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## Assessment of drinking water of different localities in Brij region: A physico-chemical study

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### ABSTRACT

*To establish quality criteria, measures of chemical, physical constituents must be specified, as well as standard methods for reporting and comparing results of water analysis. Keeping it in view the present study was taken up to analyze the drinking water sample of different localities. We calculate the water quality index with the help of fifteen physico-chemical parameters for drinking water of different localities. The estimated values shows that some parameters are under the permissible limit and other shows variation from the prescribed WHO standard. The value of W.Q.I. also varies between the 80 -200 so the water of these localities are unfit for drinking and human consumption without purification.*

**Key word:** Water Quality Index, Brij region, physico-chemical parameters, assigned unit weight, quality rating.

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### INTRODUCTION

Clean water supports an incredible diversity of plant and animal life, and it is a source of drinking water and food that sustains human life. It is a valuable resource and for these, and many more reasons, the U.S. EPA, states, and Indian tribes, carry out programs to protect the quality of the nation's waters. *Water quality is term used to describe the chemical, physical and biological characteristics of water. It is not a simple thing to say that this water is good or this water is bad. After all majority of our body and a bigger percentage of our brain is water. Hence the water quality is very important.*

Water quality standards are the foundation of the nation's surface water quality protection program. States set water quality standards for all surface waters within their boundaries. Water quality standards form the legal basis for controls on the amount of pollutants entering these waters from sources such as industrial facilities, wastewater treatment plants, and storm sewers. They are also the technical basis for reducing runoff from rural and urban areas. The absolute

minimum requirement for domestic use is 50 litres per person per day, though 100-200 litres is often recommended. Adequate supply of pollution free drinking water is the basic need for all human beings on Earth. More and more now a days we are hearing about situations where the quality of our water is not good enough for normal uses [1]. Bacteria and micro-organisms have gotten into drinking water supplies, sometimes causing severe illness in a town. Water quality has become a very big issue today. Keeping in view the different physico-chemical parameters we have tried to assess the quality of drinking water in Brij region i.e from Aligarh to Mathura.

### MATERIALS AND METHODS

For the analysis of water we have collected the water sample of different localities of Brij region from Aligarh to Mathura. Standard procedure and technique are used for the estimation of different water sample of different localities [2-4]. A brief description of sampling sites are given in Table -1.

**Table 1: A brief description of sampling sites**

S. No	Sampling site	Distance from the previous site	Physical appearance
1	Aligarh	First site	Colourless, Odourless
2	Iglas	20 km from Aligarh	Colourless, Odourless
3	Beswan	10km from Iglas & 30 km from Aligarh	Colourless, Odourless
4	Raya	20 km from Beswan	Colourless, Odourless
5	Mathura	10 km from Raya & 30 km from Beswan, 60 km from Aligarh	Colourless, Odourless

Water Quality Index (W.Q.I.) has been calculated by using estimated values of physico-chemical parameters of water samples and WHO standards. W.Q.I. has been regarded as one of the most effective way to communicate water quality [5-6]. In course to calculate W.Q.I of water samples fifteen water quality physico- chemical parameters were used.

Water Quality Index is calculated by using the methods proposed by Tiwari and Mishra (1985) [7]. Followings equations have been used for calculating the Water Quality Index.

$$(1) \quad \text{Quality rating } q_n = 100 [ ( V_n - V_i ) / ( V_s - V_i )]$$

Where

$$\begin{aligned} V_n &= \text{ACTUAL AMOUNT OF } n^{\text{th}} \text{ PARAMETER} \\ V_i &= \text{THE IDEAL VALUE OF THIS PARAMETER} \\ V_i &= 0 \text{ EXCEPT FOR pH AND DO} \\ V_i &= 7.0 \text{ Mg/Liters FOR pH} \\ V_i &= 14.6 \text{ Mg/Liters FOR D.O} \\ V_s &= \text{IT'S STANDARD VALUE} \end{aligned}$$

(2) Assigned Unit Weight for various parameter is inversely proportional to the recommended standard ( $S_n$ ) for the corresponding parameter.

