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ASIAN JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN: 0976-3376

Asian Journal of Science and Technology
Vol. 10, Issue, 11, pp.10461-10464, November, 2019

RESEARCH ARTICLE

WATER QUALITY INDEX FOR ASSESSMENT OF GROUND WATER SAMPLES OF DIFFERENT SITES IN SEONI (M.P.)

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ARTICLE INFO

Article History:
Received 25th August, 2019
Received in revised form
09th September, 2019
Accepted 17th October, 2019
Published online 27st November, 2019

Key words:
Groundwater,
Physico-chemical Parameters,
Water Quality Index.

ABSTRACT

The objectives of this study are to analyze the underground water quality of Seoni by water quality index. Fourteen physic-chemical parameters such as Turbidity, Conductivity, Total dissolved solids, pH, Alkalinity, Chloride, Calcium, Magnesium, DO, SO_4, NO_3, F, Fe, TH collected from eight different sites. In the present study groundwater sample of rainy and winter season of the selected different site of the Seoni (M.P.) area were taken for investigation and analyzed for various parameters with regard to drinking water standards and assessed for their suitability for human consumption.

Citation: ***Dr. Shrivastava and Manisha Kumariya*, 2019.** "Water quality index for assessment of ground water samples of different sites in seoni (M.P.)", *Asian Journal of Science and Technology*, 10, (11), 10461-10464.

INTRODUCTION

Groundwater is one of the major resources of the drinking water in Seoni (M.P.). A water quality index (WQI) is a measure by which water quality can be estimated for various purposes. Water Quality Index can be used to predict whether the water is suitable for drinking purpose, industrial purpose or aquatic organisms etc. The concept of indices to represent gradation in water quality was first proposed by Horton (1965) which is known as water quality index (WQI). WQI with group parameters with common scale after summation gives the output for suitability of water for specific purpose as assigned in the index. WQI can be measured on the scale 0 to 100. Classification of range for Water Quality Index:

Showing Range for Water Quality Index

S. No.	Range	WQI	Grade
1.	0 – 25	Excellent	A
2.	26 – 50	Good	B
3.	51 -75	Poor	C
4.	76 -100	Very Poor	D
5.	100<	Unfit for Consumption.	E

MATERIALS AND METHODS

Water samples were collected in pre- cleaned sterilized polypropylene bottles with necessary precaution from different sites. Samples were collected in monsoon as well as winter seasons. Various physic- chemical parameters are analyzed as given in standard manual of water analysis.

The main aim of the study is to investigate the physic-chemical parameters of ground water samples in Seoni. The Sampling stations selected, are

- Amakola (S1)
- Bamhani (S2)
- Bhata (S3)
- Gangeruwa (S4)
- Jamuniya (S5)
- Bheroganj (S6)
- Budhwari (S7)
- Iswarnager (S8)

All the water samples are taken from hand pump/bore well.
The selected water samples analyzed for fourteen parameters in the lab as per standard procedures. The pH was measured with pH meter, Turbidity, Conductivity, Total dissolved solids, Alkalinity, Chloride, Calcium, Magnesium, DO, SO_4, NO_3, F, Fe, TH were carried out in our laboratory. Assessment of water quality index followed by BROWN'S WATER QUALITY INDEX.

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The approach of Brown et al. (1975) will give precise information about raw water quality. They combined the computed weightages of biological and chemical parameters associated with pollution and worked out an average by the formula

$$WQI\ (Average) = \frac{W_1 + W2 + W3}{N}$$

$$W = \frac{A \times 100}{M}$$

WQI = Water quality index

W = Weight age of parameter (may be chemical or biological)
n = Number of parameters considered
A = Average concentration of the parameter
M = Maximum conc. of the parameter

The concept of indices to represent gradation in water quality was first proposed by Horton (1965) which is known as water quality index (WQI). WQI with a group of other quality parameters with common scale after summation gives the output for suitability of water for specific purpose as assigned in the index. Thus WQI can stand a tool to assess the quality of water for different purpose as well as it will help for management to protect the water from pollution.

The calculation of WQI was made using Weighed Arithmetic Index method (Brown et al., 1972) in the following steps:

Water Quality Index (WQI) = $\sum q_i w_i / \sum w_i$

Where,

q_i = Water quality rating of individual parameter.
w_i = Unit weight of individual parameter.

Unit weight (w_i) of each water quality parameters is calculated by using the following formula:

Unit weight (w_i) = K/S_n

The quality rating (q_i) is calculated as:
Water quality rating (q_i) = 100 X ($V_n - V_i$) / (V_s-V_i)

Where,

V_n= Actual value of individual parameter present in the water sample.
V_i = Ideal value of individual parameter in pure water which is 0 for all parameters, except pH and DO which is 7.0 and 14.6 respectively.
V_s= Standard desirable value of individual parameter.

RESULTS AND DISCUSSION

Water Quality Index for various sites are calculated for rainy and winter season. The water quality indices that were found in three different seasons have been tabulated in Table-1. Water Quality Index for various sites are calculated for rainy as well as winter season. The water quality index indices that were found in two different seasons have been tabulated in Table-3, Table- 5.

