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Study of groundwater quality parameters in Khurja city and adjoining areas of Khurja borewell and handpump water

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Abstract
This is a study undertaken to determine the impact of industrial wastewater on the overall quality of groundwater in industrial town Khurja, District Bulandshahar, UP. A comparative analysis of quality parameters of groundwater samples taken from 6 different places (NREC College, GT road near CGCRI and industrial area near Chandralok colony, Gyanlok colony, Kalindi Kunj and Dashera Kherli village 8 km from Khurja city) was performed. Though the water from all the above-mentioned sources under study was found unsuitable for drinking purposes, the quality of the NREC College water sample was found to be better than that of the other five samples.
Motivations for study: occurrence of digestive-related diseases and other diseases due to poor water quality.

Keywords: TDS, hardness, alkalinity, elemental analysis, drinking water quality

Introduction

We all know that after air, water is the second most important need for life to exist in the whole world. As a result, due to pollution in the environment, day by day water quality is degraded. Water quality is a measure of the condition of water relative to the requirements of one or more biotic species and/or to any human need or purpose. Water can be divided into groundwater and surface water. We know that both types of water can be exposed to contamination risks from agriculture, industrial, hospitals and domestic activities, which may include such types of pollutants as heavy metals, pesticides, fertilizers, hazardous chemicals and oils. Water can be contained physical, chemical, biological or radiological substances, and this type of contaminated water is unfit for drinking and domestic purpose. So many parameters can be affected to drinking water such as colour, odour, taste, turbidity, pH-value, TDS, total hardness, calcium, zinc, magnesium, chloride, fluoride, alkalinity, sulphate, iron, copper, nitrate and so on.

The World Health Organization (WHO), in its guidelines [1] for drinking water quality, defines domestic water as the "water used for all usual domestic purposes including consumption, bathing and food preparation". Today, securing adequately safe drinking water and proper sanitation has become a major challenge being faced by the residents of Khurja and other towns in NCR.

In this study, In Khurja, well known for its pottery industry is a tehsil of district Bulandshahr (UP) near Delhi. A large number of ceramic industry units are situated in the city. Most of these units are in Jewar road, Bulandshahar road, city station road and Chandralok colony areas. Upper Ganga canal & some sub-canals pass through Khurja but no major river crosses Khurja or its industrial area. A sub canal passes from the side of NREC College Khurja. District Bulandshahr is a well-irrigated agricultural area with abundant water sources including rivers, canals, sub canals and other water bodies. The study area is a part of the Ganges basin, which contains the largest river system on the subcontinent comprising of Ganga, Yamuna and their tributaries.

It's a comparative study of the quality of groundwater samples from NREC College Khurja (Sample 1), GT road near CGCRI (Sample 2) and industrial area near Chandralok colony (Sample 3), Gyanlok colony (Sample 4), Kalindi Kunj (Sample 5) and Dashera kherli Village (Sample 6) has been done in this study. The TDS of the NERC College water sample is much less than that of the GT road, industrial area, Gyanlok colony and Kalindi Kunj

water samples but slightly higher than Dashera kherli water sample. The hardness of the water sample from NREC College Khurja is significantly less than that of the GT road, industrial area, Gyanlok colony, Kalindi Kunj and Dashera kherli water samples. The alkalinity of all water samples except the Dashera kherli water sample is significantly higher than the acceptable limit for drinking water parameters. This study indicates that the groundwater from all of the test areas including potteries and industrial areas is not suitable for drinking purposes.

Material and Methods

All collected samples were analysed, using the various techniques in the present study.

Study Area: Khurja City

We know that Khurja is a city in Bulandshahr district in the Indian state of Uttar Pradesh. It is situated around 20 km from Bulandshahr, and 85 km from Delhi. Khurja supplies a large portion of the ceramics used in the country, hence it is sometimes called The Ceramics City. NREC College Originally called Natthimal Ramsahay Edward Coronation, and now called Natthimal Ramsahay Educational Courses (name changed in 2012) is one of the oldest colleges in India and offers various courses to students leading up to PhDs. The total enrolment in the college in 2003 was around 2,900 students and at present around 60 faculty members. The College also conducts LLB classes. The College is affiliated with Meerut University. Khurja City is 237.44 meters above sea level. Towards diversification of the company into other energy sectors, THDCIL entered into an MoU on 31 December 2010 with Govt. of U.P and UPPCL for setting up a 2 x 660 MW Supercritical Thermal Power Project in Tehsil Khurja, District Bulandshahar, U.P. About 1,200 acres of land was acquired by UPSIDC earlier at Khurja for industrial use which shall be utilized for the construction of the project. As per MOU, GoUP / UPPCL will assist in the transfer of this land. The average temperature is 25 ˚C in Khurja City.

Sampling Location

Sis samples of groundwater were collected from hand pumps and bore wells which drew water from the groundwater. Samples were collected in pre-washed clean Plastic bottles of 2 L capacity. Sampling work is also an important part of this analysis, so the sampling was done in such a way that the six selected areas of town were covered evenly in this study. The samples were collected from various pumps such as govt. hand pumps bore wells etc.
Sampling was done from six different locations across Khurja city from different types of sources. A list of sampling locations is given below in Table 1.