$$W_n = K / (S_n)$$

$$\sum W_n = 1$$

$$n=15$$

$$n=15$$

$$(3) \quad W.Q.I. = \sum_{n=1} (SI)_n = \sum_{n=1} (q_n)W_n$$

$$= \text{Anti log}_{10} \sum_{n=1}^{n=15} W_n \log_{10} q_n$$

It has been assumed for WQI of water if-

W.Q.I.<50 Than the water is fit for human consumption

W.Q.I.<80 Than the water is moderately polluted

W.Q.I.>80 Than the water is excessively polluted

W.Q.I.<100 Than the water is severely polluted

## RESULTS AND DISCUSSION

The estimated value of different physico-chemical characteristics of drinking water of different localities in Brij region and W.H.O standard are mentioned in Table 2B.

**Table 2B: A comparative data collecting for qualitative study**

S. No.	Parameter	Aligarh	Iglas	Beswan	Raya	Mathura	W.H.O standard
1	Temperature ( $^{\circ}$ C)	29	30	31	31	32	-
2	pH	8.02	7.35	8.32	7.27	7.30	7.0-8.0
3	Turbidity (N.T.U)	1.08	1.07	1.03	1.07	1.08	5.0
4	Conductivity( $\mu$ simen/cm)	.383	.682	1.24	1.06	1.05	.300
5	Alkalinity (mg/lit)	316	484	460	644	332	100
6	Total solid (mg/lit)	343	422	782	680	530	500
7	Total solid (mg/lit)	313	410	760	625	565	500
8	Chloride (mg/lit)	28.4	31.2	485	295	213	200
9	Hardness (mg/lit)	160	180	692	352	424	100
10	Calcium (mg/lit)	28.3	25.2	35.3	42.4	38.4	100
11	Magnesium (mg/lit)	80.3	81.3	95.2	98.4	82.1	30
12	FreeCO <sub>2</sub> (mg/lit)	110.8	120.9	129.3	132.2	118.2	10
13	Dissolved Oxygen(mg/lit)	8.3	7.9	4.3	4.5	3.8	5.0
14	Biological Oxygen Demand (mg/lit)	6.8	7.2	12.8	10.9	11.5	6.0
15	Chemical Oxygen Demand (mg/lit)	9.9	8.6	11.2	11.6	12.2	10
16	Fluoride (ppm)	.230	.210	.281	.289	.218	1.0

A critical analysis of the data shows the same variation i.e. all the values of Aligarh are lower than the other. It is evident that the drinking water sample collected from Beswan has highest value for all the parameters. These higher value is the indication of the high contamination of water at Beswan .At Aligarh estimated values of all the parameters except Turbidity, TS , TDS , Chloride, Calcium and COD, Fluoride are higher than the prescribed value of WHO drinking water standard. At Iglas estimated value of Turbidity, TS, TDS, Chloride, Calcium, COD and Fluoride are under the permissible limit. The value of Calcium is lowest at Iglas. Physico-chemical parameters at Beswan is quite very high to the desirable WHO drinking water standard. These data shows that in Beswan drinking water is highly polluted. The estimated

values for all the physico-chemical parameters except pH, Turbidity, Calcium, & DO is greater than the desirable permissible limit at Raya. At Mathura, estimated values of different parameters varies between the values of Raya and Beswan. The value is higher than the values of Raya & below the values of Beswan. These data clearly indicates that the drinking water at Beswan is highly polluted in comparison to the other localities in the Brij region.

We have also asses the water quality on the basis of W.Q.I. (Water Quality Index) [8]. For calculating W.Q.I. assigned unit weight for each parameter has been calculated with the help of WHO standard and fifteen physico-chemical parameters and the value is given in Table 3B.

The actual value, quality rating and  $W_n \log_{10} q_n$  value for all the parameters for Aligarh, Iglas, Beswan, Raya and Mathura are given in Tables 4B, 5B, 6B, 7B and 8B respectively.

