

Comparative study of trace elements concentration in surface and ground water of Satna region

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ABSTRACT

Water pollution has become one of the major threat to human health. The safe drinking water is now globally one of the most serious challenges. Water is vital for life, it should be clear, colourless, odourless and should not have any suspended particles as well as harmful and toxic chemical substances. The main aim of this study is to find out the concentration of different trace elements in the water of Satna region by analyzing surface and ground water of this region during different months of the year. This will help in analyzing the effect of season on the concentration of trace metals in the water of this region. A comparative study of concentrations of trace metals will be helpful to take potential health care by taking useful remedial actions.

Key words: Water quality, MINARS (Monitoring of Indian National Aquatic Resources), GEMS (Global Environmental Monitoring System), CPCB (Central Pollution Control Board), DALYs (Disability Adjusted Life Years).

INTRODUCTION

The main sources of water pollution in India at present are city sewage, discharge of industrial wastage, intensive use of fertilizers, insecticides and pesticides in agriculture. Excessive use of fertilizers has increased the level of nitrates in shallow ground water sources. The nitrate content in well water in Mahendragarh district in Haryana was found to be as high as 1310 mg/L. In Howrah district, intensive agriculture has contributed to high levels of such pesticides as DDT in the ground water. Satna district abounds in minerals like calcium, iron, aluminium and silicon and their concentration in water has been reported to be positive and in some cases touching the alarming limit of W.H.O. Several industries are set up in this region, prominent among them are lime and cement factories contributing inorganic and organic pollutants.

This paper reports on the drinking water quality of Satna (M.P.) by analyzing 5 samples of river water and 5 samples of ground water collected from different rivers and handpumps.

Methodology

Five samples from different rivers were collected in clear polythene bottles and incubated at normal temperature immediately. In the similar way five samples of ground water were collected in clear polythene bottles. Analysis of several parameters like hardness, fluorides, nitrates, calcium, iron, chloride, turbidity, conductivity, B.O.D and C.O.D as well as MPN of coliforms were conducted within 48 hours of sampling. Analysis of calcium, iron and nitrate was done by simple analytical methods. Calcium was estimated by E.D.T.A complexometric titration method. Estimation of iron was done by redox titration method. B.O.D.

Table 1: Status of Trace Elements in River Water (The results of chemical characteristics in mg/l)

Parameters	Stations	Nov.	Dec.	Jan.	Jun.	Jul.	Aug.
D.O.	R1	8.5	7.4	8.5	6.8	6.9	7.1
	R2	8.5	8.2	8.4	6.2	5.4	5.8
	R3	8.0	7.9	7.3	6.4	6.2	6.6
	R4	8.4	8.1	8.3	7.1	6.9	6.3
	R5	7.9	8.5	8.4	7.2	7.1	7.3
B.O.D.	R1	1.2	1.4	1.1	2.0	2.4	2.0
	R2	1.1	1.5	1.7	2.0	2.2	2.1
	R3	1.9	1.8	1.3	1.8	1.9	2.0
	R4	1.3	1.5	1.2	2.8	2.6	2.9
	R5	1.8	1.7	1.8	2.2	2.4	2.0
C.O.D.	R1	16.30	15.80	10.40	14.20	15.0	16.80
	R2	12.20	17.60	16.80	14.40	16.40	16.20
	R3	8.40	9.50	8.30	8.0	7.50	6.80
	R4	9.60	10.0	8.0	7.80	7.0	7.0
	R5	10.20	8.0	7.50	8.20	8.0	8.40
Calcium	R1	215	200	211	220	225	223
	R2	195	185	191	198	201	204
	R3	185	190	193	197	199	198
	R4	99	95	98	101	105	106
	R5	85	81	84	90	94	95
Iron	R1	0.87	0.72	0.79	0.81	0.91	0.91
	R2	0.58	0.83	0.59	0.62	0.72	0.74
	R3	0.51	0.67	0.71	0.73	0.71	0.73
	R4	0.83	0.65	0.67	0.71	0.68	0.70
	R5	0.49	0.63	0.59	0.60	0.62	0.64
Fluoride	R1	1.25	1.16	1.17	1.26	1.28	1.31
	R2	1.05	1.04	1.08	1.10	1.12	1.15
	R3	0.80	0.85	0.87	0.91	0.94	0.97
	R4	0.95	0.89	0.88	0.92	0.97	0.98
	R5	0.98	0.91	0.89	0.93	0.95	0.99
Nitrate	R1	7.04	7.10	6.94	7.20	7.86	8.40
	R2	8.72	8.40	8.10	8.13	9.30	9.10
	R3	2.99	3.00	3.51	4.20	4.88	4.91
	R4	2.40	2.54	2.71	3.10	3.26	3.43
	R5	1.90	2.10	2.14	2.85	3.10	3.56
Silica	R1	03	02	03	05	05	04
	R2	04	04	02	05	02	04
	R3	Nil	Nil	Nil	01	01	02
	R4	Nil	Nil	Nil	Nil	Nil	Nil
	R5	Nil	Nil	Nil	Nil	Nil	Nil
Turbidity	R1	10	11	10	08	12	10
	R2	10	12	10	12	10	11
	R3	12	10	11	11	11	12
	R4	08	09	08	10	08	12
	R5	08	10	09	10	09	10
Conductivity	R1	216	298	338	210	216	208