Table- 1. Showing Water Quality Standards (Sn), their Ideal Values (Vi) And Unit Weight (wi)

S. No.	Parameters	BIS 10500:2012 Standards (Sn)	Ideal Value (Vi)	Unit Weight (wi)
1.	pH	8.5	7	0.0238156
2.	EC (µmohs/cm)	1400	0	0.0010122
3.	Turbidity (NTU)	5	0	0.0404865
4.	Total Alkalinity (mg/l)	200	0	0.0010122
5.	Total Dissolved Solids (mg/l)	500	0	0.0004049
6.	Total Hardness (mg/l)	300	0	0.006748
7.	Chloride (mg/l)	250	0	0.0008097
8.	Calcium (mg/l)	75	0	0.0026991
9.	Magnesium (mg/l)	30	0	0.0068478
10.	Dissolved Oxygen (mg/l)	5	14.6	0.0404765
11.	Sulphate (SO_4), (mg/l)	200	0	0.0010123
12.	Nitrate (NO_3), (mg/l)	45	0	0.0044986
13.	Iron (Fe), (mg/l)	0.3	0	0.6847752
14.	Fluoride (F), (mg/l)	1	0	0.2025326
	∑wi =			1.0101904

Table 2. Showing Water Quality Rating (qi) Calculated for Determination of WQI during Rainy Season (July 2017 – June 2018)

S. No.	Parameters	Site S1	Site S2	Site S3	Site S4	Site S5	Site S6	Site S7	Site S8
		Qi	Qi	Qi	qi	qi	qi	qi	qi
1	pH	33.3	40.0	33.4	60	60	60	46.7	26.7
2	EC	55.6	55.1	50.3	52.8	45.5	59.8	48.6	48.9
3	Turb	58.6	65	88.6	49.4	61.4	59	76	46.6
4	TA	168.8	186.3	250	213.1	162.5	212.7	248.1	247.5
5	TDS	73.6	85.75	96.4	105.7	88.7	70.9	89.7	90.95
6	TH	83.3	92.3	96.9	108.9	91.8	64.3	89.2	85.2
7	Cl	45.2	36.9	66.26	48.4	48.5	30.6	43.1	36.0
8	Ca	55.9	83.8	70.6	124.2	107.4	70.6	85.9	96.0
9	Mg	60.0	134.4	133.8	116.5	116.6	83.2	64.4	86.5
10	DO	90.41	99.2	108.3	92.5	104.4	102.3	103.4	103.4
11	SO_4	29.1	52.7	38.3	69.6	64.1	68.3	18.6	28.25
12	NO_3	40	38.4	48.4	50.7	72.8	75	81.6	77.3
13	Fe	112	26.7	72.4	59.4	20.4	31.7	28	30.4
14	F	12.6	113	105	78	112	104	93	115

Table- 3. Showing Sub Index (qiwi) values and ∑qiwi i. e. WQI (∑qiwi/∑wi) during Rainy Season (July 2017 – June 2018)

S.No.	Parameters	Site S1	Site S2	Site S3	Site S4	Site S5	Site S6	Site S7	Site S8
		qiwi	qiwi	Qiwi	qiwi	qiwi	qiwi	Qiwi	qiwi
1.	pH	0.793	0.953	0.793	1.428	1.428	1.425	1.112	0.635
2.	EC	0.008	0.007	0.007	0.008	0.006	0.0009	0.007	0.007
3.	Turb	2.372	2.631	3.587	2.000	2.485	2.388	3.076	1.886
4.	TA	0.170	0.188	0.253	0.215	0.164	0.215	0.251	0.250
5.	TDS	0.029	0.034	0.039	0.042	0.035	0.028	0.36	0.036
6.	TH	0.056	0.062	0.065	0.073	0.061	0.043	0.060	0.057
7.	Cl	0.036	0.029	0.053	0.039	0.039	0.024	0.034	0.029
8.	Ca	0.161	0.226	0.190	0.335	0.289	0.190	0.232	0.259
9.	Mg	0.459	0.906	0.903	0.786	0.787	0.561	0.434	0.583
10.	DO	3.660	4.019	4.386	3.745	4.229	4.145	4.18	4.187
11.	SO_4	0.029	0.053	0.038	0.070	0.064	0.069	0.018	0.028
12.	NO_3	0.179	0.172	0.217	0.227	0.327	0.337	0.367	0.347
13.	Fe	8.673	18.260	49.532	40.629	13.923	21.684	19.173	20.771
14.	F	22.683	22.886	21.265	15.797	22.683	21.063	18.835	23.291
	∑qiwi=	39.30	50.52	81.33	65.38	46.51	51.83	50.05	59.60
	∑qiwi/∑wi= (∑wi= 1.02)	38.52	49.52	79.73	64.09	45.59	50.81	49.83	58.43

