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Status of Drinking Water Quality in Koneru Lakshmaiah University Campus, Guntur Dist. of Andhra Pradesh

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ABSTRACT

Water is a biological necessity and vital for all forms of life. Yet portable drinking water is a scarce resource on the earth. Rising demand of water for irrigation, agricultural, domestic consumption and industry is forcing stiff competition over the allocation of scars water resources among both, areas and types of use. 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, the present study was under taken to ascertain the quality of groundwater in various locations of Koneru Lakshmaiah University (KLU) Campus, Guntur dist. of Andhra Pradesh was assessed by examining the different groundwater samples for various physico-chemical characteristics such as pH, electrical conductivity, total dissolved solids, alkalinity, hardness, chloride, calcium, magnesium, sodium, fluoride and nitrate. The results indicated that all physico-chemical parameters fall within the permissible limits except nitrate, as compared with reference to WHO and Bureau of Indian standards. The primary objective of the study is evaluation of groundwater quality of various sampling locations, covering the entire area of KLU to assess the suitability of water for drinking and its impact on students health.

KEYWORDS:

INTRODUCTION:

Water is essential for the existence of life on the planet Earth and is major source for drinking water in rural India. Today good quality of water has become a precious commodity. The demand for water has increased over the years and that has led to a general water scarcity. The quality of water is getting deteriorated vastly due to unscientific disposal of various types of wastes, improper water management and carelessness towards the environment. This affects the groundwater too due to hydraulic conductivity in the hydrological cycle, riveted by the problem of water pollution. Water pollution is a phenomenon that is characterized by the deterioration of its quality as a result of various human activities. This has led to scarcity of potable water for affecting the human health. In India only 12% of people get good drinking water (Kudesia, 1980). Inadequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment (Karanth, 1989). Therefore, it is essential to monitor the water supply and quality of groundwater. Pollution of groundwater resources has become a major problem today in the study area, because the groundwater is the only source for drinking water in KLU.

STUDY AREA:

Koneru Lakshmaiah University (KLU) Campus, is situated on the southern bank of the River Krishna, approximately 10km away from Vijayawada towards south – west. It is located at $16^{0}24^{1}$ N latitude and $80^{0}34^{1}$ E longitude. The total area is around 50 acres. The annual rainfall of the study area is 1030mm and total strength of the students is around 20,000.

The study area (KLU)is located on flat topography with flood plain and top soil as clayey soils. The area is covered with lawns, thick vegetation, plants, gardens and agricultural crops. The main groundwater recharging areas in the study area are Buckingham canal and Krishna river. The Krishna river is passing on N-E side of the study area, whereas Buckingham canal passes on S-W side of the study area. KLU is underlined by palaeo – channels or burried channels, which are extensively developed. The palaeo-channels are the main groundwater potential zones for high groundwater occurrence in the area of investigation. The ground water levels both in open dug wells and bore wells are varying from 1 to 3 meters below the ground level.

The major geological formations around the study the area are khondalite suite of rocks, which consists of sillimanite, quartz, garnet and mica. Hydrogeologically, these rocks are known as crystalline metamorphic rocks. Generally these rocks have lack of primary porosity and hydraulic conductivity, however , the secondary porosity developed due to weathering and deformation of rocks, to store and transmit the water. The ground water flow in the study area is towards east.



MATERIALS AND METHODS:

Drinking water samples were collected in clean 2 liter polyethylene bottles from dug wells and bore wells at various enmarked locations. All the chemicals utilized were of analytical grade. The samples were analyzed for various physico – chemical parameters such as pH, electrical conductivity, total dissolved solids, alkalinity, acidity, chloride, hardness, nitrates, fluoride, calcium, magnesium and sodium.

The pH was measured by digital pH meter and total dissolved solids(TDS)by gravimetric method. Digital conductivity meter was used to measure electrical conductivity (EC). Sodium was measured by flame photometer. The remaining parameters analyzed by the standard methods given by APHA(1995) and Trivedy and Goel (1986). The water samples collected in the area of investigation are indicated as S_1 to S_{11}.