Table 1: Continue

	R2	423	492	464	412	410	402
	R3	520	534	512	486	436	405
(ohm ⁻¹ cm ⁻¹)	R4	329	481	472	421	387	366
	R5	522	526	530	496	402	396
pH	R1	8.0	7.8	7.8	7.8	8.0	8.1
	R2	8.5	8.0	8.4	7.8	8.0	8.3
	R3	8.3	8.1	8.2	7.9	7.8	7.9
	R4	8.4	7.8	8.1	8.1	8.2	8.2
	R5	8.1	8.0	8.3	8.2	8.5	8.4
Hardness	R1	160	174	192	186	175	188
	R2	180	182	160	165	155	154
	R3	188	192	190	194	191	184
	R4	160	174	170	188	184	181
	R5	172	162	150	175	171	165
Coliform cells/100 ml	R1	4	4.5	3.5	1.5	1.8	2.5
	R2	3	3	3.5	1.8	1.5	2.3
	R3	3.5	3.5	3	1.5	1.9	2.4
	R4R5	3.54.5	34	3.54.5	1.61.5	1.51.5	1.91.6
Chloride	R1	40	38	37	35	33	32
	R2	36	37	35	34	32	30
	R3	38	40	39	36	33	31
	R4	34	36	34	34	35	32
	R5	32	33	32	33	32	30

River Code	Name of the river
R1	Tamas River
R2	Satna River
R3	Kariyari River
R4	Mandakini River
R5	Paysuni River

was determined by five days B.O.D. determination method. C.O.D. was determined by using Potassium Dichromate as oxidizing agent in acidic medium using FAS solution to determine unused Potassium Dichromate. D.O. was determined by Winkeler's method. Fluoride concentration was determined spectrophotometrically using SPANDS method while other parameters were determined by APHA (1991) standard methods and results were compared with the standards prescribed so far.

RESULTS AND DISCUSSIONS

This study has investigated that dissolved oxygen contents of surface water is comparatively

more than that of ground water. D.O. contents in months of Nov., Dec. are more than D.O. contents in the months of July and August. B.O.D. and C.O.D values for the surface water are more than that of ground water in all the months of investigation. Although these values are more in rainy season than in winter but B.O.D and C.O.D. values for ground water are nil representing good quality of ground water of this region. Calcium concentration in both the seasons and in both kinds of water exceeds its maximum limit of 75 mg/L (OSPC board organization) consequently stone patients are reported in this region. The concentration of fluoride in Satna, Unchehara and Nagod Tehsil is above its standard limit of 1.5 mg/l. In Ateraha, Gurhuru and

Table 1: Status of Trace Elements in Ground Water (The results of chemical characteristics in mg/l)

