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Assessment Of Groundwater Quality In Rural Areas Of Vijayawada, A.P.

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Abstract:

The small portion of available fresh water for human consumption is being contaminated by various anthropogenic sources at a very alarming rate. With this view an attempt was made to assess the quality of groundwater in rural areas of Vijayawada by examining various physico – chemical parameters such as colour, turbidity, odour, pH, electrical conductivity, total dissolved solids, alkalinity, hardness, nitrate, sulphate, chloride, fluoride, iron and magnesium, to check the suitability of water for human consumption. Except hardness all most all parameters in the collected ground water samples are within the permissible limits given by WHO, ISI ICMR.

Introduction

Water is one of the abundantly available substances in nature and also called elixir of life. Water plays an important role in the wealth of a nation, particularly like India, Which is predominantly an agriculture dependent economy. The importance of water for the existence of life need not be over emphasized.

Ground water is the major source for drinking and domestic purposes in both rural and urban areas. Besides, it is an important source for both agriculture and industrial sectors. It has been considered as a dependable source of uncontaminated water.

The above situation is changing very rapidly and at a very alarming rate due to pollutants from various sources. Although water can be polluted naturally, due to higher degree of minerals present in the soils and rocks, the quality of ground water may vary from place to place. In addition to above, rapid population growth, increasing living standards, untreated municipal and industrial waste - waters, fertilizers, application of pesticides, sewers and landfill areas are the potential sources of groundwater pollution. Water pollution is considered with great concern, since the quality of water is of vital importance for mankind and it is associated with human welfare. With this view, the present investigation was carried out to assess the groundwater quality, as groundwater is the only source for drinking, domestic and as well as other purposes in the study area.

Study Area

A part of Vijayawada and its rural areas such as Ramavarappadu, Prasadampadu, Enikepadu and Nidamanuru constituted in the study area, which are located at $16^{0}31^{1}$N longitude and $80^{0}37^{1}$E latitudes of krishna district, A.P.

Vijayawada is the third largest city in Andhra pradesh and its population is around 15 lakhs. Vijayawada and its rural areas are situated on the bank of the River Krishna along NH5. In and around the study area, Indrakiladri hills and detached outcrops are observed. The major Geological formations comprise of khondalite suite of gneissic rocks and their variations. Hydrogelogically, these rocks are known as Crystallione metamorphic rocks with lack of primary porosity and hydraulic conductivity. However, the secondary porosity is produced due to weathering and deformation to store and transmit the groundwater. The groundwater flow is towards east. The regional trend of the geological formations is North – East and South – West. The climate is dry during December to February and hot from March to June. The study area is developed on flat top clayey soils and gravel mixed with clay near hill areas. Due to heavy rainfall, the entire study area gets flooded, beacause of flat topography and absence of effective drainage system.

The main groundwater recharging areas in the study area are Krishna River and Eluru canal. The Krishna River is passing on south side and Eluru canal passes on North – East of the study area. The groundwater levels in open-dug and bore wells are varying from 2 to 3 mts below the ground level. The

study area located on the North – East side of the Vijayawada city, which is an industrial area (Autonagar) and includes four contignous villages namely Ramavarappadu, prasadampadu, Enikepadu and Nidamanuru. A drain called Guntathippa, discharges the industrial and domestic effluents of Autonagar and other surrounding residential areas into Eluru canal. The Guntathippa drain flows on South – East side of Prasadampadu village. Prasadampadu, Enikepadu and Nidamanuru are recently well developed on flat agricultural fields, where as Nidamanuru is situated in low lying area.

Materials and Methods

Two liters of groundwater samples were collected in a clean polyethylene bottles from all the sampling locations in open - dug wells and tube – wells in the study area after operating the pump for 15minutes. Totally twelve ground water samples were collected, three from each village with necessary precautions, for determination of physico – chemical parameters. The water samples were subjected to physical and chemical analysis by Internal Water Quality Monitoring Laboratory, Rural water supply and Sanitation Department, Vijayawada, Government of A.P.

Results and Discussion

The physico chemical characteristics of groundwater in the area of investigation are given in Table-1. There is little variation in the physical characteristics of groundwater, whereas the changes have been observed in the chemical parameters of the groundwater in the study area.