**Table3B: Caculated Assinged Unit Weight  $W_n$  for each parameter with their WHO standard**

S.No.	Parameters	WHO standard	Assinged Unit Weight $W_n$
1	pH	7.0-8.0	.0236563
2	Turbidity (N.T.U)	5.0	.037850113
3	Conductivity ( $\mu$ simen/cm)	.300	.630835223
4	Alkalinity (mg/lit)	100	.001892505
5	Total solid (mg/lit)	500	.000378501
6	Total solid (mg/lit)	500	.000378501
7	Chloride (mg/lit)	200	.000946252
8	Hardness (mg/lit)	100	.001892505
9	Calcium (mg/lit)	100	.001892505
10	Magnesium (mg/lit)	30	.006308352
11	Free CO <sub>2</sub> (mg/lit)	10	.018925056
12	Dissolved Oxygen (mg/lit)	5.0	.037850113
13	Biological Oxygen Demand (mg/lit)	6.0	.031541761
14	Chemical Oxygen Demand (mg/lit)	10	.018925056
15	Fluoride (ppm)	1.0	.189250567

**Table4B: Actual value ( $V_n$ ), Quality rating ( $q_n$ ) and calculated values of  $W_n \log_{10} q_n$  for different parameters at ALIGARH**

S.No.	Parameters	Actual Value $V_n$	Quality Rating $Q_n$	$W_n \log_{10} q_n$
1	pH	8.02	25.9	.03343344
2	Turbidity (N.T.U)	1.08	25.6	.05330204
3	Conductivity ( $\mu$ simen/cm)	.383	510	1.32844478
4	Alkalinity (mg/lit)	316	316	.00473067
5	Total solid (mg/lit)	343	68.6	.00069505
6	Total solid (mg/lit)	313	62.6	.00068005
7	Chloride (mg/lit)	28.4	14.2	.001090355
8	Hardness (mg/lit)	160	160	.004171308
9	Calcium (mg/lit)	28.3	28.3	.002747513
10	Magnesium (mg/lit)	80.3	267	.01530728
11	Free CO <sub>2</sub> (mg/lit)	110.8	1100	.057558526
12	Dissolved Oxygen (mg/lit)	8.3	65.6	.068770015
13	Biological Oxygen Demand (mg/lit)	6.8	113.3	.064794028
14	Chemical Oxygen Demand (mg/lit)	9.9	99	.037767507
15	Fluoride (ppm)	.230	23	.257707

**Table5B: Actual value( $V_n$ ),Quality rating( $q_n$ ) and calculated values of  $W_n \log_{10} q_n$  for different parameters at IGLAS**

S.No	Parameters	Actual Value $V_n$	Quality Rating $Q_n$	$W_n \log_{10} q_n$
1	pH	7.35	35	.036526936
2	Turbidity (N.T.U)	1.07	21.4	.050356311
3	Conductivity ( $\mu$ simen/cm)	.682	227.3	1.32844478
4	Alkalinity (mg/lit)	484	484	.005081083
5	Total solid (mg/lit)	422	84.4	.000729122
6	Total solid (mg/lit)	410	82.0	.00072438
7	Chloride (mg/lit)	31.2	15.6	.001128996
8	Hardness (mg/lit)	180	180	.004268114
9	Calcium (mg/lit)	25.2	25.2	.00652157
10	Magnesium (mg/lit)	81.3	271	.015348026
11	Free CO <sub>2</sub> (mg/lit)	120.9	1209	.05833509
12	Dissolved Oxygen (mg/lit)	7.9	69.7	.069766568
13	Biological Oxygen Demand (mg/lit)	7.2	120	.065581037
14	Chemical Oxygen Demand (mg/lit)	8.6	86	.036610479
15	Fluoride (ppm)	.210	21	.250230751

**Table6B: Actual value( $V_n$ ),Quality rating( $q_n$ ) and calculated values of  $W_n \log_{10} q_n$  for different parameters at Beswan**

