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Research article

STATUS OF THE DRINKING WATER QUALITY IN SCHOOL OF DATIA TOWN (M.P.)

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ABSTRACT: The water quality of different sources of water viz. hand pumps, wells, bore wells and tabs were studied of urban areas of Datia (M.P.). The results of Physico-chemical analysis such as pH, Electrical conductivity, T.S. , T.D.S., T.S.S, T. H, T.A. NO_3, Cl, SO_4, Na, and K of four (Govt. H.S. School (No. 01), Govt. H.S. School (No. 02), Holi Cross H. S. School and Govt. M. L. B. (Girls) H. S. School, Datia) water samples collected from above school in urban area of Datia city are presented. The present study calculates the Water Quality Index (WQI) of Datia city and assesses the impact of industries and hum-an activities. Physicochemical parameters were monitored for the calculation of WQI for the some Schools in Datia City.

Key words: School of Datia City, Physicochemical characteristics, Water Quality Index (WQI), and correlation coefficients.

INTRODUCTION

Ground water is a good source of fresh water available on the earth. It is the important renewable resource having several inherent advantages over surface water. Water has its multipurpose uses. The potential and quality of groundwater, is an economic resource and essential component of our life, is getting deteriorated in major cities and urban centers due to pollution caused by population explosion, urbanization and industrialization. Chemical quality of the surface and ground water is a factor which has paramount importance in its utilization for municipal and industrial uses, thus water is practically a universal solvent which dissolves almost everything comes in its contact. Since, water is valuable natural resources, surface and ground water has some importance for every natural being, continued development and increasing used ground water combines with its reuse and quality suffers unless consideration is given to protecting it. The mineral impurities in water include principally the Chlorides, Nitrate, Fluoride, and Iron. The water samples were analyzed from major cations, i.e. Total dissolved solids (T.D.S.), electrical conductivity (E.C.), total hardness and pH. Ground water is generally used for drinking, domestic and agricultural purposes. The present study attempts to evaluate the quality of drinking water of some schools urban area Datia, (M.P.)

STUDY AREA

The district is situated in the north part of M.P. and is located between the latitudes 25^0 28'N and 28^0 20' N and longitudes of 78^0 10', E and 78^0 45' E, and Total geographical area 2691 sq Km. and the major part of the study area covers with the sand stone rocky quartzite and granite stone, types of soil .

MATERIAL AND METHOD

Drinking water samples from 27 different locations of Datia district were collected spreading over period of one year 2009. Sample ware collected in average three seasons observations in used in all computation water samples were collected in clean bottles two liter. Chemical characteristics were determined by the standard methods by APHA (1989).

Water quality index (WQI) and coefficient of variation are the two statistical parameters considered for variability measurement among the parameters. The correlation coefficient (r) has been calculated between each pair of parameters using experimental data given in Table: 02, 03, 04, 05, 06 and 07.

Table: 1 Chemical parameters and their methods used (APHA-1989).

PARAMETERS	METHODS
E.C. (Electrical conductivity)	Conductivity bridge.
µmho/cm.	H+ ion sensitive electrode methods.
pH	Evaporation to Residue in Crucible
Total dissolved solids (T.D.S.)	E.D.T.A. Titrimetric method.
Total Hardness (T.H.)	E.D.T.A. Titrimetric Method
Calcium Hardness	Calculation Method
Magnesium Hardness	Argentometric method.
Chlorides	Brucine sulfanilic acid method.
Nitrate	Phenolphthalein and Methyl Orange Indicator
Total Alkalinity	Method
Sulphate	Turbidimetric Method
Nitrites	N - (1-Napthy) - Ethylene Diamine Dihydro cloride
Potassium	Flame Photometric Method
Sodium	Flame Photometric Method

Water Quality Index (WQI):

The concept of indices to represent gradation in water quality was first proposed[8]. It indicates the quality by an index number, which represents the overall quality of water for any intended use. It is defined as a rating reflecting the composite influence of different water quality parameters on the overall quality of water [05, 07, 10]. The WQI has been calculated from the point of view of the suitability of lake water for human consumption.

a) WQI Calculation :

For calculation of WQI, selection of parameters has great importance. Since selection of too many parameters might widen the water quality index, and the importance of various parameters depends on the intended use of water, eight physicochemical parameters, namely pH, TS, TDS, TSS, EC, total alkalinity, magnesium, calcium, total hardness, chloride, sulphate, were used to calculate the WQI. The calculation of WQI was made using a weighted arithmetic index method given below [3] in the following steps.

b) Calculation of sub index of quality rating (q_n) :

Let there be n water quality parameters where the quality rating or sub index (q_n) corresponding to the nth parameter is a number reflecting the relative value of this parameter in the polluted water with respect to its standard permissible value. The value of *qn* is calculated using the following expression.

$$q_n = 100[(Vn - Vio) / (Sn - Vio)] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where

q_n = quality rating for the n^{th} water quality parameter.
Vn = estimated value of the n^{th} parameter at a given sampling station.
Sn = standard permissible value of n^{th} parameter
Vio = ideal value of n^{th} parameter in pure water.

c) Calculation of unit weight (*Wn*) :

Calculation of unit weight (*Wn*) for various water quality parameters are inversely proportional to the recommended standards for the corresponding parameters.

$$Wn = K/Sn \quad \text{……} \quad (2)$$

Where
Wn = unit weight for n^{th} parameter
Sn = standard value for n^{th} parameters
K = proportionality constant.

