



MATHEMATICAL ASSESSMENT OF WATER QUALITY AT SAMBHAL, MORADABAD, UTTAR PRADESH (INDIA)

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ABSTRACT

Underground water samples at ten different water sites of public places were collected and analyzed for different water quality parameters following standard methods of sampling and estimation. The water quality index has been calculated for all the sites using the data of all parameters and WHO drinking water standards. The calculated data reveals that the underground water at Sambhal, Moradabad is severely polluted invariably at all the sites of study. The present study suggests that people exposed to this water are prone to health hazards of polluted drinking water.

Key words: Water quality, Water quality index, Unit weight, Quality rating.

INTRODUCTION

Though water is renewable resource, improper management and reckless use of water systems are causing serious threats to the availability and quality of water¹⁻³. It is the duty of scientists to test the available water in any locality in and around any residential area. As a part of society, it is a must. Attention on water pollution and its management has become a need of hour because of far reaching impact on human health^{4,5}.

Moradabad is a 'B' class city of western Uttar Pradesh. It is situated at the bank of Ram Ganga river and its altitude from the sea level is about 670 feet. It is extended from Himalaya in north to Chambal river in south. It is at 28°20', 29°15' N and 78°4', 79°E. Sambhal is head quarter of tehsil previously a part of Moradabad district now of Sambhal district itself. The total area of Sambhal Tehsil is 45 Km² with total population of more than 3 Lacs. It is famous for mentha production and seeng work. Silver foil making is also prominent.

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EXPERIMENTAL

Underground water samples of ten sites of India Mark-II (IM2) hand pump of public places at Sambhal were collected and analyzed quantitatively following standard methods of sampling and estimation⁶. The estimated parameters are pH, turbidity, conductivity, alkalinity, total solids, total dissolved solids, total hardness, calcium, magnesium, dissolved oxygen, biological oxygen demand, chemical oxygen demand, Free CO₂, chloride and fluoride.

A brief description of sampling sites is presented in Table 1. Water quality index for all sites was calculated using the data of estimated parameters and WHO⁷ standards by the methods prepared by Horton⁸ and modified by Tiwari and Mishra⁹. The standard assumptions are: WQI < 50: fit for human consumption; WQI > 80: excessively polluted and WQI. 100: severely polluted.

Table 1: Details of sampling sites

Site No.	Name	Location of site	Apparent water quality	Usage
I	Veterinary Hospital	6.0 Km East from tehsil	Pale yellow on standing, odourless	Drinking & Bathing
II	Sambhal Block	0.5 Km South to site No. I	Colourless, odourless	Drinking & Bathing
III	Roadways	5.0 Km South-West from tehsil	Colourless, odourless	Drinking & Bathing
IV	Samudayik Swasthya Kendra	4.5 Km East from tehsil	Colourless, odourless	Drinking & Bathing
V	District Court	5.0 Km North-East from tehsil	Pale yellow on standing, odourless	Drinking & Bathing
VI	Shankar College Square	4.0 Km North to site No. III	Colourless, odourless	Drinking & Bathing
VII	Government Hospital	2.0 Km North to site No. VI	Colourless, odourless	Drinking & Bathing
VIII	Nagar Palika Parishad	3.5 Km South-East from tehsil	Colourless, odourless	Drinking & Bathing

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Site No.	Name	Location of site	Apparent water quality	Usage
IX	Sambhal Tehsil	8.0 Km North-East to site No. III	Colourless, odourless	Drinking & Bathing
X	Railway Station	8.0 Km South-East to site No. IX	Pale yellow on standing, odourless	Drinking & Bathing

RESULTS AND DISCUSSION

The estimated values of water quality parameters for different sites are listed in Table 2. The parameters with their WHO standards and assigned unit weight (Wn) are given in Table 3. The calculated values of WQI are presented in Table 4. Critical analysis of data and its comparison with WHO standards and assumptions for WQI reveal following facts regarding the underground water quality at public places of Sambhal, Moradabad during the period of study.