S. No.	Parameters	Actual Value $V_n$	Quality Rating $Q_n$	$W_n \log_{10} q_n$
1	pH	8.32	132	.0028523
2	Turbidity (N.T.U)	1.03	20.6	.049730022
3	Conductivity ( $\mu$ simen/cm)	1.24	413.3	1.65043237
4	Alkalinity (mg/lit)	460	460	.005039282
5	Total solid (mg/lit)	782	148.4	.0008219
6	Total solid (mg/lit)	760	152	.000825829
7	Chloride (mg/lit)	485	242.5	.00225653
8	Hardness (mg/lit)	692	692	.005374914
9	Calcium (mg/lit)	35.3	35.3	.002929171
10	Magnesium (mg/lit)	95.2	317.3	.015780153
11	Free CO <sub>2</sub> (mg/lit)	129.3	1293	.058887176
12	Dissolved Oxygen (mg/lit)	4.3	107.29	.076856896
13	Biological Oxygen Demand(mg/lit)	12.8	213.3	.073460472
14	Chemical Oxygen Demand (mg/lit)	11.2	112	.038781565
15	Fluoride (ppm)	.281	28.1	.274168492

**Table7B: Actual value ( $V_n$ ),Quality rating( $q_n$ ) and calculated values of  $W_n \log_{10} q_n$  for different parameters at Raya**

S.No.	Parameters	Actual Value $V_n$	Quality Rating $Q_n$	$W_n \log_{10} q_n$
1	pH	7.27	27	.03386077
2	Turbidity (N.T.U)	1.07	21.4	.050356311
3	Conductivity ( $\mu$ simen/cm)	1.06	353	1.607226024
4	Alkalinity (mg/lit)	644	644	.00531583
5	Total solid (mg/lit)	680	136	.000807546
6	Total solid (mg/lit)	625	125	.000793682
7	Chloride (mg/lit)	295	147.5	.00205222
8	Hardness (mg/lit)	352	352	.00481934

9	Calcium (mg/lit)	42.4	42.4	.00307979
10	Magnesium (mg/lit)	98.4	328	.015871017
11	Free CO <sub>2</sub> (mg/lit)	132.2	1322	.05906948
12	Dissolved Oxygen (mg/lit)	4.5	104.16	.076370209
13	Biological Oxygen Demand (mg/lit)	10.9	181.6	.071256492
14	Chemical Oxygen Demand(mg/lit)	11.6	116	.039069983
15	Fluoride (ppm)	.289	28.9	.27927160

**Table8B: Actual value ( $V_n$ ),Quality rating( $q_n$ ) and calculated values of  $W_n \log_{10} q_n$  for different parameters at Mathura**

