A Case Study on Physico-Chemical Properties of Ground Water in Deoria, Uttar Pradesh (India)

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Abstract

By using various physico-chemical parameters the investigation of quality of water for the drinking and irrigation purposes can be determined. Samples of ground water were collected from different area in Deoria of Uttar Pradesh and analysed for 10 water quality parameters viz. pH, EC, TDS, Total Hardness, Calcium, Magnesium, sodium, potassium, nitrates and Chlorides. On comparing results with BIS and WHO standard of water for drinking purpose, it was found that most of the parameters analyzed have shown that they are within the acceptable limits. The pH value varies between 6.87 to 8.98 which shows that the values are in the range prescribed by BIS and WHO. The low pH does not cause any harmful effect. EC values varied between 128.8 to 330.0 μ S/cm. Calcium and magnesium content in the water presents 10 to 40 mg/l and 10.2 to 48mg/l l respectively. The nitrate concentration in ground water found from 21to 44 mg/l. The TDS values ranges from 71 to 200mg/l. which is within the preferable limit of WHO and BIS.

Keywords: ground water quality, Chloride, Total hardness, Deoria, TDS, Electrical Conductivity, Nitrates

1. Introduction

Ground Water is one of the main source of water for agricultural, Industrial and domestic purposes in many countries. Ground water is one of the most precious and basic requirement for human existence [1]. During the last few decades the groundwater is drastically polluted due to increase in population and industrialization [2].

Water pollution affects the water quality and ultimately the human health [3]. The ground water quality can be controlled by several factors that includes precipitation, anthropogenic activities, geological structure and mineralogy of the watershed and aquifer [4]. Physico- chemical properties of ground water are one of the important tool to estimate the quality of water and its use for irrigation, domestic and drinking purposes [5-6]

The issue of ground water has become a problem of significance for the development of India. Vast investigation of ground water and extreme use of pesticides and fertilizers make probable the access of determine the ground water [7]

The objective of the current study is an experiment to investigate the physico- chemical parameters of groundwater in Deoria to find out whether the quality of groundwater is safe or unsafe for drinking purpose

2. Materials and Methods

Deoria is situated from 26 degrees and 28 degrees north latitude and 83 degrees and 85 degrees east longitude, District Kushinagar was established in 1994 from the north and east portion of Deoria district. In the north of Deoria district there is district Kushinagar , Gopalganj and Siwan (Bihar state) in the east, district Mau and district Ballia in the south and district Gorakhpur in the west.

