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Characteristics and Quality Assessment of Ground Water with Reference to Town Deeg, District Bharatpur, Rajasthan, India

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Abstract

Fresh water resources are degrading through population increase, pollution, regional and global change in climate and industrialization. The assessment and management of groundwater resources has become a prerequisite to satisfy the need of water for domestic and agriculture purposes. The main objective of the present investigations is to assess and identify the quality of ground water (well and hand pump) of four areas in town Deeg (Bharatpur), Rajasthan during postmonsoon season (October,2008 to January, 2009) to find out pH, T.D.S., T.H., CaH., Total Alkalinity, F, Cl, Dissolved Oxygen (DO), Phosphorus, Nitrate, Salinity and E coli. A comparison with ISI standards shows that TDS, TH, salinity, chloride, nitrate, and fluoride (all water) and CaH (hand pump) exceeded permissible limits. DO and phosphorus are within the limits. The E coli in well water has been recorded very high than the limits. Water borne diseases such as of heart, respiratory, gastric, skeletal deformities, diarrhea, jaundice, amoebiosis, arthritis etc. are prevalent in the area. The groundwater (well and hand pump) of Deeg (Bharatpur) is not fit for drinking purpose. Management strategies such as recharging ground water, registration and regulation of groundwater extraction, collection and disposal of waste water, adoption of traditional conservation methods, de-fluoridation (food rich in calcium and phosphorus, adoption of an activated alumina adsorption technique), nitrate removal (use of yellow mustard and food with vitamin-C) and awareness of public about the water quality importance and hygienic conditions may be employed.

Keywords: Groundwater quality, Water Borne Diseases, Management Strategies.

Introduction

Ground water is an important source of water for sustaining human populations which rely on it for their drinking water[1]. Ground water is equally essential to ecosystems and species across the world. Rivers and streams depend on ground water for base flow or cool water inputs, and many wetlands and most lakes are directly connected to ground water[2]. Ground water contamination and extraction have been recognized as a crucial danger to the environment and biodiversity around the world[3.]. Groundwater is also often withdrawn for agricultural, municipal and industrial use by constructing and operating extraction wells. In many parts, the demand for ground water already exceeds supply. In addition surface water supplies is fully allocated for use, thus water users are turning to ground water to meet further water need[4]. Furthermore, ground water fails to meet drinking water standards. Ground water contamination by nutrients or chemicals from agriculture, waste disposal and industrial operation is prevalent. Waste materials which are subjected to reaction with percolating rain water and reach the aquifer system hence degrade the ground water quality[5]. Consequently, ground water depletion and contamination pose a looming and widespread threat to aquatic ecosystem and suitability for agricultural, industrial and domestic uses. The transmission of water borne disease has been a matter of concern for many years[6]. Microbiological evaluation of water is very essential. Safe drinking water is the basic need and the residents of town Deeg (Bharatpur) Rajasthan do not totally depend on PHED water supply scheme but they use it only for bathing and washing of clothes. For drinking purpose they fetch untreated water from the wells and hand pumps at some places situated sometimes at far off places from their residences. Water borne diseases such as of heart, skeletal deformities, diarrhea, jaundice, amoebiosis, arthritis etc. are prevalent in the residents of town Deeg. Water quality studies were carried out by several workers ie[7-15]. Therefore, the present study is aimed to evaluate the suitability of ground water for domestic uses.

Materials and Methods

The town Deeg is located on the north of Bharatpur City and lie in between $27^0$20' N latitudes and $77^0$15' E longitudes**.** In town Deeg there are different sources of drinking water such as hand pumps, open wells, PHED water supply and open pond water. Four different areas the Jal Mahal, Goverdhan road, Kaman road and Nagar road and their nearby places of town Deeg were selected for sampling of water. The approximate distance between the four areas was one and a half kilometer. Samples were taken from all the four areas including four samples each from hand pump and well water every fortnightly during post

monsoon season from October, 2008 to January 2009.