The Hydrogen ion concentration (pH) is an important factor in water analysis, since it enters into the calculation of acidity, alkalinity and the processes like coagulation, disinfection and corrosion control. The pH of water indicates the form in which the carbon dioxide is present. A change of pH from 6 to 7 indicates that there is a tenfold decrease in the hydrogen ions concentration. In a similar fashion, a change of pH 7 to 8 indicates a tenfold increase in hydroxyl ions. In all the sampling locations of the study area, the pH values of groundwater varied from 7.2 to 7.74, which is reported as alkaline in nature and also within the permissible limits of drinking water (WHO 1971, ISI 1991)

Drinking water quality is affected by the presence of soluble salts. The total dissolved solids (TDS) up to 500 to 1500 mg/l is permitted for drinking as well as other domestic purposes as per the standards. TDS also affect the strength and durability of concrete and palatability of food cooked. The TDS concentration in the present study ranged from 472 to 1599 mg/l. A slightly higher concentration of TDS recorded at Nidamanuru (N_1) due to organic and inorganic salts from paddy fields. Water containing high TDS concentration may cause constipation effects on humans (Kumara swamy,1991)

Electrical conductivity (EC) is a measure of the salt content of water in the form of ions. EC values ranged from 726 to 2460 µ mohs/cm. There is an increase of EC value at Nidamanuru due to the presence of salts in clayey soils. A sudden rise in Electrical Conductivity in the water indicates addition of some pollutants to it (Trivedi and Goel, 1986). The area Nidamanuru (N_1) is having the highest Electrical Conductivity and also has the highest pH.

Chloride occurs naturally in all types of waters. High concentration of chlorides is considered to be the indicators of pollution due to high organic wastes of animal or industrial origin. Human body releases a very high quantity (6 grams per person per day) of chloride (Sharma and Pande, 1988). From the present observation in the study area, maximum (440 mg/l) and minimum (104 mg/l) chloride values are reported in Nidamanuru (N_1 & N_2) among all the sampling locations. Higher concentration of chlorides may be due to improper disposal of sewage wastes and feeding of salt to certain type of trees like coconuts in the study area. Excess chloride cause vascular problems, salt taste to water, steel corrosion and reduced the strength of concrete.

Alkalinity is a measure of ability to neutralize acids. Excess alkalinity gives bitter taste to water and reacts with cations forming precipitates, which can damage the pipes, valves, etc. However, some alkalinity is required for drinking water to neutralize acids, such as lactic acid and citric acid produced in the human body. Minimum and maximum alkalinity values in the study area ranged from 92 to 420 mg/l at Nidamanuru locations N_2 & N_1 respectively.

Hardness is the chemical property of water, which prevents the formation of lather with soap, caused mainly by the multivalent metallic cations like calcium, magnesium, iron and strontium. Waters with hardness greater than 300 mg/l may lead to heart and kidney problem. It is reported that total hardness varying from 168 to 620 mg/l during investigation. In almost all the sampling locations of the study area, the total hardness is within the desirable limits, except at Nidamanuru (N_1). It is mainly due to calcium, magnesium and chlorides in domestic sewage and subsurface clayey soils.

Water in contact with natural deposits such as topaz, fluorspar and criolite are found to contain excess fluoride. The fluoride concentrations in all the

groundwater samples of the study area are found within the permissible limits.

In groundwater's, most of the Nitrogen is found in the form of Nitrates. If these waters show an appreciable amount of nitrates as much as 45 mg/l, which adversely affect the health of children, producing a disease called Methylhaemoglobinaneamia or Blue Baby Syndrome, which results skin colour becomes dark, the child falls sick, vomits and in extreme cases dies. Nitrate concentration in all the sampling locations are reported as within the permissible limits (less than 45mg/l), except at location N_1 in Nidamanuru (48mg/l). The higher concentration of Nitrates in the study area may be due to the decomposition of organic wastes from paddy fields.

Calcium is the major constituent of most of the igneous, sedimentary and metamorphic rocks. The main sources of calcium content in groundwater are weathering of Plagioclase feldspar, pyroxenes, limestone and gypsum. The calcium values reported in the study area are varying from 64 to 220 mg/l, which are within the permissible limits, except at Nidamanuru (N_1) sampling location.