Parameters	Stations	Nov	Dec	Jan	Jun	Jul	Aug
D.O.	G1	6.5	6.7	6.5	5.8	6.9	6.6
	G2	6.4	6.4	6.6	5.2	6.4	6.8
	G3	6.7	6.8	7.3	6.4	6.2	6.1
	G4	7.2	7.5	7.6	6.1	6.7	6.4
	G5	7.2	7.2	7.0	6.5	6.6	6.3
B.O.D.	G1	NIL	NIL	NIL	NIL	NIL	NIL
	G2	NIL	NIL	NIL	NIL	NIL	NIL
	G3	NIL	NIL	NIL	NIL	NIL	NIL
	G4	NIL	NIL	NIL	NIL	NIL	NIL
	G5	NIL	NIL	NIL	NIL	NIL	NIL
C.O.D.	G1	NIL	NIL	NIL	NIL	NIL	NIL
	G2	NIL	NIL	NIL	NIL	NIL	NIL
	G3	NIL	NIL	NIL	NIL	NIL	NIL
	G4	NIL	NIL	NIL	NIL	NIL	NIL
	G5	NIL	NIL	NIL	NIL	NIL	NIL
Calcium	G1	255	215	218	225	235	243
	G2	195	189	191	198	205	208
	G3	189	195	193	196	200	198
	G4	105	125	115	125	130	126
	G5	85	86	87	90	98	100
Iron	G1	0.81	0.63	0.70	0.79	0.91	0.90
	G2	0.47	0.64	0.57	0.62	0.74	0.78
	G3	0.52	0.57	0.61	0.54	0.61	0.63
	G4	0.63	0.65	0.64	0.71	0.65	0.70
	G5	0.43	0.42	0.49	0.50	0.52	0.54
Fluoride	G1	2.15	2.10	1.55	2.11	2.00	1.55
	G2	1.80	1.20	1.10	1.20	1.65	1.50
	G3	1.10	1.26	1.58	3.31	2.33	3.02
	G4	1.54	1.34	1.58	2.41	3.80	2.41
	G5	0.34	0.25	0.14	0.26	0.23	0.34
Nitrate	G1	7.04	7.10	6.94	7.92	8.72	9.68
	G2	7.70	8.40	8.10	8.18	9.33	9.36
	G3	0.66	0.65	0.94	0.98	0.66	0.65
	G4	0.88	0.41	0.49	0.52	0.88	0.35
	G5	1.46	1.76	1.09	1.48	1.76	1.78
Turbidity	G1	09	10	09	10	12	11
	G2	09	09	08	10	11	11
	G3	08	08	09	09	10	10
	G4	07	08	07	08	09	10
	G5	08	10	08	07	09	10
Conductivity (ohm ⁻¹ cm ⁻¹)	G1	316	301	288	346	356	357
	G2	340	392	360	410	412	402
	G3	423	434	412	480	486	485
	G4	333	318	370	396	400	402
	G5	420	396	380	400	402	400
PH	G1	7.2	7.5	7.8	7.4	7.5	7.1

Table 1: Continue

	G2	7.5	7.6	7.4	7.2	7.4	7.4
	G3	7.2	7.5	7.4	7.1	7.8	7.5
	G4	7.3	7.6	7.1	7.1	7.5	7.2
	G5	7.1	7.2	7.5	7.2	7.5	7.4
Hardness	G1	228	256	292	310	323	358
	G2	250	234	260	315	325	328
	G3	278	210	320	305	315	314
	G4	260	250	240	298	301	303
	G5	261	262	220	305	311	315
Coliform cells/ 100 ml	G1	NIL	NIL	NIL	1.5	1.3	NIL
	G2	NIL	NIL	NIL	1.0	0.86	NIL
	G3	NIL	NIL	NIL	1.3	NIL	NIL
	G4	NIL	NIL	NIL	NIL	1.5	1.3
	G5	NIL	NIL	NIL	1.5	1.1	1.0
Chloride	G1	48	40	37	36	34	33
	G2	38	39	32	37	35	32
	G3	40	41	40	37	34	32
	G4	36	38	36	35	37	34
	G5	34	34	32	35	36	31

Station Code (Tehsil)	Name of Tehsil
G1	Rampur Baghelan
G2	Nagod
G3	Unchehara
G4	Amarpatan
G5	Maihar

Gorriya of Rampur Tehsil fluoride concentration is 1.25, 2.1 and 2.15 mg/l respectively which is suspicious for fluorosis. Unchehara Tehsil has even 3.31 mg/l concentration of fluoride attracting remedial precautions. Even in Nagod Tehsil fluoride concentration in marha tola 2.05 mg/l which is a matter of anxiety. Nitrate concentrations in surface water is more than that in ground water in both the seasons but its concentration even in ground water in Rampur Tehsil is beyond its maximum permissible concentration. Nitrate ion concentration in rainy season is more indicating uncontrolled use of urea and ammonium sulphate as fertilizers. Iron and fluorides concentration are within the permissible limits. Coliform cells are more in winter than in rainy

season and is nil in ground water. Silica is either nil or present in little concentration in Tamas river water. Chloride concentration is much lower in both type of water in both the seasons. On comparing the observations with the permissible limits (BIS&WHO 1989) it is obvious that ground water of Satna is too safe for drinking and domestic purposes but river water needs its treatment for disinfection. Calcium concentration should be minimized because its concentration is more in both types of water in both the seasons. The observations are also compared with observations of MINARS and GEMS and are found within the permissible limits except calcium, nitrate and fluoride. Hardness in ground water in both the seasons is more than the permissible limit.

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