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WATER QUALITY ASSESSMENT BY USING AN INDEX AT CITY LEVEL - A CASE STUDY

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ABSTRACT

Water Quality Index (WQI) is one of the most effective way to assess the quality of water. The present study is to assess the groundwater quality in relation to domestic use in Azamgarh district of Uttar Pradesh. The analysed of the physico-chemical properties and computed WQI are grouped groundwater of the study area in moderate to good quality zone and suitable for drinking and domestic usage. The WQI of the current study will be of much use for the planners in the management and monitoring of water resources.

KEYWORDS : Ground Water, Physico-Chemical Analysis, Azamgarh City, Water Quality, Index

Ground water is an important source of water supply throughout the world. It is the major source of drinking water supply for urban and rural areas. The evaluation of groundwater quality is an important as its quantity, since the physical and chemical characteristics of groundwater determines its suitability for agricultural, industrial and domestic uses. Water Quality Index (WQI) has been regarded as one of the most effective way to assess the quality of water and is communicated on the basis of calculate water quality indices (Pradhan et al., 2001).The present study area Azamgarh is located on the East. The aim of the present study is to investigate the state of groundwater quality of the wells using WQI studies.

MATERIAL AND METHODS

A total number of thirteen samples were collected from bore wells (Hand pump) in the study area during month of October, 2012. TDS was estimated indirectly by making use of following formula :). 64xEC in ms/cm (Raghunath, 2003). All water quality analysis were carried out as per APHA, 1998 and Kotaiah and Kumar Swamy, 1994).

Computation of Water Quality Index

Water Quality Index (WQI) denoting the intergrated effect of the various parameters that are relevant and significant to a particular use that is proposed to express the water quality for different uses. It is one of the most effective ways to communicate information on water quality trends to policy makers, to shape sound public policy and implement the water quality improvement programmes efficiently. Water Quality Index (WQI) was computed by weighted index method to determine the suitability of groundwater for drinking purpose (Padmanabha and Belagali, 2005). The estimated qualtitative values of water quality parameters and their standards (BIS, 1991) are used for the calculation of water quality indices. WQI has been computed using the formula given in equation number 1

$$\text{Water Quality Index (WQI)} = \sum_{i=I}^{\eta} wiqi \quad \text{..... 1}$$

Where, wi = weightage factor of i^{th} parameter

qi = quality rating of i^{th} parameter

w, is caulculated from the following equation

$$\frac{k}{wi} = \frac{I}{I/vs1 + I/vs2 \text{ ..... } + I/vsh}$$

Where, k= constant

s_{η} = standard value of ith parameter

qi is caiculated from the following equation

$$qi = \frac{Va - Vi}{Vs - Vi} \times 100$$

Where,

Va = actual value obtained from laboratory analysis of ith parameter

Vs = standard value of ith parameter

Vi = ideal value (pH = 7 and 0 for all parameter)

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Table-1 Physico-Chemical Properties of Groundwater Samples in the Study Area

Sample No.	Location Name	pH	Alkalinity mg/L	EC mS/cm	TDS mg/L	TH mg/L	CaH mg/L	MgH mg/L	Cl mg/L	SO_4 mg/L	NO_3 mg/L	PO_4 mg/L
S1	D.A.V. Degree College	7.95	180	1400	896	278	202	76	158.4	78	2.06	0.9
S2	Bus Station	7.52	138	800	512	64	56	8	88.8	16.2	4.68	0.13
S3	Rahul Nagar	7.86	142	700	448	212	186	26	68.2	10.8	0.8	1.4
S4	Raidopur Colony	7.03	96	800	512	168	142	26	112.8	22	4.11	0.16
S5	G.I.C.	7.51	120	900	576	88	72	16	126.4	19.4	4.14	0.14
S6	Kunwar Singh Park	7.14	96	800	512	112	84	28	102.4	3.2	2.4	0.14
S7	Baradeo	7.08	112	900	576	94	70	24	148.2	2	3.62	0.12
S8	Matbarganj	7.22	116	700	448	116	108	8	58	14.2	1.02	0.26
S9	Narauli Stand	7.15	98	800	512	136	108	28	106.6	18	3.86	1.2
S10	Vishal theatre	7.45	122	800	512	102	74	28	102.4	4.6	1.85	0.46
S11	Sidhari	7.26	116	800	512	180	154	26	80	15.2	4.12	0.12
S12	Railway Colony	7.51	46	1200	768	102	88	14	118.6	94	3.82	0.1
S13	Harbanspur	8.01	186	1500	960	284	224	60	188.2	112	1.35	2.8