Table 1: Sample type and its location in Khurja city

Sample Number	Sample Type	Sample Location
1	Hand Pump	NREC College
2	Govt. Hand Pump	Near CGCRI-G.T. Road, (Industrial Area)
3	Govt. Hand Pump	Chandralok Colony
4	Govt. Hand Pump	Gyanlok Colony
5	Govt. Hand Pump	Kalindi Kunj
6	Bore Well	Dashera Kherli Village, near Khurja

Result and Discussion

Deterioration of drinking water quality is a problem that has been increasingly affecting the areas in and around the industrial town of Khurja. In accordance with the distribution of industrial units, 6 points were selected for water sampling throughout the city. Drinking (ground) water samples from these locations were collected by random grab sampling [2]. Different water quality parameters were examined to determine the suitability of the water from these sources for drinking purposes as per BIS specifications (IS: 10500) accepted as the Indian standard for drinking water. The physical and chemical parameters tested in this study include pH, total dissolved solids (TDS), hardness, alkalinity, as well as cons. of sulphate, chloride, nitrate, calcium, magnesium and iron [3-6]. Analysis was performed in accordance with established various procedures [7, 8].

Table 2: Water quality parameters of groundwater samples

S. No.	Parameters	Unit	Desirable Limits (IS:10500)	Sample 1 (NREC)	Sample 2 (CGCRI) GT Road	Sample 3 (I_{nd} Area)	Sample 4 (Gyanlok Colony)	Sample 5 (Kalindi Kunj)	Sample 6 (Dashera kherli)
1	Colour	Hazen	**5**	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2	Odour		Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste		Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity	NTU 1	1	<1	<1	<1	<1	<1	<1
5	*p*H Value		6.5 – 8.5	7.6	7.7	7.9	7.3	7.2	7.81
6	TDS	Mg/l	500	509	752	1138	812	964	426
7	Total Hardness	Mg/l	300	326	378	395	343	336	280
8	Calcium as $CaCO_3$	Mg/l	75	45.3	65	70.4	66	67.2	80.0
9	Magnesium	Mg/l	30	32.7	35.3	36.8	39.7	40.8	19.4
10	Alkalinity	Mg/l	200	318	576	622	584	616	140
11	Chloride	Mg/l	250	122	146	179	139	164.37	235
12	Sulphate	Mg/l	200	56	83	87	79	64	9.2
13	Nitrate	Mg/l	45	0.35	0.46	0.50	.93	.85	<0.01

14	Iron as Fe	Mg/l	.3	0.69	0.062	0.071	0.093	0.05	0.063
15	Manganese	Mg/l	.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
16	Copper	Mg/l	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
17	Fluoride	Mg/l	1	0.52	0.47	0.69	0.59	0.59	0.58
18	Boron	Mg/l	0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
19	Zinc	Mg/l	5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
20	Lead	Mg/l	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
21	Cadmium	Mg/l	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
22	Arsenic	Mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
23	Phenolic Compound	Mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
24	Anionic Detergents	Mg/l	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Free residual Chlorine	Mg/l	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
26	Ammonia	Mg/l	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
27	Nickel	Mg/l	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Mercury	Mg/l	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
29	Molybdenum	Mg/l	0.07	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
30	E. Coli	E. Coli/ 100ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent
31	Coliform	MPN/ 100ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent