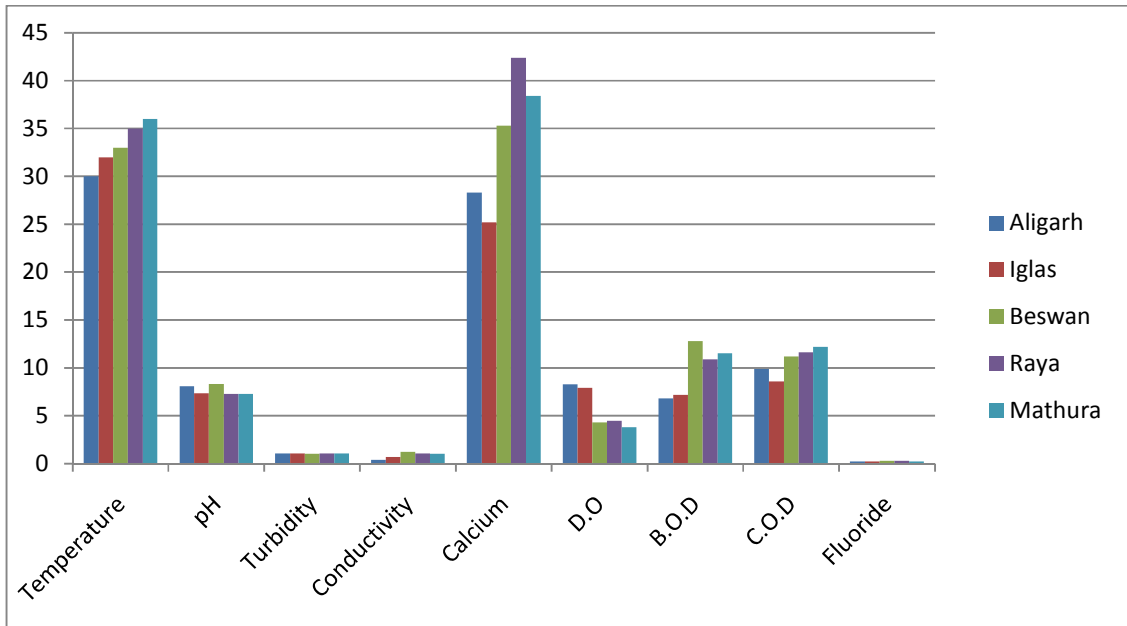
S.No.	Parameters	Actual Value $V_n$	Quality Rating $Q_n$	$W_n \log_{10} q_n$
1	pH	7.30	30	.034943223
2	Turbidity (N.T.U)	1.08	21.6	.050509225
3	Conductivity ( $\mu$ simen/cm)	1.05	350	1.604887732
4	Alkalinity (mg/lit)	332	332	.004771266
5	Total solid (mg/lit)	530	106	.00076658
6	Total solid (mg/lit)	565	113	.000777092
7	Chloride (mg/lit)	213	106.5	.001918383
8	Hardness (mg/lit)	424	424	.004972303
9	Calcium (mg/lit)	38.4	38.4	.002998354
10	Magnesium (mg/lit)	82.1	273.6	.015374186
11	Free CO <sub>2</sub> (mg/lit)	118.2	1182	.058149457
12	Dissolved Oxygen (mg/lit)	3.8	112.5	.077636354
13	Biological Oxygen Demand(mg/lit)	11.5	191.6	.071990773
14	Chemical Oxygen Demand(mg/lit)	12.2	122	.039484476
15	Fluoride (ppm)	.218	21.8	.252546129

The Table 9B shows the calculated value of W.Q.I. for Mathura, Raya and Beswan is 166, 177.5, and 180.87 respectively which clearly indicates that the water is severely polluted and is not fit for drinking or any other purpose of human being . So the people live in these localities must use drinking water after purification. However the calculated value of W.Q.I. for Aligarh and Iglas lies in the range of 80-100 indicating that it is excessively polluted.

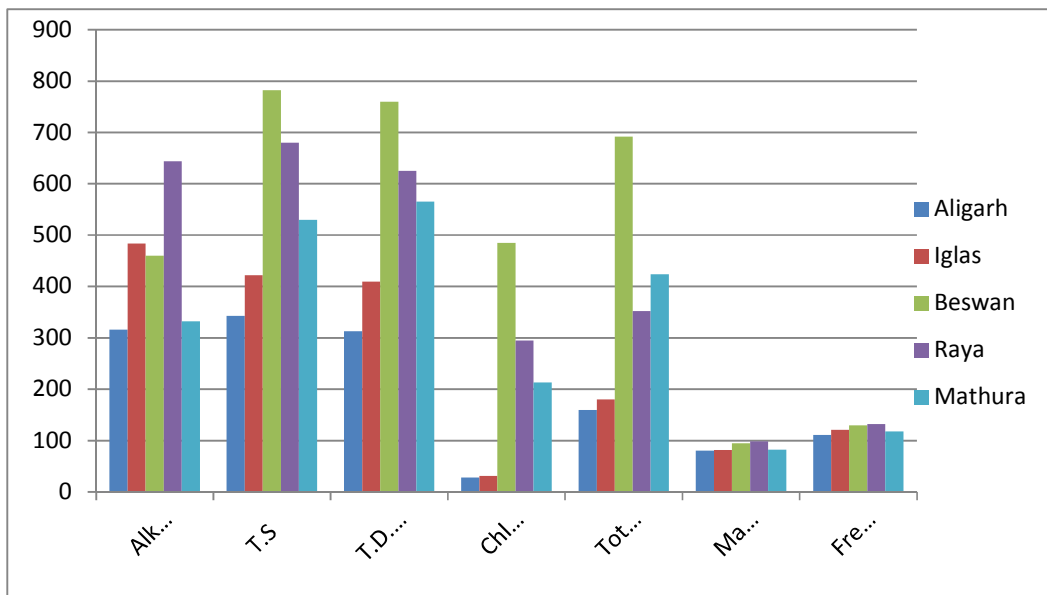
**Table 9B: Calculated value of W.Q.I. for different sites**