Samples were taken in clean sterilized polythene bags. Water samples were analysed to find out pH, Total alkalinity, Total hardness (TH), Calcium hardness (CaH), Nitrate (NO_3), Total dissolved solids (TDS), Phosphorus (P), Fluoride (F), Salinity, Chloride, Dissolved Oxygen (DO) and *E coli* by using methods as given[16,17]. pH of the samples was analysed at the spot and compared with standard methed[18].

Results and Discussion

The average value of each parameter with standard error is presented in Table-1. The pH of all water samples of all areas is within the permissible limits. The TDS and TH of all the hand pump and well water of all areas are higher to the permissible limits in the present studies. The high TDS may be due to ground water pollution by waste waters which is discharged into pits and deposition of large heaps of cattles and human wastes around the well of town deeg in the present studies. The present findings are in agreement to different authors[19,20].

The higher values of CaH in the water of hand pump has been noted in the present studies which may be due to the addition of calcium ions to a natural water system as it passes through soils and rocks containing large amounts of calcium in mineral deposits[21]. The total alkalinity in hand pump water of Goverdhan road exceeds the permissible limits. The dissolved oxygen and phosphorus are within the prescribed limits. Very high salinity in the ground water may be due to a combination of low rainfall and high evaporation. The values of chloride in well and hand pump water (except Jal Mahal) of all four areas exceeds permissible limits.

The fluoride content of all areas (except hand pump of Goverdhan road and jal mahal) exceeds far from prescribed limits which may be due to natural phenomenon, influenced by the local and regional geological setting and hydro geological conditions. Further, aridity of climate, dissolution of F bearing minerals, ion exchange and evaporative concentrations may locally reasoned for high fluoride in groundwater[22,23].

High fluoride contents in groundwater have also been reported by researchers[24,25]. Presence of fluoride above permissible limit in most of the sources of drinking water is the concern of public health and have serious health consequences[25]. In the surveyed area it is evident that children and older people are affected by teeth molting, teeth coloring, dental and skeletal fluorosis, weakness, neurological problem (damage brain development), gastrointestinal problems, urine trouble, abnormal behavior, reduction of IQ etc[26-28.] in the area by taking fluoride contaminated water.

Table-1
Physicochemical and microbiological parameter of ground water during postmonsoon season in Deeg (Bharatpur) Rajasthan

Area	Type of water	pH	TDS (ppm)	Total alkalinity (ppm)	TH (ppm)	CaH (ppm)	Chloride (ppm)	DO (ppm)	Salinity µs/cm	P (ppm)	Nitrate (ppm)	F (ppm)	*E coli*/ 100ml
Nagar Road	Hand pump	7.07 ±.007	6769 ±8.27	388 ±4.79	4820 ±8.16	612 ±2.8	3337 ±28.98	4.79 ±0.03	9942 ±26.68	.06 ±0.002	125.50 ±0.98	3.56 ±0.05	00.00 ±0.00
	Well	7.58 ±.015	3529 ±4.27	119 ±1.25	2828 ±12.83	629 ±2.51	1906 ±16.96	6.53 ±0.02	4673 ±18.12	0.00 ±0.00	142.65 ±0.07	6.96 ±0.04	2500 ±13.46
Goverdhan Road	Hand pump	7.17 ±.018	3576 ±2.23	545 ±2.04	1845 ±15.54	1222 ±5.08	1665 ±22.69	4.75 ±0.06	4952 ±18.44	.03 ±0.00	115.25 ±0.38	1.20 ±0.018	8.00 ±0.06
	Well	7.15 ±.015	4673 ±2.38	746 ±2.39	2040 ±10.80	229 ±2.51	1984 ±4.33	3.95 ±0.03	6444 ±34.44	.10 ±.007	82.67 ±0.07	7.69 ±0.01	2220 ±24.32
Jal Mahal	Hand pump	7.05 ±.064	2589 ±4.27	216 ±2.39	2555 ±12.50	470 ±3.82	995 ±14.52	3.88 ±0.01	4060 ±14.46	0.00 ±0.00	115.25 ±0.38	0.76 ±0.04	00.00 ±0.00
	Well	7.40 ±.019	2176 ±2.39	390 ±4.08	2063 ±21.59	172 ±9.52	614 ±6.02	5.39 ±0.13	3141 ±13.24	.17 ±0.004	125.25 ±0.38	7.96 ±0.035	2000 ±19.83
Kaman Road	Hand pump	6.91 ±.016	8618 ±12.09	478 ±4.79	4470 ±28.86	455 ±5.08	3284 ±54.11	3.55 ±0.01	12645 ±34.44	.10 ±0.004	325.75 ±0.48	2.60 ±0.043	14.00 ±0.25
	Well	7.50 ±.017	8246 ±2.39	520 ±4.08	2375 ±47.87	235 ±6.65	4580 ±45.83	4.40 ±0.00	12110 ±43.48	0.00 ±0.00	142.65 ±0.07	8.61 ±0.054	2420 ±22.64
Permissible Limits (BIS Standards)		6.5 To 8.5	500 To 2000	200 To 600	300 To 600	75 To 200	250 To 1000	3-7	0-1500	0.1 – No relax	45 – No relax	1.00 To 1.5	Less than 10.00

