

## **EVALUATION OF GROUND WATER QUALITY OF BAREILLY CITY**

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### **ABSTRACT**

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**The quality of ground water across the Bareilly city has been determined by analyzing different physico-chemical parameters. Alkalinity and hardness of ground water is beyond the WHO limits. Water quality index of different sites is also calculated.**

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### **INTRODUCTION**

There is an uneven distribution of water resources on this planet. Only 30% of global water is found in the continents and the rest is present in oceans. Even in this 30% of water found on the land, about  $\frac{3}{4}$  is locked in icebergs and glaciers. Thus, the sources of water available to the humans, is less than a percent present in lakes, streams and ground. A large section of the population uses raw water from surface and ground water bodies for human consumption. Ground water acts as a reservoir by virtue of large pore space in earth materials, and as a mechanical filter which improves water quality by removing suspended solids and bacterial contamination. Ground water contamination is generally irreversible i.e. once it is contaminated, it is difficult to restore the original water quality of the acquifer. Excessive mineralization of ground water degrades water quality producing an objectionable taste, odour and excessive hardness. Although the soil mantle through which water passes acts as an adsorbent retaining a large part of colloidal and soluble ions with its cation exchange capacity, but ground water is not completely free from the menace of chronic pollution. The main cause of ground water pollution is direct contamination due to lateral travel of polluted water. The

disposal of wastes into abandoned quarries, gravel pits etc. can cause ground water pollution from leachates. The contaminated water requires permanent remedy otherwise it will affect the health of consumers.

### STUDY AREA

The district of Bareilly lies between latitude 28°1' and 28°54' N and longitude 78°58' & 79°47' E running over a distance of about 60 miles from North to South and about 47 miles from East to West and covering an area of appx. 1578 square miles.

The main river of the district, the Ramganga river, flows from the west to the south-East, separating Tehsil Aonla. The other rivers-the Siddha, the Dojora, the Bahgul (west), the Sankha, the Deorianan and the Nakatia and their tributaries, which mostly rise in the Tarai, generally run through the district in Southern & South-Eastern direction to join the Ramganga river.

A number of industries such as J.K Sugar mills, Coca-cola industry, Katha factory, Rubber factory, distilleries, IFFCO etc. are situated within the 30 km radius of Bareilly city. They discharge their effluents (treated & untreated) into the ground and the river. This polluted water leaches down the soil and contaminate the ground water.

### MATERIAL & METHODS

To evaluate the nature of the ground water in the city, water samples were collected from the handpumps at nine different sites -two sites each in north, south, east & west directions and one in the center, to cover the whole city (Table 1). The samples were collected in 5 litre plastic containers, which were thoroughly washed twice with the water to be analysed.

Determination of pH, electrical conductance and dissolved oxygen (DO) has been done within 6 hours after bringing the samples to the laboratory. BOD

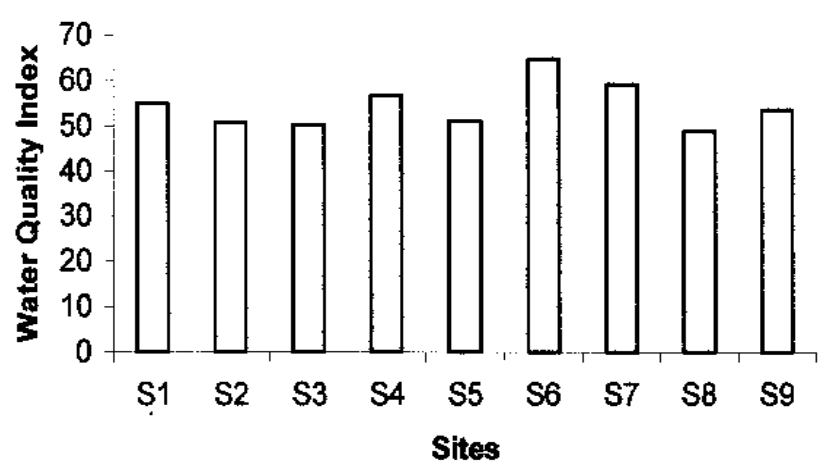


Fig. 1- Water quality index for different sampling sites of Bareilly city

**TABLE - 1**  
Location code of different sampling sites of Bareilly city

S.No.	Location code	Location Code
<b>North</b>		
1.	Izatnagar	S1
2.	Premnagar	S2
<b>South</b>		
3.	Railway Station	S3
4.	Rampur Garden	S4
<b>East</b>		
5.	Suresh Sharma Nagar	S5
6.	Pilibhit bypass	S6
<b>West</b>		
7.	Maninath	S7
8.	Quila	S8
<b>Centre</b>		
9.	Kutubkhana	S9

**TABLE - 2**  
Physical characterization of drinking water in the Bareilly city

No.	Location code	Colour	Odour	Taste	Temperature (°C)	Turbidity (NTU)
1.	S1	colourless	Unobjectionable	Agreeable	22.5	2.48
2.	S2	colourless	Unobjectionable	Agreeable	20	2.54
3.	S3	colourless	Unobjectionable	Agreeable	21	1.69
4.	S4	colourless	Unobjectionable	Agreeable	24.3	3.43
5.	S5	colourless	Unobjectionable	Agreeable	20.4	2.25
6.	S6	colourless	Unobjectionable	Agreeable	20.2	3.16
7.	S7	colourless	Unobjectionable	Agreeable	20.6	1.22
8.	S8	colourless	Unobjectionable	Agreeable	21.4	1.66
9.	S9	colourless	Unobjectionable	Agreeable	20	1.69

has been estimated by incubating the water samples at 25°C for 5 days in the dark. The other physico-chemical parameters were estimated as per APHA, AWWA (1992). Water quality index of different sites has been calculated to determine the overall quality of the ground water of the particular site. The Index used is based on Yazdandoost & Katdare (2000) and Tiwari et al. (1986).