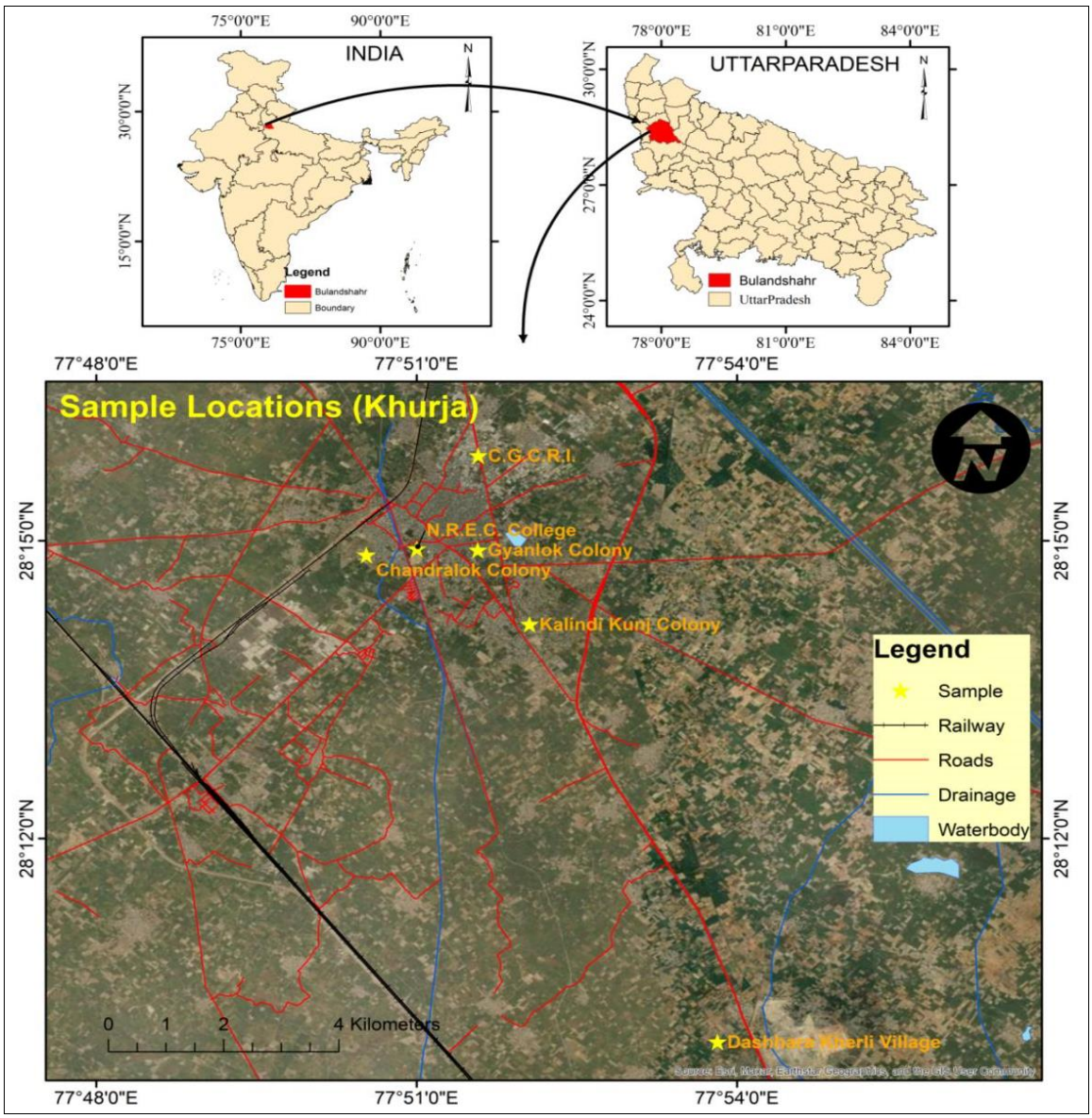

Fig 1: Sites Locations on Map of Khurja

Fig 2 & 3: Released waste through meat and ceramic industries

The samples showed (from table: 2) high values of total dissolved solids, hardness, calcium, magnesium and alkalinity. The value for total dissolved solids (TDS) in all of the water samples except the Dashera kherli water sample ranged from 509 to 1138 which far exceeds the desired limit of 500 mg/L. Reason behind it?, the increased TDS level can be based on various reasons such as minerals in springs from geological formations, disinfection by-products from chemicals used to treat the water, surplus from road salts, pesticides, fertilizers from agricultural run-off, and rust, lead from pipes through which water has been supplied. The total hardness of samples except for the Dashera kherli water sample also far exceeds the highest permissible limit of 300 mg/L. Similarly, Samples showed high alkalinity which exceeds the permissible limit of 200 mg/L. This is attributed to the effluents from ceramic industries due to the presence of bicarbonate, sulphates, carbonate and hydroxide of calcium, sodium and potassium. Reasons (from the figure1: map of Khurja City) behind this, released industrial waste/ dumped waste through the ceramic industries on selected areas and animal blood, bones and unused parts of animals, which were contaminated by the water of ponds, soil and water canals and could be affected to drinking water on selected sites (figure 2 and 3).

In a region with a very low density of industrial units, the main source of heavy metals in groundwater is the mineral composition of the bedrock or local geological features of the region. In contrast, heavily industrialized areas receive most of their heavy metal contaminants from industrial waste. In the town of Khurja, there is always a possibility of contamination of water resources with heavy metals and toxic substances, therefore, continuous monitoring is essential. Heavy metals can accumulate in vegetation and animal, including human, tissues over a long period of time and may cause adverse effects on human health [9-15].

Conclusion

From the above discussion, the groundwater collected from all of the test areas is of the low-quality index and is not suitable for drinking purposes. The consumption of water around these industrial areas is suspected to have caused water-related diseases among residents. Various analyses have shown that the quality of life improves as the water quality index increases. Thus, it is essential to initiate measures to check the pollution from industrial effluents and to monitor the quality of groundwater regularly in the study area. Present results show the ceramic industries due to the presence of bicarbonate, sulphate, carbonate and hydroxide of calcium, sodium and potassium. The reasons behind this, released industrial waste/ dumped waste through the ceramic industries on selected areas and animal blood, bones and unused parts of animals, which may contaminate the water of ponds, soil and water canals and could be affected to drinking water on selected sites. These locations need some degree of treatment of water before consumption. Rigorous implementation of water treatment and monitoring regulations is needed to protect the local population from the perils of water contamination. Continuous monitoring of drinking/wastewater quality in terms of heavy metals and toxic materials etc. is essential to ensure a sustainable environment and healthy society. In this study, an indicator of a poor environmental and domestic hand pump and bore well water quality can affect drinking water and it would hazard human health.

Conflicts of Interest

The authors declare no conflict of interest.

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