Values are Mean ± Standard Error

The Nitrate concentration in all areas is higher than the permissible limits which may be attributed to the percolating nitrate from decaying plants and animal material, agricultural fertilizer, industrial and sewage waste into dugwells during rainfall and plantation of leguminosae crops which fix atmospheric nitrogen in the form of nitrate. This may create serious health problems such as methamoglobinemia (blue baby) in infants and pregnant women, gastric cancer, acute respiratory tract infection due to the formation of carcinogenic nitrosamine and nitrosarcosine[29,30] if used for drinking purpose. The reason being nitrite (NO_2) in the human intestine combines with haemoglobin making it ineffective to absorb oxygen. The high concentration of Nitrate (NO_3) in ground water has also been reported by earlier researchers[31-34]. In the present study. the *E coli* was 2000 to 2500/100ml in well water indicating the chance of pathogenicity and not fit for drinking without treatment and gain support by scientists[35] who investigated bacterial contamination of well water.

Conclusion

From the present study it is evident that ground water quality is gradually getting deteriorated and it may deteriorate further with time. The water quality of well and handpump of all areas are polluted and unfit for human consumption for any use.

Suggestive Remedies and Management Strategies: For the conservation and management of water resources the traditional methods such as recharging water system by ponds, pokhars and reservoirs and rain water harvesting must be employed. Groundwater extraction structures (tube well, handpump, deepbore, and well) should be registered and regulated. to decrease over-abstraction and degradation of ground water quality. The groundwater must be assessed before use to ensure suitability of the quality for human consumption. The ground water sources and their surroundings should be maintained to ensure hygienic conditions and no sewage or polluted water should be allowed to percolate directly to ground water aquifer. Systematic testing of all drinking water sources in affected areas should be performed. Maintenance and management of the drinking water network with regular control for the detection of leaks, because all water exits are an entry for the polluting matters. Use of kits and devices for field treatment of drinking water. Encouragement of the neighbors, family and friends to install flow water fixtures and to practice water conservation. Municipal sewage should not be dumped into water system directly. Industries should not be allowed in residential areas. There should be no stagnation of wastewater to prevent percolation of pollutants in groundwater (CPCB). Industrial effluents should be mixed with water only after treatment. Washing activities should be done at single point and there should be treatment of water before getting mixed with drinking water[25,36]. The de-fluoridation treatment (domestic level) should be undertaken if the water is having high fluoride. Stringent action should be taken against the trespassers of water resources such as ponds, wells and hand pumps[24,37]. Treatment option for nitrate should be undertaken in ground water drawn from sources exceeding the permissible limit of 50 mg/L. Nitrates must not be removed by boiling as this will concentrate the nitrates making levels high. Yellow mustard is effective for the removal of nitrate[34]. Use of canned milk and food to children should be banned in the areas with high nitrate. Vitamin-C with food should be provided because it develops immunity to nitrates[33]. Environmental awareness through education is highly recommended as this is very important to conserve water resources and equally to maintain health.

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