Calculation of WQI :

WQI is calculated from the following equation -

$$\text{WIQ} = \sum_{n=1}^{n} \frac{qn\,Wn}{\sum_{n=1}^{n} Wn} \quad \text{……..……} \quad (3)$$

Table: 02: Status of water quality based on WQI.

Water Quality Index (WQI)	Status
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very Poor
< 100	Unsuitable for drinking

Table : (03) Drinking Water Standards recommending Agencies and unit weights.

Parameters	**Standards**	**Recommended agency**	**Unit Wight (w_n)**
pH	6.5-8.5	BIS	0.2190
Electrical conductivity µmho/cm.	1000	BIS	0.0018
Total Dissolved Solids	500	BIS	0.0037
Total Alkalinity	200	BIS	0.0092
Chloride	250	BIS	0.0074
Sulphate	200	BIS	0.0092
Calcium	75	BIS	0.0247
Magnesium	30	BIS	0.0618
Total Hardness	300	BIS	0.0061
Nitrate	45	BIS	0.0412

Table: 4 Calculation of WQI Govt. H.S. School (No. 01) in Datia.

Parameter	Observed value	Standards	Recommended agency	Unit Wight (wn)	Quality rating (qn)	wnqn
pH	7.8	6.5-8.5	BIS	0.2190	53.33	10.36
EC	3390	1000	BIS	0.0018	339.0	0.628
T.D.S	1587	500	BIS	0.0037	317.4	1.177
T.A	622	200	BIS	0.0092	311.0	2.883
Cl^-	522	250	BIS	0.0074	208.8	1.548
SO_4^{2-}	292	200	BIS	0.0092	146.0	1.353
Ca_2^+	176	75	BIS	0.0247	234.6	5.802
Mg_2^+	10.7	30	BIS	0.0618	35.66	2.204
T.H.	220	300	BIS	0.0061	73.33	0.453
No_3	24.2	45	BIS	0.0412	53.77	2.216
WIQ = 74.48			**W_n = 0.3844**		**W_nq_n = 28.6337**	

Table: 5 Calculation of WQI Govt. H.S. School (No. 02) in Datia.

Parameter	Observed value	Standards	Recommended agency	Unit Wight (w_n)	Quality rating (q_n)	w_nq_n
pH	7.2	6.5-8.5	BIS	0.2190	13.33	10.36
EC	1687	1000	BIS	0.0018	168.7	0.312
T.D.S	868	500	BIS	0.0037	173.6	0.643
T.A	532	200	BIS	0.0092	266.0	2.466
Cl^-	194	250	BIS	0.0074	77.60	0.575
SO_4^{2-}	82	200	BIS	0.0092	41.00	0.380
Ca_2^+	48	75	BIS	0.0247	64.00	1.582
Mg_2^+	59.3	30	BIS	0.0618	197.6	12.21
T.H.	532	300	BIS	0.0061	177.3	1.096
No_3	12.5	45	BIS	0.0412	27.77	1.144
WIQ = 80.08			**W_n =0.3844**		**W_nq_n = 30.78605**	

Table : 6 Calculation of WQI Holi Cross H. S. School in Datia.

Parameter	Observed value	Standards	Recommended agency	Unit Wight (w_n)	Quality rating (q_n)	w_nq_n
pH	7.9	6.5-8.5	BIS	0.219	60.00	10.36
EC	642.6	1000	BIS	0.0018545	64.26	0.119
T.D.S	313	500	BIS	0.0037089	62.60	0.233
T.A	192	200	BIS	0.0092723	96.00	0.890
Cl^-	42	250	BIS	0.0074178	16.80	0.124
SO_4^{2-}	17	200	BIS	0.0092723	8.500	0.078
Ca_2^+	48	75	BIS	0.024726	64.00	1.582
Mg_2^+	40.8	30	BIS	0.061815	136.0	8.406
T.H.	216	300	BIS	0.0061815	72.00	0.445
No_3	5.02	45	BIS	0.04121	11.16	0.459
WIQ = 59.05			**W_n = 0.3844**		**W_nq_n =22.704**	

Table : 7 Calculation of WQI Govt. M. L. B. Girls H. S. School in Datia.

Parameter	Observed value	Standards	Recommended agency	Unit Wight (w_n)	Quality rating (q_n)	w_nq_n
pH	7.6	6.5-8.5	BIS	0.219	40.00	10.36
EC	1250	1000	BIS	0.0018545	125.0	0.231
T.D.S	1053	500	BIS	0.0037089	210.6	0.781
T.A	423	200	BIS	0.0092723	211.5	1.961
Cl^-	82	250	BIS	0.0074178	32.80	0.243
SO_4^{2-}	46	200	BIS	0.0092723	23.00	0.213
Ca_2^+	43	75	BIS	0.024726	57.33	1.417
Mg_2^+	51.3	30	BIS	0.061815	171.0	10.57
T.H.	219	300	BIS	0.0061815	73.00	0.451
No_3	9.5	45	BIS	0.04121	21.11	0.869
WIQ = 70.50			**W_n = 0.3844**		**W_nq_n =27.11**	

Table: 8 Physico-chemical parameters of drinking water samples in School of Datia town.