Ground water samples were collected from 10 different sampling point during June 2017. The samples to be analyzed was collected in 500ml polyethylene bottle. pH were determined at the site. The analysis of the samples were carried out using standard method, APHA 1995 [8]. The different methods used for analysis of various water quality parameters are shown in Table 1. WHO and BIS standard of desirable and permissible limits of various water quality parameters are shown in Table 2 [9]
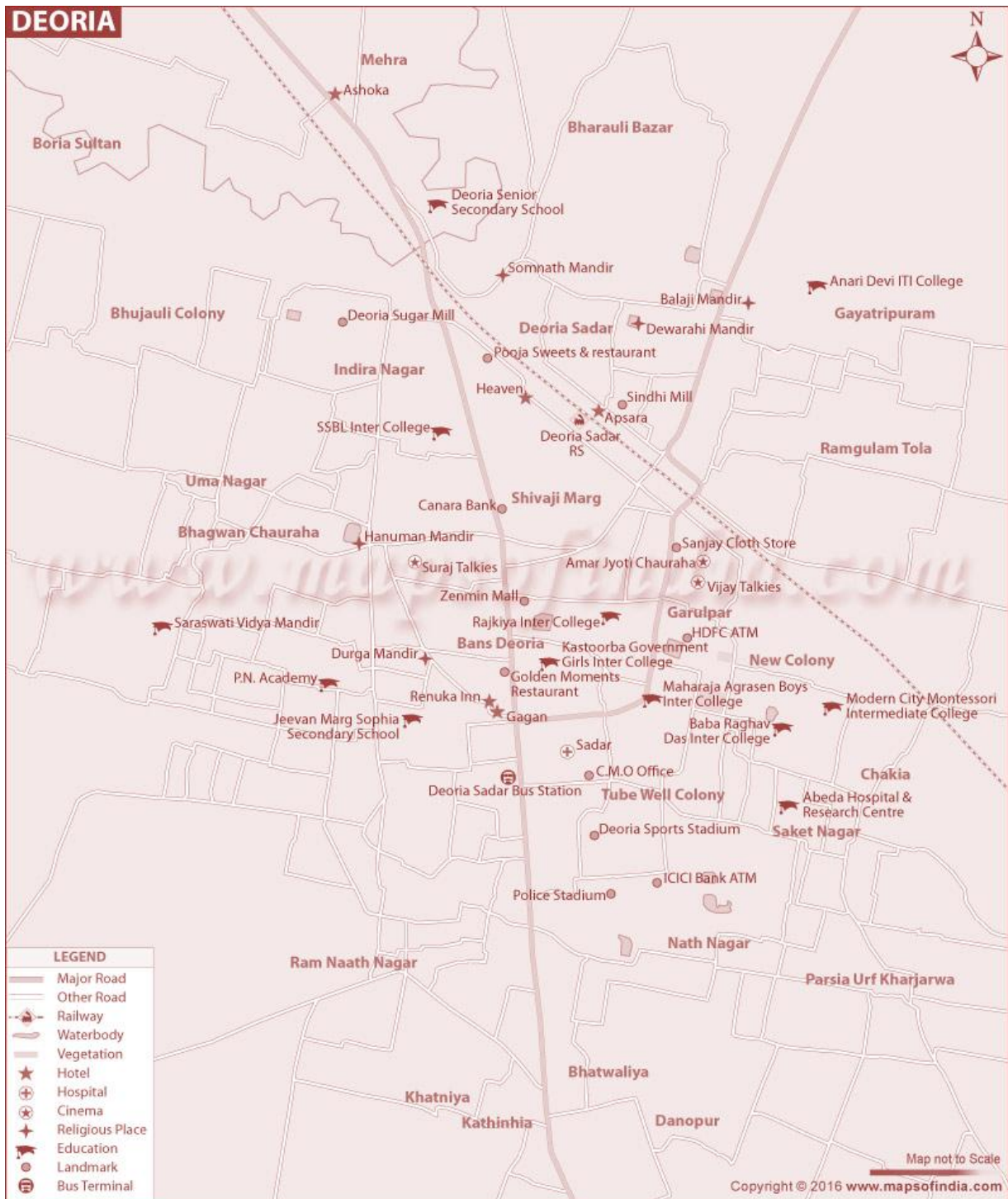
Fig. 1 Layout diagram of Study area

Table 1: - Method of determination of water quality parameters

S.No.	Parameters	Methods of determination
1	Electrical Conductivity	Conductivity meter
2	Total Alkalinity	Titration method
3	Chloride	(Argentometric method) Titrimetry
4	Sodium	Flame photometry
5	Potassium	Flame photometry
6	Calcium	EDTA titration
7	Magnesium	EDTA titration
8	Total dissolved solids	Gravimetric method
9	Dissolved oxygen	Wrinkler's method
10	Biological oxygen demand (BOD)	Wrinkler's method
11	Chemical oxygen demand (COD)	Open reflux method
12	pH	pH metry
13	Total hardness	EDTA titration

Table 2:- WHO and BIS standard of desirable and permissible limits of various water quality parameters.