### RESULT AND DISCUSSION

#### Physical parameters

The appearance of samples is in general clear. They have no odour and taste. The range of temperature measurement for the ground water samples investigated is found to be in the range of 20°C to 25°C. Turbidity of all the samples is found to be within the range of permissible limit. Turbidity is an expression

of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through the sample. Turbidity in water is caused by suspended matter such as clay, silt, finely divided organic & inorganic matter, soluble colored organic compounds and plankton and other microscopic organisms (Table2).

### Chemical parameters

The results of chemical parameters analysed are given in Table 3 and are compared with water quality standards of WHO (Table 4).

### pH & Electrical conductivity

The pH of the water samples are found to be in mild alkaline range of 7.5-8.2 and is within the permissible range. It indicates the presence of very weak basic salts.

The ground water of three out of nine sites shows the electrical conductivity less than the permissible limit (1000 mmho/cm) whereas the six sites have the electrical conductivity beyond the permissible limit. High values suggest the presence of high amount of dissolved inorganic substances in ionized form.

### Total dissolved solids

All of the sites have been found to have high concentration of dissolved solids. The western area of the city( Maninath & Quila) have the maximum amount of solids.

High level of dissolved solids may be aesthetically unsatisfactory for bathing and washing. Water with high dissolved solids generally is of inferior palatability and may induce an unfavourable physiological reaction in the transient consumer.

### Chloride

Chloride concentration of all the stations is found to be within the permissible limit. Chloride, in the form of chloride ions, is one of the major inorganic anions in water. The high chloride content may harm metallic pipes and structures.

### Alkalinity

Alkalinity in the water samples is primarily a function of carbonate, bicarbonate and hydroxide content. All the samples show the very high alkalinity values, which are indicative of the eutrophic nature of the water. Alkalinity observed, is due to carbonates and bicarbonates. Hydroxide alkalinity is absent in all the samples.

### Total hardness

Hardness of water as calcium carbonate is an important measure of pollution. Four sites have hardness beyond the permissible limit (500 ppm) given by WHO. Increase in the hardness is due to the presence of the salts of calcium, magnesium and iron.

TABLE - 3  
Chemical characterization of drinking water in Bareilly city

S.No.	Location code	pH	Electrical Conductance ( $\mu$ mhos/cm)	Total Dissolved Solids	Chloride	Alkalinity	Total Hardness	Sulphate	Nitrate	Fluoride	DO	BOD
1.	S1	8.25	790	650	46.09	285	700	85	89	0.4	2.1	1.7
2.	S2	8.02	890	1000	74.45	260	370	70	10	0.4	1.7	0.76
3.	S3	7.6	1290	650	109.91	380	650	96	14	0.39	1.6	1.5
4.	S4	8.23	870	800	70.91	370	500	73	15	0.44	1.9	1.1
5.	S5	7.64	1290	790	60.27	260	450	64	12	0.4	1.8	2.1
6.	S6	7.82	1820	1850	177.28	570	1020	69	32	0.61	2	0.78
7.	S7	7.69	1920	1150	99.27	410	480	104	7	0.53	1.8	1.7
8.	S8	7.88	1900	2500	170.19	520	470	94	8	0.38	1.6	0.6
9.	S9	7.52	1470	1850	134.73	385	700	115	20	0.44	1.7	1.12

\*All values except pH and Electrical conductivity are expressed in mg/l.

### Sulphate

Ingestion of water containing high concentration of sulphate can have laxative effect, which is enhanced when sulphate is consumed in combination with magnesium. Sulphate contents in all the samples have been found to be within the permissible limit (200 mg/l).

### Nitrates

In surface water, nitrate occurs in trace quantities but may attain high levels in some ground waters. In excessive amounts, it contributes to the illness of infant methemoglobinemia. To prevent this disorder a limit of 45mg/l of nitrate nitrogen is imposed on drinking water. The level of nitrate in the ground water of the city is under the WHO limits.

### Fluoride

Concentration of fluoride is significantly low in all the samples. Fluoride ions have dual significance in water supplies. Excess concentration of fluoride causes dental fluorosis. At the same time, a concentration less than 0.8 mg/l results in dental caries.

### DO & BOD

Due to physical, chemical & biological activities in water, the level of dissolved oxygen may vary. All the sites have been found to have less than 4.0 mg/l DO. The lower values of BOD illustrate that there is no organic matter in the ground water.

### Water quality index

**TABLE - 4**  
**WHO standards for drinking water**

S.No.	Parameter	WHO Standards
1.	Colour	acceptable
2.	Odour	unobjectionable
3.	Taste	agreeable
4.	Turbidity	5 NTU
5.	pH	7-8.5
6.	Electrical conductivity	1000 $\mu$ mhos/cm
7.	Total Dissolved Solids	500
8.	Chloride	250
9.	Alkalinity	120
10.	Hardness	300
11.	Sulphate	200
12.	Nitrate	45
13.	Fluoride	1
14.	Dissolved Oxygen	5
15.	BOD	3

\* All values except Turbidity, pH and Electrical conductivity are expressed in mg/l.

A water quality Index (WQI) may be defined as a rating reflecting the composite influence of the overall quality of a number of quality characteristics or water quality parameters. In the formulation of WQI, the importance of various parameters depends on the intended use of water. Since the aim is to calculate the WQI from the point of view of drinking purpose, the standards recommended for drinking water have been considered. The recommended limit of WQI for drinking water is 100. WQI of all the nine sites have been found to be below 100 (Fig.1). Therefore, it can be said that the quality of ground water of the city is satisfactory for drinking purposes.

### REFERENCES

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