowingly human activities. In most parts of India, groundwater is used intensively for irrigation as well as for industrial purposes, resulting water pollution or degradation of ground water resources [2]. The over-exploitation of ground water is not only causing aquifer contamination but also more mineralization of ground water. Generally near the seacoast marine components dominate while the terrestrial components and anthropogenic activities dominate in arid areas. Human activities have a high impact on water quality in and around highly populated and intensive agricultural area [3]. In India, groundwater is not only used for irrigation but also for drinking and other purposes. People living in those areas where high concentration of different pollutants present in ground water used for drinking will be effected by water borne diseases like cholera, fluorosis, jaundice, typhoid etc, severalty is more in premature babies and in infants [4]. In this study we discussed about quality of ground water in a rural set up of West Godavari district of Andhra Pradesh, India (Fig. 1).

Fig. 1 Location map of study area



Material and Methods: Study area: The present paper focuses on the paddy rich area of Mogalthur mandal of West Godavari district, Andhra Pradesh, India. The study area is a part of river Godavari delta. Besides domestic use, ground water is liberally used for agriculture, aquaculture and industrial activities.

Material and Methods: As per the standard procedures laid down by Central Pollution Control Board, India groundwater samples from the study area were collected in clean polyethylene bottles of capacity 2 liters and brought to the laboratory for the physical and chemical analysis [5]. All the chemicals used for analysis were of AR grade. The ground water samples were analyzed for pH, colour, total dissolved solids (TDS), electrical conductivity (EC), alkalinity, total hardness (TH), turbidity, calcium, sulphates, nitrates, chlorides, iron and fluorides following standard methods [6]. The physico-chemical analysis of ground water samples are presented in Table 1. Each value included in the table is an average of three analyses.

Tab.1 Parameter wise observed range and mean values of ground water

S.No	Parameter	Observed range	Mean	DrinkingWater Standards (IS-10500: 2012)	
				Acceptable	Maximum Permissible limits
1	pH	6.81 – 7.91	7.39	6.5-8.5	No relaxation
2	Colour Hazen units	0-20	4.19	5	15
3	TDS (mg/l)	238 – 2868	1384.8	500	2000
4	EC µmho/cm	548 – 7305	2228	1500	3000
5	Alkalinity (mg/l)	208 – 1296	526.14	200	600
6	Total Hardness (mg/l)	188 - 1864	611.56	200	600
7	Turbidity NTU	1.3 – 7.9	3.62	1	5
8	Calcium (mg/l)	31.2-158.4	103.28	75	200
9	Sulphate (mg/l)	10.2 – 115.6	49.13	200	400
10	Nitrate (mg/l)	0.93 – 24.6	8.02	45	Nil
11	Chloride (mg/l)	78.9 – 1222	317.72	250	1000
12	Iron (mg/l)	0.22 – 0.99	0.57	0.3	Nil
13	Fluoride (mg/l)	Nil	Nil	1	1.5

Results and Discussion: The pH range of ground water samples in the study area ranged between 6.81–7.91, the mean value was 7.39; this shows that many of the water samples were slightly alkaline in nature and well within the permissible levels of IS 10500. If water possesses more pH vale toxic trihalomethanes will be developed, on other hand water with pH below 6.5 results corrosion in pipes [7].

In the study area observed colour of ground water samples lies between 0 – 20 Hazen units with a mean of 4.19. Colour to ground water arises due to presence of organic matter like leaves, wood etc. The reason for colour of water is due to decomposition of lignin resulting emission of humic acid. Sometimes vegetable extracts may also contribute to colours.

The total dissolved solids (TDS) in the study area ranged between 238 – 2868 mg/l, the mean value was 1384.8 mg/l. The increase in TDS of ground water samples was due to inorganic salts, organic matter and dissolved gases. Table-2 shows the classification of groundwater based on TDS. The results show that the groundwater is slightly saline indicating preventive strategies in the study area.

Tab. 2 Classification of groundwater based on TDS			
S. No	Water Type	TDS (mg/l)	No. of samples exceeds the limit
1	Non saline	<1000	09
2	Slightly saline	1000-3000	05
3	Moderately saline	3000-10000	01
4	High saline	>10.0000	Nil

The capacity of water to conduct electricity is measured as electrical conductivity. The water samples in the study area exhibit electrical conductivity between 548 – 7305 µsiemen/cm with a mean of 2228 µsiemen/cm. The groundwaters exhibit high electrical conductivity due to the presence of excess dissolved salts in ionic form in the study area. The classification of electrical conductivity of the study area is shown in Table-3. The results indicate that the ground water quality of the study area is within the permissible limits and fit for drinking.

Tab. 3 Classification of groundwater based on EC			
S. No	Water Quality	EC(µsmn/cm) at 25^{o}C	No. of samples exceeds the limit
1	Excellent	<250	00
2	Good	250 – 750	09
3	Permissible	750 – 2000	05
4	Doubtful	2000 - 3000	01
5	Unsuitable	>3000	00

In the study area alkalinity of the water samples are observed between 208 – 1296 mg/l, the mean value is 526.14 mg/l. The acceptable range of alkalinity is about 200 mg/l. The observed results indicate the water shows moderate to high alkaline nature. The reason for showing a little high alkalinity may be due to mineral rich soil of the study area. The high alkalinity in water is due to presence of bicarbonates, carbonates, phosphates, silicates and small amounts of organic acids. The presence of ammonia and hydroxide ions also contribute high alkalinity.