S.NO	PARAMETERS	WHO		BIS	
		highest desirable limit	maximum permissible limit	highest desirable limit	maximum permissible limit
1	pH	7.0-8.5	6.5- 9.2	6.5 – 8.5	8.5 – 9.2
2	Electrical conductivity (μ S/cm)	750	1500	---	---
3	Total Dissolved Solids (Mg/L)	500	1500	500	2000
4	Total Hardness (Mg/L)	100	500	300	600
5	Calcium (mg/l)	75	200	75	200
6	Magnesium (mg/l)	30	150	30	100
7	Sodium (mg/l)	50	200	----	---
8	Potassium (mg/l)	100	200	------	-----
9	Chloride (mg/l)	250	600	250	1000
10	Nitrate (mg/l)	--	50	45	100

Table 3: - Water quality parameters of drinking water in Deoria

Parameters	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8	Station 9	Station 10
pH	8.98	8.65	7.93	6.94	8.54	6.87	7.75	7.99	7.2	8.3
Electrical conductivity (μ S/cm)	220	3008	215.7	130.4	330	260.8	205.5	162.2	128.8	141.7
Total dissolved solid (mg/l)	110	170	110	69	200	125	102	95	71	74
Total hardness (mg/l)	115	120	395	155	125	172	99	60	202	130
Calcium (mg/l)	15	40	16	40	40	27	28	10	12	18
Magnesium (mg/l)	25	10.8	48	14.4	12	31	13.3	13.3	47	27
Sodium (mg/l)	30	20	65	21	22	50	22	61	42	41
Potassium (mg/l)	10.1	11.8	58	12.4	12.1	16	8.8	8.8	122	8.1
Chloride (mg/l)	9.5	21	126	21	26	64	32	14.1	89	35
Nitrate (mg/l)	35	21	25	32	26	44	31	34	27	42

3.   Results and Discussion

The intensity of the acidic or basic character of solution at given temperature is defined as pH. High pH value can form the trihalomethane, which are toxic [10]. The pH value ranges from 6.87 to 8.98 which is within the permissible limit of WHO and BIS.

Electrical conductivity is the presence of salt in the form of ions in water [11]. EC values found in the range from 128.8 to 330.0 μ S/cm which is within the desirable limit of WHO

In neutral water, total dissolved solids are composed of salts of sulphates, chlorides, bicarbonates, carbonates and elements like magnesium, calcium, sodium and potassium [12]. The TDS results are in

the range of 71 to 200mg/l. which indicates that the TDS value is within the preferable limit of WHO and BIS

The hardness in water is caused due to the presence of calcium and magnesium in water [12]. Hardness has no known adverse effect on health, but it can prevent the formation of lather and increase the boiling point of water [13]

The total hardness values ranges from 60 to 395 mg/l which indicates that the value is in between the acceptable limit of WHO and BIS.

Calcium and magnesium content in the water present 10 to 40 mg/l and 10.2 to 48mg/l respectively. It shows that calcium is within the desirable limit of WHO and BIS while magnesium is within the acceptable limit of WHO and BIS

Sodium and potassium content in the water were found in between 20 to 65 mg/l and 8.1 to 122 mg/l which are within the acceptable limit of WHO. A higher concentration of sodium may cause hypertension, congenial heart diseases and kidney problems [14]

High concentration of chloride may be due to the pollution caused by high organic waste of animal origin [10]. The chloride found in the range between 9.5 to 126 mg/l shows that it is within the preferable limit of WHO and BIS.

High concentration of nitrate is an indicator of organic pollution and eutrophication [15]. The nitrate found in the range between 21to 44 mg/l

4.   Conclusions

It is concluded from the present study that the water quality parameters viz electrical conductivity, TDS, calcium, chloride, nitrate are in between   the preferable limit of drinking water as prescribed by WHO and BIS and pH, total hardness, magnesium, sodium, potassium are in between the acceptable limit of water for drinking purposes as per WHO and BIS standard. The physico-chemical parameters of ground water suggested that the water is suitable for pisiculture, irrigation and drinking purposes

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