Table 4. Showing Water Quality Rating (qi) Calculated for Determination of WQI during Winter Season (July 2017 – June 2018)

S. No.	Parameters	Site S1	Site S2	Site S3	Site S4	Site S5	Site S6	Site S7	Site S8
		qi	qi	Qi	Qi	Qi	qi	Qi	qi
1	pH	33.3	33.4	66.6	53.3	70	20	76.6	20
22	EC	48.0	63.5	73.5	49.0	46.5	51.9	47.8	43.0
33	Turb	32.6	35.6	56	30	36.6	36	38.6	23
44	TA	172.5	225.1	235.8	226	199.7	231.8	220.7	238.7
55	TDS	81.1	103.7	92.35	128.4	86.3	99.6	82.9	77.0
66	TH	94.75	116.9	122	106.0	115.5	102.3	87	87.7
7	Cl	37.2	42.3	41.3	51.1	38.6	34.5	34.1	40.24
8	Ca	110.9	143.5	124.0	125.8	141.2	99.3	110.4	100.8
9	Mg	67.9	105.8	88.8	112.9	138.3	105.4	99.4	95.3
10	DO	91.6	93.2	93.2	86.2	96.1	99.7	109.3	105
11	SO_4	20.2	46.8	38.6	28.8	37.7	17	21.6	23.8
12	NO_3	52.8	46.11	50.0	33.5	75.3	71.2	69.4	67.7
13	Fe	38	31.4	51.7	47	29.4	28.7	46	23.4
14	F	105	101	112	88	99	117	78	98

Table 5. Showing Sub Index (qiwi) values and ∑qiwi i. e. WQI (∑qiwi/∑wi)during Winter Season (July 2017 – June 2018)

S.No.	Parameters	Site S1	Site S2	Site S3	Site S4	Site S5	Site S6	Site S7	Site S8
		qiwi	qiwi	qiwi	qiwi	iwi	qiwi	qiwi	qiwi
1.	pH	0.793	0.794	1.586	1.270	1.667	0.476	1.825	1.667
2.	EC	0.006	0.009	0.010	0.007	0.006	0.0007	0.006	0.006
3.	Turb	1.319	1.441	2.267	1.214	1.481	1.457	1.562	0.931
4.	TA	0.174	0.277	0.238	0.228	0.202	0.234	0.223	0.241
5.	TDS	0.032	0.042	0.037	0.052	0.034	0.040	0.033	0.031
6.	TH	0.063	0.078	0.082	0.071	0.077	0.069	0.058	0.059
7.	Cl	0.030	0.034	0.033	0.041	0.031	0.027	0.027	0.032
8.	Ca	0.299	0.387	0.334	0.339	0.381	0.268	0.298	0.272
9.	Mg	0.464	0.724	0.608	0.773	0.947	0.721	0.680	0.652
10.	DO	3.711	3.774	3.774	3.491	3.892	4.040	4.420	4.251
11.	SO_4	0.020	0.047	0.039	0.029	0.038	0.017	0.021	0.024
12.	NO_3	0.237	0.207	0.225	0.150	0.338	0.319	0.311	0.304
13.	Fe	26.021	21.456	35.380	32.184	20.086	19.630	31.499	15.978
14.	F	21.265	20.455	22.683	17.822	20.050	23.696	15.797	19.848
	∑qiwi =	54.43	49.66	67.07	57.66	49.22	50.93	56.76	44.35
	∑qiwi/∑wi=(∑wi= 1.02)	53.36	48.68	65.75	56.52	48.25	49.93	55.64	43.48

From the comparative analysis of WQI values for all sampling location in both rainy and winter season, it was observed that WQI values for site S1 varied from 38.52 in rainy season to 53.36 in winter season. In site S2, WQI value is 49.52 in rainy season and 48.68 in winter season. At site S3, WQI varied from 79.73 to 65.75. In location S4, it varied from 64.09 to 56.52 and for S5 from 45.59 to 48.25 rainy and winter season respectively. In site S6, WQI value is 50.81in rainy season and 49.93 in winter season.

In site S7, S8, WQI value are 49.83 in rainy, 55.64 in winter and 58.43 in rainy seasons 43.48 in winter season. This could be due to the fact that the microbial activity get reduced due to low temperature, thereby keeping Do level at a very satisfactory range during entire rainy season, Also during winter, the water quality deteriorates on account of the increase in microbial activity as well as increase in pollutants concentration due water evaporation as the temperature is normally higher in the area. The permissible WQI for human consumption is up to 100.

Samples S1and S5 shows water quality good for drinking purpose in rainy and winter seasons. In majority of the cases water contamination has been remarkably increased.

Conclusion

Application of Water Quality Index (WQI) in this study has been found useful in assessing the overall quality of water and to get rid of judgment on quality of the water. This method appears to be more systematic and gives comparative evaluation of the water quality of sampling stations. Samples S2 and S5 show water quality are good for drinking purpose in rainy and winter seasons. Sample S1 is good in rainy season. Samples S6, S8 are good in winter season.

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