The major ions that cause hardness to water are carbonates, magnesium, strontium, calcium and manganese. In some cases hardness in water prevents corrosion in water pipes and prevents the entry of heavy metals into the water [8]. The total hardness of water samples in the study area ranges between188 to 1864 mg/l; the average value is 611.56 mg/l. The results indicate that the total hardness of the water samples exceeds the acceptable limits of IS 10500 standards.

Turbidity has no direct effect on human health but can interfere with disinfection and provide a medium for microbial growth. The increase in turbidity could be attributed due to soil erosion in nearby catchments and massive contribution of suspended solids from sewage canals. Another reason for this increase may also be due to surface runoff and domestic wastes. The observed value of turbidity in the study area is between 1.3 – 7.9 NTU, with an average value of 3.62 NTU. In some locations of study area the value of turbidity shows more than acceptable level of IS10500 standards, which indicates presence of suspended and colloidal particles.

Calcium is one abundant element found in natural waters. The ground water with high calcium level cannot be used for washing clothes, bathing and laundering purposes. But small amounts of calcium in water reduce corrosion of pipes. The observed value of calcium in the study area is between 31.2 mg/l to 158.40 mg/l, the average value is 103.28 mg/l. This shows the ground water is slightly excess in calcium than desirable according to IS10500 standards.

Sulphates and nitrates in the study area ranged between 10.2 – 115.6 mg/l and 0.93 – 24.6 mg/l, the average values are 49.13 mg/l and 8.2 mg/l respectively. Sulphate and Nitrate ions are the major anions in natural waters due to oxidation of sulphite ores, gypsum in solution form, animal and human wastes, fertilizers, chemicals used in agriculture and aqua culture. A disease called 'methenoglobinemia' may be observed in infants, if the high concentration of nitrates is observed in drinking water [9, 10]. The results obtained shows that in the study area the ground water is not contaminated either by sulphates or nitrates.

Chlorides in ground water are due to the presence of minerals like mica and apatite. The other source of chloride contamination is human excreta and urine, generally chlorides enters in to human body with food. Chlorides ranged from 78.9 – 1222 mg/l with a mean value of 317.72 mg/l, the acceptable limit is 250mg/l, indicating excess concentrations of chlorides. In addition, leachate from landfills also adds a small amount of chloride to ground water.

The concentration of iron in the samples analysed ranged between 0.22 – 0.99 mg/l, the mean value is 0.57 mg/l exceeding the 0.3mg/l specified by IS10500. The excess levels of iron in the ground water samples of the study area is one major cause of rusting of pipes used for water flow, non usage of bore wells for a long time, percolation of iron contamination through space between bore hole and the sassing pipe, disposal of iron scrap in open fields etc.

Fluoride is an essential element but deficiency or excess of fluoride in drinking water may lead serious health effects like fluorosis. Fluoride enters into human body by drinking water directly [11]. Fluoride in water samples from the study area is either not traced or within the permissible range.

Conclusion: We may conclude that in the study area ground water pollution becoming more and more in comparison with the surface water pollution. Majority of water quality parameters of the ground water samples analyzed from the study area are either crossing the permissible levels or at the threshold of IS-10500 standards. The results indicates that the complex system of interactions between basic environmental components is very often complicated by anthropogenic activities gradually deterioting the groundwater resource with time. Hence, there is an immediate necessity to initiate mitigation strategies to enhance the quality of the ground water regime.

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References:

1. UNICEF: 2012. Progress on sanitation and drinking water-update 2012, pp 8-9.
2. Yadav Janeswar, Pathak R.K. and Khan Eliyas., 2013, Analysis of Water Quality using Physico – chemical parameters Satak Reservoir in Khargone District, M.P, India, *International Research Journal of Environmental Sciences,* 2(1), 9-11.
3. Appelo, C.A.J., and Postma, D., 1993, Geochemistry, groundwater and pollution: Rotterdam, A.A. Balkema, p 536.
4. Bhattacharya T., Chakroborty S. and Tuck Neha, 2012, Physico Chemical Charaterization of Groundwater of Anand District Gujarat, India, *International Research Journal of Environmental Sciences,* 1(1), 28-33.
5. CPCB,2008, Guidelines for Water Quality Management, CPCB.
6. APHA, AWWA and WPCF:1995, Standard methods for the examination of water and waste water. 19th Edition., APHA New York.
7. Suryanarayana, K.:1995, Effect of groundwater quality on health hazards in parts of eastern ghats. *Indian J. Environ. Protec.,* 15(7), 497-500.
8. Li Peiyue, Wu Qian and Wu Jianhua., 2011, Groundwater Suitability for Drinking and Agricultural usage in Yinchuan Area , China, *International Journal of Environmental Sciences*, 1(6), 1241-1249.
9. Ramachandra, S., A. Narayanan and N.V. Pundarikathan: 1991, Nitrate and pesticide concentrations in groundwater of cultivated areas in north Madras. *Indian J. Environ. Hlth.,* 33(4), 421-424.
10. Spalding, R. and M. Exner: 1993, Occurrence of nitrate in groundwater: A review. *J. Environ. Qual.,* 22, 392-402.
11. Dinesh, C.:1999, Fluoride and human health – cause for concern. *Indian J. Environ. Protect.,* 19(2), 81-89.

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