Table 2: Site-wise estimated values of water quality parameters

S. No.	Parameter	Site I	Site II	Site III	Site IV	Site V	Site VI	Site VII	Site VIII	Site IX	Site X
1	pH	8.16	8.20	7.95	7.97	8.03	7.83	7.97	7.76	7.91	8.09
2	Turbidity (NTU)	4.55	5.40	4.85	3.24	3.20	2.80	2.71	3.20	2.90	4.43
3	Conductivity ($\mu\text{S}/\text{cm}$)	0.755	0.832	0.551	0.470	0.712	0.479	0.491	0.360	0.461	0.711
4	Alkalinity (mg/L)	240	176	260	168	256	268	284	120	68	84
5	Total solids	1100	1250	1050	870	1210	710	815	650	705	1085
6	Total dissolved solids	819	875	795	610	871	418	517	395	585	905
7	Total hardness	508	560	656	576	492	720	584	620	684	472
8	Calcium	136	184	204	196	192	216	272	260	276	248
9	Magnesium	372	376	454	380	300	504	312	360	408	224

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S. No.	Parameter	Site I	Site II	Site III	Site IV	Site V	Site VI	Site VII	Site VIII	Site IX	Site X
10	Dissolved oxygen	2.11	2.0	2.25	2.45	2.22	3.0	2.50	3.0	2.30	2.15
11	Biological oxygen demand	31.20	28.10	29.20	26.10	31.85	18.10	17.10	14.40	16.15	27.40
12	Chemical oxygen demand	52	61	49	31	48	26	34	24	30	49
13	Free CO ₂	88	149.6	198	268.4	171.6	140.8	180.4	250.8	189.2	162.8
14	Chloride	53.98	89.97	101.96	148.95	82.97	125.96	48.98	138.95	114.96	35.98
15	Fluoride	1.20	1.14	1.0	0.81	1.10	0.81	0.73	0.61	0.79	1.14

Table 3: Parameters, WHO standards and their assigned unit weights (Wn)

S. No.	Parameters	WHO standard	Unit weight (Wn)
1	pH	8.0	0.023597
2	Turbidity (NTU)	5.0	0.037755
3	Conductivity (μ S/cm)	0.300	0.629247
4	Alkalinity (mg/L)	100.0	0.001888
5	Total Solids (mg/L)	500.0	0.000377
6	Total Dissolved Solids (mg/L)	500.0	0.000377
7	Total Hardness (mg/L)	100.0	0.001887
8	Calcium (mg/L)	100.0	0.001887
9	Magnesium (mg/L)	30.0	0.006292
10	Dissolved Oxygen (mg/L)	5.0	0.037755
11	Biological Oxygen Demand (mg/L)	6.0	0.031462
12	Chemical Oxygen Demand (mg/L)	10.0	0.018877
13	Free CO ₂ (mg/L)	10.0	0.018877
14	Chloride (mg/L)	200.0	0.000944
15	Fluoride (mg/L)	1.0	0.188774

Table 4: Site-wise calculated values of water quality index

Site No.	Name of Site	Water quality index (WQI)
I	Veterinary Hospital	216
II	Sambhal Block	231
III	Roadways	166
IV	Samudayik Swasthya Kendra	147
V	District Court	204
VI	Shankar College Square	144
VII	Government Hospital	146
VIII	Nagar Palika Parishad	114
IX	Sambhal Tehsil	141
X	Railway Station	206

Estimated values of different parameters indicate very clearly that their values are much higher than prescribed WHO drinking water standards and water is polluted and unfit for human consumption and other domestic purposes.

The calculated water quality index ranges from 114 to 231. Highest pollution is observed at site No. II and it is lowest at site No. VIII, however, it is still severely polluted. The pollution level at site No. III, IV, VI, VII and IX is almost similar and water is some what less polluted as compared to site No. I, II, V and X.

CONCLUSION

It may be concluded that underground water at study area of Sambhal, Moradabad is severely polluted as indicated both by estimated values of parameters and calculated values of WQI and it is matter of great concern. People exposed to this water are prone to health hazards of polluted drinking water and underground water pollution management is urgently needed in the area of study. It may also be added that WQI is once again proved to be a fruitful tool for mathematical and collective assessment of water quality.

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