SNO	NAME OF THE SITES	VALUE OF W.Q.I.	ASSESSMENT OF WATER
1	Aligarh	84.571	Excessively Polluted
2	Iglas	84.29	Excessively Polluted
3	Beswan	180.87	Severely Polluted
4	Raya	177.5	Severely Polluted
5	Mathura	166	Severely Polluted

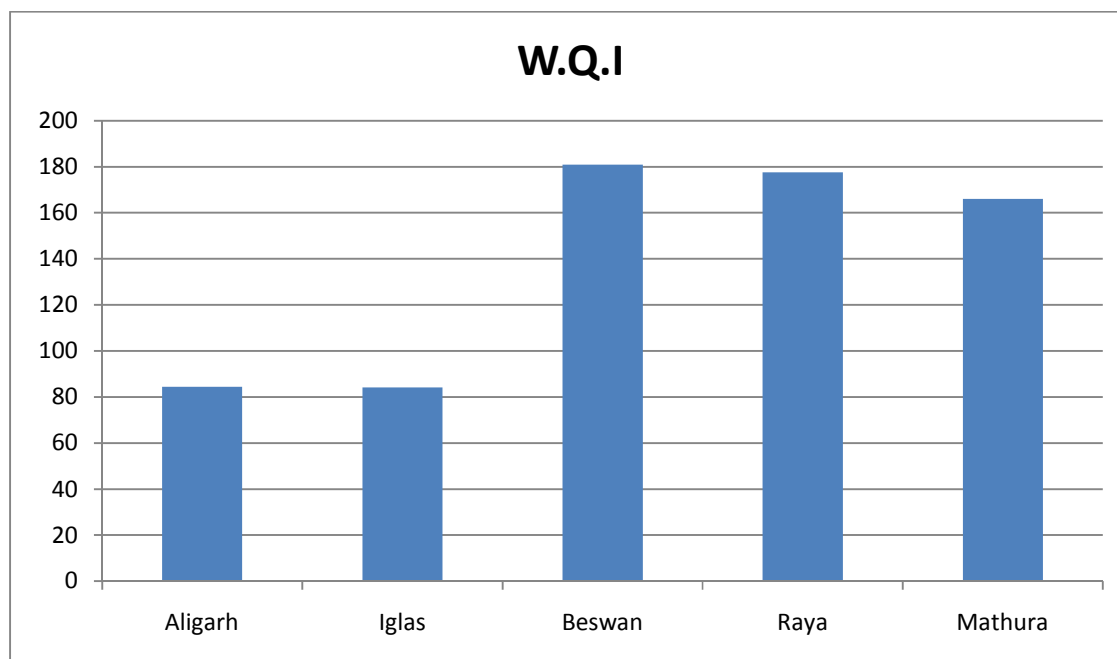
Graphical representation of water quality in this region also clearly indicates that the water quality at Beswan is very poor. All the physico-chemical parameters shows highest value except Alkalinity, Magnesium, FreeCO<sub>2</sub>, Calcium, DO, COD at all sites (Graph10C&11C). Fluoride concentration is under the permissible limit for the entire site as clear from Graph 10C. Variation of W.Q.I. for all the site from Aligarh to Mathura is shown by graph12C.



Graph10C



Graph11C



Graph12C

### CONCLUSION

On the basis of exhaustive discussion, it was found that the drinking water at all the sites in Brij region is highly polluted. The drinking water at Beswan is severely polluted with reference to W.Q.I. and all the physico-chemical parameters. People dependent on this water are prone to health hazards of contaminated water. So they must use drinking water after purification.

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