RESULTS AND DISCUSSION:

The physico – chemical characteristics of groundwater in the area of investigation are given in table-1. There is little changes in the physical and chemical parameters of ground water, whereas higher concentration of nitrates has been noticed in the study area.

Table – 1 : The analytical results showing the quality of groundwater in KLU.

	Sampling Locations in the study area										
Parameters	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}
pH	8.5	8.5	7.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	7.5
Electrical Conductivity (EC) in μ μ mho/cm	560	880	860	570	800	610	690	760	870	680	580
Total Dissolved Solids (TDS) in mg/l	355.4	563.2	550.4	365.8	512.1	390.4	441.6	486.4	556.8	435.2	375.2
Alkalinity in mg/l	235	250	235	105	155	150	245	235	220	190	250
Acidity in mg/l	5	10	5	10	10	5	10	10	5	5	10
Chloride in mg/l	102.49	87.49	114.99	87.49	67.49	59.48	82.49	127.49	74.99	79.99	109.99
Total Hardness in mg/l	225	220	230	185	125	105	280	240	195	165	250
Nitrate in mg/l	46.75	32.45	35.45	46.50	41.25	41.75	41.75	50.35	74.75	38.45	46.25
Fluoride in mg/l	0.50	0.40	0.46	0.60	0.50	0.60	0.52	0.42	0.92	0.80	0.70
Calcium in mg/l	50.1	66.13	52.1	38.1	32.1	30.1	36.7	60.1	46.1	34.1	50.1
Magnesium in mg/l	40.08	22.04	40.08	36.07	18.03	22.04	76.15	46.09	32.06	20.04	50.1
Sodium in mg/l	69.1	84.7	76.7	69.1	70.5	58.8	58.8	75.2	77.1	59.3	60.0

S_1 = Near Computer Block; S_2 =Beside FED; S_3 =S – W Corner of Indore stadium; S_4 =Opposite to FED and Garden

S_5 =N – W Corner of Ladies Hostel; S_6 = Behind Satyam College; S_7=Near Workshops; S_8 =Behind Thermal Lab

S_9 =Behind Canteen; S_{10} =N – E Corner of Playground; S_{11} =S – W Corner of Mechanical Block

The hydrogen ion concentration (pH) is an important parameter in water analysis. 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 ion concentration. In a similar way, a change of pH 7 to 8 indicates a tenfold increase in hydroxyl ions. The pH value of natural water changes due to biological activities and industrial contamination. In the study area, the pH ranged from 7.5 to 8.5 showing all water samples are alkaline in nature and none of the sources of drinking water crossed the standard limits (WHO 1971,ISI 1991). Beyond pH 8.5, the water is bitter in taste.

Electrical conductivity (EC) is a measure of the salts of water in the form of ions. Electrical conductivity is also a norm to measure solids, ranged from 560 to 880 μ μ mho/cm in the study. There is a slight increase of EC value at FED block, S-W corner of Indore stadium, and behind canteen. But all the samples are within the maximum permissible limit (2200 μ μ mho/cm). A sudden rise in electrical conductivity of water indicates the addition of some pollutants in it (Trivedy and Goel, 1986)

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. The TDS affect the strength and the durability of concrete and palatability of food cooked. The TDS concentration in the present study area ranged from 355 to 563 mg/l is found to be within the limit. The total dissolved solids in groundwater are also originate from natural sources, sewage, urban run-of and industrial waste.

High alkaline waters are usually unpalatable. Excess alkalinity gives bitter tastes to water and reacts with cations forming precipitates, which can damage pipes and other appurtenances like valves, pumps, etc. Total alkalinity of the water samples ranged from 105 to 250mg/l is found within the permissible limit. Alkalinity in itself is not harmful to human beings, still the water samples with less than 600mg/l are desirable for domestic use.

Chloride occur 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 wastes, salt water intrusion and also due to primary use of fertilizers to crops. The concentration of chloride is high in groundwater, where temperature is high and rainfall is less. The chloride values ranged from 59.98 to 127.49 mg/l in the study. All chloride values are as per the standard limits prescribed (BIS:10500,1991). High concentration of chloride values causes Cardio Vascular problem, salt taste to water, steel corrosion and reduced the strength of concrete.