Conclusions and Recommendations

In the present study areas such as Ramavarappadu, Prasadampadu, Enikepadu and Nidamanuru, groudnwater is the only source exploited by the people through number of shallow tube – wells and open - dug wells for drinking, domestic and other purposes. The investigation revealed that all most all the physical and chemical parameters are within the permissible limits of standards, except at Nidamanuru (N_1) near FCI Godowns. Higher concentrations of all the chemical parameters are reported at the above location due to sewage, poor drainage systems, as well as the sampling location was situated in paddy field. Hard waters are noticed in almost all the sampling stations due to excavation of wells in clayey soils. Hence groundwater in all the sampling sites, can be used safely for drinking and domestic purposes after proper treatment.

After thorough observation of the study area and chemical analysis of the groundwater samples, the following suggestions are made.

1. Environmental awareness among the people regarding environmental pollutions, particularly different ways of groundwater pollution aspects to be created.
2. The provision of underground drainage system has to be adopted, to check the percolation of sewage water in to the sub-basins.
3. Providing adequate drainage system with proper treatment before disposal of wastes and also removal of faulty constructed lined or unlined septic tanks and cesspools, which may restrict the deterioration of groundwater quality.
4. Eucalyptus (Nilagiri) trees can be grown at the sides of streets and roads. Such trees consume more water and hence water logging problem can be avoided in the study areas.
5. Each house is to be taken as unit and sewage is let enter into the septic tank. Then only the treated effluents from the septic-tank is allowed to go into the outside drain.

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Table – 1: Physical and Chemical parameters in the study area

S.No	Parameter	Sampling Locations												
		R_1	R_2	R_3	P_1	P_2	P_3	E_1	E_2	E_3	N_1	N_2	N_3	Limits as per IS 10500-1991
1	Colour	2	2	2	2	2	2	2	2	2	2	2	2	5-25
2	Turbidity (in NTU)	2	2	2	2	2	2	2	2	2	2	2	2	5-10
3	Odour	Un objectinable												Un objectinable
4	P_H	7.2	7.3	7.4	7.6	7.5	7.6	7.6	7.5	7.4	7.74	7.2	7.6	6.5-8.5
5	Electrical Conductivity	880	1020	1048	1198	1260	1280	940	1080	1060	2460	726	1740	2500 µ mohs/cm
6	Total Dissolved Solods	572	663	681	779	819	832	611	702	689	1599	472	1131	500-2000mg/l
7	Alkalinity	112	124	140	164	180	188	120	128	128	420	92	268	200-600
8	Total Hardness	212	236	260	288	300	304	228	252	248	620	168	408	300-600
9	Carbonate Hardness	112	124	140	164	180	188	120	128	128	420	92	288	75-200
10	Calcium	80	88	100	112	116	120	84	100	100	220	64	140	75-200
11	Nitrate	14	16	18	20	22	22	16	18	18	48	12	28	45.100
12	Sulphate	26	36	38	48	50	52	24	36	36	102	20	68	200-400
13	Chloride	120	140	148	168	168	172	132	140	140	440	104	220	250-1000
14	Fluride	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.0-1.5
15	Iron	0.10	0.10	0.10	0.4	0.6	0.4	0.08	0.10	0.10	0.1	0.06	0.08	0.3-1.0
16	Magnesium	28	32	36	52	58	60	28	34	34	97	24	25	30-150

Index:

R_1= Ramavarappadu (Highschool road), R_2=Ramavarappadu (Railway station), R_3= Ramavarappadu (slum area near canal)

P_1= Prasadampadu (Vivekananda School), P_2= Prasadampadu (Kanuru road) P_3= Prasamdampadu (Behind Ford Show room)

E_1= Enikepadu (SRK Institute of Tech) E_2= Enikepadu (Vijaya Institute of Tech) E_3= Enikepadu (Pradamika High School)

N_1= Nidamanuru (Near FCI Godowns) N_2= Nidamanuru (Poranki road) N_3= Nidamanuru (Petrol bunk)