Schools No.	pH	E.C. µmho/cm.	T.D.S.	T.A.	T.H.	Ca	Mg	Cl	So_4	Na	K	NO_3	WQI
S_1	7.8	3390	1587	622	220	176	10.7	522	292	31.8	21.1	24.2	**74.48**
S_2	7.2	1687	868	532	292	48	59.3	194	82	10.4	21.4	12.5	**80.08**
S_3	7.9	642.6	313	192	216	48	40.8	42	17	1.3	18.8	5.02	**59.05**
S_4	7.6	1250	1053	423	219	43	51.3	82	46	18.2	19.3	9.5	**70.50**

Note : All values are mg. l-1 except **pH , E.C.** (µmho/cm.) and **Na, K** (PPM).
S_1= Govt. H.S. School (No. 01), Datia.
S2 = Govt. H.S. School (No. 02), Datia.
S_3 = Holi Cross H. S. School, Datia.
S_4 = Govt. M. L. B. (Girls) H. S. School, Datia.

RESULTS AND DISCUSSION

The pH values of all the sample shows in the range of pH 7.2 to 7.9, which indicates they were within the desirable limits. Electrical Conductivity of water samples varied from 642.6 to 3390 µmho/cm. in some schools Datia City**,** but samples S_1 had relatively higher conductivity in Govt. H. S. School (No.01) Datia, which may be due to contamination of conducting material in water samples. Total dissolved solids varied from 313 to 1587 mg l^{-1}. These values were the lowest in Govt. H. S. School (No.02) Datia, from 192 to 622 mg l^{-1} in some schools Datia City**.** But sample S_1 had relatively higher total alkalinity in (Govt. H. S. School (No.01), Datia) maximum permissible limit (600 mg l^{-1}). Total hardness levels varied from 216 to 292 mg l^{-1}. The BIS desirable limit for total hardness was 300 mg l^{-1} and permissible limit 600 mg l^{-1}. The leaching of calcium and magnesium rich minerals from rocks and other deposits like limestone, gypsum and clay minerals possibly contributed to total hardness. Sewage and domestic wastes may also be contributing to total hardness in ground water. Calcium determination is usually required for portability of water. Its values varied from 43 to 176 mg l^{-1} (BIS desirable value 75 mg l^{-1} and permissible limit of 200 mg l^{-1}). Magnesium is an essential element for human being. Its desirable limit is 30 mg l^{-1}(BIS 1992). However at higher levels, magnesium salts have a laxative effect. In the present study, magnesium values varied from 10.7 to 59.3 mg l^{-1}. Chloride is one of the important parameters to adjudge water quality. High chloride content causes cardiovascular problem, gives a bitter taste to water, corrodes steel and affects the solidity and strength of concrete. The study showed chloride values ranging from 42 to 522 mg l^{-1}. The value was within the permissible limit of 250 mg l^{-1} for S_1 sample in Govt. H. S. School (No.01), Datia (BIS 1992). Sodium is commonly present in water and its concentration in unpolluted water is less than that of calcium or magnesium. The concentration of sodium (1.3 to 31.8 mg l^{-1}) was below the BIS permissible limit (200 mg l^{-1}). Potassium is a naturally occurring element. Its concentration (18.8 to 21.4 mg l^{-1}) is however, usually quite lower than that of sodium, calcium and magnesium (BIS permissible limit 12 mg l^{-1}). Thus, the excess amount of potassium present in the water sample may lead nervous and digestive disorder [11].

High amount of sulphate imparts bitter taste to the sample S_1 in Govt. H. S. School (No.01), Datia. Also, this will cause laxative effect to the children in hot weather climates[6]. Nitrate in food may cause methemoglobinemia in babies[10], cancer of the colon, rectum or other gastrointestinal cancer[4,13], Alzeimer's disease, vascular dementia of Biswanger type or multiple small infarct type [12]. All samples have nitrate concentration below permissible limit (45 mg l^{-1}) according to BIS 1992.

- **Water Quality Index (WQI) :**

Water Quality Index (WQI) out of 4 schools, shows that 03 Samples poor and 01 sample very poor. The physic-chemical properties of the dirking water highly varied in Schools in Datia city. The area having poor and very poor for drinking water quality requires treatment before use for School Students consumption.

CONCLUSION

The above observations in the present study indicate the higher values of some parameters of the samples. They minimize the suitability of these samples for drinking purposes without treatment. But, after the filtration and disinfection, naturally present impurities can be removed in water, which provide its suitability for drinking and domestic purposes. People depend on this water are often prone to health hazards due to polluted drinking water.

Therefore, some effective measures are urgently required to enhance the drinking water quality by delineating an effective water quality management plan for the region some Schools Datia City (M.P.).

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