Hardness is the chemical property of water, which prevents the formation of lather with soap, which is mainly caused by the multivalent metallic cations like calcium, magnesium, iron and strontium. Therefore, the hardness of water reflects the nature of geological formations, with which it has been in contact. In the present study, hardness varied between 105 to 280 mg/l. Slightly high hardness value has been noticed at source -7 (between workshops). It is mainly due to calcium, magnesium and chloride in sewage and sub-surface clayey soils . Waters with hardness greater than 300 mg/l may lead to heart and kidney problems.

In groundwater, most of the nitrogen is found in the form of nitrates. Nitrate formed by the biochemical activities of micro organisms or add in chemically synthesized forms to lithosphere and biosphere, which enters hydrosphere with relative ease. All these environmental components are dynamically interconnected. Nitrate concentration in all the sampling locations of the study area, varied from 32.45 to 74.75 mg/l. The concentration of nitrates is exceeding the limit at the sources S_1 (Computer Block), S_4 (Opposite to FED Block) S_8 (Behind Thermal lab), S_9 (Behind Canteen) and S_{11} (S-W Corner of Mechanical Block). Much of the nitrate to the groundwater reaches with the percolating water through soil. If groundwater show an appreciable amount of nitrates as much as 45 mg/l, which adversely affect the health of children, producing a disease called Blue Baby, results skin color becomes dark, the child falls sick, vomits and extreme causes dies. High nitrate concentrations indicate the sources of past or present pollution. High concentration of nitrates in the study area owing to the agricultural practices that can leach and entire in to the groundwater.

Water in contact with natural deposits such as topaz, fluorspar and criolite are found to contain excess fluoride. High profile of fluoride in shallow zone of ground waters is due to geo-chemical deposition in the vicinity of the groundwater extraction structures. The toxicity of fluoride is also influenced by high ambient temperature, alkalinity calcium and magnesium contents in the water. The concentration of fluoride in the study area varying from 0.40 to 0.92 mg/l are found to be within the permissible limits. High concentration (>1.5 mg/l) causes dental fluorosis and lower concentration (< 0.5 mg/l) causes dental caries. A fluoride concentration of approximately 1.5 mg/l in drinking water is recommended.

In the present study, calcium and magnesium varied from 30.06 to 66.13 mg/l and 18.03 to 76.15 mg/l respectively. Although, it is common place and no series ill effects on humans, but hard water can be annoyance. The primary preventive measure is to install a water softener. The results are that the water has little if any soda taste and the formation of soap curd and mineral deposits are eliminated.

Sodium content of groundwater rise due to weathering of plagioclase feldspar (Albite) in igneous and metamorphic rocks. Sodium content in groundwater ranges from 1mg/l in humid areas and 10,00000mg/l in brines (Satyanarayana and Guru Prasad, 2006). The minimum sodium value 58.8mg/l at the sources S_6 (Behind Satyam College)& S_7 (Near Workshops)and maximum sodium value 84.7mg/l at source S_2 – (FED Block)were found in the study area.

CONCLUSION:

In the present study area, groundwater is the only source for drinking, which is exploited by people through number of shallow tube wells and dugwells. The investigation revealed that almost all parameters except nitrate, are within the limits of standards. In general, the quality of groundwater available to the students of KLU campus is suitable for potable and drinking purposes. It is recommended that groundwater analysis may be carried out frequently to monitor the rate and kind of contamination. A Reverse Osmosis system with a softener can remove as much as 95% of nitrate and nitrate contamination from water, however, ammonia may pass through. A negative ion - exchange method may also be used.

It has been widely acknowledged that destruction of forests, degradation of lands and loss of vegetation reduces the recharge of underground aquifers, making drinking water sources unsustainable and, therefore effecting the groundwater quality. In all such initiative, local communities have been in the forefront. It has been seen that rain water harvesting, artificial recharge and watershed development efforts though active, participation of local community have played an important role in addressing the problem. The present study illustrates the need for the restoration of degraded forests to ensure sustainability of drinking water sources.

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