Table-2 Water Quality Index of Groundwater Samples in the Study Area

Parameter	Standard Sa and Vs	Weight age Wi	Vi	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13
pH	8.5	0.5715	7	63.33	34.67	57.33	2.0	34	9.33	5.33	14.67	10.0	30.1	17.33	34.0	67.33
Alkalinity	200	0.0243	0	0.9	0.69	0.71	0.48	0.6	0.48	0.56	0.58	0.49	0.61	0.58	0.73	0.93
TDS	500	0.0097	0	1.792	1.024	0.896	1.024	1.152	1.024	1.152	0.896	1.024	1.024	1.024	1.536	1.92
TH	300	0.0162	0	0.93	0.21	0.71	0.56	0.29	0.37	0.31	0.39	0.45	0.34	0.6	0.34	0.95
CaH	75	0.0648	0	2.963	0.747	2.48	1.893	0.96	1.12	0.933	1.44	1.44	0.987	2.053	1.173	2.987
MgH	30	0.1619	0	2.533	0.267	0.867	0.867	0.533	0.933	0.8	0.267	0.933	0.933	0.867	0.467	2.01
Cl	250	0.0194	0	0.634	0.355	0.273	0.451	0.506	0.41	0.593	0.232	0.426	0.41	0.32	0.474	0.753
SO4	200	0.0243	0	0.39	0.081	0.054	0.11	0.097	0.016	0.01	0.07	0.09	0.023	0.076	0.47	0.56
NO3	45	0.1079	0	0.046	0.104	0.018	0.091	0.092	0.053	0.08	0.023	0.086	0.041	0.092	0.085	0.03
Swi x qi				73.25	38.15	63.34	7.48	38.24	3.75	9.78	18.56	4.95	34.37	22.95	39.28	77.46

Using the water quality index, all the samples were categorized into five classes as excellent (0 to 25), good (26 to 50), moderately polluted (51 to 75), severely polluted (76 to 100) and unfit (above 100) based on their suitability for human consumption.

RESULTS AND DISCUSSION

The collected water samples were analyzed for physico-chemical parameters and these are listed in Table 1. The potability of drinking water is judged based on Indian standard drinking water specification of Bureau of Indian Standards (Table 2).

In the present study, pH values of groundwater were found in the range of 7.03 to 8.01. All the water samples were slightly alkaline in nature. The constituents of alkalinity in natural waters mainly include carbonate, bicarbonate and hydroxide which are resultants of dissolves mineral substance in soil and atmosphere. In the study area alkalinity in water samples range between 96 to 186 mg/L and these are below the acceptable limits.

The EC groundwater at Azamgarh City varied between 700 and 1500 mS/cm. The concentration of total dissolved solids in all the samples in the study area ranges from 448 to 960 mg/L. According to BIS, the acceptable limit for TDS in goundwater is 500 mg/L. The total samples were fall in excessive limits of BIS standards, except S3 S8. The excess solids may be due to insoluble organic matter in the domestic waste water and open ground sewage disposal. High concentrations may be attributed to small scale industrial activities in that area. Variations of TDS concentrations of all the samples.

In the present study, total hardness of the samples ranged from 64 to 284 mg/L and classified (Todd, 2001) the samples in the range of moderately hard to hard. Calcium present in excessive limits of standards in 70 percent of the total samples. The Mg hardness concentrations of all well waters are within the permissible limits, except S1 and S13 samples.

In this area, chloride ranges between 58 and 188.2 mg/L and the concentration of chloride in all the samples of study area is below the limit. In most natural waters, sulphate is found in smaller concentrations than chloride

(Powell, 1964). The sulfate content in the area varies from 2 to 112 mg/L. The result explain that the values of sulphate concentrations in all the samples are well below the premissible limits.

Nitrates and phosphates are essential nutrients for plant growth. Excessive concentrations of nitrate in drinking water may cause methemoglobinemia in small children. Concentrations in excess of 10 mg/L as N, equivatent to 44 mg/L of NO3 evidently present this hazard (Hem, 1985). The concentration of nitrate in the study area ranges from 0.8 to 4.68 mg/L. Phosphorus is fairly abundant in sediments, but concentrations present in solution in natural water are normally not more than a few tenths of a milligram per liter. It is component of sewage, as the element is essential in metabolism, and it is always present in animal metabolic waste. The concentrations of phosphate of the water samples varied from 0.1 to 2.8 mg/L.

Estimated water quality index values and its graphical representation of all sampling stations are given in Table 2. The water quality index of areas like Raidopur Colony (S4), Kunwar Singh Park (S6), Baradev (S7), Matberganj (S8), Narauli Stand (S9) and Sidhari (S11) are well below 25 and are absolutely fit for human consumption. Four samples such as S2, S5, S10 and S12 are in good condition as per WQI rating. Areas like D.A.V. Degree College (S1), Bus Station (S3), are in poor condition and Harbunspur (S13) is very poor condition, this may be due to industrial domestic sewage effluents and runoff from agricultural fields through fertilizers.

CONCLUSION

Hydrochemical analysis of the study clearly indicates that most of the areas fall in under moderate to good water quality zones. The water quality studies explained that certain parameters like pH, alkalinity, total hardness, chloride, nitrates, phosphates and sulphates were within permissible limits prescribed by Bureau of Indian Standards. However, total dissolved solids and calcium hardness were exceeding the standards in some locations. WQI study reveals that three samples were fall in polluted zone in the area.

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